Chapter 3

Production Response

This chapter briefly reviews how West African Agriculture has responded, in terms of increased production and productivity growth, to the driving forces discussed in Chapter 2. The chapter begins with a description of the region's diverse agricultural production base, which has strongly influenced the region's ability to respond to growing demands for its Agricultural products. The chapter then examines region-wide trends in production of agricultural commodities over the past 30 years, as reported in FAOSTAT. In order to see whether the production increases resulted from simply devoting more resources to agricultural production using existing technologies or from greater productivity, the chapter then turns to an analysis of trends in land, labour and total factor productivity in West African agriculture over the past 30 to 40 years.

The analysis in these first three sections of the chapter demonstrate that production response in West Africa, while vigorous with respect to some products and countries, has been weak and inconsistent in others. The chapter then goes on to discuss the main factors that have led to this mixed supply response, ranging from limited market access in many areas to weak Agricultural research and extension systems in many countries. The limited supply response of West African agriculture has contributed to growing food imports into the region, which are described in Chapter 4. The present chapter thus sets the stage for more disaggregated analysis based on trade data in Chapter 4 and the analysis by specific value chains and agroprocessing industries in Part III.

3.1 A highly diverse agricultural production base

The region's production response to the forces discussed in Chapter 2 is strongly conditioned by West Africa's highly diverse agro-ecological conditions and its vulnerability to weather shocks.

3.1.1 Diversity of agro-ecologic conditions

West Africa is a diverse region characterised by a wide variety of ecosystems and an equally high number of production systems. The region extends from the Sahara Desert in the north, with a typical rainfall of less than 100 mm per year, through the Sahelian transition zones (200-600 mm per year) and the Sudanian savannahs to the rainy forests of the coastal zones of the Gulf of Guinea and Southern Nigeria, which have over 2 000 mm of rainfall per year. Agricultural activities range from nomadic pastoralism in the far north through agropastoral systems based in the Sahel, a mixed cereal-root crop system in the Sudanian savannah areas (the so-called "Middle Belt"), root-crop and tree-crop systems in higher rainfall areas farther south, to the sub-humid and coastal-artisanal fishing system along the Atlantic. There is a five-fold increase in crop output per ha as one moves from the agropastoral systems of the Sahel (approximately US$240/ha) to the tree-crop systems of the south (US$1 125/ha) (Benin *et al.*, 2011). Overall, roughly a third of West Africa's land area is devoted to agricultural uses, of which only one third is used for crop production and the remainder serves as rangeland and pastures.

Crop production is concentrated in areas with favourable combinations of agro-ecologic conditions, population densities, infrastructure and market access. Water availability plays an overarching role in determining production potential. Most crop production takes place in the humid and semi-humid areas. The humid zones along the coast are suitable for the production of roots, tubers, tree crops such as rubber, coffee, cocoa and oil palm, but also legumes, maize and pineapples. Tick-borne diseases and trypanosomiasis, however, severely limit cattle production along the humid coast. The Middle Belt has a more diverse production potential due to its climatic and soil conditions. Crops grown include millet, sorghum, maize, oilseeds (sesame, shea and groundnuts), cashew nuts, cotton, cassava, mango, citrus fruits and beans. Its abundant pasture resources support widespread production of livestock, including cattle, goats and sheep.

In the arid and semi-arid areas of the Sahel, livestock production is more important than crop production, which is mainly confined by water availability and concentrated along rivers, irrigated areas and lowland areas. The Sahelian zone has a long tradition of livestock production based on extensive transhumant systems adapted to seasonal rainfall patterns. Crops grown include millet, sorghum, irrigated and rainfed rice, legumes (especially cowpeas), onions and groundnuts (Blein *et al.*, 2008). There has been an increasing convergence of production in the Sudanian zone, with roots, tubers and maize moving north from their traditional production zones in the south, and Sahelian products such as legumes, sorghum, millet and cattle moving south from their traditional production zones in the north.

3.1.2 High vulnerability to weather conditions

West Africa in general, and the Sahelian region in particular, is characterised by some of the most variable climates on the planet, and this variability increases as one moves north through the sub-humid and semi-arid zones. The semi-arid regions are particularly vulnerable to climatic variability such as droughts and flooding. Most crop production in West Africa is rainfed; hence production levels and pasture conditions are susceptible to fluctuations in precipitation, particularly in the Sahel. Only 10% of the total cropland in ECOWAS and 2% of the cropland in the Sahel is irrigated. Moreover, about half of the population lives in areas with a growing period of fewer than 6 six months. These areas represent slightly more than half of the total cropland (Johnson, *et al.*, 2008). Hence, West African agriculture continues to be characterised by high inter-annual production variability and a low level of intensification. Between 1965 and 2012, annual aggregate coarse grain production recorded nine instances of negative growth in one year followed by double-digit growth the following year; three of these instances have occurred since 2007 (FAOSTAT, 2013).

The irrigation potential of the region varies widely between agro-ecological zones due to the very unequal distribution of rainfall. The Everett dry zone (Burkina Faso, Cape Verde, Mali, Niger, and Senegal) receives less than a quarter of the total rainfall of West Africa for an area accounting for roughly 60% of the whole region. The irrigation potential of this zone is about 16% of the regional potential. Over three-quarters of total rainfall (77%) is accounted for by the humid and semi-humid areas, and Nigeria and Ghana have the highest irrigation potential, accounting for 26% and 21%, respectively (Blein, *et al.*, 2008).

Only 10% of the potentially irrigable lands are equipped for irrigation, with the agricultural water-managed area ranging from 29% of the cultivated area in Sierra Leone to less than 1% in Benin, Ghana and Togo (Sirte, 2008). On the other hand, 86% of inventoried water withdrawals[20] are used for agriculture, a value higher than the global agricultural water withdrawal (70%). Agricultural water use ranges from 71% in the Gulf of Guinea to 95% in the Sudano-Sahelian zone. Growing urbanization and economic diversification will lead to increased competition over the use of available water resources between agriculture and other sectors.

3.2 Trends in regional agricultural production

The performance of the agricultural sector in West Africa over the last three decades has been characterised by strong output growth. Production volumes of most crops, both for domestic and export markets, has grown vigorously since 1980, often outpacing population growth. In value terms

20 Water withdrawal refers to the gross quantity of water withdrawn annually for a given use.

(based on 2012 production), aggregate agricultural production is dominated by yams and cassava, followed by paddy rice, groundnuts, cattle meat, and cocoa beans (Table 3.1). These are followed by four staples (millet, maize, cowpeas and sorghum). With the exception of cocoa, the top items in terms of value of production are all food commodities, destined overwhelmingly for local and regional consumption.

Table 3.2 shows growth rates of major crops between the 1980 and the first decade of the 21st century and production volumes for three-years average from 1987-89 to 2007-09. Cashew nuts show the highest average annual growth rate over the entire period (16%) – albeit from low initial levels – followed by roots and tubers (6.4%), cowpeas (6.3%) and cotton (5.7%). Cereal production increased at 3.9% per annum, outpacing the region's population growth during the period 1980-2009. This increase of cereal output has been mainly driven by maize, which grew annually by 5.8%, resulting in a five-fold cumulative increase. Moreover, the average annual share of maize in total cereal production rose from approximately 14% in the 1980s to 26 % in 2000-09. Production levels of rice, sorghum and millet grew slower and are about two and a half times higher than in the early 1980s. Vegetable production grew by 4.2% per annum. Growth in vegetable production has been particularly strong in the urban periphery of small towns as well as in irrigated perimeters in the Sahel (Blein, *et al.*, 2008).

Growth of livestock production has been slower. Meat and milk production did not grow in line

Table 3.1 *ECOWAS Agricultural production by value*

Millions of 2004-06 US$, 2007-2011

Commodity	2007	2009	2011
Yams	11 147	11 081	13 332
Cassava	6 529	6 104	7 952
Rice, paddy	2 202	2 910	3 282
Groundnuts, with shell	2 202	2 802	2 551
Indigenous Cattle Meat	2 413	2 439	2 503
Cocoa beans	2 400	2 525	2 901
Millet	2 544	2 096	2 383[a]
Maize	1 681	2 085	2 337
Cowpeas, dry	1 468	1 287	1 336
Sorghum	2 028	1 555	1 741
Citrus fruit	1 661	1 887	1 891
Plantains	1 713	1 729	1 750
Vegetables, fresh	1 196	1 127	1 443
Cashew nuts, with shell	1 015	1 238	1 359
Indigenous Goat Meat	1 087	1 185	1 260
Cotton lint	897	827	924
Indigenous Sheep Meat	794	869	962
Taro (cocoyam)	1 450	994	1 000
Indigenous Chicken Meat	690	754	845
Indigenous Pig Meat	836	835	716
Indigenous Sheep Meat	497	526	562
Coffee, green	253	226	196

