Chapter 5

CEREAL PRODUCTION, MARKETS, AND POLICY IN SUDAN

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Cereal production has long been a cornerstone of Sudan's food security and economy, especially wheat, sorghum, and millet. Given the importance of these staples, policy related to imports and prices of wheat (and sorghum, to a lesser extent) has major effects on food production and consumption. In particular, before 2023, government interventions in wheat markets involved huge implicit—and sometimes explicit—fiscal costs, including interventions on large food aid inflows, official sales prices, direct controls on commercial imports, and subsidies on wheat milling (D'Silva and Badawi 1988; Faki and Taha 2009; Abdelaziz et al. 2022). These policies have generally benefited urban consumers at the expense of rural producers and have not always been well-targeted to the poor (Resnick 2021; Resnick 2026, Chapter 3 in this volume).

The conflict in 2023 forced an end to the government's provision of wheat to domestic wheat mills and subsequent subsidized sales of flour in Khartoum, as well as the rest of the country. Moreover, the fighting has resulted in major disruptions to cereal markets, significantly adding to transport and marketing costs within the country, and greatly hindering flows of food aid and other cereal imports from the international market to western Sudan.

This chapter provides an analysis of Sudan's cereal markets, along with model simulations of the impacts of recent shocks and policy options to mitigate these adverse effects. The second section presents an overview of cereal production and consumption patterns, focusing on regional differences between western and eastern Sudan. The third section describes the evolution of wheat and sorghum prices in recent years, including a comparison of international border prices of wheat and domestic prices. In the fourth section, the major implications of wheat trade and price policy prior to 2023 are examined, including the complex set of subsidies on imports of wheat and wheat flour, wheat processing, and bread. We present an analysis of more recent wheat policy in the fifth section, including model simulations of the conflict's

disruption to regional wheat markets in 2023 and policy options to increase wheat production and consumption. The final section concludes with a summary of the findings, policy implications, and priorities for further research and analysis.

Cereal production and markets in Sudan

Structure of cereal production in Sudan before and during the conflict

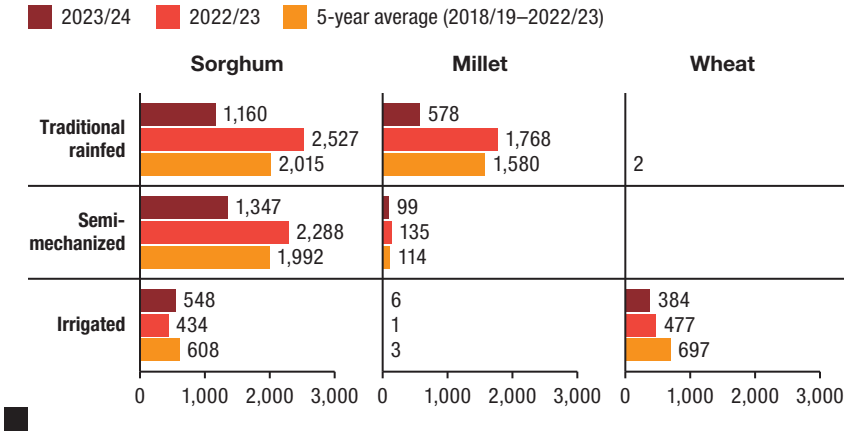
Sorghum, millet, and wheat are the primary staples that form the foundation of Sudan's food security. These crops are cultivated across the country's three main farming systems (irrigated, semi-mechanized, and traditional rainfed), with each playing a distinct role in overall production. However, the conflict that erupted on April 15, 2023, has severely disrupted production patterns, posing significant threats to food security, livelihoods, and rural economies.

This section draws on the latest available data from the Crop and Food Supply Assessment Mission (CFSAM) (FAO 2024c) to compare production levels in the 2023/2024 season with the preceding five-year average (2018/2019–2022/2023). The five-year average serves as a robust baseline for assessing the spatial distribution of these staple crops, while the 2023/2024 data provide a critical reference point to quantify the impact of the first year of conflict on agricultural production and supply.

Differential impacts by farming system

The impact of the conflict on cereal production varied significantly across farming systems. Although the irrigated systems in some parts of the country showed resilience, particularly for wheat and sorghum, the reliance on stable infrastructure made them vulnerable to disruptions (Figure 5.1). For instance, wheat production in Aj Jazirah declined due to infrastructure damage and instability, though localized resilience was observed in the River Nile and Northern states. The entry of the Rapid Support Forces (RSF) into Aj Jazirah State in late 2023 coincided with the peak harvest season, during which farmers were compelled to pay exorbitant fees to access their fields, transport crops, and store harvested grains. Additionally, reports indicate that RSF forces looted significant quantities of wheat and chickpeas from storage facilities, exacerbating food insecurity (STPT and Istiqsa'i) 2025).

FIGURE 5.1 Production of sorghum, millet, and wheat in Sudan, 2018–2023 (thousand tons)



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The semi-mechanized systems, particularly in Gedaref state, proved relatively stable, contributing significantly to sorghum production in 2023/2024 and benefiting from being away from confrontation and the inflow of workers and investments. Nevertheless, rising input costs and labor shortages posed challenges to sustained productivity.

The traditional rainfed systems, however, were the hardest hit by the conflict, particularly for millet (Figure 5.1). States such as West Darfur and South Darfur experienced catastrophic declines, with West Darfur reporting zero millet production. Conversely, North Darfur managed to increase its share of millet production, highlighting the complex and localized nature of conflict impacts.

