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**The Architecture of the Sudanese Agricultural Sector and Its
Contribution to the Economy between 1990 and 2021**

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ABSTRACT

The paper reviews the performance of the Sudanese agricultural sector over the last three decades (1990 through 2021) and examines the drivers of that performance. Key findings show that the sector's contribution to gross domestic product was greater during the 1990–1999 period than during the other two decades; agricultural productivity as well was higher in that decade than in the subsequent two decades. The sector has remained a major source of employment and livelihood. During the last decade reviewed (2010–2021), the sector regained its leading position as a generator of foreign currency. Public investment in agriculture and government spending allocated to the sector were lower than in other countries in the region. Political elites have generally lacked commitment to development plans in the sector. Political developments in Sudan have disrupted more recent efforts to revitalize the sector. Climate change, as manifested in rising temperature, declining rainfall, and drought, is a substantial determinant currently affecting the sector. The paper discusses some broad recommendations for improving the performance of the Sudanese agricultural sector.

Key words: agricultural sector, productivity, climate change, Sudan

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1. INTRODUCTION

The Sudanese economy faced an unprecedented economic downturn in the aftermath of the secession of South Sudan in 2011 (oil revenues dropped approximately 75 percent) as well as civil strife and political instability (Nour and Mohamedain 2020). Most recently, the COVID-19 pandemic, the Russia–Ukraine war, and political conflict between civilians and military entities have added to the woes of the economy (Abay et al. 2023).

The downturn has manifested in the deterioration of all macroeconomic indicators. For instance, the rate of inflation increased from 63.3 percent in 2018 to 359.7 percent in 2021 before declining slightly to 217.7 percent in 2022 (Sudan, Central Bureau of Statistics 2022). Such inflation rates are unprecedented since independence. Exchange rates in the parallel market reached an average of 550 Sudanese pounds (SDG 550) to US\$1¹ in 2022 compared with SDG 70 and SDG 42 to the dollar in 2019 and 2018, respectively. The trade deficit (the difference between total exports and imports) also expanded from \$3.6 billion in 2018 to \$4.0 billion in 2021, while in the same year the economy shrank by 1.9 percent compared with 2.8 percent growth in 2018 (CBoS 2022a). Furthermore, 11.7 million people in the country faced acute food insecurity between May and September 2022 (UNOCHA 2023), and the response to that crisis is insufficient.²

After the 2018 revolution, the former Transitional Government of Sudan (TGoS) (2019–2021) adopted several macroeconomic measures—including removing fuel subsidies (November 2021), unifying exchange rates (February 2021), and implementing some shock response measures such as the Sudan Family Support Program launched in February 2021—aimed at qualifying for assistance under the Heavily Indebted Poor Countries Initiative in three years (Abdalla 2021). However, when the military overthrew the TGoS in October 2021, donor supports were immediately suspended or frozen, depriving the country of expected flows of external resources in terms of debt forgiveness, development assistance, and concessional loans because those were tied to realizing a transition to democracy.

¹ Unless otherwise noted all references to dollars are to US dollars.

² Refer to Table A1 in the appendix for more details about the performance of macroeconomic indicators during 1990–2021.

Despite such challenges, Sudan has great potential, including its considerable agricultural natural resources base. Those resources include around 183.3 million feddan of arable land, representing around 39.3 percent of the country's area. In addition, Sudan has diverse sources of water, including rivers, lakes, seasonal streams, and rainfall. Moreover, the country has diversified climate zones (UNEP and HCENR 2020, 105, 135). With those resources and the numbers of people employed in the agricultural sector, the future well-being of the Sudanese people, particularly the poor, will depend on agriculture (Khan 2004). Although over the last two decades, the sector's performance has been poor compared with its enormous potential, agriculture can once again lead growth as it did before 1999. But to rely on the sector to realize inclusive and sustainable growth, several challenges need to be addressed.

The paper aims to address two research questions:

- What has Sudan's agricultural sector contributed to the country's food security, economic growth (including external sectors), and employment during the last three decades? and
- What are the core causes of the observed agricultural sector performance?

To answer those questions, we look at the amounts of investment allocated to agriculture specifically by the government, the formulation of agricultural transformation policies within the national plans, and the outcomes of the plans aimed at transforming the sector. Furthermore, we posit that climate change is another constraint that has had significant impact on the sector. We present the agricultural sector's performance for the last three decades (1990–2021), dividing the period into three subperiods, namely, before the oil era (1990–1999); the oil era (2000–2010); and post–South Sudan secession (2011–2021). After that, we review the drivers of the sector's performance with a focus on policies, investment, and resilience.

The review of the agricultural sector's performance shows that between 1990 and 2021, the sector's share in gross domestic product (GDP) was 34.2 percent on average, whereas the sector's contribution to real economic growth was only 2 percent. In addition, the sector is the main source of livelihood for around 65 percent of the population and accounts for a considerable contribution to the labor force as 47 percent of the total labor force was employed in agriculture during the 1990 to 2021 period. Furthermore, the sector has historically been the main source of foreign currency—

contributing around 80 percent of exports until 1999. That share decreased to around 10 percent during the 1999–2011 period. In the aftermath of the South Sudan secession, the sector has since returned to the top of exports—with an average share of 55 percent of total exports (CBoS 2021).

The agricultural sector's generally poor performance is reflected in low productivity (relative to other countries in the region). We can attribute the low productivity to several factors, the most important of which are poor access to and use of inputs, technology, credit, and agricultural services. This is compounded by substandard infrastructure.

With the oil sector assuming the central role in development during the oil era (2000–2010), the importance and potential of agriculture as a driver of growth and foreign currency earnings was overlooked. That has led to the reallocation of resources and new investments away from the agricultural sector to benefit the oil sector. This can be observed directly when oil exports declined after the secession of South Sudan, with exports' share in real GDP declining to 1 percent in 2011 from 28 percent in 2010 (World Bank 2023), although that share had been more than 8 percent in 1998 (i.e., before oil exports started). Labor also shifted from agriculture to the oil industry and related services sectors that flourished with the oil, resulting as well in rapid migration from rural to urban centers (due to the concentration of basic services in the main cities); hence, oil has led to uneven development. The low investment in the agricultural sector has led to negative effects on the cost-efficiency and the competitiveness of agricultural exports in the international market.

The promise of agricultural transformation has not materialized given the lack of political commitment by the political elite. This is manifested in the meagre allocation of resources and the lack of commitment to follow through on development plans. Furthermore, government expenditure directed to the sector is low and it is unfairly distributed among the subsectors—the traditional³ subsector receives the smallest share compared with the irrigated subsector (World Bank Group 2016). Additionally, climate change represents a serious risk for the sector's current and future performance. Four main climate stressors have been identified as affecting all subsectors, regions, and groups: declining rainfall, rising temperature, drought, and flooding (Siddig et al. 2020).

³ The traditional subsector refers to subsistence rain-fed farming practiced by much of the country's population. Many such farmers live in the low-rainfall areas, growing crops of sorghum and millet.

Despite the plans made before 2018 targeted at transforming the agricultural sector, commitment to the execution of those plans was limited. After 2018, the TGoS's efforts were interrupted by the military's overthrow of the government in October 2021. In this paper, we review the existing literature and analyze the performance and contributions of the agricultural sector, focusing on the sector's contributions to economic growth, livelihoods, employment, and exports. Moreover, the paper sheds light on the performance of the sector's productivity through time and links both contributions and productivity to the policies that have been applied to the sector, climate change, and land use.

2. CONTEXTUAL BACKGROUND

Sudan’s agricultural value added is generated from crops produced broadly in three farming systems—irrigated, semi-mechanized, and traditional rainfed—as well as livestock, forestry, and fisheries. Crops and livestock are the major contributors to agriculture value added. The traditional rainfed system accounts for the largest share of land area (52 percent) followed by semi-mechanized (39 percent) and irrigated (9 percent) (Table A). During 2011–2020, the crop and livestock subsectors contributed 46 percent and 54 percent, respectively, to the agricultural value added (CBoS 2021).

Table A Farming systems, cultivated land, and major crop and livestock activities

Farming system	Area (%)	Main crops
Irrigated	9.3	Sugarcane, cotton, sorghum, groundnuts, wheat, legumes spices, vegetables, and fruits
Traditional rainfed	52.0	Sorghum, millet, sesame, groundnuts, hibiscus, watermelon, gum arabic, and livestock
Semi-mechanized rainfed	38.7	Sesame, sunflower, cotton, millet, and livestock

Source: FAO (2022, 8–9) and Elbadawi et al. (2022, 38–53).

The performance of the agricultural sector and the constraints that limit the role the sector plays in the economy have received considerable attention in the past. Several studies have analyzed the sector’s performance in terms of real agriculture value added, productivity, and investment. More recently, some studies have investigated the impact of climate change on the sector. In this contextual section, we review the more recent literature discussing the performance of the sector, the constraints it faces, and its prospects.

Igaimi (2016) and, more recently, Elbadawi and colleagues (2022) find that the sector has contributed poorly to GDP and real GDP growth. In their study, Elbadawi and colleagues (2022) analyzed sectoral performance and further suggested a sectoral transformation strategy through productivity convergence, addressing challenges, and realizing opportunities in the three farming systems. Furthermore, the sector’s contribution to exports was 56.3 percent in 2021 (CBoS 2021). This mirrors the sector’s capacity to be a leading source of foreign exchange and possibly offset the loss of oil revenue during the last two decades (World Bank Group 2019).

The productivity (production per feddan) of various crops has declined compared with that of previous decades and is relatively lower compared with what we see in other countries in the region. For example, between 2000 and 2019 crop productivity in Egypt increased by 80 percent compared with only around a 19 percent increase in Sudan (Elbadawi et al. 2022). Similarly, productivity in South Africa grew by 190 percent between 1995 and 2014 while that of Sudan increased by only 19 percent. With respect to selected crops, the productivity of sorghum in Sudan is 75 percent of that crop's average productivity across Africa. Similarly, millet and sesame productivity are 70 percent and 67 percent, respectively, of the continental average. According to the World Bank Group (2019), productivity of wheat, sorghum, and millet in Sudan is lower than in the competitive countries. For instance, in Ethiopia and Nigeria, sorghum productivity amounts to 2,600 kilograms per feddan and 1,200 kilograms per feddan, respectively, compared to 700 kilograms in Sudan.