Source: FAOSTAT, 2011
[a]Figure refers to 2010

***Table 3.2** Volume and growth rates of main crops*

By three-year averages, 1987-2009

Crop	Volume 1987-89	Volume 1997-99	Volume 2007-09	AAGR 1980-89	AAGR 1990-99	AAGR 2000-09	AAGR 1980-09	AAGR per capita 1980-09
	(1 000 metric tonnes)			(%)				(%)
Total Cereals	29 137	37 642	54 875	8.2	2.7	5.6	3.9	1.2
Millet	8 212	10 549	15 897	6.0	2.8	5.7	3.5	0.8
Rice, paddy	5 310	6 959	10 091	6.5	2.1	5.7	3.7	1.0
Sorghum	7 919	10 517	14 363	5.6	4.5	4.3	3.4	0.7
Maize	7 417	9 259	13 986	18.4	1.1	7.0	5.7	2.9
Roots and Tubers	38 349	88 140	124 495	4.8	6.0	3.9	6.4	3.6
Yams	13 470	34 287	47 862	4.7	5.6	3.8	6.9	4.1
Cassava	22 521	46 207	64 387	4.7	5.1	4.1	5.7	2.9
Oil palm fruit	9 358	11 758	13 449	1.0	2.2	1.3	1.9	-0.8
Groundnuts, w. shell	2 628	4 588	6 633	4.3	7.8	4.0	5.0	2.3
Fruit (excl. Melons)	10 536	15 500	18 803	2.1	4.2	2.1	2.9	0.2
Sugar cane	4 347	4 449	5 816	0.5	-0.2	2.2	1.0	-1.6
Coffee (green)	291	371	192	-1.4	2.1	-7.3	-1.1	-3.6
Cow peas, dry	1 480	2 964	4 728	6.2	5.9	6.5	6.3	3.6
Cocoa beans	1 262	1 883	2 604	5.8	5.0	3.3	4.6	1.9
Cashew nuts, w. shell	59	394	1 137	9.0	22.9	7.0	16.0	13.0
Vegetables & Melons	7 208	11 804	15 779	4.2	5.2	3.3	4.2	1.5
Cotton lint	415	872	650	12.5	7.0	-3.6	5.7	2.9

Source: FAOSTAT

***Table 3.3** Volume and growth rates of main livestock products, by three-year averages*

Livestock Product	Volume 1987-89	Volume 1997-99	Volume 2007-09	AAGR 1980-89	AAGR 1990-99	AAGR 2000-09	AAGR 1980-09	AAGR per capita 1980-09
	(metric tons)			(%)				(%)
Total Meat	1 740	2 254	3 166	1.3	3.0	3.4	2.6	-0.1
Cattle meat	540	727	989	-2.3	3.9	3.8	1.7	-0.9
Goat meat	207	321	462	3.5	5.0	3.0	4.3	1.6
Sheep meat	133	215	322	1.6	5.7	3.2	4.3	1.6
Game meat	303	325	392	1.5	0.4	1.3	1.3	-1.3
Poultry meat	295	338	513	4.1	1.3	4.9	2.8	0.1
Pig meat	165	222	338	9.0	3.1	3.9	4.8	2.0
Eggs Primary	366	542	776	3.4	1.6	3.4	3.7	1.0
Total Milk	1 575	2 070	2 971	-0.4	2.5	3.8	2.5	-0.2

Source: FAOSTAT

with demand, with annual growth rates averaging 2.6 and 2.5% during the period 1980-2009, albeit with marked inter-annual fluctuations (Table 3.3). Although cattle herds in Sahelian countries were restocked after the droughts of the 1970 and 1980s, the overall increase of cattle numbers has been modest. In contrast, the number of small ruminants, which have shorter production cycles, grew faster. Pig meat production grew at 4.8% annually, followed by sheep and goat meat. Poultry production grew only at 2.8%, although egg production averaged 3.7% growth per year.

On a per capita basis, maize, starchy roots and cowpeas exhibited strong growth (3% per year and above), whereas oil crops and vegetables showed a more modest annual growth rate of 1 to 2%. Per capita production of millet, sorghum, rice and fruits increased annually by less than 1%, while that of meat, milk and sugar cane actually declined on an annual basis over the last thirty years. Concerning livestock products, pig, sheep and goat meat achieved annual average growth rates per capita of 2% and 1.6%, whereas cattle meat and milk production declined on a per capita basis. Hence, while the per capita production of basic food staples has shown the highest increase, crop and livestock products with the most dynamic markets, such as meat, dairy products, rice and vegetable oils, showed a weaker performance and were not able to meet increasing demand. As will be seen in Chapter 4, the gap was met by increasing imports of these commodities.

Despite the growth shown in Table 3.2, however, it has not been rapid enough to allow most West African countries to meet their poverty reduction goals. A computation based on IFPRI's multi-market model revealed that West African agriculture would have to generate and sustain an annual GDP growth rate of 6.8% between 2004 and 2015 in order to achieve Millennium Development Goal (MDG) 1's target of reducing extreme poverty by 50% between 2000 and 2015 (Johnson, *et al.*, 2008).

3.3 Trends in agricultural productivity

Agricultural productivity refers to the agricultural output produced for a given level of inputs. While output levels can generally be increased by raising the amount of input use, lower unit costs of production and improved economic competitiveness require improvements in productivity. There are two types of productivity indicators: those of partial factor productivity, which measure output per unit of a given input, such as land or labour; and those of total factor productivity, which attempt to measure the value of output divided by the value of all inputs used in its production. Because of data limitations, most studies in West Africa have focused on measures of partial factor productivity, particularly yields per ha. As discussed below, however, more recent studies (particularly by ReSAKSS) have attempted to measure total factor productivity.

3.3.1 Yields per hectare

Agricultural growth in the region has been driven largely by area expansion, whereas land productivity increases have been modest, with yields remaining well below global benchmarks (Table 3.4). Nonetheless, in the most recent period shown in Table 3.4 (2008-2012), there have been some modest increases in region-wide yields, particularly for some of the staple crops. These increases may reflect greater access of farmers to fertilizers and improved seed as a result of major agricultural intensification efforts launched in response to the 2008 spike in world food prices and the more favourable price incentives they faced during this period. It should also be borne in mind that the figures in Table 3.4 are broad averages across many different production systems in West Africa and, as noted below, in particular settings throughout the region where production conditions are more favourable, yields are substantially higher than these region-wide averages.

This caveat notwithstanding, as shown in Figure 3.2 on page 77, West Africa's agricultural growth (like that of most of sub-Saharan Africa) over the past 30 years has been driven overwhelming by area expansion, in sharp contrast to other regions of the world, where yield increases have been the main drivers of output expansion. For instance, the area planted to cereals increased by 3.9% per annum while growth in yields increased by less than 1.0% between 1980 and 2009 (see Figure 3.2 on page 77). Within this general pattern of extensification, the share of roots, tubers and pulses in the total area under food crop production increased (53%) while cereals witnessed a 7% drop over the last three decades.

The land productivity challenges facing West Africa are pronounced. With the exception of maize, for which average yields grew annually by 2.2% between 1980 and 2009, yields of other food crops increased only modestly or even stagnated (annual growth rates ranging from 0.0 to 1.3%). The performances of the cattle and poultry sub-sectors, measured in terms of output per animal, have even been worse over the last 30 years, with average yields declining for beef (-0.9%) and stagnating for poultry and dairy sectors (Table 3.4).

With the production initiatives launched in the wake of the 2008 food crisis, cereal yields in the region have begun to increase beyond those shown in Table 3.4, but still lag other areas of the world. Cereal yields averaged 1 152 kg/ha in West Africa in 2008-12 compared to 1 435 kg/ha in East Africa, 1 883 in North Africa and 3 044 in Southern Africa. Average rice (paddy) yields (which include both irrigated and rainfed systems) are also markedly lower in West Africa (2 009 kg/ha) than in East Africa (2 436 kg/ha), North Africa (9 507 kg/ha), and Southern Africa (2 616 kg/ha). Average rice yields in South-Eastern Asia (4 136 kg/ha) and Southern Asia (3 512 kg/ha) are also much higher than the West African average, reflecting the much higher proportion of production produced under irrigation in these regions than in West Africa. Contrary to cereals, average cassava yields in West Africa are higher (at 12 338 kg/ha) than in other regions of Africa, yet substantially lower than levels in South-Eastern Asia (where yields are 52% higher than in West Africa) and South Asia (167% higher).[21]

These regional averages also mask wide variations in intra-regional performance. For example, while yields of Nigerian and Guinean rice declined between 1980 and 2009, average paddy

21 All figures are calculated from FAOSTAT data.

***Table 3.4** Average yields for selected commodities in West Africa and other regions (1990–2012)*

	Western Africa			Sub-Saharan Africa			South-Eastern Asia		
	1990-99	2000-2009	2008-12	1990-99	2000-2009	2008-12	1990-99	2000-2009	2008-12
Commodity	Yield (kg/ha)			Yield (kg/ha)			Yield (kg/ha)		
Wheat	1.902	1.359	1.699	1.781	2.176	2.405	940	1.441	1.776
Rice, paddy	1.640	1.672	2.009	2.153	2.372	2.523	3.242	3.836	4.136
Maize	1.258	1.556	1.715	1.543	1.774	1.983	2.119	3.086	3.813
Millet	700	845	736	651	763	690	668	812	913
Sorghum	838	938	980	808	910	952	1.266	976	1.065
Total Cereals	954	1.102	1.186	1.199	1.372	1.517	3.013	3.677	4.045
Beef and Buffalo Meat[a]	128	123	123	143	151	158	185	197	196
Poultry Meat[a]	0,9	0,9	0,9	1,1	1,2	1,2	1,1	1,1	1,1
Cows milk[b]	217	220	231	455	497	503	667	896	892
Pulses	336	434	500	504	568	633	804	950	1.179
Yams	10.593	10.543	11.277	10.219	10.295	10.824	4.693	4.844	5.172
Cassava	10.023	10.653	12.338	8.244	9.225	10.324	12.318	16.365	18.805
Oilcrops	316	352	362	262	284	303	1.246	1.904	2.195
Oil palm fruit	3.282	3.230	3.261	3.694	3.712	3.863	17.814	18.914	18.868
Cocoa beans	478	475	469	454	461	458	765	688	509
Coffee, green	296	308	258	434	425	431	734	850	958
Sugar cane	45.125	40.062	37.080	62.215	65.506	64.232	59.489	63.763	68.247
Seed cotton	958	1.016	1.083	978	955	978	738	705	1.112