War-induced changes in patterns of cereal production

The ongoing conflict has reshaped the geographical distribution of cereal production in Sudan, altering traditional production hubs and amplifying regional disparities. While some areas have managed to sustain cultivation, others have suffered a near-total collapse due to displacement, insecurity, and restricted access to inputs and markets. In the following subsection, we examine the shifting production landscape for sorghum, millet, and wheat, highlighting the differential impacts of the conflict across states and farming systems. This analysis underscores the extent to which the conflict has reconfigured Sudan's agricultural map, with potentially lasting implications for food security and rural economies.

SORGHUM

Sorghum has traditionally been the most widely produced cereal in Sudan, accounting for the largest share of national cultivated land and cereal production. Traditional rainfed systems dominated sorghum production over the five-year average, contributing 44 percent of total output, followed by semi-mechanized systems at 43 percent, and irrigated systems at 13 percent (Figure 5.1). During this period, Gedaref emerged as the leading sorghum-producing state, contributing 16.1 percent of national output, followed by Aj Jazirah (9.4 percent) and Sennar (8.1 percent) (Figure 5.2).

The 2023/2024 season marked a dramatic decline in national sorghum production, shrinking by 34 percent compared to the five-year average (2018/2019–2022/2023) and 42 percent of the level of the 2022/2023 season. The shares of Gedaref and Sennar states rose to 24.7 percent and 20.1 percent, respectively, reflecting the relative stability of the regions until the harvest at the end of the summer in 2024. By contrast, traditional rainfed systems suffered significant disruptions, with production in South Darfur and Blue Nile declining sharply. South Darfur's contribution fell from 8.2 percent to 3.8 percent, while Blue Nile's share dropped from 7.3 percent to 4.8 percent. Aj Jazirah's contribution increased slightly to 10.9 percent, highlighting localized resilience in irrigated systems. Meanwhile, conflict-affected states such as West Darfur and Central Darfur reported zero production (Figure 5.2).

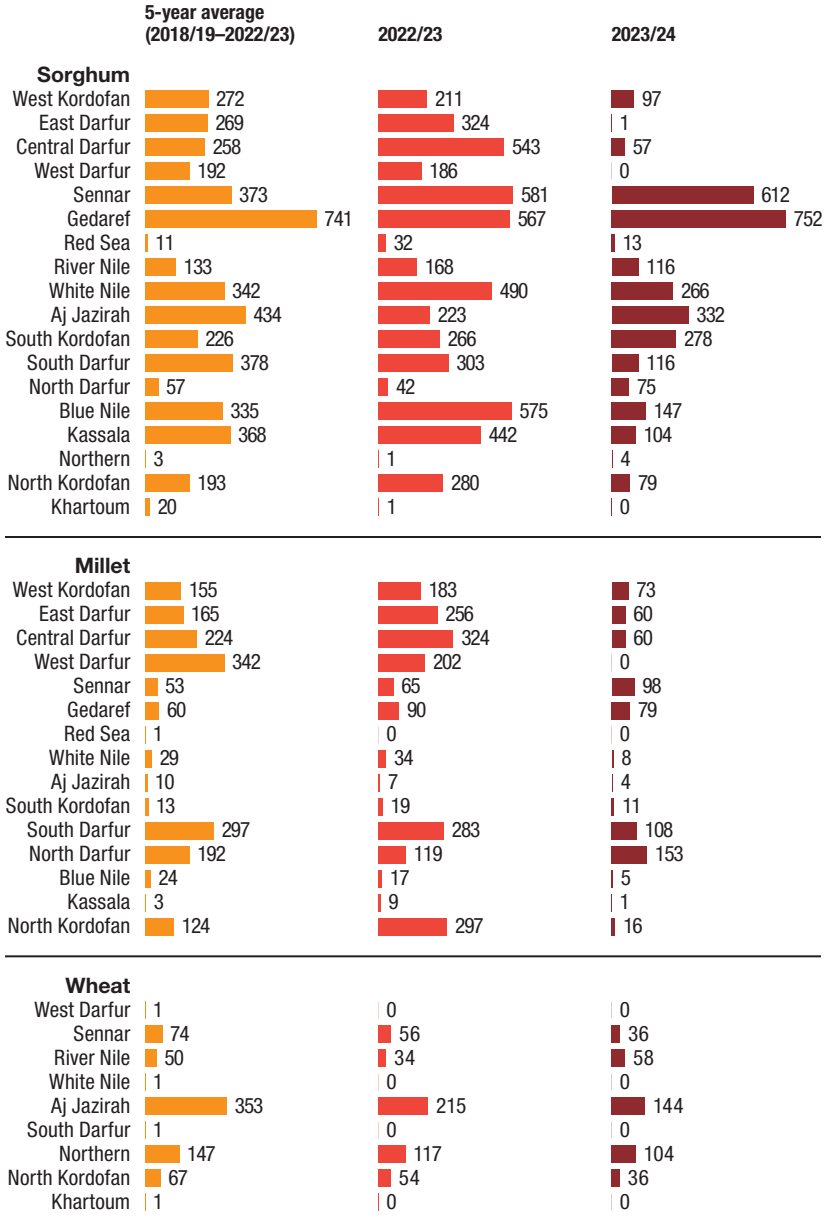
The decline in sorghum production was further exacerbated by rising input costs, logistical challenges, and delayed planting. CFSAM noted that while the provision of certified seeds mitigated some losses, the overall production decline underscores the vulnerability of rainfed systems to conflict-induced disruptions (FAO 2024c).

MILLET

Predominantly grown in traditional rainfed systems, millet plays a vital role in the diets of communities in Sudan's arid and semi-arid regions (Figure 5.1). Over the five-year average, traditional rainfed systems accounted for 93 percent of millet production. West Darfur was the largest producer, contributing 20.2 percent, followed by South Darfur (17.5 percent) and Central Darfur (13.2 percent).