With respect to private investment in agriculture, the World Bank Group (2019) estimated that agricultural households growing sesame and sorghum spent only 20 to 30 percent of their income on inputs (fertilizers and pesticides), which is very low compared with peer countries in the region. Additionally, the government has concentrated its investment in agriculture on the irrigated subsector and neglected the rainfed subsectors (Elbadawi et al. 2022).

We highlight several factors that could explain the poor performance of Sudan's agricultural sector in the past three decades. Those factors are categorized as macro- or micro-level constraints. The macro-level constraints include the lack of political commitment by the political elite to develop the sector, economic instability and its impact on the sector (rising production costs and price fluctuations), political instability in the form of civil wars and tribal conflicts, a lack of economic diversity, climate change challenges, the lack of an enabling economic environment, weak and fragmented agricultural institutions, devastated infrastructure, and trade-related challenges (for example, limited access to markets, poor linkages with other sectors, and weak competitiveness of the sector's exports) (Igaimi 2016). In addition, the economy's reliance on oil during the 1999–2011 period led to an exchange rate overvaluation (Dutch disease), leading to the reduced competitiveness of agricultural exports (Elbadawi et al. 2022).

At the micro level, productivity constraints are widely considered to be a major cause of poor performance. Subpar productivity at the micro level is attributed to limited adoption of technology, limited use of fertilizers and improved seeds, limited access to credit (specifically for farmers in the traditional subsector), inadequate agricultural services (marketing and other services), and a failure to enable the producers' environment (including multiple taxes and levies by national and subnational governments) (World Bank Group 2019; Igaimi 2016). For example, the 2021 growing season was marked by inadequate seed use (only 828.6 metric tons of seed were distributed by the federal government, which is half of the target, that is, the 2020 level of seed use), a lack of regular maintenance, low quality of spare parts (FAO 2022), and the out-migration of labor from agricultural areas to urban centers and to gold mining (Elbadawi et al. 2022). A review of government spending in the sector also revealed low governmental investment in the sector—well below the targeted 10 percent of total public spending (Elbadawi et al. 2022).

Some recommendations advanced in the literature include enhancing the government's efforts, particularly in infrastructure development, to realize agricultural transformation (Igaimi 2016); investment in research and enhancing the capacity of stakeholders (Siddig et al. 2020); and adopting drought-tolerant varieties (World Bank Group 2019). In addition, policy measures that might improve productivity include investment in inputs (specifically fertilizers and pesticides), diversification of the crop portfolio (by introducing cash crops) in the short run, investment in human capital in the long run, facilitating access to credit and subsidizing inputs, expanding and repairing the existing irrigation infrastructure, adopting distributive land reform policies, enhancing water harvesting, and adopting institutional reforms (World Bank Group 2019; Elbadawi et al. 2022; Igaimi 2016).

To secure the food supply, Nour and Mohamedain (2020) offer some policy recommendations. They include (1) promotion of cash crops and increasing commercial agriculture, (2) targeting households' income, (3) improving irrigation systems, (4) enhancing agricultural services, (5) increasing productivity through technology adoption and long-term human capital development, and (6) providing fertilizer and seed subsidies.

Elbadawi and colleagues (2022, 42–43) propose a national industrial policy that could transform the agricultural sector and improve the macroeconomic policy environment (including a competitive exchange rate regime). They offer comprehensive policy measures and proposed interventions. In the traditional rainfed sector, they suggest the following measures: (1) provide services related to agricultural production such as crop insurance, access to credit and financial institutions, vaccination of livestock, and support of universities, labs, research centers, and the animal feed industry; (2) provide services related to local farmers and producers such as health services, education in farms (field schools), and capacity building for farmers and producers; (3) engage local institutions; (4) adopt climate-smart practices; (5) enhance the use of information and communication technology; and (6) develop roads and other infrastructure. Their report provides core recommendations for transformation in the irrigated subsector—among those measures are modernization of the irrigation infrastructure, promotion of industry and value-added maximization, and encouraging contract farming in the sector (Elbadawi et al. 2022, 53).

With respect to climate change resilience, literature identifies several measures. These include (1) micro-fencing to reduce sand encroachment, rangelands reseeding, and village nurseries for rehabilitation of rangelands for increasing resilience; (2) promotion of water harvesting to mitigate water stress from temporal and spatial variability of rainfall and the high risks of interseasonal dry spells; (3) establishment of community-managed horticultural farms to enhance adaptive capacities, household incomes, and food security; (4) introduction of drought- and heat-tolerant varieties of crop and vegetable seeds; (5) vaccination of pastoralist herds against epidemics, as well as provision of supplementary feeding and better-adapted animal species; and (6) shifting from total dependence on biomass energy to butane gas units for domestic energy (cooking) to reduce deforestation and to reduce sand dune movement (Hassan et al. 2022, 13).

3. AGRICULTURAL SECTOR'S CONTRIBUTION TO THE ECONOMY

3.1 Contribution to GDP

Despite the stylized fact highlighted in the previous sections that Sudan's agriculture holds great potential and enormous endowments, the sector has performed poorly in terms of contribution to GDP and real GDP growth during the past two decades. Overall, real GDP and real export values have grown rapidly since the 1990s. GDP values peaked around the 2008–2010 period before their notable decline in 2011, which is clearly associated with the loss of oil revenues following the secession of South Sudan (Figure 1). Meanwhile, real exports followed suit, showing a development pattern similar to real GDP values. They increased rapidly from 1999 through 2010, followed by a sharp decline in 2011. Both GDP and exports have been relatively flatter beginning in 2012. That is also demonstrated by the line depicting the share of exports in GDP (Figure 1).

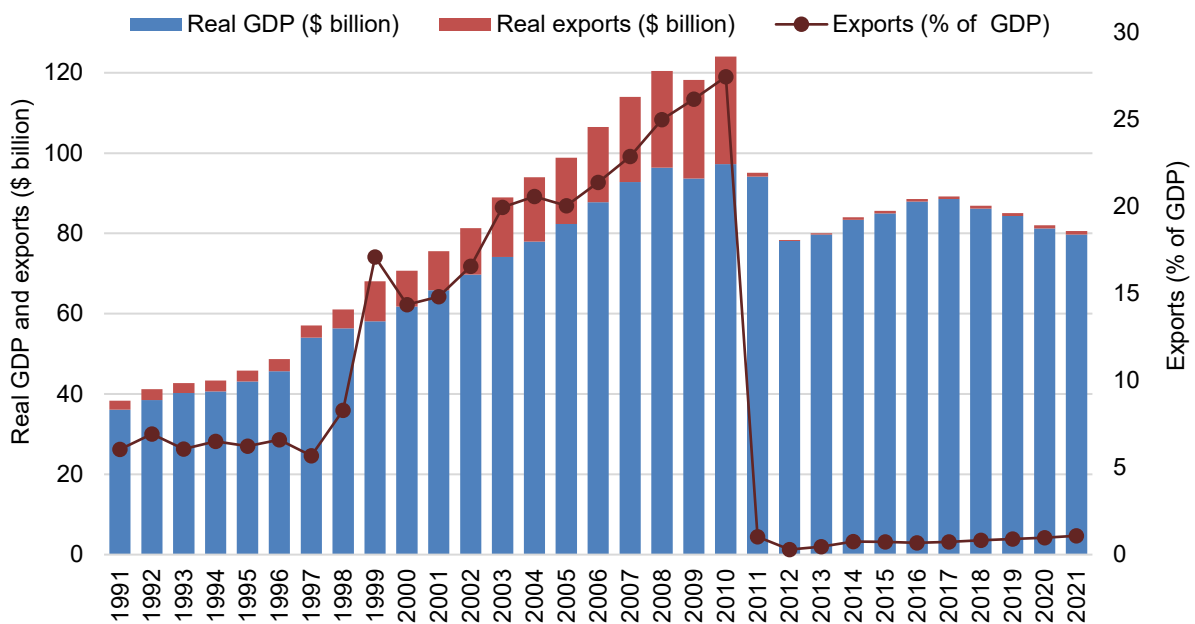


Figure 1 Real GDP (US\$ billion), real exports (US\$ billion), and exports' share in GDP, 1990–2021

Source: Authors' compilation based on World Development Indicators data (World Bank 2023).

As Figure 2 shows, growth in the agricultural sector and its contributions to GDP and real GDP growth were greater in the 1990s than in the subsequent two decades. During the 1990s, the agricultural sector led economic growth with a relatively high share of GDP.

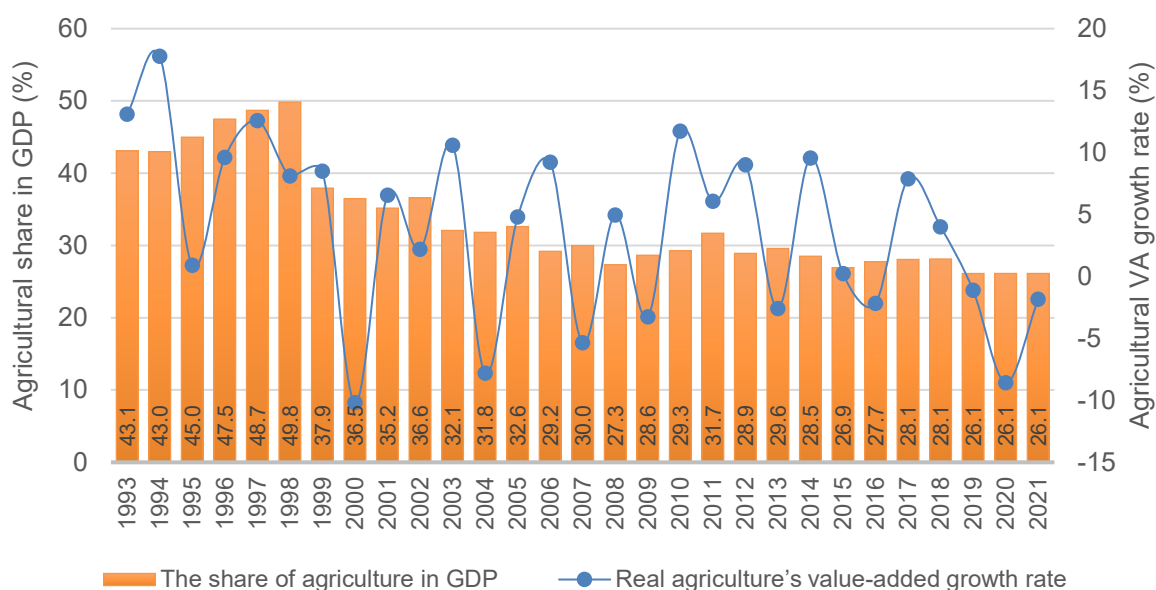


Figure 2 Contribution to GDP and growth of agricultural value added (%), 1990–2021

Source: Authors' compilation based on data from CBoS Annual Reports, 1993–2021.