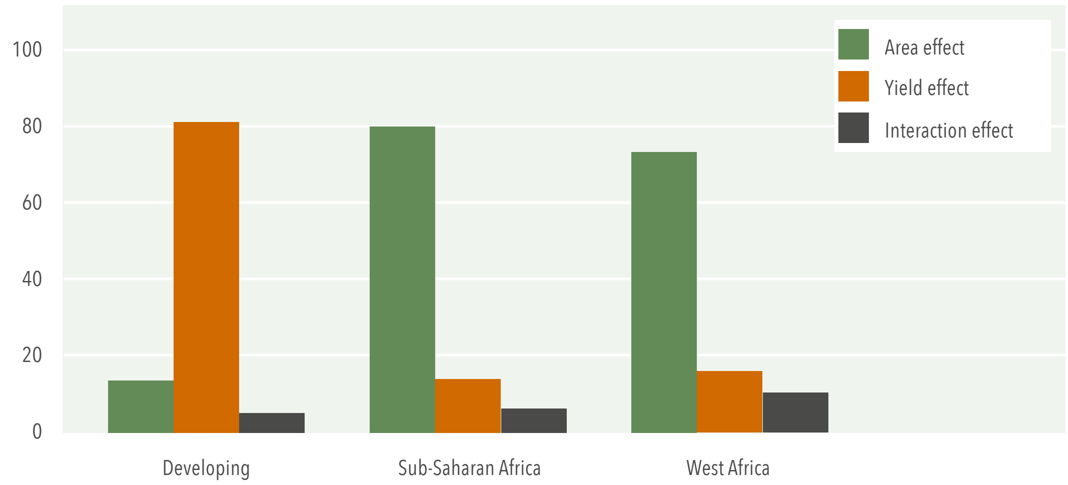
Source: FAOSTAT,
[a] Yield = Carcass Weight (kg/animal);
[b] Kg/animal/year

yields in the other big rice producing countries of Côte d'Ivoire, Mali and Sierra Leone increased substantially; these figures conceal even more pronounced productivity success stories in certain irrigated perimeters in these countries (e.g. Office du Niger in Mali). Similarly, cassava yields have increased much more sharply in Nigeria and Ghana over the past 20 years (in response to the spread of improved varieties developed by IITA) than in several other coastal countries such as Sierra Leone and Liberia; and until the mid-2000s, the performance of the cotton sector in Francophone West Africa was much stronger than in the Anglophone countries (see Chapter 10 for details).

Table 3.5 displays examples of striking differences in country-wide average yields in 2008–10 for selected crops. For certain crops, yields may vary by up to a factor of five, reflecting vast differ-

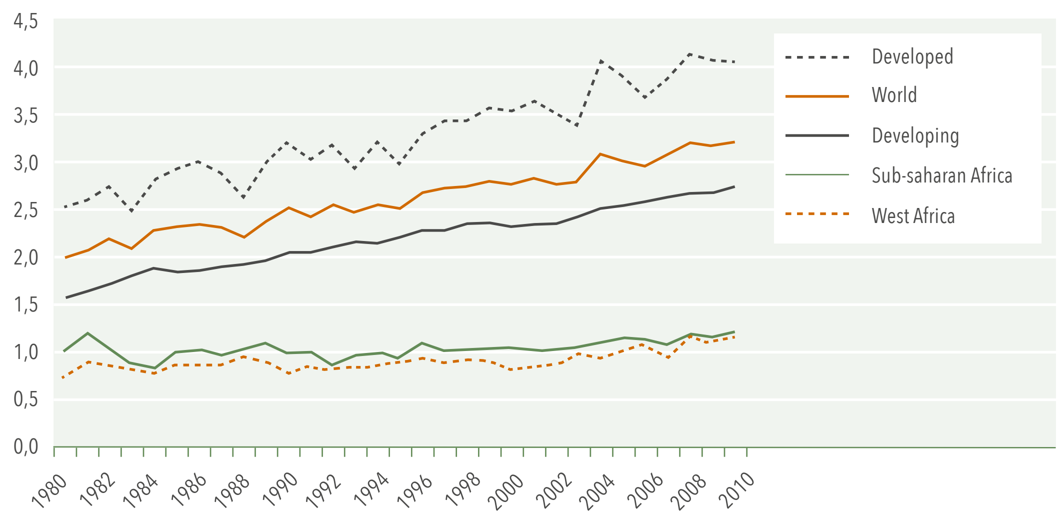
Figure 3.1 *Contribution of area and yield to output growth*

1980-89 to 2000-09 (%)



Source: Konandreas, 2012a.

Figure 3.2 *Trends in cereal yields (mt/ha)*



Source: Konandreas, 2012a

Table 3.5 *Country-average yields for selected crops in West Africa, 2008–2010*

	Cassava	Cowpeas	Groundnuts	Maize	Sorghum	Rice, paddy	Sugar Cane	Oil Palm Fruit
Country	(mt/ha)							
Benin	13.9	–	0.9	1.3	1.1	3.7	100.0	10.3
Burkina Faso	1.5	0.5	0.8	1.5	1.0	2.3	19.0	7.1
Cape Verde	12.9	–	–	0.3	–	–	74.5	10.0
Côte d'Ivoire	7.0	–	1.1	2.0	0.7	1.8	–	5.7
Ghana	14.3	–	1.4	1.8	1.3	2.5	25.4	8.4
Guinea	7.9	–	1.4	1.2	1.2	1.8	53.4	10.2
Guinea-Bissau	11.6	0.2	1.5	0.9	1.0	1.9	27.3	–
Liberia	7.8	–	0.9	–	–	1.3	10.2	–
Mali	16.4	0.4	0.8	2.7	1.1	3.7	73.9	–
Niger	16.1	0.3	0.5	0.8	0.4	1.6	49.4	–
Nigeria	11.9	0.8	1.1	2.1	1.1	1.8	19.4	2.7
Senegal	7.8	0.4	1.0	1.6	1.0	3.7	115.7	10.8
Sierra Leone	5.2	–	0.8	0.9	1.0	1.7	69.7	8.0
The Gambia	3.3	–	0.9	1.2	1.1	1.1	–	2.7
Togo	6.2	–	0.7	1.2	1.1	2.4	–	8.5

Source: FAOSTAT

ences in agro-ecologic zones, production systems, access to inputs, and varieties. These disparities across countries also suggest that there is substantial scope for improving yields in low-performing areas by learning successful approaches from neighbouring countries.

A more aggregate measure of land productivity is given by the value of agricultural output per ha rather than the physical yield of individual commodities. Table 3.6 presents data on the average annual growth rate of land and labour productivity from 1980 through 2010 for different regions of Africa, as measured in value terms. The West African regional figures are strongly influenced by the performance of Nigeria over this period.

Three observations emerge from Table 3.6. First, land productivity in West Africa appears to have grown faster over time than labour productivity. As discussed below, however, this may be an artefact of an overestimation of the size of the agricultural labour force. Second, over the entire period 1980-2010, land productivity (in value terms) has grown more quickly than the Africa-wide average and has exceeded the rate of growth of all other subregions of Africa except Central Africa. Third, the most rapid increase in land (and labour) productivity

Table 3.6 *Average annual growth rates of land and labour productivity for Africa*

	1980-1990		1990-2000		2000-2010		1980-2010	
Region	land	labour	land	labour	land	labour	land	labour
Central Africa	1.7	0	3.5	2.6	4	2.8	2.6	1.6
Eastern Africa	2.1	1.2	0.7	2.4	2.4	0.3	1.5	1.3
Northern Africa	1.1	3.3	1.4	1.6	1.7	3.3	1.4	2.7
Southern Africa	2.5	3.3	3	0.8	0.1	2.3	1.7	1.8
Western Africa	1.3	-1.6	3.1	1.9	2.1	1.2	2.3	0.9
Africa	**2.0-**	**3.1**	**1.0**	**1.2**	**2.2**	**3.0**	**1.6**	**2.3**

Source: Benin, *et al.*, 2011

occurred during the decade of the 1990s. This was the era of structural adjustment, when devaluations of local currencies and changes in relative prices induced farmers to expand production of export crops and shift into more high-value products (see Chapter 11).

3.3.2 Labour productivity

In contrast to trends in land productivity, Table 3.6 indicates that labour productivity over the 30-year period 1980-2010 grew more slowly in West Africa than in any of the other regions of Africa. This slow growth rate over the entire period was in part a function of falling labour productivity in the 1980s. The same forces of changing relative prices and shifts in the mix of farm-level production that likely explained the jump in land productivity in the 1990s are likely also behind the increase in labour productivity in that period. In the most recent decade, the rate of growth of labour productivity for the region slowed a bit from the 1990s but exceeded that of East Africa (Benin, *et al.*, 2011).

Labour productivity, however, may have grown more than is generally acknowledged because of a significant but poorly measured shift by rural populations into non-agricultural activities. Josserand reports that based on data from sample surveys in several West African countries, it appears that the ratio of the total population not primarily engaged in farming to the farm population increased from 0.42 in 1970 to 1.17 in 2010. This shift implies that each farm worker is feeding more than twice as many non-farm people as 40 years ago, even when one takes into account the increased food imports discussed in Chapter 4. Some of this increase in food production per worker results from a shift in area planted from export crops to food crops (especially roots and tubers), but some is also undoubtedly due to an increase in farm-level labour productivity (Josserand, 2011).

3.3.3 Total factor productivity

Total factor productivity (TFP) in agriculture, a measure of the value of all agricultural outputs divided by the value of all inputs used in production, can change for two reasons. First, the efficiency with which existing inputs are used can change by reallocating them among different products (e.g. from low-value outputs to high-value outputs). Even if the mix and physical volume of production stays the same, if output prices rise faster than input prices, this will also translate into an increase in efficiency, as the formerly lower-value outputs now have a higher value. Second, technical change (e.g. the introduction of new crop varieties) can increase the amount of output produced by a given set of inputs.