The military conflict had a devastating impact on millet production in 2023/2024. West Darfur's share plummeted to zero, reflecting the complete disruption of agricultural activities in the region. North Darfur, on the other hand, experienced a significant increase in its contribution,

FIGURE 5.2 Production of sorghum, millet, and wheat in Sudan by state, 2018–2023, thousand tons



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rising from 11.3 percent to 22.6 percent, possibly due to localized shifts in production dynamics. South Darfur maintained a relatively high contribution of 16 percent, while Sennar and Gedaref emerged as notable contributors, with shares of 14.5 percent and 11.7 percent, respectively. These changes highlight the uneven impact of the conflict, with some regions managing to sustain production while others have faced total collapse (Figure 5.2).

WHEAT

Primarily cultivated in irrigated systems, wheat follows a winter cropping cycle, making it less susceptible to immediate disruptions caused by the conflict. Over the five-year average, irrigated systems accounted for almost all wheat production, with Aj Jazirah contributing 50.8 percent, Northern 21.2 percent, and Sennar 10.7 percent (Figure 5.2).

The 2023/2024 season, however, exposed vulnerabilities within the wheat sector. Aj Jazirah's contribution fell to 38.1 percent, largely due to damage to irrigation infrastructure and logistical constraints imposed by the conflict. Benefiting from relative stability, Northern and River Nile increased their shares to 27.5 percent and 15.4 percent, respectively. Sennar's contribution declined slightly from 10.7 percent to 9.5 percent, reflecting localized disruptions imposed by the conflict. While interventions, including the provision of seeds, from the Food and Agriculture Organization of the United Nations (FAO) and World Food Programme helped sustain some production, overall wheat output remained significantly below the five-year average (2018/2019–2022/2023) and 2022/2023 season by 45.7 percent and 20.7 percent, respectively (Figure 5.2).

The East–West divide in cereal production

The 2023/2024 season highlighted the critical impact of political and territorial control on cereal production, with the country effectively divided based on regions under the control of the Sudanese Armed Forces (SAF) and those under the RSF. This division was not strictly geographic, as key agricultural states such as Aj Jazirah were primarily under RSF control, despite being in central Sudan. The implications of this divide are reflected in the production and supply dynamics of sorghum, millet, and wheat.

Under SAF control in 2024, even during the season affected by the conflict (2023/2024), states such as Gedaref and Sennar accounted for significant shares of cereal production. Gedaref alone contributed

38.4 percent of sorghum output and 40.6 percent of millet in SAF regions, leveraging the resilience of its semi-mechanized systems. Sennar also played a crucial role in cereal supply, contributing 25 percent of sorghum and 40.3 percent of millet under SAF control, reflecting the importance of stability in these areas. However, logistical disruptions and rising input costs tempered these contributions and reduced overall production compared to other seasons.

In RSF-controlled regions in 2024, including Aj Jazirah and large parts of Darfur, cereal production faced severe disruptions. Aj Jazirah, a historically dominant wheat-producing state, experienced a significant drop in its share from 50.8 percent in the five-year average (2019–2023) to only 38.1 percent. Within the SAF regions, Aj Jazirah's contribution to wheat production was only 6.8 percent, while in the RSF-controlled wheat production regions, it contributed 77.5 percent as it remained mainly under the RSF from December 2024 until January 2025. Meanwhile, Darfur states, traditionally reliant on rainfed systems, saw drastic declines. West Darfur reported zero production for millet and sorghum, and Central Darfur recorded sharp reductions across all cereals. These challenges reflect the compounded effects of displacement, insecurity, and restricted market access.

Comparatively, SAF-controlled areas were expected to supply a larger proportion of national cereal output, albeit at levels well below historical averages. RSF-controlled regions, meanwhile, have faced acute deficits, with food insecurity exacerbated by limited production and constrained distribution networks. This polarized dynamic underscores the urgent need for interventions tailored to the specific challenges in SAF and RSF regions. In SAF zones, stabilizing semi-mechanized and irrigated systems should be prioritized, while RSF regions require immediate humanitarian assistance to address food shortages and revive rainfed agriculture.

In conclusion, the 2023 conflict has had a profound and multifaceted impact on Sudan's cereal production. National output for sorghum, millet, and wheat in 2023/2024 is estimated to be 46 percent below the previous year's levels and 40 percent below the five-year average. The stark variations across states and farming systems underscore the need for targeted, context-specific interventions. Immediate priorities include restoring irrigation infrastructure in the irrigated farming systems, ensuring the availability of agricultural inputs to farmers across the country, and supporting displaced farming communities. These measures are essential to mitigate the long-term consequences of the conflict and stabilize Sudan's agricultural sector.

The structure of Sudan's cereal markets and regional price integration

Wheat and sorghum market price movements[1]

The armed conflict that began in mid-April 2023 had a profound impact on wheat prices across Sudan (Figure 5.3). Prior to the conflict, wheat prices exhibited moderate seasonal fluctuations but remained relatively stable. However, as the crisis intensified, prices soared, with some regions experiencing increases of more than fivefold compared to early 2023. The most significant price hikes were recorded in Al Fashir and El-Obeid, where access to staple foods was severely constrained. By late 2024, price disparities across regions widened, further reducing affordability in conflict-affected areas.