On average, during the 1990s (1990–1999), the sector's share of value added in GDP was 43 percent, which dropped to 32 percent during the subsequent decade (2000–2010) and to 28 percent during the last decade (2011–2021) (Table B). A review of other sectors' performance shows that industry witnessed enormous growth during the oil era with its average share in GDP increasing from 9 percent during 1990–1999 to 25 percent during 2000–2010; however, it declined during 2011–2021 to 22 percent (Figure 3). The service sector was relatively stable during the first and last decades with its average share in GDP of 50 percent, whereas that dropped to 43 percent in the second decade.⁴

⁴ For more detail about the performance of GDP decomposition, refer to Table A2 and Table A3 in the appendix. Sectoral shares in GDP are further depicted in Figure A1 in the appendix.

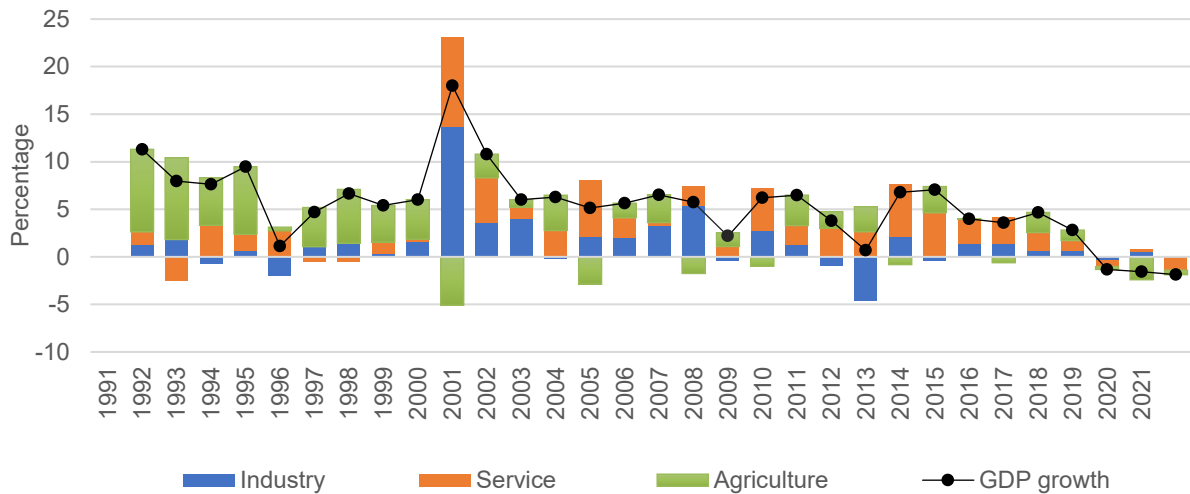


Figure 3 Agricultural sector’s contribution to growth and overall GDP growth (%), 1990–2021

Source: Authors’ preparation based on data from CBoS Annual Reports, 1991–2021.

Note: Contribution to growth is calculated as follows: the sector’s growth in the current year multiplied by the sector’s share in GDP in the previous year.

This downturn is consistent with another stylized fact associated with agricultural sector performance. Despite the high growth rates reported during the 1990s, the real growth rates of the sector’s value added sharply decreased during the past two decades (Table B). On average, the real growth rate of the sector’s value added was more than 14 percent during the first decade of our review period; however, that decreased to 2.2 percent in the second decade, reflecting the shift from an agriculture-based economy to an oil-based economy, and during the last decade, the sector evinced even more paltry growth, at only 1.7 percent (Table B).

In terms of the sector’s contribution to real GDP growth, it is noticeable that it led that growth during the 1990–1999 decade, contributing around 80 percent of real GDP growth. However, from 2000 through 2010 (the oil era), that contribution dropped to around 7 percent before it increased slightly to 20 percent during 2011–2021 (Table B).

Understanding the poor performance of the sector is essential for development planning if the country is to eventually realize high and sustainable growth rates for the sake of poverty reduction, as we suggested in the previous section. In the subsequent sections, we offer some further explanations about the drivers of this poor performance.

Table B Performance of the agricultural sector, 1990–2021

Decade	Agriculture share (%)	Agriculture value-added growth (%)	Agriculture contribution to growth (%)	GDP growth (%)	Agriculture relative contribution to growth (%) ^a
1990–1999	42.6	13.8	5.2	6.6	78.8
2000–2010	32.3	2.2	0.5	7.0	7.1
2011–2021	28.2	1.7	0.5	2.4	20.8
Average	34.3	5.9	2.1	5.3	39.6

Source: Authors' preparation based on data from CBoS Annual Reports, 1990–2021.

Note: Growth rate is calculated for each period separately using year-over-year formula.

^a The contribution to growth takes into consideration both the sector's growth and the sector's share in GDP. We calculated it based on a simple formula: the share in the previous year multiplied by the growth in the current year. Then we divided the sector's contribution by the overall growth to transform it to percentages. This gives the distribution of growth among the sectors—for example, agriculture, industry, and service. Negative contribution means that the sector is negatively contributing to growth. Alternatively, relative contribution to growth can be obtained by dividing the absolute contribution by the overall growth.

3.2 Contribution to Income, Livelihood, and Employment

Despite the illustrated poor performance of the agricultural sector, it remains the main source of employment and livelihood for most of Sudan's population in rural areas as well as for the skilled labor. Table C summarizes statistics on the contribution of the sector to employment and income generation collected from selected studies.

Table C Agriculture's contribution to livelihood and employment in Sudan

Variable	Contribution (%)	Source	GDP growth (%)
Population livelihood	65.00	Igaimi (2016); FAO (2022)	6.6
National labor force	75.0 (1990s), 44.0	CBoS (1999); Etang Ndip and Lange (2019)	7.0
Employment generation	47.40	Elbadawi et al. (2022)	2.4
Skilled labor	35.70	Elbadawi et al. (2022)	5.3
Rural population engagement in agriculture	80.0 (1997), 50.0 (2009), 40.0 (2014)	CBoS (1997); World Bank Group (2019)	
Average rural household income	33.33	World Bank Group (2019)	

Source: Authors' compilation based on the studies cited in the table.

As Table C shows, the sector is a major source of income. According to Etang Ndip and Lange (2019) and based on the National Household Baseline Poverty Survey 2014/15, the sector employed around 44 percent of the labor force in 2014, a contribution that was higher during the 1990s-75 percent according to CBoS (1999). Rural population engagement in agriculture was very high before 1999, with 80 percent of the total population engaged in agriculture versus 50 percent and 40 percent in 2009 and

2014, respectively. The population growth and labor force associated with agriculture were both higher during the third decade compared with the earlier two decades.⁵

The sector not only is a major source of income in rural areas but also employs 35.7 percent of skilled labor (Elbadawi et al. 2022). The most recent data extracted from the Sudan Poverty Reduction Strategy Paper (Sudan, MoFEP 2021a) indicate that the sector employs 43 percent of the labor force. That share is higher in rural areas with 47 percent relying on agriculture as their main source of income. It is worth mentioning that the share of people who rely on agriculture varies across states and that the dependency on agriculture is associated with higher poverty rates. For instance, in Central Darfur state, where the poverty rate is the highest among all states, 69 percent of the labor force is employed in agriculture (Sudan, MoFEP 2021a).

3.3 Contribution to Exports

Except for during the oil era (2000–2010), when oil exports constituted the main source of foreign currency in Sudan, agricultural exports were the main source of foreign currency over our review period. During the first decade, Sudan relied extensively on agriculture as a main source of exports (Figure 4 and Table D). On average, the share of agricultural exports in total exports was more than 78 percent, but that decreased to around 11 percent during the oil era.

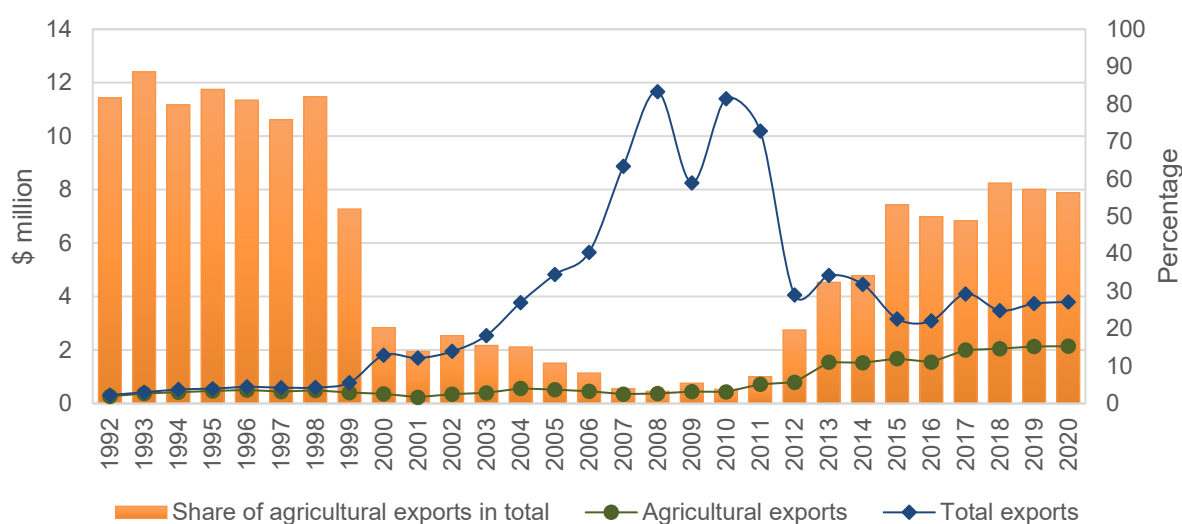


Figure 4 Total and agricultural exports (US\$ million) and share of agricultural exports (%), 1992–2020

Source: Data from CBoS Annual Reports, 1992–2020.

⁵ See Table A1 in the appendix for a comparison of population and labor force across the three decades.

During the 1990–1999 and 2000–2010 decades, growth rates of agricultural exports were relatively lower than those of the third decade. The average growth rates were 10 percent and 9 percent, respectively, whereas the last decade witnessed relatively higher growth rates with an average rate of 15 percent (Table D). This demonstrates that the sector has restored its importance as a main source of exports after 2011 in terms of its contribution to overall export earnings and to sectoral growth.