Table 3.7 presents estimated annual average rates of change of TFP for different regions of Sub-Saharan Africa over the period 1961-2005, decomposed into its two parts: gains due to efficiency and gains due to technical change. Several messages emerge from the table. First, in contrast to all the other regions of sub-Saharan Africa, over the long period from 1961 to 2005 (the last year for which data are available), TFP declined in West Africa, driven by a decline in the efficiency with which resources were used. The West Africa results were very much driven by the performance of Nigeria, where the decline in efficiency averaged over 1% per year. For the period as a whole there was a very modest (0.23%) annual gain in technical efficiency, but this was not large enough to offset the decline in the efficiency of resource use. Second, the long-term average obscures very different patterns in each of the sub-periods shown in the table. After modest increases in TFP in the 1960s, driven by technical change, there were huge declines in the efficiency of resource use, both in the subregion as a whole and even more so in Nigeria, during the 1970s (the period before structural adjustment). This was followed by modest but growing TFP growth from the 1980s through 2000, which continued at about 2% per year from 2000 through 2005. Third, in the period since 1980, the overwhelming source of TFP growth in the subregion has been increases in the efficiency of resource use. Technical change, such as would emanate from national and regional systems of agricultural research, contributed extremely little to total factor productivity growth for the region since the 1970s.

***Table 3.7** Percentage change in total factor productivity, efficiency and technical change*

Total Factor Productivity = TFP; efficiency = Eff; and technical change = Tech; annual average in %, 1961-2005

	1961-1970			1970-1980			1980-1990			1990-2000			2000-2005			1961-2005		
Region	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech	TFP	Eff	Tech
Central Africa	-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 Africa	-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 Africa	-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 Africa	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
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
Sub-Saharan Africa[a]	-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

Source: Benin, *et al.*, 2011
[a]29 countries for which data are available

Looking at geographical patterns of TFP, a 2008 ReSAKSS study indicated that coastal countries achieved 2.1% productivity growth per year between 1985 and 2002, whereas Sahelian countries experienced a decline of 0.29% during the same period. The top performers in this period were Nigeria, Ghana and Benin (Johnson, *et al.*, 2008).

More recent analysis for 11 ECOWAS countries for which data are available through 2005 shows that eight countries (Benin, Burkina Faso, Ghana, Guinea, Mali, Nigeria, Sierra Leone and Togo) had positive TFP growth over the more recent period 2000-2005, with six of them achieving annual rates of growth of 2% or more (Benin, *et al.*, 2011). The top performers were Sierra Leone, which was just recovering from civil war (with an annual average growth rate of nearly 10%), Burkina Faso, and Mali. For all countries except Benin, the vast majority of the increase came from improvements in efficiency, with technical change contributing very little. Three countries, The Gambia, Senegal, and Côte d'Ivoire, had negative growth rates for TFP during this period, due entirely to declines in efficiency of resource use.[22]

While technical change appears to have contributed very little to gains in total factor productivity over the past 20 years in West Africa, this does not imply that agricultural research systems have made no contribution in the region. To the extent that research has led to new varieties and/or agronomic practices that have stabilized yields that would have otherwise declined in the face of falling rainfall, there have been important contributions, although these would not be reflected in the TFP calculations.

22 Senegal had a slightly positive rate of growth of technical-change-induced TFP during this period, but it was more than offset by declines in efficiency, resulting in a net annual average decline of TFP of a little under 2%.

3.4 Reasons why supply response has lagged the growth of demand

The mixed overall performance of West African Agriculture with respect to increasing agricultural production and productivity is due to a host of structural problems, many of which have been further aggravated by inappropriate policies. These structural problems include (1) the limited market access of many producers in the region, a function of weak infrastructure; (2) the low availability and poor reliability of electrical energy, both in urban and rural areas, which limits value-added activities and manufacture of agricultural implements; (3) the high risks and uncertainties facing actors in the Agricultural sector and limited means of reducing and managing those risks; (4) poor access to improved technologies and inputs; (5) weak systems of Agricultural research, development, and advisory services; (6) similarly weak systems of Agricultural education that are necessary to develop the human capital for 21st Century West African Agriculture; (7) systems of financing that are poorly adapted to the challenges facing actors in the agrifood system; and (8) a poor overall business environment in many countries.

These structural problems affect the profitability and risks of investments in agriculture and related upstream and downstream segments, hence reducing the incentives facing individual farmers and other value-chain actors to undertake such investments. While many constraints and possible solutions are value-chain specific (see Part III), this section discusses generic constraints cutting across most subsectors and stages of agricultural value chains.

3.4.1 Market access constraints

Limited market access is a key disincentive for producers to increase production and adopt productivity-enhancing technologies, as it directly affects the prices producers receive for their outputs and pay for their inputs. Market access is conditioned by the geographic distance between producers and consumers and by the availability and quality of connecting infrastructures. As the population urbanises and as consumption patterns increasingly shift towards more perishable and higher-value products (see Part II), the state of the connecting systems – roads, communication and market infrastructure and transport – becomes critical, especially since a growing share of the population is located close to the coastal areas which tend to be better connected to the ports than to the hinterland. Physical market access constraints facing domestic rural producers include long distances and travel times, poor road conditions or missing roads, low transport volumes, especially in rural areas, and high transport costs. High costs of and limited access to transport not only affect farmers and traders but also providers of services such as finance, extension, and veterinary medicine. Hence, the road and transport sectors play a key role for agricultural growth.

Limited physical market access and high transport costs. West Africa's quality of transport services, as measured by the Logistics Performance Index, is lower than in other African regions and in the rest of the world (AfDB, 2011c). Transporting agricultural goods to the region's cities and ports, or raw materials to agroprocessors, is essentially done by road. Waterways, despite being widespread, are not well developed for transport, while rail transport has fallen into disuse in most countries with the exception of the Dakar – Mali and the Abidjan-Ouagadougou routes (the latter having been disrupted during the Ivorian crisis).

While important investments have been made in recent years, especially on the main international corridors and main trunk roads, road density in West Africa remains low compared to other developing regions. A World Bank study estimates that 75% of farmers in sub-Saharan Africa are located more than four hours away from the nearest market by motorised transport, compared to 45% in Asia (Sebastian, 2007). Moreover, rural communities continue to have by far the lowest accessibility to all-season roads in the developing world. Infrastructure-related market access constraints are exacerbated by limited availability of transport vehicles and low traffic volumes, especially in remote rural areas.

The low road density needs to be interpreted in the context of the vastness of the territory and low population densities. Measured against income (and, hence, ability to pay for maintenance), even current levels of road density seem rather high (World Bank, 2008). In some countries the asset value of the road network exceeds 30% of GDP (Foster, 2008). Road density differs among countries, however, being much higher in densely-populated areas and more developed countries such as Ghana and Nigeria, compared with the large Sahelian countries and the small, conflict-ridden countries along the coast.

Transport prices in West Africa are much higher than in other developing regions and constitute major constraints to agricultural competitiveness in general, and for smallholder market access in particular. Transport costs are a function of the state of transport infrastructure (roads, ports), costs of vehicles and fuel, wages of transport operators, and the policies and institutions governing the transport and road sectors. While investments in transport infrastructure (roads, port, bridges, etc.) are important preconditions for reducing travel time and vehicle operating costs, this does not necessarily translate into lower transport prices. Recent studies found that road infrastructure along major international trade corridors is in fair to good condition and no longer is the primary reason for high transport costs (World Bank, 2012a). While costs to transport operators are similar to other developing regions, truck freight rates continue to be much higher (Teravaninthorn and Raballand, 2009). Moreover, trucking times are slowed down by frequent checkpoints and long queuing times at borders and ports.

The trucking environment and market structure in West Africa are characterised by strong market regulation through freight bureaus and shippers' councils, reducing competition. As a result, there are few large, modern trucking companies and fewer new trucks. Hence, road governance and structural issues in the transport sector are the reasons for persistently high transport prices (view Chapter 12 for further discussion). However, road sector interventions so far have focused mainly on constructing and improving hardware, with far less attention given to institutional and governance structures. Even though addressing the latter is likely to produce quick wins for transport users and the whole economy, reforms will have to confront vested interests and are politically more difficult (World Bank, 2009b; World Bank, 2010). Still, there is a risk that, unless transport sector reforms are addressed more vigorously, further investments in road infrastructure will not lead to better services and lower prices for transport users and hence fall short on delivering their full economic benefits to West African societies.

Transport costs remain especially high for producers in rural areas. Transport prices per ton kilometre from farmgate to primary collection markets tend to be three to five times higher than those from secondary (often rural wholesale) markets to wholesale markets located in the countries´ capitals. Hence, 45% of average transport charges accrue during the first 28% of the transport distance (World Bank, 2009a). Hence, the "first kilometre" tends to be the biggest hurdle to connect small rural producers to markets. Here, poor or missing road infrastructure is still the heart of the problem.

However, the challenge of expanding and maintaining the rural road network is huge and requires strategic choices. One way of doing so is to strategically align rural road investments with agricultural development programmes at the national level in order to prioritise those roads likely to have the largest effect on agricultural productivity and market access. This may entail focusing on areas that are still within reach of major urban markets or trunk roads, and where all-year rural roads alleviate a key constraint to market access. Moreover, the type of road needs to be matched with volumes of production likely to be transported. In many rural communities, production volumes may be well below the threshold needed to justify the use of the truck, and simpler roads targeted at two wheeled vehicles or animal-drawn carts may be more suitable. Moreover, financing and technical capacity for road maintenance at local levels remain important challenges. Given the limited revenue-generating capacity of local governments, sufficient budget transfers from the central level need to be ensured. Dedicated road funds with clear responsibilities to co-finance rural road maintenance could be one possibility to ensure adequate, steady funding. Countries such as Mali have also instituted toll systems on some main highways, although such systems are less practical for rural roads.