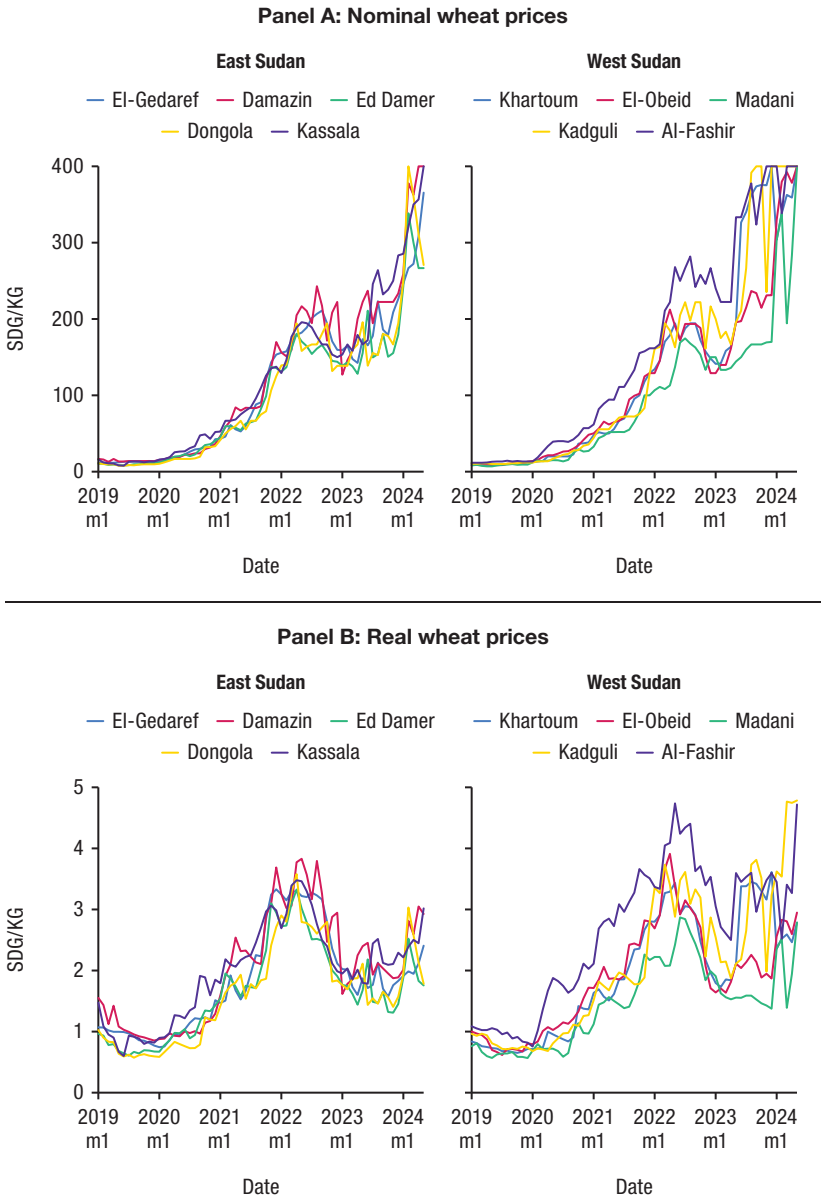
Sorghum prices also saw substantial increases during this period, though at a lower rate than wheat. While relatively stable in early 2023, sorghum prices surged by the end of 2024 in most markets (Figure 5.4). Some regions experienced more than sixfold increases in prices compared to early 2023, driven by disruptions in agricultural production, displacement of farmers, and supply chain instability. Remote regions, which were already vulnerable, saw some of the steepest increases, reflecting their reliance on increasingly expensive and insecure supply routes.

Wheat and sorghum market integration

To assess the degree of market integration, we applied standard time-series econometric techniques. First, Augmented Dickey-Fuller (ADF) unit root tests were used to test whether wheat and sorghum price series were stationary in levels or in first differences (Dickey and Fuller 1979; Said and Dickey 1984). Since most series were found to be nonstationary in levels but stationary after first differencing, we proceeded with Johansen cointegration tests to examine whether long-run equilibrium relationships exist between pairs of markets (Johansen 1988; 1991). The Johansen framework is based on a vector autoregressive model of order k (Engle and Granger 1987; Johansen and Juselius 1990), which can be expressed in its error-correction form as:

1 The primary variables analyzed were nominal retail prices of wheat and sorghum in selected markets across eastern and western Sudan between January 2019 and August 2024. The cointegration models tested whether these prices exhibit long-run equilibrium relationships across regions, thereby indicating market integration. All data were sourced from FEWS NET market monitoring.