Sudan’s agricultural exports consist of either crops or livestock with their respective contributions being 64 percent and 36 percent between 2000 and 2021. Sesame and sheep have been the main contributors to agricultural exports, specifically after the oil era. On average, between 2011 and 2020, sesame accounted for 30 percent while sheep accounted for 24 percent of agricultural exports (Table D).

Table D Contribution of agriculture to exports

Sector	Share and growth rate	1990–1999	2000–2010	2011–2021
Agricultural sector	Share in total exports	78.1	10.5	46.6
	Growth rate	9.7	8.9	15.1
Livestock	Share in agricultural exports		30.3	42.9
	Share in total exports		3.0	17.9
Sheep	Growth rate	19.0	25.5	10.0
	Share in agricultural exports	18.0	19.5	24.5
Crops	Share in the sector’s exports		69.8	57.1
	Share in total exports		6.8	26.1
Sesame	Growth rate	19.5	11.5	21.0
	Share in exports	23.0	28.0	29.5
Cotton	Growth rate	8.5	0.0	42.0
	Share in exports	21.0	17.0	15.5
Gum arabic	Growth rate	25.5	4.0	26.0
	Share in exports	9.0	11.5	6.5
Fertilizer imports %		2.9	0.85	1.1
Growth of imported quantity of fertilizers ^a		64.3	-12.4	15.05
Wheat imports as a share of Imports		10.65	7.1	9.9

Source: Authors’ compilation based on data from CBoS Annual Reports, 1990–2021.

^a Detailed data on the growth of the imported quantity of fertilizers is found in Figure A2 in the appendix.

Figure 5 shows the contributions of the various main commodities to agricultural exports. Over the last three decades sesame and sheep have been the main contributors to growth in agricultural exports. In the first decade, average agricultural export growth was 8 percent compared

with 9 percent and 16 percent in the second and third decades, respectively. During the last decade, and especially in 2013, growth was relatively high, driven by sesame, cotton, and sheep.

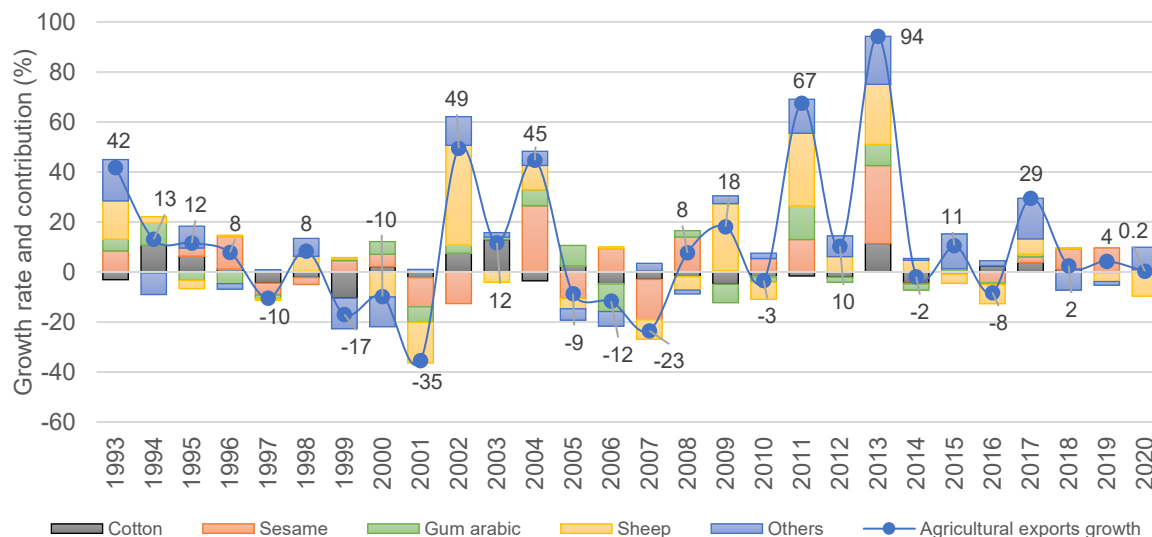


Figure 5 Contributions of main commodities to overall agricultural exports (%), 1993–2020

Source: Authors’ preparation based on data from CBoS, 1993–2021.

3.4 Contribution to Food Security and Related Policies

The agricultural sector plays an essential role in the country’s food security by supplying the bulk of cereals (sorghum and millet) and oilseeds (groundnuts and sesame). Locally produced wheat accounts for about 15 percent of Sudan’s total domestic wheat consumption (Figure 6).

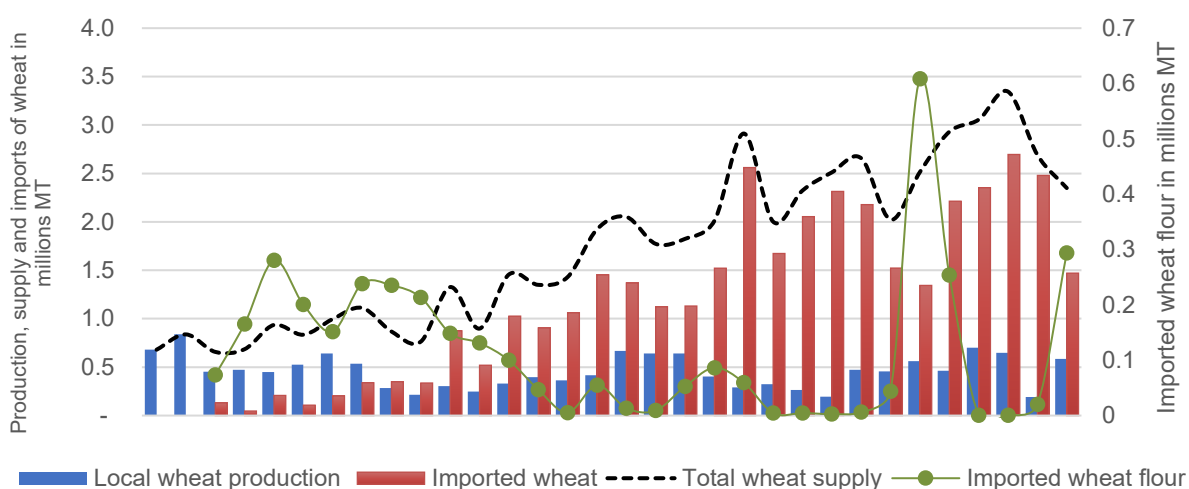


Figure 6 Wheat production, supply, and imports (million tons), 1990–2021

Source: Authors’ preparation based on data from CBoS, 1990–2020.

Note: MT = metric ton.

Given agriculture's poor performance coupled with political developments in wheat-exporting countries (Russia and Ukraine), Sudan faces acute food security challenges. To face them, the Sudanese government announced some measures as described in the following paragraphs.

Wheat subsidies. Despite the adoption of a plan of reforms that was aimed at eventually removing commodity subsidies, the government decided not to completely remove wheat subsidies. The 2022 estimated budget contains 29 percent of current spending as commodity subsidies, with wheat representing 2 percent compared with 14 percent in 2021. During the 2018–2022 period, the share of subsidies in current public spending amounted to 41 percent, 40 percent, 25 percent, 41 percent, and 29 percent in the five years, respectively. During the same period, the wheat subsidies' share in total subsidies was 6 percent, 14 percent, 31 percent, 14 percent, and 2 percent, respectively (Sudan, MoFEP 2022b).

Trade restrictions. In April 2022, the Central Bank of Sudan and the Ministry of Industry and Trade announced a ban on exports of sorghum, wheat, pasta, and vermicelli (CBoS 2022b).

Government purchase of locally produced wheat. The government adopted a policy of purchasing locally produced wheat from farmers, with the price usually identified by joint committees between the government bodies (Strategic Reserve Corporation, Agricultural Bank of Sudan) and the farmers associations. In the 2022 season, the government announced a price for locally produced wheat of SDG 43,000 per 100-kilogram sack (Fereeni 2022). In 2023, the government announced it was withdrawing from purchasing wheat and refused to announce a concentrated price for wheat ahead of the growing season (Dorosh, Siddig, and Kirui 2022). This is expected to cause a considerable decline in the season's domestic production of wheat.

Building strategic reserves from sorghum and wheat. In 2022, the Ministry of Finance and Economic Planning announced a budget of SDG 173 billion to build strategic reserves from sorghum (200,000 metric tons at a cost of SDG 44 billion) and wheat (300,000 metric tons at a cost of SDG 129) (Sudan, MoFEP 2022a).

Importing wheat from other sources. A review of sources of wheat imports during the first quarter of 2022 compared with those of 2021 revealed that in the first quarter, Sudan imported 30 percent of its wheat from Poland. The value of wheat imports from Egypt and Romania in the first

quarter of 2022 compared with 2021 increased from 16 percent to 23 percent and from 6 percent to 10 percent, respectively (Table E).

Table E Wheat import sources in 2021 and the first quarter of 2022

Country	2021		First quarter of 2022	
	Value (\$US million)	Share (%)	Value (\$US million)	Share (%)
Russia	141,023	26.0	85,444	23.3
Romania	86,403	15.9	84,152	23.0
Canada	40,113	7.4	—	0.0
Australia	55,171	10.2	4,367	1.2
United States	60,337	11.1	19,382	5.3
Germany	23,058	4.3	4,525	1.2
Egypt	30,826	5.7	37,543	10.2
Poland	—	0.0	108,677	29.7
Others	105,025	19.4	22,357	6.10
Total	541,956	100	366447	100

Source: CBoS, foreign trade statistics, 2021–2022.

4. CROP PRODUCTIVITY

Sorghum is the main crop grown in Sudan, with most of its production being in the rainfed sector (both the mechanized and traditional subsectors). It is essential for food security as it is consumed widely throughout the country. Between 2014 and 2020, the share of land under sorghum cultivation in the semi-mechanized subsector was 59 percent compared with 38 percent and 4 percent in the traditional and irrigated subsectors, respectively (based on CBoS Annual Reports, 2014–2020). Productivity averaged 208 kilograms/feddan during the 1990s compared with 207 kilograms/feddan in the 2000s, whereas it increased to 363 kilograms/feddan during the most recent decade. Cultivated land decreased by 11 percent in the last decade compared with an average decrease estimated at 23 percent during 2000–2010. Therefore, output growth was very high in the first decade versus that of the second and the third decades. Sorghum productivity is higher in the irrigated subsector than in the other subsectors. Average sorghum productivity between 2014 and 2020 in the irrigated subsector was 795 kilograms/feddan compared with 172 kilograms/feddan and 179 kilograms/feddan in the semi-mechanized and traditional subsectors, respectively (based on CBoS Annual Reports, 2014–2020).