Market infrastructure gaps. Physical market infrastructure is important for efficient product aggregation and post-harvest handling, including storage, sorting, grading and packaging of agricultural produce. In West Africa, marketing infrastructure is generally insufficient to cope with the burgeoning demand and supply of agricultural produce as more and more consumers rely on the market for their food. This applies to wholesale and retail markets, cold storage and abattoirs. This infrastructure gap tends to be largest in rural areas. As a result, buyers face high transaction costs for product aggregation, quality control, and sorting into batches of homogenous quality. Quality deterioration and spoilage is a further serious problem, especially of perishable products such as fruits, vegetables and animal products, in absence of cold chains. Moreover, poor hygienic conditions in markets and improper sewage systems can cause threats to human health as well as environmental hazards. Urban retail and wholesale markets can rarely cope with rapid urban growth, and infrastructure facilities are often grossly inadequate (see Chapter 8).

As in case of roads, investments in market infrastructure need to be complemented by investments in "market software", i.e. the policies and institutions governing market infrastructure, as well as the broader marketing functions. These include improvements in (1) planning, governance and management of markets, (2) market and price information systems, and (3) grades and standards in line with consumer demands and food safety regulations.

In many subsectors, value chains are characterised by poor transmission of incentives from consumers and agroprocessors to farmers concerning demands for specific product qualities, particularly regarding cleanliness, safety and consistency of supply. In order to enhance the value addition, farmers and other upstream actors need better information about market segmentation at the consumer level concerning qualities and prices. Moreover, price differentiation at the consumer level needs to be passed on to farmers. Without higher prices for improved qualities, farmers have no incentives to carry out necessary investments or change their farming practices.

The weak transmission of information regarding the willingness of consumers and processors to pay for different product qualities is due to:

- Lack of grades and standards that reflect the nature of demand in the market.
- The low volume of marketed surplus per farm, which makes product segregation by quality costly for traders; hence, products of differing qualities are frequently pooled in the marketing system, which dilutes any incentive to award producers of high-quality products.
- Traders and agroprocessors located in larger towns and cities frequently lacking information about product availability in the hinterland. Hence, they find it easier to import.
- Meeting market demands in terms of quality, quantity and consistency of supply often requires specialized investments and skills that are beyond the reach of many smallholders and traders.

Some value chains (e.g. cotton and cocoa) require capturing important economies of scale in marketing – in order to meet minimum order sizes by overseas buyers – and in acquisition of inputs at lower prices for farmers and ensuring tight vertical coordination in order to be competitive in international markets. West African countries have had difficulties over the past 50 years designing institutional arrangements that coordinate these value chains and are both transparent and accountable to stakeholders (see Chapter 10).

Market information systems in West Africa. Actors throughout the agrifood system obtain market information in a myriad of ways, from word-of-mouth to cell phones to formal market information systems. In the wake of the market liberalizations that swept the region as part of structural adjustment in the 1980s and early 1990s, many governments in West Africa established formal market information systems (MIS). The purposes were initially three-fold: (1) to permit governments and donors to monitor the impacts of market reforms initiated under structural adjustment and the effects on prices of food aid distributions, (2) to level the playing field among different actors in the markets – especially between farmers and traders – in terms of their ability to bargain for prices; and (3) to promote better spatial integration of markets. The public MIS typically collect information through a network of enumerators and diffuse their reports through radio, television, printed media, and in a few cases, by SMS – often on a weekly basis. Regionally, the publicly funded MIS in 10 West African countries are organized into a regional network (RESIMAO – Réseau des systèmes d'information des marches en Afrique de l'ouest), which facilitates sharing of market information across countries, development of improved market monitoring and diffusion techniques and staff development.[23] ECOWAS is helping to support the network as part of the ECOWAP/CAADP programme described in Chapter 11.

23 http://www.resimao.net

The publicly funded MIS – sometimes referred to as "first generation MIS" (David-Benz *et al.*, 2012) – focus primarily on food crops, agricultural inputs and, in some cases, livestock. They have been complemented over the past 10 years by a growing array of other MIS organized by farmer organizations (e.g. in the cocoa value chain in Côte d'Ivoire), NGO's, donor-funded projects, and private companies. Notable among the latter is Esoko-Ghana, which provides clients with market information via SMS and web-access. These "second generation" MIS attempt to address some of the shortcomings of the publicly funded MIS in terms of timeliness of information collection and diffusion, range of product coverage, and more precise description of the product qualities to which the prices refer.

While the spread of MIS throughout the region has improved information available to many actors in the system, problems persist. In the absence of well-defined grades and standards, it is not always clear what the reported prices represent. Many of the MIS report prices that may be up to a week old, which are of limited use for buyers and sellers of perishable products. Many buyers and sellers of such products, as well as larger-scale sellers of staple products, rely increasingly on cell phones to obtain timely market information from colleagues in different markets. Often, the MIS provide information only on prices and market supply conditions, but market actors frequently have need for a wider range of information, such as availability and cost of transport services, location and availability of credit services, access to advisory information, etc. Some of the second-generation cellphone based systems are attempting to provide this broader range of services. While some of the MIS conduct medium-term market outlook studies, their capacity for short-term price forecasting (which is a critical need for sellers of perishable products) remains very limited. Nonetheless, the public MIS continue to play an important role in helping inform governments of market conditions, which is often a critical input into decisions regarding import and export regulations and possible needs for food aid (Kizito, 2011). They also provide important information to smaller farmers in more remote areas, even as larger and more commercial farmers turn to other sources of market information.

3.4.2 Electrical energy

Similar to other regions in sub-Saharan Africa, West Africa's largest infrastructure deficit is in the electrical power sector. This deficit is particularly constraining to the development of agroprocessing. A World Bank study on African infrastructure (World Bank, 2010) states that the 48 countries (with a combined population of 800 million) generate roughly the same amount of electrical power as Spain (with a population of 45 million). Africa has fallen back vis-à-vis other developing regions. While sub-Saharan Africa had almost three times as much power generating capacity per million inhabitants as South Asia in 1970, the situation had inverted by 2000.

Electrical energy costs in Africa are higher than in other developing regions. Many countries rely on small diesel generators, resulting in costs several times higher than those faced by countries with large scale power systems, which are typically hydro-electric-based (World Bank, 2008). High costs are combined with unreliable service, characterised by frequent power outages. This forces agroprocessing firms either to face frequent product losses when power goes out while goods are on the production line or invest in their own generators. The latter, however, drives up their costs of production, frequently undercutting firms´ competitiveness relative to imports.

West Africa's energy generation potential is concentrated mainly in Nigeria (oil and gas), Guinea (hydropower), Côte d'Ivoire (oil and gas), Ghana (oil and gas), Niger (uranium), Benin and Togo (hydropower), and in the shared water basins of the Gambia, Senegal and Volta Rivers. ECOWAS has taken the lead in recent years in promoting a region-wide power grid aimed at facilitating the sale of electricity across borders and allowing the capturing of regional economies of scale in power generation.

3.4.3 High risks

Actors throughout the West African agrifood system face high production risks (due to weather and pests) and price risk (due to volatile markets), and often lack adequate tools to deal with these risks. Their main tool is diversification of their activities, which limits productivity gains from specialization. These risks are compounded by insecurity of land tenure, which discourages long-term investments that could increase productivity. Key among the factors generating these risks are the following:

Low reliance on irrigation to mitigate weather risks. As discussed in section 3.1, the region is highly vulnerable to erratic weather conditions, particularly drought in the Sahelian areas, but has only 10% of its total cropland under irrigation. The expansion of irrigated area has been slower in sub-Saharan Africa compared to other developing regions. Donor investments in agriculture or water infrastructure declined sharply between the 1970s and the mid-1990s as donor attention shifted away from agriculture (World Bank, 2010). There have been major efforts since the mid-2000s to expand irrigated area in some of the Sahelian countries, and national CAADP investment plans of many ECOWAS countries devote substantial resources to expanding irrigation infrastructure (see Chapter 11). Yet the expansion of irrigation in the region hinges upon the ability to contain costs. Physical suitability for irrigation does not necessarily entail economic viability, which is highly sensitive to initial investment, land and water productivity of the crops grown and access to markets and support services. Africa has a legacy of poorly managed and maintained irrigation schemes and investment costs were often much higher than in other developing regions. Best-practice experiences in Africa show that well-designed and implemented irrigation projects can lead to costs no more than USD 3 000 per ha for large-scale irrigation schemes (water distribution component) and USD 2 000 for small-scale irrigation schemes. Large-scale irrigation schemes are only viable, however, if the costs of dam construction can be recovered from hydropower use and irrigation only bears the costs of the water distribution infrastructure (World Bank, 2010). In view of the high costs of irrigation development, there might be some scope for public-private partnerships, as called for in some of the expansion plans for Mali's Office du Niger. However, experiences are yet limited and too recent to draw lessons from the suitability of different management and financing arrangements.

Price volatility. While volatility originating in international markets has been a particular concern following the 2008 price spikes, the main sources of price volatility are often domestic (view focus section A for further details). Erratic climate conditions lead to strong fluctuations in production, which, in combination with weak spatial market integration and overall low production levels result in strong price volatility. These endogenous sources of price volatility undermine smallholders' incentives to invest and commercialize. Weak storage systems and unpredictable government market interventions further contribute to price volatility. Strong price fluctuations also pose threats to contracting relationships between farmers and potential buyers, such as agroprocessors. On the one hand, these buyers have difficulties in fixing prices ex ante in the absence of hedging or other price risk management instruments. On the other hand, risks of contract breach by both parties increase with price volatility, especially in an environment with poor contract enforceability.

Limited access to modern risk management instruments. West African farmers and other value chain actors generally lack access to modern risk management products and services such as agricultural insurance or instruments to manage price risks. This is aggravated by limited access to modern inputs which could help stabilize yield risks, such as plant protectants and veterinary drugs and services, as discussed below. In the absence of such products and services, farmers' main response to the various risks and uncertainties is to diversify their limited resources into many different activities. The resulting scales of operation are often too small for adopting improved technologies and lead to higher per unit marketing costs.