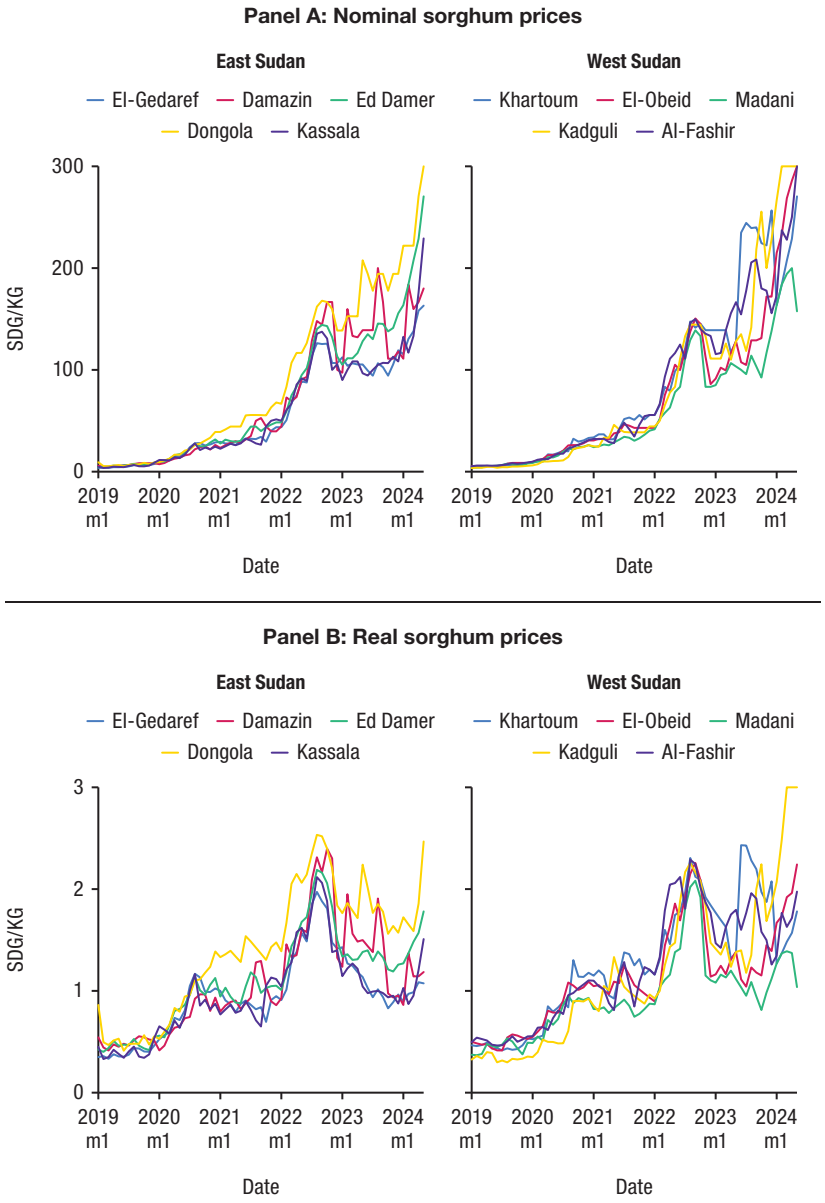
FIGURE 5.3 Retail prices of wheat in markets in Sudan, 2019–2024



Source: Authors' calculations using FEWS NET data (2025).

Note: m1 = month 1 (January).

FIGURE 5.4 Retail prices of sorghum in markets in Sudan, 2019–2024



Source: Authors' calculations using FEWS NET data (2025).

Note: m1 = month 1 (January).

TABLE 5.1 Co-integrated cereal market pairs in Sudan, January 2015–August 2024 data (nominal prices)

Series	Total Market Pairs	Co-Integrated Market Pairs	
	(Number)	(Number)	(Names)
Panel A: Wheat (among 7 markets in eastern Sudan)[a]	21	4	Gedaref–Damazin, Gedaref–Kassala, Gedaref–Dongola, Damazin–Kassala
Panel B: Wheat (among 8 markets in western Sudan)[b]	28	7	Madani–Kosti, Madani–Zalingei, Madani–Kadugli, Kosti–Zalingei, Khartoum–Madani, Khartoum–Kosti, Nyala–Zalingei
Panel C: Sorghum (among 8 markets in eastern Sudan)[c]	28	5	Gedaref–Damazin, Kassala–Port Sudan, Damazin–Singa, El-Damer–Dongola, Sennar–Gedaref
Panel D: Sorghum (among 8 markets in western Sudan)[b]	28	4	Khartoum–Madani, Kosti–Zalingei, Kadugli–Nyala, Geneina–Zalingei

Source: Authors' calculations based using FEWS NET data (2025).

Note: a = Gedaref, Al Damazin, Dongola, Kassala, El-Damer, Singa, and Sennar. b = Khartoum, El-Obeid, El-Fasher, Kosti, Madani, Kaduqli, Nyala, and Zalingei. c = Port Sudan, Gedaref, Al Damazin, Dongola, Kassala, El-Damer, Singa, and Sennar.

$$\Delta P_t = \Pi P_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta P_{t-1} + \epsilon_t$$

where P_t is a vector of wheat or sorghum prices across markets at time t; Δ is the first-difference operator; Π is the long-run impact matrix, whose rank determines the number of cointegrating vectors (long-run relationships); Γ_i are short-run adjustment coefficients; and ϵ_t is a vector of error terms. The cointegration tests were therefore applied to the price vectors across markets to determine whether the series move together in the long run, which is taken as evidence of market integration (Fackler and Goodwin 2001; Abdulai 2000).

To test for co-integration (co-movement) of price series across markets over the period January 2019 through August 2024, we first conducted ADF tests on the raw price series to check for stationarity (the absence of a trend in the series). Nearly all price series for both wheat and sorghum were found to be nonstationary, but ADF test results for the first differences of both wheat and sorghum price series showed strong evidence of stationarity.

Johansen tests of the residuals from regressions of market prices from various pairs of markets indicated distinct patterns of market integration in eastern and western Sudan. In eastern Sudan, the results shown in Table 5.1 indicate moderate evidence of cointegration within the region, with four cointegrating

relationships among seven markets for wheat (Panel A) and five cointegrating relationships among eight markets for sorghum (Panel C). However, the trace statistics in both panels are close to, but below, the 5 percent critical values, suggesting that while some degree of market integration exists, it is not particularly strong. In contrast, markets in western Sudan show stronger evidence of integration within the region, particularly for wheat. Panel B identifies seven cointegrating relationships among eight markets for wheat, with the trace statistic very close to the critical value, indicating robust market linkages. For sorghum, we found co-integration between prices for four of the eight markets.