Wheat productivity (shown in the right vertical axis of Figure 7) is relatively higher than that of sorghum because it is mainly produced in the irrigated subsector. Comparing the productivity of wheat over the last three decades reveals an average of 756 kilograms/feddan in the first decade compared with 835 kilograms/feddan and 1,807 kilograms/feddan in the second and the third decades, respectively. Production growth was higher in the last decade than in the other two decades, whereas cultivated land decreased in the last decade (Figure 7 and Table F).

Millet productivity stayed nearly constant during the first two decades. On average, it was 73 kilograms/feddan in the first decade versus 74 kilograms/feddan and 257 kilograms/feddan in the second and third decades, respectively (Figure 7). Thus, millet production growth was lower during the oil era with an average growth rate of 8 percent compared with rates of 40 percent and 49 percent during the first and the last decades, respectively (Table F). Despite a reduction in the area cultivated in millet in the last decade compared with the second decade, output was higher in the last decade (Table F), thanks to the recent improvement in millet land productivity.

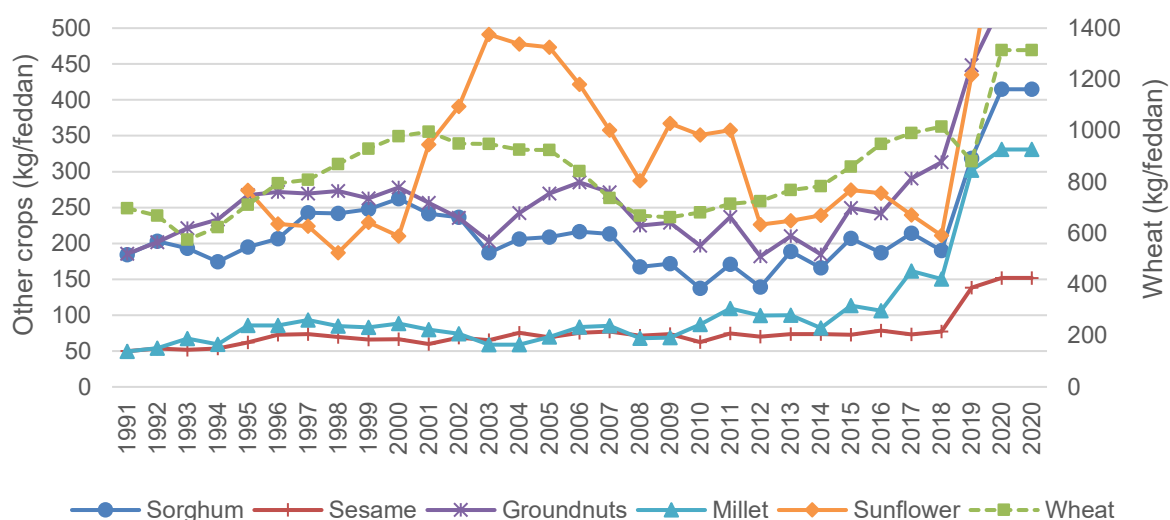


Figure 7 Trends in crop productivity (kilograms/feddan), 1990–2021

Source: CBoS, 1991–2020 data, and data for 2020 from FAO (2022).

Note: We used a three-year moving average to detrend the data. kg = kilograms.

Table F Average crop productivity (kilograms/feddan) by decade, 1990–2021

Period	Sorghum	Sesame	Wheat	Groundnuts	Millet	Sunflower
1990–1999	208.0	61.4	755.7	241.9	73.0	208.7
2000–2010	207.2	70.9	835.2	244.5	74.1	390.0
2011–2021	363.0	148.4	1,806.9	529.0	256.8	461.4
Average	259.4	93.6	1,132.6	338.5	134.6	353.4

Source: CBoS Annual Reports, 1990–2021.

Sesame productivity was higher in the last decade compared with the first two. On average, it was 148 kilograms/feddan in the last decade versus 61 and 71 kilograms/feddan in the first and second decades, respectively (Table F). The area under the major cereals (sorghum, millet, and wheat) and oil seeds (groundnuts, sesame and sunflower) and the production in metric tons for the three decades is reported in Table G and Table H. On average, over the three decades, sorghum occupied the lion’s share of cultivated land (17,829 feddan), followed by millet (7,474 feddan), sesame (5,100 feddan), and groundnuts (3,917 feddan) (Table G and Table H). On the other hand, the average production was 3,700, 755, and 460 metric tons for sorghum, millet and what respectively over the three decades. The inter-decade variations in area and production are reported in Table G and Table H.

Table G Cultivated area (thousand feddan) and production (million metric tons) of sorghum, wheat, and millet, 1990–2021

Period	Sorghum		Millet		Wheat	
	Area	Production	Area	Production	Area	Production
1990–1999	14,971.3	3,141.3	6,628.3	483.3	682.6	494.3
2000–2010	18,989.1	3,813.0	8,305.7	605.5	554.0	436.1
2011–2021	19,525.5	4,174.4	7,489.1	1,176.7	468.5	448.5
Average	17,828.6	3,709.6	7,474.4	755.2	568.4	459.6

Source: CBoS Annual Reports, 1990–2021.

Table H Cultivated area (thousand feddan) and production (million metric tons) of groundnuts, sesame, and sunflower, 1990–2021

Period	Groundnuts		Sesame		Sunflower	
	Area	Production	Area	Production	Area	Production
1990–1999	2,579.8	659.34	3,912.2	248.3	0.00	0.00
2000–2010	3,197.7	758.27	4,166.6	298.3	185.7	66.4
2011–2021	5,974.1	1,858.7	7,223.5	647.8	347.2	92.1
Average	3,917.2	1,092.1	5,100.7	398.1	177.6	52.8

Source: CBoS Annual Reports, 1990–2021.

With regard to growth rates in land under each of the crops as well as productivity changes, the data show that land under sesame, groundnuts, and sunflower increased by about 48 percent, 38 percent, and 9 percent, respectively, during the last decade. On the other hand, land under wheat, sorghum, and millet shrank by about 18 percent, 11 percent, and 10 percent, respectively (Table I and Table J).

Similarly, productivity of sesame, groundnuts, and millet saw a significant increase by an average of 78 percent, 74 percent, and 49 percent, respectively. To sum up, productivity for all cereals (except wheat) was lower during the oil era (2000–2010) compared with either of the two decades before and after the oil era. Productivity has improved during the 2011–2021 period, indicating that the country’s heavy reliance on oil has contributed to diverting the attention away from agriculture. Moreover, the recent performance of crop productivity during the last decade confirms that agriculture has the potential and ability to lead economic growth in Sudan.

Table I Growth rates of cultivated area and productivity of sorghum, wheat, and millet (%), 1990–2021

Period	Sorghum		Millet		Wheat	
	Area	Productivity	Area	Productivity	Area	Productivity
1990–1999	-8.08	18.0	-4.9	39.5	-41.6	-26.5
2000–2010	23.2	9.3	14.5	7.8	40.0	18.1
2011–2021	-10.8	3.6	-9.5	49.4	-18.8	4.1

Source: CBoS Annual Reports, 1990–2021, and authors' calculations.

Table J Growth rates of cultivated area and productivity of groundnuts, sesame, and sunflower (%), 1990–2021

Period	Groundnuts		Sesame		Sunflower	
	Area	Productivity	Area	Productivity	Area	Productivity
1990–1999	64.3	108.7	29.7	70.1	—	—
2000–2010	3.5	-4.8	-3.5	-1.2	—	—
2011–2021	38.1	74.7	47.8	78.1	9.1	5.33

Source: CBoS Annual Reports, 1990–2021, and authors' calculations.

5. NATIONAL DEVELOPMENT PLANS, INVESTMENT IN AGRICULTURE, AND THE RESPONSE TO CLIMATE CHANGE

Having relied enormously on oil during the 2000–2010 period while neglecting the agricultural sector, Sudan now faces several constraints and challenges to reform in that sector. In this section, we review some of those challenges. We first examine the country’s agricultural sector development plans. Next, we look at investment in agriculture by the government, credit provided by the banking sector, foreign direct investment (FDI), and other private credit sources. In the third subsection, we review the challenge of climate change, its expected consequences, and the government’s responses to them.

5.1 Agriculture in Sudan’s National Development Plans

Responses by the Sudanese government to the observed challenges have been either limited or ineffective (Elbadawi et al. 2022). Since 2011, the successive governments of Sudan have prepared many national development programs and plans. The former Ingaz regime prepared the Five-Year Economic Reform Program (2015–2019) and Sudan’s National Agriculture Investment Plan (SUDNAIP) (2016–2020). Despite the ambitious objectives and quantitative targets of the two blueprints, their implementation was limited, and they have, therefore, been ineffective in realizing the agricultural sector’s potential. Despite decades of several economic development plans and public policy initiatives aimed at transforming the country’s agriculture, its vast agricultural potential is far from being realized (Elbadawi et al. 2022, 7).

More recently, the former TGoS (2019–2021) announced its Three-Year Economic Stability and Development Program (2021–2023) and the Sudan Poverty Reduction Strategy Paper (2021–2023) (hereafter referred to as the PRSP). Unfortunately, the two plans (described in subsections 5.1.3 and 5.1.4) lack clear quantitative targets, and, as well, they were interrupted by the October 25, 2021, military coup. The PRSP relies on donor support with the core objective of Sudan’s meeting the criteria of the Heavily Indebted Poor Countries Initiative, an objective that is no longer feasible considering the recent political developments in the country. The following subsections provide additional details on the objectives and policies of the post-2011 plans.

5.1.1 Five-Year Economic Reform Program (2015–2019)

The core objective of the Five-Year Economic Reform Program was to realize the necessary economic reforms that could lead to positive economic growth of 7 percent by 2019. Table K shows the plan's quantitative targets for crop production and productivity. For instance, the plan targeted increasing the production of sorghum by 69.6 percent by 2019 from its 2015 level, which should be associated with productivity increase of 55.2 percent and an area growth of 9 percent.

Table K Crop production and productivity quantitative targets of the Five-Year Economic Reform Program

Crop	Production growth by 2019	Productivity growth by 2019
	(percent)	(percent)
Sorghum	69.6	55.2
Wheat	240.0	36.1
Millet	34.8	14.2
Cotton	76.4	0.0
Groundnuts	50.0	25.0
Sunflower	780.0	140.0
Sesame	350.0	275.9

Source: Sudan, MoFEP (2015).