Land access and tenure security. Population growth, climate change and degrading soil quality are exerting growing pressures on land, water and forest resources, with several consequences:

- ***Land fragmentation*** due to declining per capita availability of cultivable land, especially in areas with high population densities, good agricultural potential and market access. The resulting farms are often too small to feed the families that cultivate them, let alone commercialize;

- ***Increasing demand for communal land from outside investors***, both domestic and foreign investors, triggered by the promise of future demand growth and increased profitability in agriculture;

- ***Land conversion and reallocation of water rights***, due to rapid urbanization and expansion of roads and other infrastructure. This not only affects agricultural production directly, especially in high potential areas with access to markets and services, but also poses threads to existing holders of rights to these resources if not properly protected.

As a result of the above forces, tenure systems, property rights to natural resources and the rules for exchanging and protecting these rights are increasingly under stress. Current tenure systems are characterised by legal pluralism, whereby customary tenure systems co-exist and often overlap with statutory systems. Such a situation provides little security for rights holders under each system and constrains an orderly transfer of property rights. Insecure land tenure and water rights undermine incentives to invest in land improvements, irrigation and other fixed assets by existing land users. They also constrain the ability of agroprocessors to acquire land in an orderly and consensual way in order to invest in new processing plants or nucleus farms (typically core components of outgrower schemes). Moreover, conflicts over land and water destroy social capital, especially in areas with the highest production and market potentials (see Focus Section D in Part IV). Finally, the lack of recognized land records precludes local governments from establishing land taxes that could provide the fiscal basis for provision of many of the critical supporting services needed by rural communities, such as primary education, health, and extension.

3.4.4 Access to technology and inputs

Low and inconsistent use of improved inputs such as seeds, fertilizer, pesticides and veterinary drugs remains the single most important factor explaining low productivity in West Africa. Analysis of total factor productivity (TFP) growth over the period 1985-2005, discussed above, showed that technological change accounted for only 1.5% of all TFP growth; the remainder came from efficiency gains due to reallocation of resources to higher value activities, for example as farmers changed crop mixes in response to changing relative prices that resulted from liberalization and as output prices rose faster than input prices (Benin, *et al.*, 2011). Over the long term, however, productivity gains will need to be driven more by technological change, as the scope for improvements in allocative efficiency will decline as the "easy gains" in response to economic reforms are exhausted and as political pressures rise to limit the increases in output prices for food.

Improved inputs not only play an important role in increasing yields but also in stabilising yields and managing production risks. Improved seeds can enhance tolerance to drought, pests and diseases. Lack of access to farm power and mechanization at critical stages during the growing cycle can lead to significant yield penalties. Inadequate mechanization of post-harvest operations such as threshing, drying and cleaning can cause high product losses and quality deterioration. Low fertilizer use not only depresses current yield levels but also contributes to declining yields in the future, as soil nutrients are mined continually (see Chapter 2).

While fragmentary and often outdated, existing data suggest very low levels of modern input use in West Africa, even compared to other African regions.

Uneven access to inputs, technologies and support services between men and women constrains produc-

tivity growth. Cutting across the discussion below of all the factors limiting productivity growth of West African Agriculture are gender considerations. Social conventions in many countries restrict women's access to factors of production and services such as improved land and credit that are critical to productivity growth. Extension services often are predominantly staffed by men, and extension messages may not be oriented to women's concerns. These restrictions not only bias the benefits of growth away from women; they also reduce overall productivity growth by limiting the growth-enhancing resources available to women, who represent a large proportion of the actors in the agrifood system.

Fertilizer. Average fertilizer use per ha is extremely low, even if compared to other parts of Africa, let alone other developing regions (Table 3.8). Over the period 2003-2009, fertilizer nutrient use per ha of crop land in West Africa averaged, on a nation-wide basis, less than 7 kg, ranging from a low of less than 1 kg in Niger and Guinea to a high of 16.5 kg in Mali, where its use is concentrated in the irrigated Office du Niger rice zone and the rainfed cotton zone. West Africa's average fertilizer use per kg was just over half that of Eastern Africa and 15% that of Southern Africa. The West African average of under 7 kg/ha is in stark contrast with a world average of over 100 kg/ha and a regional high of 370 kg/ha in East Asia. The region's already meagre fertilizer use fell starting in 2007 when world fertilizer prices shot up rapidly, in spite of the expansion of fertilizer subsidies in several West African countries.

Seeds. The use of improved seeds is marginal, especially for food crops. Seed coming from commercial seed systems provided only 3% of the millet seed used in Senegal and 2% of that used in Niger in 1997, and the availability of improved maize seed met only one-fifth of the potential demand in Ghana and one-tenth of the potential demand in Nigeria (Niangado, 2010).[24] However,

24 Potential demand was conservatively estimated at 20% of the total area planted to the crop.

Table 3.8 *Fertilizer nutrient consumption, kg/ha, 2003-09*[a]

Country/Region	2003	2004	2005	2006	2007	2008	2009	Average 2003-09
Burkina Faso	10.8	11.8	15.2	12.5	9.4	9.0	9.1	11.1
Côte d'Ivoire	12.6	11.4	7.1	9.0	9.8	7.4	6.3	9.1
The Gambia	9.1	7.4	9.5	9.1	7.9	4.0	6.7	7.7
Ghana	4.4	7.8	3.5	12.0	10.6	9.1	12.4	8.5
Guinea	0.6	0.8	0.7	0.7	1.0	1.0	0.5	0.8
Mali	–	–	15.4	17.2	30.5	12.0	7.5	16.5
Niger	0.3	0.2	0.4	0.5	0.4	0.2	0.4	0.3
Nigeria	6.2	4.4	6.8	9.2	3.8	7.1	2.0	5.6
Senegal	10.6	12.3	9.6	2.2	2.0	2.3	4.9	6.2
Togo	7.1	3.2	8.3	4.7	6.0	0.2	0.9	4.3
ECOWAS average[b]	**6.6**	**8.3**	**6.5**	**8.0**	**6.2**	**6.0**	**3.8**	**6.5**
Eastern Africa	10.8	10.7	11.4	12.3	13.6	14.3	13.3	12.3
Southern Africa	43.6	46.8	36.3	46.3	45.3	42.2	41.9	43.2
Southern Asia	99.0	109.1	119.2	126.4	127.5	133.3	149.5	123.4
Eastern Asia	327.4	296.4	360.7	379.3	412.4	393.5	425.6	370.8
Southeast Asia	97.2	101.8	91.3	93.2	102.9	101.5	100.8	98.4
South America	111.7	118.5	100.2	105.3	129.1	115.9	90.6	110.2
World Average	**99.0**	**99.2**	**103.2**	**107.1**	**112.9**	**105.9**	**108.8**	**105.2**

Source: Calculated from FAOSTAT data.
[a] Total fertilizer nutrients expressed in terms of kg of N, P2O5 and K20. Hectares = arable land + land under permanent crops.
[b] Average for 10 ECOWAS countries for which data are available. 2003 and 2004 averages exclude Mali

in some cases, systematic use of improved seeds and planting materials has resulted in significant yield increases. Examples include improved rice varieties in the Office du Niger zone in Mali, improved maize seeds in Ghana and stem cuttings of improved cassava varieties in Nigeria.

Farm power and mechanization. Despite the dearth of recent and comprehensive data on mechanization in West Africa, available evidence points to low levels of tractor- and engine-based mechanization. Even animal traction remains underutilized. Furthermore, with the collapse of government-sponsored medium-term credit programmes in many countries following structural adjustment, renewal of existing equipment has slowed and new farmers find it increasingly difficult to purchase new equipment. Mechanization levels of post-harvest operations and irrigation also remain low. The reliance on hand tools and human power not only causes drudgery for farm operators, especially for women, but also creates a strong disincentive for youth to enter and stay in agriculture. It also poses serious limitations to the land area that can be cultivated by a single farm family. Apart from pockets of commercial farming in the region, most progress in farm mechanization has been made in the cotton-based farming systems where financing for equipment could be easily deducted from cotton sales within single-channel marketing outlets.

Input supply and the private sector. While the use of productivity-enhancing inputs has traditionally been very limited, their availability and quality further declined following the abolition of marketing boards and the withdrawal of governments from input and service provision during structural adjustment. The production and distribution of certified seed had been largely a government undertaking up through the mid-1980s, when structural adjustment programmes led most governments to abandon this activity. Many countries operated mechanization centres providing tractor hiring services, albeit at low levels of operational efficiency and financial sustainability. Governments were also heavily involved in the importation and distribution of fertilizer at subsidised costs in order to compensate partially for the disincentives facing farmers due to overvalued exchange rates and high levels of direct taxation (see Chapter 11). Structural adjustment led to an abrupt disengagement of the state in agricultural input provision, and the private sector was expected to take over these functions. However, the private sector has been slow to fill the void due to a number of specific features of agricultural input markets affecting both demand and supply (see Focus Section C in Part IV).

Many of the factors constraining the development of private-sector-based input markets are generic to agribusiness. These include limited access to finance, high distribution costs in servicing a highly scattered demand due to poor infrastructure and high transport costs, and a generally weak business enabling environment. Other constraints are linked to the specific features of agricultural inputs, such as the difficulty of judging their quality through simple visual inspection and their profitability depending on weather conditions and output prices. From the farmers' perspective, investing in expensive improved inputs is very risky in an environment of volatile weather and market conditions and uncertain quality of the inputs, even in cases where access to finance is available. In turn, from an input supplier's or machinery dealer's perspective, lack of an established demand discourages investments in new outlets in rural areas and stocking a broader range of products. So far, the adoption of modern inputs and technologies has developed mainly in tightly coordinated value chains, often through interlocked transactions where, in addition to overcoming constraints to input supply and finance, market risks are limited and advisory services are available.