Wheat trade and price policy

Wheat subsidies, foreign exchange markets, and market prices

Sudan has a long history of intervening in the domestic markets and international trade of wheat, the only major cereal in the country that is widely traded internationally (world markets for sorghum and millet are much smaller than the world wheat market in terms of volumes traded and value).[2] Before 2023, successive Sudanese governments attempted to keep food prices low by providing wheat grain and/or flour to millers and bakers at subsidized prices and setting low official sales prices for traditional bread.[3] However, persistent domestic inflation, partly caused by increases in money supply, necessitated frequent adjustments in prices. Moreover, periodic devaluations of the Sudanese pound (SDG) resulted in large increases in border prices (international market prices, including transport and marketing costs, converted to Sudanese pounds using official exchange rates), which necessitated major adjustments in official prices.

Three major devaluations of the Sudanese pound occurred between 2018 and 2021, including in January 2018 (169 percent, from 6.7 to 18 SDG/US$) and in October 2018 (164 percent, from 18 to 47.5 SDG/US$). In February 2021, the exchange rate policy shifted from a fixed nominal exchange rate to a managed float policy, with an initial depreciation of almost 400 percent (from 55

2 See D'Silva and Elbadawi (1988), Faki and Taha (2009), and Dorosh (2021) for a more extensive discussion of wheat and overall agricultural trade policies in Sudan.

3 This subsidy on (traditional) bread was not well-targeted. Calculations based on the patterns of consumption derived from the 2009 national household survey data (NBHS 2009), along with data on prices and wheat supply, showed that urban poor and nonpoor households received similar amounts (18,900 and 20,800 SDG/capita, respectively) in 2021. Rural poor households received far less—only 2,700 SDG/capita. See Dorosh (2021).

TABLE 5.2 Wheat prices in various markets, Sudan, 2023–2024

	El-Obeid	Om Durman	Port Sudan	El-Gedaref	Al Fashir
Average retail price (SDG/kg)					
(1) Jan.–Apr. 2023	427	441	592	461	680
(2) May–Dec. 2023	668	1,114	639	578	1,107
(3) Jan.–Apr. 2024	1,110	–	1,193	820	1,397
(4) May–Dec. 2024	2,573	1,550	1,564	1,585	3,290
Jan. 2023–Dec. 2024	1,251	1,059	972	875	1,691
(4) / (1)	6.02	3.51	2.64	3.44	4.84
Margins (SDG/kg)[a]					
(5) Jan.–Apr. 2023	(164)	(151)	–	(131)	88
(6) May–Dec. 2024	1,009	(14)	–	21	1,726
Change (6) – (5)	1,173	136	–	152	1,637

Source: Authors' calculations from FAO (2025) price data.
Note: [a] = Marketing margin to Port Sudan.

to 378 SDG/US$), which essentially unified the official and parallel markets until September 2023. Thereafter, a moderate premium on the parallel market emerged again: the parallel exchange rate in December 2024 was 2,445 SDG/US$, 23 percent above the official rate of 1994 (SDG/US$).[4]

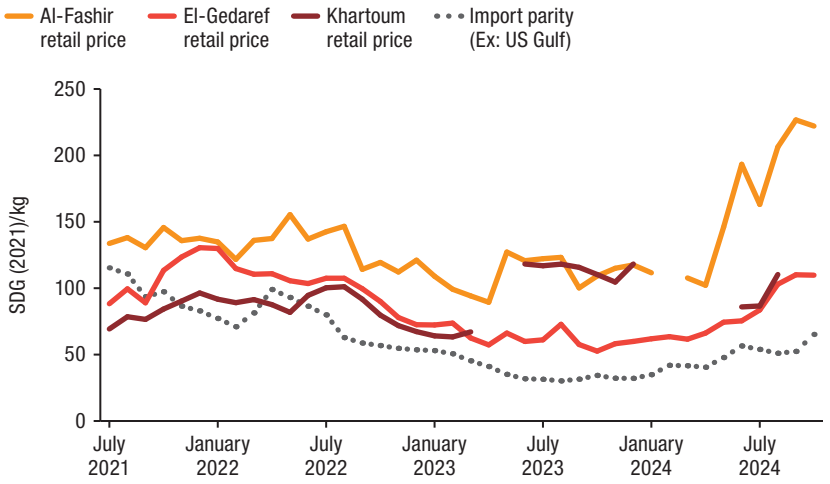
Between the middle of 2021 and 2022, just before the start of the civil war, significant market imperfections kept the retail prices of wheat in major Sudanese markets from closely tracking import parity prices (the full financial cost of imported wheat) (in Khartoum) (Figure 5.5).[5] Subsequently, the civil war brought about a disruption in market flows and a significant increase in costs, reflected in a widening margin between prices in western and eastern Sudan (Figure 5.6).

Average wheat prices in Al Fashir and El-Obeid in western Sudan were 6 and 4.8 times higher, respectively, from May to December 2024 than from January to April 2023 (Table 5.2). In the same periods, prices in Port Sudan and Gedaref in eastern Sudan were only 2.6 and 3.4 times higher, respectively. Marketing margins between these two western markets and Port Sudan thus increased by more than 1,600 SDG/kg, while margins between Gedaref and Port Sudan increased by less than 200 SDG/kg, as did the margins between Om Durman and Port Sudan.

4 Calculated from data in the WFP Market Monitors (various dates).

5 The prices plotted in Figure 5.5 are nominal prices deflated by the consumer price index (CPI). Note that the CPI from February 2023 to December 2024 is estimated using the CPI growth rate between January and February 2023, that is, an annual rate of 23.2 percent.