To achieve its targets, the program proposed the following policies:

- Focus on infrastructure development.
- Introduce modern agricultural systems in the irrigation schemes.
- Develop the traditional rainfed system.
- Expand cotton areas and introduce new crops (for example, soybean and maize).
- Introduce livestock into irrigated agriculture.
- Expand credit, the mechanization of agriculture, and the use of improved seeds.
- Provide government-insured fair prices to farmers, especially for wheat every August.
- Enhance the use of water harvesting.

5.1.2 Sudan's National Agriculture Investment Plan (2016–2020)

Like the Five-Year Economic Reform Program, SUDNAIP set out quantitative targets to be realized by 2020. It was prepared within the Comprehensive Africa Agriculture Development Programme (CAADP) in which the government committed to allocate 10 percent of total budgetary resources to the sector to realize 6 percent annual growth in agriculture's value added.

The total required resources were \$5,542 million. The government committed to secure \$3,648 million (around 65.8 percent) with the expectation that the private sector would contribute \$1,263 million (22.8 percent) and that Sudan's partners and the international community would cover the gap of \$631 million (11.4 percent). The plan identified seven strategic objectives together with the required resources as Table L shows.

Table L Strategic objectives and required resources of SUDNAIP

Objective	Resource (US\$ million)	Percentage
Enabling environment for sustainable agricultural development	26	0.5
Institutional reform, change management, and promotion of capacity	35	0.6
Increasing production and productivity	1,833	33.0
Developing agricultural supportive services, information, and knowledge networks	877	16.0
Agro-industrial development, access to markets, and development of value chain	2,062	37.0
Addressing land issues, sustainability of natural resources including biodiversity	189	3.0
Realizing food security	520	9.0
Total	5,542	100

Source: Sudan, MoFEP (2016).

5.1.3 Three-Year Economic Stability and Development Program (2021–2023)

The Three-Year Economic Stability and Development Program (Sudan, MoFEP 2021b) was intended to address the legacy of economic instability in the agricultural sector. However, it lacks quantitative targets and fails to identify the required resources. The following are its proposed areas of interventions to realize agricultural sector development:

- Creating an enabling environment for sustainable agricultural development
- Institutional and policy reform
- Sustainable management of natural resources
- Building inclusive agricultural institutions
- Developing and modernizing agricultural systems
- Developing supportive services in the sector
- Promotion of information and knowledge
- Strategic partnerships with foreign countries
- Agro-industrial development
- Addressing land issues

5.1.4 Sudan Poverty Reduction Strategy Paper (2021–2023)

Within the framework of enabling Sudan to meet the criteria of the Heavily Indebted Poor Countries Initiative, the TGoS prepared the PRSP of 2021 to be adopted in 2021–2023. By implementing the PRSP for at least one year and implementing further economic reforms set out under the Extended Credit Facility, Sudan could gain debt relief and arrears clearance from the international financial community. One of the main pillars of the PRSP is agricultural sector development as a way of realizing balanced and sustainable economic growth.

5.2 Investment in Agriculture

Despite the positive effects of public spending policies on the agricultural sector and the ambitious plans announced by the African Union and ratified by Sudan, as stated in SUDNAIP (2016–2020), government spending on agriculture has remained below the planned levels of spending on the sector.

The bulk of Sudan’s government expenditure is allocated to current spending, including wages and salaries, commodity subsidies, and grants (transfers to subnational governments). As Table M shows, between 1990 and 2021, public investment in agriculture constituted a small share of government expenditure. Sudan is still far away from achieving the goal set out in the 2003 Maputo Declaration of allocating 10 percent of national budgetary resources to agriculture and rural development.

Actual public spending on agriculture has lagged far behind the planned expenditure. On average, between 1990 and 2021 the government allocated around 3 percent of its spending (0.4 percent of GDP) to the agricultural sector.

Table M Government spending on agriculture, 1990–2021

Time	Agriculture revenue (%)	Agriculture’s share in total expenditure (%)	Agriculture’s share of GDP (%)
1990–1999	3.5	2.8	0.3
2000–2010	5.7	5.2	0.8
2011–2021	1.4	1.2	0.2
Average	3.5	3.0	0.4

Source: Authors’ calculation based on MoFEP federal budgets, 1990–2021.

Since 2011, that share has decreased on average, with the sector receiving only 1.2 percent of government expenditure during 2011–2021 (Figure 8). In 2022, the government announced a bump up in spending on agriculture, namely, that 25 percent of the announced development spending would be directed to the sector (Sudan, MoFEP 2022a).

A challenging aspect of government investment in agriculture is the distribution of the sector’s spending. According to Elbadawi et al. (2022), public spending on agriculture is concentrated in the irrigated subsector. For example, in 2017 and 2018, the irrigated sector received 37 percent and 67 percent of the public spending on agriculture, respectively.

A comparison between government spending on agriculture and other pro-poor government spending conducted by the World Bank in 2016 revealed that Sudan was about to meet the goal of allocating 10 percent of spending on agriculture and related sectors. In 2012, 2013, and 2014, the government allocated 6.4 percent, 8.5 percent, and 8.2 percent to agriculture and related sectors,

respectively. However, the bulk of government spending falling into this category was directed to dams (60 percent) and roads and railways (22 percent). Investment in agricultural research is limited as well—for example, an average of only 0.08 percent of agriculture value added was spent by the government during 2012–2014 on research (World Bank Group 2016).

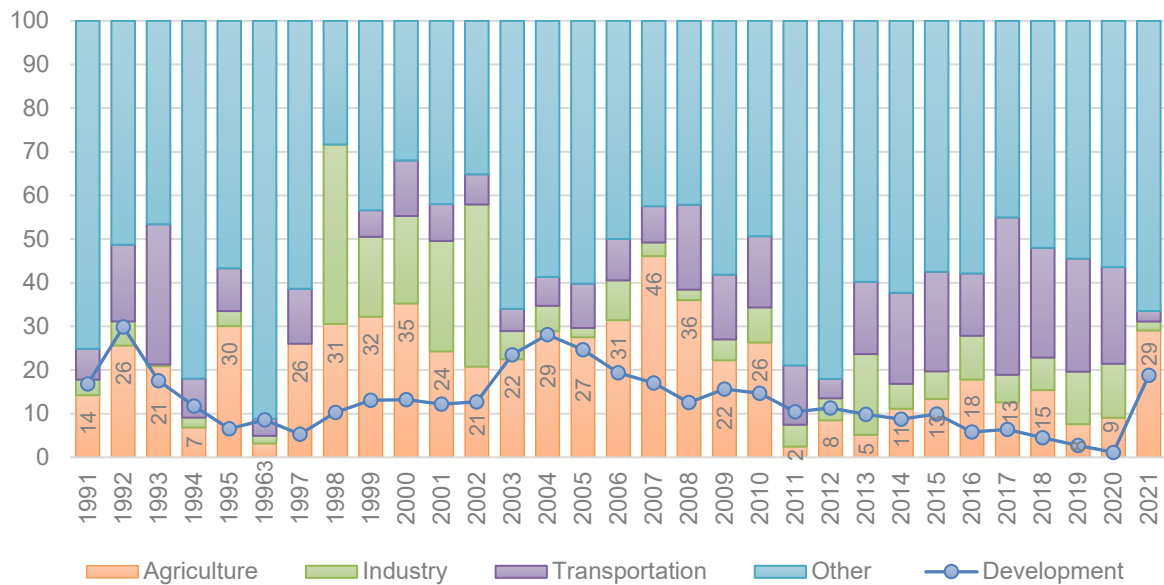


Figure 8 Distribution of development expenditure (%), 1991–2021

Source: CBoS Annual Reports, 1991–2021.

According to the World Bank Group (2019), household spending on agricultural inputs is very low, with only 20 to 30 percent of agricultural households buying fertilizers and pesticides for sesame and sorghum. Furthermore, household access to finance is limited: only 50 percent of households have access to finance from private sources. Moreover, access to institutionalized finance is limited as well. FDI flows into Sudan are concentrated in the extractive industries (particularly oil and related industries). For example, during 1998–2008, agriculture received only 3 percent of FDI (Ebaidalla 2013). Bank financing allocated to agriculture has stagnated. Between 1990 and 2021, the sector received 29 percent of banking advances, while other sectors received 71 percent. Second to agriculture, the foreign trade and industrial sectors received 23 percent and 17 percent, respectively, of the total financing provided by banks. Agriculture’s share in banking advances was 28 percent, 30 percent, and 29 percent during 1990–1999, 2000–2010, and 2011–2021, respectively (Table N).

Table N Distribution of banking finance across sectors (%), 1990–2021

Time	Agriculture	Industry	Local trade	Others	Exports	Imports
1990–1999	27.6	16.8	7.3	26.4	20.5	1.5
2000–2010	30.0	17.6	5.0	24.3	21.4	1.8
2011–2021	28.5	17.2	4.8	26.9	20.5	2.2
Average	28.7	17.2	5.7	25.9	20.8	1.8

Source: CBoS Annual Reports, 1990–2021.

5.3 Climate Change Resilience and Responses

5.3.1 Climate Change Impact

Like many other countries, Sudan faces the challenges of climate change and its consequences accompanied by rapid population growth. Its population is projected to double by 2050 (Siddig et al. 2020), driven by an estimated current annual population growth rate of 2.4 percent (UNEP and HCENR 2020). Thus, intervention to protect the environment and natural resources is urgently needed for the sake of future food production. The literature has identified four major climate change stressors for Sudan, namely, rising temperature, decreasing and variable rainfall, repeated episodes of extreme events (droughts and floods), and desertification (Hassan et al. 2022; Siddig et al. 2020; Igaimi 2016; Zakieldeem 2009).

With the separation of South Sudan in 2011, Sudan now is located entirely within the continent’s drylands, meaning that the country is especially subject to climate change risk (Igaimi 2016). Hassan and colleagues (2022) reiterate that Sudan is experiencing four climate stressors related to rainfall patterns, temperature, and extreme weather events (droughts and floods). Rainfall is projected to decrease, and in fact is decreasing compared with past years—according to FAO (2022), rainfall decreased in 2021 compared with 2020. Precipitation is predicted to decrease by 4 percent per decade, thus leading to a cumulative reduction of 12 percent in 2050 compared with 2020 (Siddig et al. 2020). In addition, temperature is predicted to increase by 3 degrees Centigrade by 2050 (Siddig et al. 2020). During the last two decades, Sudan witnessed repeated episodes of drought (UNEP and HCENR 2020, 41). Furthermore, future droughts threaten 19 million hectares devoted to rainfed agriculture and livestock (Hassan et al. 2022).