As a result of these constraints, fertilizer supply systems are underdeveloped in the region and prices, especially in the interior, are higher than in other parts of the world. Port charges and inland transport costs are the single largest cost item, accounting for 20 to 40% of farmgate costs. Domestic production of fertilizer is extremely limited. No country in the region produces substantial amounts of nitrogen-based fertilizers, although in 2013 Nigeria announced expansion of two private-sector production facilities. As of late 2013, Nigeria, in spite of its substantial energy resources and large market, continued to import the bulk of its fertilizer.[25] Several countries in the region have phosphate deposits, and five countries (Burkina Faso, Côte d'Ivoire, Mali, Nigeria and Senegal) have fertilizer blending plants. Throughout the region, a general observation is that the fertilizer industry tends to be oligopolistic at the import level, but much more competitive at the wholesale and retail levels. Tendering processes that are sometimes limited to a few firms reduce competition and provide opportunities for collusion and corruption, leading to further price increases. Moreover, farmers often complain about the unreliable quality of fertilizers available in the market due to the lack of enforced standards for fertilizer combined with the ease of adulterating the product.

The legal and regulatory framework also constrains the availability of improved seeds. Certification plays a crucial role in enhancing confidence in the quality of seeds offered. However, seed policies are often outdated, unduly rigid, and difficult to implement. Procedures for the release of new varieties were designed to meet the needs of public research institutes, and seed certification was primarily an internal quality control mechanism for those institutes. Current requirements lead to long delays in the introduction of new varieties (World Bank, 2012b). Moreover, in the past, each West African country developed its own seed regulatory regime, which makes sourcing seeds from neighbouring countries complicated, lengthy, and expensive (World Bank, 2012a).

Erratic and poorly designed policy interventions in recent years in seed and fertilizer markets have contributed further to slowing down the development of robust private-sector based supply chains. While fertilizer subsidies may be warranted in the early stages of market development and to induce small farmers to begin using fertilizer, they only address one part of the fertilizer profitability calculation – the price of the input. Moreover, as discussed in Focus Section C, the way in which subsidies are administered has a huge effect on their cost-effectiveness. Large programmes of untargeted subsidies can drain resources from programmes of rural infrastructure development and sustainable intensification (see Box 2.2, p. 65). A combination of agricultural research to develop more fertilizer-responsive varieties and reduced transport costs, which both boosts output prices to farmers and reduces their input costs, would offer a more sustainable way of encouraging fertilizer use. This approach could be combined with increased government actions to ensure input quality and to support the development of professional agrodealer networks.

3.4.5 Research and development

Globally, there is ample evidence on the high returns of public spending in agricultural research and development (R&D), compared to other types of spending (FAO, 2012). The power of public research and development has been demonstrated by emerging economies such as Brazil, China and Thailand. Apart from hybrid seeds, the private sector has limited incentives to invest in research in Africa. Given the need for adaptation to local agro-ecologic and soil conditions, importing technologies works less well in agriculture than in other industries. The comparatively large number of main staple crops, the diversity of farming systems and small markets make technology development in West Africa more challenging than in other regions (World Bank, 2013b).

Recent data on private-sector agricultural research and development in West Africa are lacking. In most countries private-sector agricultural R&D appears to be very limited and is concentrated primarily in a few cash crops, such as cocoa, oil palm and cotton (Lucas, 2012). The private-sector's share of total agricultural research in West Africa in 2000 was estimated at less than 1% (Beintema and Stads, 2006). There are, however, two exceptions. In Côte d'Ivoire, much of the agricultural research is carried out by the Centre National de Recherche Agricole (CNRA), a public-private partnership. The bulk of CNRA's funding comes from marketing levies assessed on cash crops, collected through producer and interprofessional organizations, hence the private sector. The other example is Senegal, where government structures dominate the research on food crops

25 The government of Nigeria set up two state-run fertilizer companies, the Federal Super phosphate Fertilizer Company (FSFC) (established 1976) and the National Fertilizer Company of Nigeria (NAFCON), established in 1988, but by 1999 both had quit producing significant quantities of fertilizer. NAFCON was sold to the private-sector firm NOTORE in 2005, and by mid-2009 it began producing urea. While its production is expanding, the vast bulk of Nigeria's urea continues to be imported. For details, see Kwa, 2011 and http://www.notore.com/index.php/about/index.

but where private companies have been major innovators in cash-crops, such as cotton and groundnuts, as well as horticulture and fisheries. Private-sector organizations have also been innovative in food processing, storage and packaging and helping Senegalese exporters meet the tight standards to export into the European market (Stads, 2011).

Given the importance of research and development for improving productivity, NEPAD has established a budget target for countries to spend 1% of their agricultural GDP on research and development in agriculture. In 2008, none of the ten ECOWAS countries for which data are available met this target. Ghana was the highest, at 0.9%, while the average for the ten countries was 0.5%. Nigeria was below the average, at 0.42% but, as discussed below, probably benefitted from scale economies in research unavailable to the smaller countries. Strikingly, public agricultural research expenditures as a percentage of agricultural GDP have fallen sharply from the early 1990s, when the average in Africa across the countries for which data are available was at the 1% level.[26] (ASTI, 2013). Gauging researcher numbers against economically active farming populations (research intensity), only Mali and Nigeria are amongst the top ten countries in Africa with more than 100 researchers per million of economically active agricultural population; the average across countries for West Africa was 69, having fallen from 84 in 1991 (ibid.).

Although the number of researchers in West African public agricultural research systems grew strongly during the 1970s (at 4.5% per year) and the 1980s (3.8% per year), it slowed to just 1.3% per year during the 1990s, following structural adjustment. Low salaries and other disincentives have depleted human resources, and scientific personnel are ageing (World Bank, 2013b). Since 2000, a number of national governments have stepped up their allocations to agricultural research, but overall investment levels in most countries are still below the levels required to sustain agricultural R&D needs.

The ASTI data shows an increase of aggregate public spending for agricultural R&D by 32% in the 13 ECOWAS countries for which data are available between 2001 and 2008, and growth in researcher numbers also accelerated. However, trends in spending levels varied widely by country. In Mali, expenditures in real terms declined by 31% between 2001 and 2008, whereas in Ghana they more than doubled (ASTI, 2013). Looking at a longer time span, comparing average annual real government expenditures on agricultural R&D during the 2001-2008 period with the period 1991-1998 reveals that, of the 11 countries for which data are available, only Benin, Ghana and Nigeria increased their average expenditures. In terms of numbers of researchers, the picture is equally heterogeneous. Despite the overall positive trends since 2001, especially in the larger countries, strong increases in R&D spending in some cases largely reflect salary increases from previously low levels rather than expanding research activities or greater investment in equipment and infrastructure. These increases were necessary, as national research institutions were facing increasing difficulties in attracting and maintaining highly-qualified staff (Stads, 2011).

One of the major challenges in many countries is a rapidly ageing pool of scientists close to retirement. This is in part due to a prolonged period of hiring freezes in many research organizations, especially following structural adjustment. Moreover, in many countries, salary and retirement packages and conditions of service remain poor. As a result, research agencies have difficulty retaining staff once they attain higher degrees and can attract offers of better remuneration and conditions in higher education or the private sector. Attracting and retaining staff is an even more serious problem in countries with small research capacities.

Despite growth in R&D capacity across the region, average levels of staff qualifications deteriorated somewhat. During the 1970s and 1980s, many countries received considerable financial support for staff training, often as part of large World Bank funded projects or through contributions from bilateral donors. By the late 1990s, most donors had either cut or eliminated their funding

26 The decline began in 1997 and continued until 2002, at which point it plateaued through 2008, the last year for which data are available.

for graduate training. More recently, this trend has been reversed by new multi-and bilateral projects. However, reliance on outside funding from donors and development banks carries its own problems as funding tends to be unstable. Over the period 2001-2008, over 98% of the budget of the national agricultural research institutes (NARIs) in Nigeria came from the national budget, and for Sierra Leone, the figure was 93%. Other countries covering the bulk of the NARI funding from the national budget included The Gambia, Niger, and Togo. In contrast, the NARIs of Benin, Burkina Faso, Guinea and Mali all received at least 50% of their funding from donors and development banks, and often faced sharp drops in funding once externally funded projects ended.

There are important economies of scale in R&D limiting the efficiency and effectiveness of small and fragmented research systems, especially in small countries. Evidence points to low returns to public spending on R&D in small African countries because they lack a critical mass of research capacity (Fuglie and Rada 2011). In West Africa, R&D systems are also fragmented. The recent growth of researcher numbers has done little to change this situation, since much of it has taken place in the higher education sector, through the establishment of new higher education units involved in agricultural research. Nevertheless, individual capacity of most systems, in terms of full-time researchers, remains limited. Of the 12 ECOWAS countries for which data are available, in 2008, 4 of them had NARIs with fewer than 100 full-time equivalent researchers (FTEs), an additional 4 had between 100 and 200 FTEs, and 2 had between 200 and 300. Nigeria, on the other hand, had over 2 000 FTEs and thus was likely to have a critical mass in several key areas. The low numbers in most West African NARIs highlights the importance of regional research initiatives to help small countries take advantage of economies of scale and collaborative synergies. Regional approaches to research partnered along similar agro-ecologic and soil conditions hold the promise of overcoming problems resulting from small markets and limited budgets in these countries. Important progress in this direction has been made by regional research institutions such as CORAF and CILSS/INSAH. A recent example is CORAF's West Africa Productivity Programme (WAAP). The programme, which covers 10 countries in West Africa, aims to generate and disseminate improved agricultural technologies by fostering regional research networks in which different NARIs become centres of excellence for the region in R&D for key strategic commodities (e.g., Ghana for roots and tubers, Senegal for certain rainfed cereals and Mali for rice) (Stads, 2011).