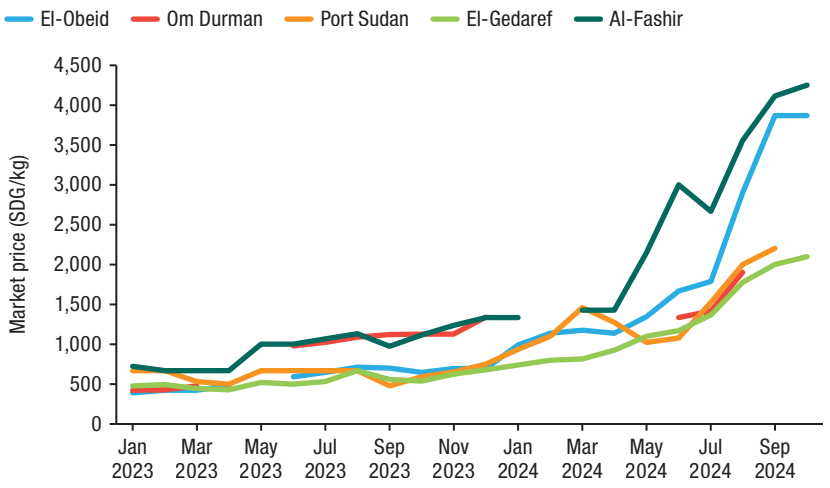
FIGURE 5.5 Domestic and import parity wheat prices in Sudan (2021 SDG/kg), 2021–2024



Source: Authors' calculations using IMF (2025), World Bank (2025), WFP 2025, and FAO (2025) price data.

Note: Calculations of import parity use parallel market exchange rates from October 2024 (no commercial exchange rate data were available for this period). Note that the parallel exchange rate averaged 26.3 percent above the commercial market exchange rate from September 2023 through September 2024.

FIGURE 5.6 Retail wheat prices in Sudan (SDG/kg), 2023–2024



Source: Authors' calculations from FAO (2025) price data.

From July 2022 through July 2024, the wholesale price of wheat in Gedaref in eastern Sudan broadly tracked the estimated import parity price (see Figure 5.6). In this period, the monthly average ratio of Gedaref's prices to estimated import parity prices was 1.60. However, from August through October 2024, import parity prices rose faster than domestic prices, such that this ratio rose to an average of 1.91. This increase in margins may have reflected quantitative restrictions on imports or increased domestic trade and transport costs. If the earlier price ratio had been maintained, the market price would have been about 20 percent lower.[6]

By comparison, sorghum prices rose faster during this period than wheat prices in Om Durman (sorghum and wheat were 4.6 and 3.5 times higher, respectively) and Gedaref (4.4 and 3.4 times higher). The marketing margins for sorghum between major markets also exhibited considerable instability. Sorghum price margins between western Sudan (El-Obeid and Al Fashir) and Port Sudan were consistently higher than the margins between eastern Sudan and Port Sudan. However, the marketing margins between Om Durman and Port Sudan, which increased by only 136 SDG/kg for wheat, increased much more sharply for sorghum (by 899 SDG/kg). This likely reflects the effect of a shift in the region's control from the RSF to SAF, which controlled much of the Port Sudan area in this period. In contrast, given the shorter distance and generally greater security, the marketing margins between Gedaref and Port Sudan remained relatively small for both wheat and sorghum (Table 5.3 and Figure 5.7). Intense fighting in Darfur region reduced local production and greatly inhibited market flows in 2025, however, leading to a huge surge in average sorghum price margins between Al Fashir and Port Sudan, from 1,700 SDG/kg from May to December 2024 to 27,400 SDG/kg from June to August 2025.

IMPLICATIONS OF WHEAT SUBSIDIES AND FOREIGN EXCHANGE RATIONING[7]

Model simulations by Dorosh (2021) indicate that increased wheat imports, such as those financed by food aid, added to supplies for processing into wheat flour, flatbread, and other wheat products, which resulted in reduced prices for consumers and increased consumption. The analysis showed that these imports also led to disincentives for production: a 300,000-ton increase in wheat imports, as occurred in early 2021, led to an 8 percent increase in wheat consumption and a 35 percent decline in the market price of non-flatbread wheat products. In this

6 As of late 2025, data on market prices of wheat after December 2024 were not available on the Food and Agriculture Organization's or World Food Programme's websites.

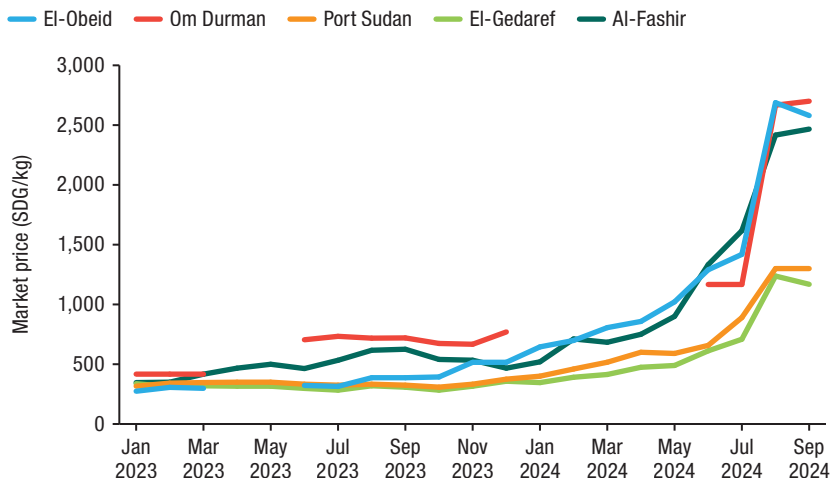
7 This section summarizes results from Dorosh (2021).