Among the stressors, desertification of arable land is threatening food production (Zakieldeen 2009).⁶ At the same time, in 2020, Sudan experienced unprecedented floods causing catastrophic damage to productivity, infrastructure, and human lives. These stressors have had serious impacts on productivity, human lives, infrastructure, biodiversity, energy, and water. They will affect poor communities in rural areas in all regions, where much of the population consists of pastoralists and farmers, who depend on agriculture as their major source of income (UNEP and HCENR 2020, 91–93).⁷

Sorghum and millet productivity is predicted to decrease as a result of climate change stressors, and decreasing rainfall will affect rainfed agriculture in general, irrigated agriculture, grazing land, and groundwater; at the same time, floods will continue to wreak havoc on the already devastated infrastructure and ecosystem (Hassan et al. 2022).

5.3.2 Response to Climate Change

Hassan et al. (2022) summarized the constraints complicating Sudan’s response to climate change as constituting of seven major challenges:

- Slow transition to cleaner energy (solar and wind)
- Data constraints (robustness, reliability, and availability of data)
- Reluctant private-sector investment in climate change–related innovations
- Limited institutional and human development capacity
- Limited engagement of stakeholders in the process of responding to climate change
- Political instability (high turnover in public sector)
- Weak public–private partnerships

Addressing such constraints is key for an effective response to climate change risks (UNEP and HCENR 2020). Since 1956, Sudan has signed and ratified more than 40 multilateral environmental agreements. In 1956, Sudan ratified the Constitution of the Food and Agriculture

⁶ For more details about desertification in Sudan, see, for instance, Hassan and colleagues (2022, 14–16).

⁷ Extreme weather and climate conditions, droughts, floods, and other events have serious impact on many sectors and areas. Refer to Table 3 in Hassan and colleagues (2022, 12) and Siddig and colleagues (2020, 5) for more details.

Organization of the United Nations. More recently, in 2017, Sudan ratified the Paris Agreement under the United Nations Framework Convention on Climate Change (UNEP and HCENR 2020, 60–61). Furthermore, Sudan has developed several climate change–related strategies or features that it has incorporated into its national-level development plans (Hassan et al. 2022). For instance, chapter 8 of the Three-Year Economic Stability and Development Program (2021–2023) sets out the following environmental priorities:

- Policy, legislative, and institutional reform
- Addressing environmental degradation
- Enhancing resilience to climate change risks among communities
- Community awareness about climate change
- Promotion of scientific research related to climate change
- Promotion of alternative renewable energy sources

Sudan’s 2021 PRSP introduced different measures to address concerns about Sudan’s environment and natural resources. It aims at meeting the United Nations Sustainable Development Goals and ensuring environmental sustainability. It calls attention to the negative impacts environmental degradation and climate change can have on the food security and incomes of a rural population that depends on agriculture and that often lives in poverty. The PRSP proposes addressing these environmental challenges through the following measures:

- Creating an enabling regulatory, institutional, and policy framework to protect the environment—to stop the degradation of natural resources, land, and forests (short term)
- Strengthening the resilience of communities in the face of climate change (medium term)
- Developing a national strategy to address desertification (short term)
- Strengthening international cooperation on the environment and climate change (short term)

6. AGRICULTURAL LAND CHALLENGES AND POLICIES

Sudan is one of the largest countries on the African continent with an area of 1.88 million square kilometers, around 72 percent of which is desert and 10 percent forest. It has an estimated 183.3 million feddan of arable land, which represents around 39.3 percent of the country's area; however, only 36 percent of the arable land is currently under cultivation (UNEP and HCENR 2020). Land suitable for grazing that could be used to raise livestock is estimated at 120 to 150 million feddan (Omer 2011), and the country has a large cattle stock estimated at 111 million head (FAO 2022).

Distribution of arable land is concentrated in two regions, Darfur and Kordofan, with more than half of total arable land located there. As Figure 9 shows, those regions contain 32 percent and 36 percent of the arable land, respectively (UNEP and HCENR 2020). Cultivated land expansion occurred slowly during the period covering 1990 to 2021. On average, cultivated land grew at only 5 percent per annum during the entire period (Figure 10).

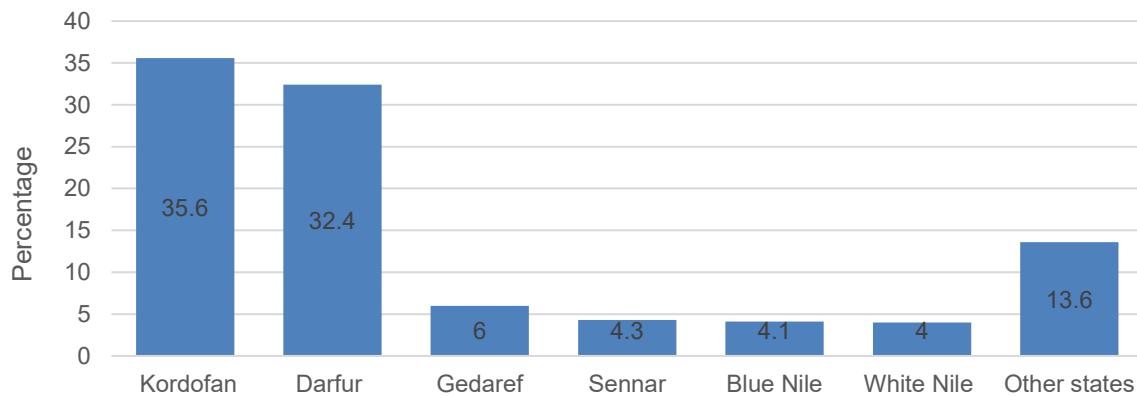


Figure 9 Distribution of arable land in Sudan (%) by state

Source: UNEP and HCENR (2020).

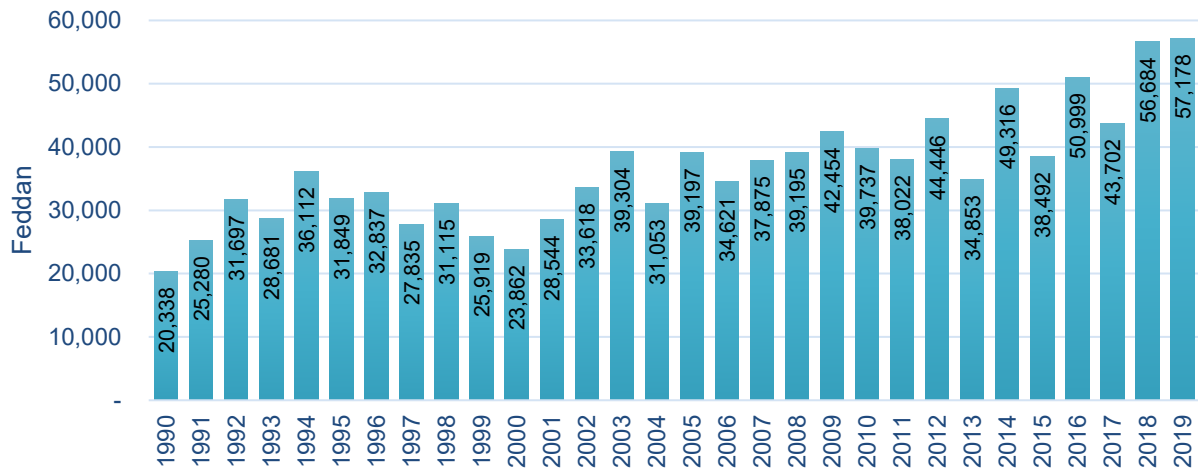


Figure 10 Cultivated land expansion (feddan), 1990–2019

Source: CBoS Annual Reports, 1990–2019.

UNEP and HCENR (2020) summarize the pressures and challenges bearing on Sudan’s land resources as follows:

- Increasing numbers of livestock
- Rapid population growth
- Expansion of extractive industries
- Ecological problems
- Using land as a mechanism for attracting FDI
- Rapid urban expansion, as the urban population grew from 8.8 percent of the total population in 1956 to 34 percent in 2018
- Conflict over land resources between farmers and pastoralists, conflicts within each group, and tribal conflicts on the borders, with 75 percent of conflict incidence occurring in Darfur and 20 percent in Kordofan in 2015
- Internally displaced persons (IDPs), refugees, and returnees, with 2,406 million IDPs in 2015, 88 percent of them in Darfur states and 9 percent in Kordofan states, and in additional 570,000 refugees in Sudan during the same year
- Other challenges associated with the IDPs, refugees, and returnees, such as establishing camps on farmers’ lands and settlement of refugees on agricultural land, among others
- Land degradation

Sudan has legislated many land policies (legislations). Private ownership is granted by law, and the 1970 Unregistered Land Act provided for a communal land arrangement.⁸ There are two types of land tenure arrangements:

- Statutory: private ownership is allowed according to rules and regulations.
- Customary: the native authorities play a considerable role.⁹

Current policies and strategies directed at land management are notable for the absence of specific land arrangements or policies. In 2020, the TGoS signed the Juba Peace Agreement¹⁰, which contains institutional arrangements regarding land with a land commission to be formed for addressing outstanding land issues.

⁸ Refer to Omer (2011, 8–11) for details on land tenure historical developments.

⁹ Several acts and institutional arrangements pertaining to land tenure and land use were incorporated in many documents throughout the history of post-independence Sudan—for example, the Land Settlement and Registration Ordinance of 1925, the Unregistered Land Act of 1970, the Permanent Constitution of 1973, the Civil Transaction Act of 1984, the Interim National Institution of 2005, and the 2015 Adjustment of Article 188 of 2005.

¹⁰ The parties in the Juba Peace Agreement (JPA) included the armed groups and political parties included in the Freedom and Change Front. Based on the JPA the transitional government of the pre-coup was established.

7. CONCLUDING REMARKS AND POLICY RECOMMENDATIONS

The paper reviewed the performance of Sudan's agricultural sector through the last three decades (1990–2021). It focusses on two main themes—one, the contribution of agriculture to economic growth, food security, and employment, and two, the causes of the poor performance of the sector during the last three decades in terms of its contribution to real GDP growth, food security, and employment. The agricultural sector was a driver of growth in the decade prior to the oil era with a considerable contribution to real GDP growth, but that contribution shrank during and after the oil era. The withering of the sector's contribution to GDP during the oil decade reflected a structural shift from agriculture to oil.