3.4.6 Extension and advisory services[27]

Extension and farmer advisory services in West Africa are characterised by a plurality of approaches and actors. This is in contrast with the situation in the late 1980s through the mid-1990s, when the World-Bank promoted Training and Visit (T&V) system was dominant in many of the public extension systems in the region. Disappointment with the high cost and limited effectiveness of the T&V system, however, led to its widespread abandonment. This abandonment, combined by a general retreat of donor organizations from support of agriculture in the 1990s (see Chapter 11), led to shrinking funding for public extension systems and experimentation in many countries in the region with a number of different approaches. No widespread consensus has emerged about which methods work best, and many actors express the view that extension systems in the region are broken and that further experimentation is needed to come up with new models. The effectiveness of extension systems, however, is highly dependent on the productivity of the agricultural research system (and hence having useful technologies and practices to extend) and the state of infrastructure in the country, which conditions the ability of extension agents to reach their clients. The low levels of literacy in many countries also raise the cost of carrying out extension activities, as much of the information has to be delivered in oral form rather than in more cost-effective written formats. On a regional level, there is no central repository of information on agricultural technologies and practices upon which extension services can draw, although in 2005-06 the

27 This section draws on material in Simpson, 2006 and Agricultural and Extension Services Worldwide, 2013.

Institut du Sahel of CILSS developed an on-line technology database system capable of providing such a repository.

Currently, in addition to generally underfunded public extension systems, farmer advisory services in West Africa are provided by many NGOs, farmer organizations, donor-funded projects, and, in a few cases, private firms and state-run companies (primarily for export crops). The role of the private sector is likely to grow with the expansion of outgrower schemes in the region. Private agro-input dealers also sometimes provide advice on use of their products, but the quality of that advice is highly variable. Currently, ECOWAS is working with IFDC on efforts to upgrade the quality of knowledge of these agrodealers and strengthen their ability to give unbiased and accurate information to farmers. The involvement of the region's agricultural universities in extension is generally weak.

The degree of involvement of non-state actors in extension varies by countries; for example, NGOs seem to be less involved in providing extension services in Nigeria than in many other countries in the subregion. There is little coordination of programmes across actors providing these advisory services in most countries, although Ghana has created a "Private Sector Extension Unit" within its Ministry of Food and Agriculture to regulate the extension activities of NGOs, faith-based organizations and private companies (Agricultural and Extension Services Worldwide, 2013). While most advisory service providers emphasize "participatory methods of extension", there is no universal agreement on what that term means, so approaches vary – although farmer field schools are becoming increasingly seen as an effective approach for reaching small, resource-poor farmers.

The scale of operations of the different advisory service providers varies widely. The non-state providers typically have small numbers of agents, but often more operating funds per agent, while the public services are much larger but often with few operating resources. For example, in 2009, various NGOs and farmer organizations in Guinea employed between 5 and 40 extension agents each, while the national extension service had 1 446 staff members. (ibid.) This diversity in size suggests that if there are productive innovations to diffuse, the national systems likely have greater potential to scale up the innovations than do the NGOs. Thus, there might be scope for specialization, with the non-state providers doing pilot testing of different approaches and the state-run organizations involved in scaling-up. Increasing use of modern communication and information technologies may also help in scaling up innovations, although challenges remain in how to transmit key information to illiterate farmers via cell phones and similar technologies.

Another striking characteristic of extension systems in the region is the generally low level of training of many of the agents. This limits their ability to transmit information about more sophisticated techniques, such as integrated pest management, that are increasingly needed in the region. Although many of the crash agricultural production programmes launched in the region in 2008 in the wake of the world food crisis involved hiring new public-sector extension staff, this expansion was often accompanied by only limited training of the new staff members. Strengthening the human capital in both the state and non-state advisory systems will be critical to improving the ability of West African farmers to respond to the growing and changing demands for their products.

3.4.7 Weak systems of Agricultural education

The weak human capital base at all levels of the food system hinder agro-industrial growth. The weak base ranges from low levels of literacy at the farm level in many countries (for example, Mali has one of the lowest levels of female literacy in the world) to inadequate numbers of well-trained personnel in skills such as food science and technology, packaging, and marketing – all critical needs for agro-industry. These weaknesses include:

- ***Basic literacy.*** Adult literacy rates in most of the ECOWAS countries are low, frequently under 50%, particularly for women. High rates of illiteracy mean that information on new technologies and institutional arrangements needed to move farming from a hand-hoe era to a modern era all have to be transmitted in oral form, which greatly increases the cost of extension efforts and undoubtedly results in poorer retention of knowledge.

- ***Primary and secondary education.*** The curriculum content of primary and secondary schools in most countries is not oriented towards applications of concepts (e.g. in mathematics and biology) to either farming or agro-industry.

- ***Vocational education.*** Technical training in the skills needed to carry out many of the jobs in a modern agrifood system, from irrigation technician to operator of sophisticated food processing machinery, is a weak link in most West African educational systems. Yet a modern Agriculture will require large numbers of such technicians if it is to grow.

- ***University education.*** The undergraduate curricula of most faculties of agriculture in the region focus heavily on topics related to on-farm production (e.g. agronomy and animal science), with relatively little attention to fields critical in downstream areas of the agrifood system, such as food science, packaging and logistics. Crucial elements in developing the needed skills will include encouraging private- as well as public educational institutions and building more productive links between the private sector and educational institutions (e.g. through internship programmes and advisory boards with heavy participation from the private sector) so that the curriculum evolves with the changing skill sets demanded by the job market.

3.4.8 Limited access to and high costs of finance

The aforementioned high risks and transaction costs render the provision of financial services to farmers and other agricultural value-chain actors risky and costly. In addition to the limited availability of risk-management instruments, widespread collateral constraints, problems of contract enforcement and a poor loan repayment culture reduce the appetite of the financial sector to venture into Agricultural finance. Efforts to circumvent the underlying structural problems through public agricultural development banks and subsidised credit lines have proved unsustainably costly and inefficient. Some of the dynamic decentralized financial networks in the region have been successful in providing finance to farmers and other value-chain stakeholders, even though meeting only a fraction of the demand. Agribusinesses, traders and input suppliers also play an increasing role in value-chain financing, either by directly providing financing to farmers or buying agents or by facilitating bank financing to them through establishing firm purchasing contracts. Tight coordination and links between value-chain actors reduces risks and transaction costs and acts as an in-built collateral substitute, whereby a successful track record of repeat transactions is often more important than the existence of formal contracts. Historically, agricultural finance has been more successful in organised export value chains such as cotton. In a liberalized environment, side-selling is a constant threat and more easy to control where product characteristics such as bulkiness or perishability reduce side-selling options or where buyers serve niche markets. Other value-chain finance instruments such as warehouse receipt financing, receivables financing, and leasing are of growing importance. Additional financial services such as savings and payment services are critically important, and their future growth may be fostered by the potential rapid expansion of cell-phone-based banking and money-transfer services in the region.

Globally, there is also a growing number of investment finance organizations looking at opportunities in agribusiness. These funds range from fully commercial equity ventures to impact investors with a double or triple bottom line.[28] However, given West Africa's difficult business environment, finding suitable companies able and willing to accept equity investors has remained challenging.

3.4.9 Poor business enabling environment

28 "Double and triple bottom line" refer to a broader set of objectives. Rather than maximizing financial returns, impact investors place greater emphasis on social and environmental impacts of their investments given decent financial returns.

The slow and uneven entry of the private sector into Agricultural value chains and related services is also due to West Africa's poor business climate relative to other regions of the world. Weak contract enforcement and high transaction costs discourage investment and raise costs and risks for agroprocessors who rely on national markets for their raw materials. For example, of the 183 countries included in the World Bank's 2012 Ease of Doing Business rankings, only one of the 15 ECOWAS countries – Ghana, at no. 60 – ranked in the top third. One additional country (Cape Verde, at 119) barely made it into the top two-thirds, while the remaining 13 ECOWAS member states clustered in the bottom third – from Nigeria, at 133, to Guinea, at 179 (World Bank, 2012b).

3.5 Conclusions regarding production response

West Africa's performance in terms of production performance over the past 30 years has been mixed. Production has kept up with or slightly exceeded population growth for many key staples, through expansion of cultivated area, modest yield improvements, and improvement in labour productivity as rural workers have diversified more into non-farm activities. In certain areas such as oilseed and palm oil production, however, performance has been more dismal. Agricultural productivity performance has been strikingly variable across countries, however, reflecting large differences in agro-ecological and institutional environments but also suggesting the scope for as-yet under-exploited sharing of successes across countries.

Factors constraining production from responding more robustly to the growing and rapidly changing demand include constrained access of producers and processors, particularly in the inland areas, to the burgeoning urban markets due to poor transport infrastructure; rules governing the trucking industry that drive up transport costs; inadequate wholesale and retail market infrastructure, which increase costs of product aggregation, quality control and carrying out trade; and in some countries, weak systems of market information. In addition, unreliable electrical supplies have driven up agroprocessors' costs and have particularly constrained the growth of markets for perishables by limiting the expansion of cold chains. A host factors ranging from unpredictable rainfall to insecure land tenure raise risks throughout the agrifood system and discourage investments in productivity-enhancing improvements. A number of structural problems plague the markets for critical inputs such as improved seeds, fertilizer and farm equipment, often linked to the small size of most national markets for these inputs. Access to these improved technologies is further hindered by financial systems that are poorly adapted to the needs of the agrifood system. Development and diffusion of new agricultural technologies and practices has been slowed because agricultural research systems and advisory services faced funding cuts for many years and are now only beginning to recover. Weak systems of agricultural education, from the primary school level to post-graduate university programmes, have failed to provide most students with the skills needed for a 21st Century, private-sector- driven Agriculture. Finally, the overall ease-of-doing business climate in West Africa generally remains low by international standards, discouraging both domestic and foreign investment in innovations that could raise agrifood system productivity. Part III of this report examines in more detail how West African retailers, agroprocessors and individual value chains have coped with these constraints, while Part IV and the concluding chapter analyze policy options to address them.