Agriculture was the main source of Sudan's exports before 1999, but that importance sharply declined during the 1999–2010 period with the introduction of oil. Recently, the sector has become a major source of exports with more than 50 percent of total exports from 2018-2020 consisting of agricultural exports. Despite the sector's overall poor performance, it has remained the main source of livelihoods and income for the Sudanese people, especially in rural areas. Sudan's crop productivity lags behind that of other countries in the region as well as underperforming historically. Productivity was lower in the second decade reviewed than in the first and the last decades. This disappointing record of the sector's performance has received considerable attention in the literature. Scholars have posited several factors as key determinants of the poor performance. Those include instability of macroeconomic policies and politics such as exchange rate overvaluation and conflicts over land. Whereas the sector's poor performance is linked to substandard productivity at the micro level, that itself has been caused by limited adoption and use of technologies, fertilizers, and other inputs, which are all affected by the macro-level factors. Institutional constraints have also affected the sector's performance, which include weak and fragmented agricultural institutions, the lack of or ineffective producer and farmer associations, and the lack of agricultural services provided to farmers and producers.

Our review finds that the Sudanese government's investment in agriculture has been low with limited resources allocated to the sector throughout the three decades. That is accompanied by the

challenges inherent in distributing public expenditure across sectors and regions. Ineffective economic planning associated with the lack of political will to develop the sector has plagued the country.

Before the 2018 revolution, several development plans and programs had been proposed, but they had mostly not been fully implemented due to a lack of commitment from the government. Post-revolution plans for agricultural development were interrupted when the military seized power in October 2021. Climate change compounds the sector's performance problems. Identified climate stressors are rising temperature, decreasing and variable rainfall, droughts, and floods. Such stressors affect the productivity and overall performance of the sector and all actors, particularly poor households in rural areas reliant on agriculture. Sudan has enormous land resources; however, they are threatened by conflict, urbanization, and ecological problems.

The studies we reviewed suggest that for the sector to face its myriad challenges requires a strong governance framework and political will by the political elites and the Sudanese people to allocate more resources to the sector and make it attractive for investors and agricultural labor. The government must play a bigger role than it has, and it could start by allocating the targeted 10 percent of public spending especially considering the fiscal space the government is enjoying due to ending commodity subsidies. In addition, the government can also facilitate implementing the necessary institutional reforms (agricultural institutions, macroeconomic stability, public-sector reform).

Scrutinizing the role of agriculture in employment can help identify the present and future labor force engagement in agriculture. To that end, the government can conduct national surveys and agricultural censuses. Economic modeling of agricultural sector outcomes and evaluation of agriculture-related public policy will help in adopting sound policies. Research centers, universities, and think tanks can address this gap.

Updating Sudan's existing economic development plans with clear quantitative targets can play a role in transforming the sector. This would help mobilize resources locally, attract foreign investments and donor support, and encourage related industries that can add value in agriculture. Banks should prioritize the sector when allocating resources, and disparities related to credit availability and distribution should be addressed. Finally, a comprehensive mainstreaming of climate-related policies in the national plans and spending is necessary for the future of agricultural

production, besides engaging the private sector and the people of Sudan to understand and contribute to mitigating the impact of climate change.

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APPENDIX

Table A1 Sudan's key indicators

Indicator	Source	1990– 1999, average	2000– 2010, average	2011– 2021, average	Average over 30 years
Share of industry (%) in GDP	CBoS (Annual Reports)	8.6	24.5	21.7	18.3
Service (%)	CBoS (Annual Reports)	49.9	43.0	50.0	47.6
Agriculture (%)	CBoS (Annual Reports)	41.5	32.5	28.3	34.1
Inflation rate (%)	CBoS (Annual Reports)	80.4	9.1	73.3	54.3
Oil exports (\$US billion)	CBoS (Annual Reports)	0.0	5.0	1.7	2.2
Exchange rate (\$US/SDG)	CBoS (Annual Reports)	1.1	2.4	51.0	18.2
Trade balance (\$US billion) deficit	CBoS (Annual Reports)	(0.6)	0.4	(3.6)	(1,3)
FDI%	World Bank (2023)	0.8	3.8	2.3	2.3
Population (million)	World Bank (2023)	23.4	29.8	39.6	30.9
Growth (%)	World Bank (2023)	2.2	2.5	2.8	2.5
Land (average, feddan, million)	CBoS (Annual Reports)	29.2	35.4	41.5	35.4
Labor force (%)	World Bank (2023)	27.0	28.1	28.3	27.8
Unemployment (%)	World Bank (2023)	15.6	14.9	17.8	16.1

Source: CBoS Annual Reports, 1990–2021, and World Bank (2023).

Table A2 Cultivated area (%) and main crops in the three farming systems in Sudan

Sector	Area	Main crops
Irrigated	9.30%	Sugarcane, cotton, sorghum, groundnuts, wheat, legumes, spices, vegetables, and fruits
Traditional rainfed	52.00%	Sorghum, millet, sesame, groundnuts, hibiscus, watermelon, gum arabic, and livestock
Semi-mechanized rainfed	38.70%	Sesame, sunflower, cotton, millet, livestock

Source: FAO (2022, 8–9); Elbadawi et al. (2022, 38–53).

Table A3 Sudan's agriculture sector: Importance and current issues

Sector	Importance and current issues	
Irrigated	Importance	Exports and food security / cotton, vegetables, and fruits
	Current issues	<ol style="list-style-type: none"> 1. Maintenance of canals 2. Modernization of pumps and drainage systems 3. Deterioration of irrigation infrastructure
Traditional rainfed	Importance	Food security and exports Livestock (45% of cattle, 37% of sheep, 65% of camels, and 32% of goats) Gum arabic and groundnuts, 90% coming from this sector 95% of millet and 17% of sorghum
	Current issues	<ol style="list-style-type: none"> 1. Limited financial resources due to poverty and access to finance 2. Fluctuations of weather conditions (rainfall) 3. Political instability and social conflict 4. Tax and fees (multiplicity of fees) 5. Labor movement to traditional mining
Semi-mechanized	Importance	Food security 80% of land allocated for sorghum All sunflower comes from this sector
	Current issues	<ol style="list-style-type: none"> 1. Access to drinking water 2. Poor infrastructure 3. Finance

Source: FAO (2022); Igaimi (2016); Elbadawi et al. (2022).

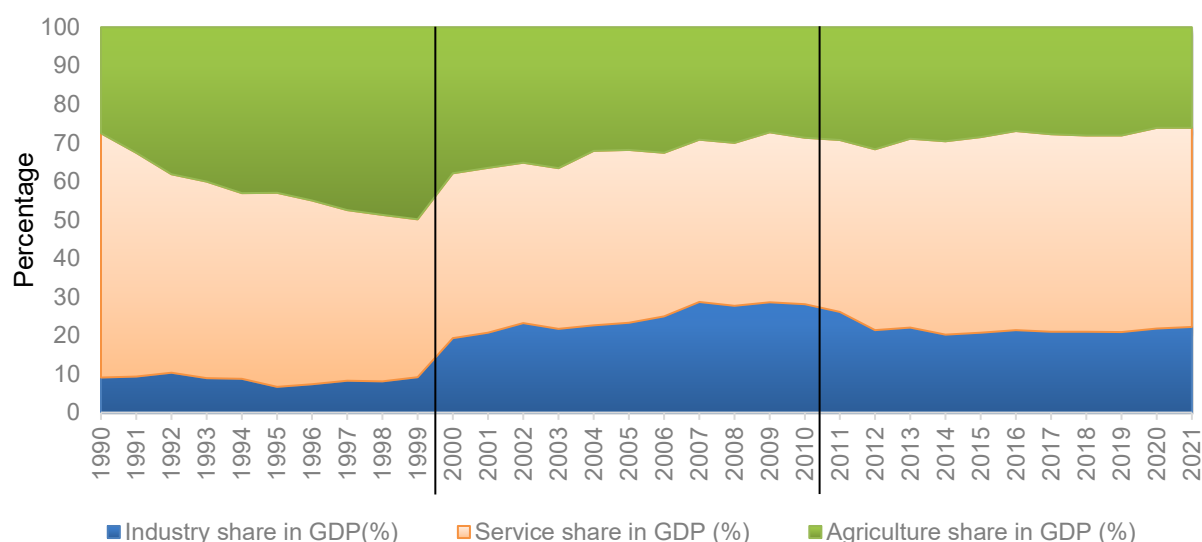


Figure A1 Sectoral shares in GDP (%), 1990–2021

Source: CBoS (2021).

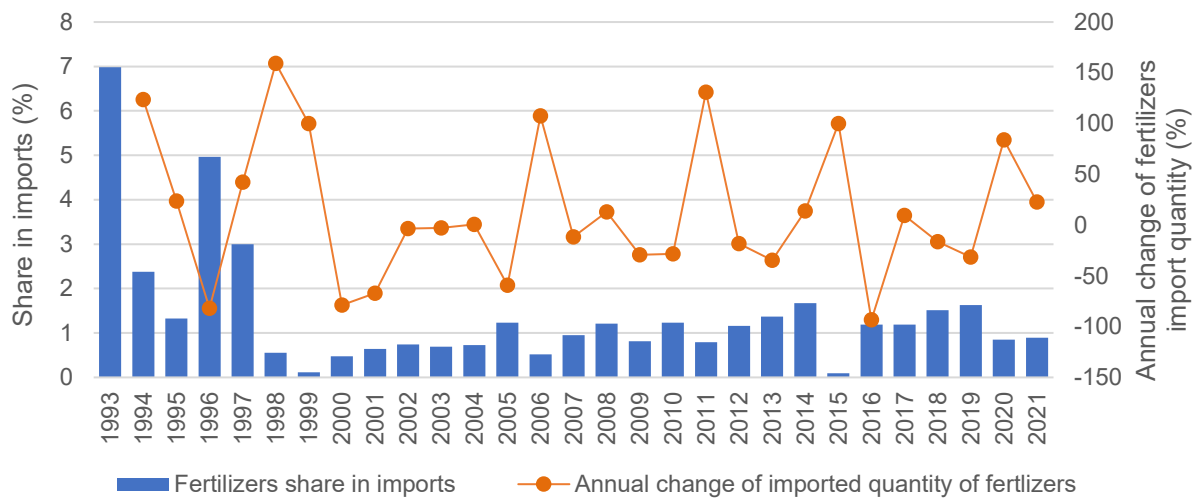


Figure A2 Share of fertilizer in imports (%) and annual change in fertilizer imports

Source: CBoS (2021).

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