TABLE 5.3 Sorghum prices in various markets, Sudan, 2023–2024

	El-Obeid	Om Durman	Port Sudan	El-Gedaref	Al Fashir
Average retail price (SDG/kg)					
(1) Jan.–Apr. 2023	293	417	339	321	395
(2) May–Dec. 2023	405	712	335	310	535
(3) Jan.–Apr. 2024	752	–	494	406	666
(4) May–Dec. 2024	2,000	1,910	1,088	889	1,747
(5) June–Aug. 2025	1,358	1,231	1,179	1,169	30,299
Jan. 2023–Dec. 2024	936	1,153	613	521	822
(4) / (1)	6.82	4.58	3.21	2.77	4.42
Margins (SDG/kg)[a]					
(6) Jan.–Apr. 2023	293	417	339	321	395
(7) May–Dec. 2024	2,000	1,910	1,088	889	1,747
Change: (7) – (6)	1,707	1,493	750	568	1,352
(8) June–Aug. 2025	179	52	–	(11)	29,119
Change: (8) – (7)	(1,821)	(1,858)	(1,088)	(899)	27,373

Source: Authors' calculations using FAO (2025) price data.
Note: [a] = Marketing margin to Port Sudan.

FIGURE 5.7 Sorghum prices in various markets, Sudan, 2023–2024



Source: Authors' calculations from FAO (2025) price data.

scenario, production fell by 12 percent. Since flatbread prices are unchanged in this simulation, wheat consumption increased by only 4 percent among the urban poor, for whom flatbread is the major wheat product consumed.

Other simulations show that raising flatbread prices by 30 percent to reduce the size of the fiscal subsidy would lead to a 17 percent reduction in total consumption of flatbread, sharply reduced wheat consumption, and lower real incomes of the urban poor. All households would suffer a loss in this scenario, by 41 to 45 percent in the value of flatbread subsidies received. The urban poor would experience the largest decline in total consumption of wheat (14 percent) and in total income (11 percent). Thus, reducing the flatbread subsidy without a compensating income transfer would significantly reduce the welfare of the urban poor and likely threaten political stability. These results suggest that a combination of key wheat policies involving high levels of imports—including the injection of food aid wheat into the economy in late 2020—and subsidized flatbread would have significantly benefited urban poor households.

Thus, Sudan's wheat policies immediately before 2022, such as increased wheat imports, price subsidies in the wheat value chain, and low prices of flatbread, generally favored consumers to the detriment of producers. These interventions in the wheat value chain, especially those related to subsidies on flatbread, had especially large effects on the welfare of urban households, making these policies particularly politically sensitive. However, because of their high fiscal costs, these policies also threatened macroeconomic stability and crowded out other possible investments to promote growth and poverty reduction.

Impacts of exogenous shocks and policy changes on Sudan's wheat economy: Model simulations

Model structure

For this analysis, we utilize a simple partial equilibrium model of Sudan's wheat economy following that of Dorosh (2021) and earlier models of other countries by Dorosh (2001), Coady and colleagues (2009), and Schmidt and colleagues (2021). Model simulations provide estimates of the effects of supply and income shocks, as well as the impact of changes in the import parity price of wheat on its production, imports, and consumption by various household groups. Unlike in Dorosh (2021) and simulations using the other models cited above, these model simulations include changes in marketing costs between regions, but they do not include the effects of changes in production and prices on wheat farmer incomes.

Annex Table 5.1 lists the equations and variables used in the model. Wheat production is a function of the domestic wheat price with a constant own-price elasticity of supply. Household demand for wheat for each of the eight household groups (urban poor, urban nonpoor, rural poor, and rural nonpoor in each of the two regions, namely western and eastern Sudan) is a function of household incomes and prices. Household incomes are exogenous, though some simulations include shocks to the incomes of selected households. In most simulations, the level of imports is exogenous, and the domestic price of wheat adjusts to equilibrate total supply and demand. In simulations of liberalized international wheat trade, however, the domestic price is set equal to the import parity price, and imports adjust to balance supply and demand.

The model's base data on national levels of wheat production, imports, seed, feed, and other uses are sourced from the U.S. Department of Agriculture (USDA) Supply Utilization Tables for 2022 (USDA 2024) and FAO Food Balance Sheets (FAO 2024b). Household demand for wheat for the eight household groups is constructed using data from national household surveys of Sudan (Sudan, Central Bureau of Statistics 2009), following calculations similar to those used in Dorosh (2021).

Model simulation results

The civil war that began in April 2023 has resulted in hundreds of thousands of casualties, as well as massive displacements of people and disruptions to the economy. Given these cataclysmic events, the wheat harvest in March 2024 was only 384,200 tons, which is 19.5 percent less than in 2023 (FAO 2024a). Assuming imports of 2.1 million tons (somewhat less than the 2.4 million ton estimate of USDA), total availability in 2023/2024 was 2.48 million tons (excluding deductions for losses).[8] Thus, per capita supply fell from 58.4 kgs/person in 2022 to 49.6 kgs/person in 2024 (a 15 percent drop).[9] These assumptions for production and trade are used in the base simulation, in which the simulated price of wheat is 28.3 percent higher than in 2022 (Simulation 0 in Annex Table 5.2).

Beginning from this base simulation, we ran two simulations designed to simulate other shocks that affected the wheat economy between 2022 and 2024: a 50 percent increase in the marketing margins between eastern and western Sudan (Simulation 1) and, in addition, a 20 percent reduction in

8 These calculations use ratios of seed, feed, and other uses from USDA (2024) and assume a population increase of 3 percent per year.

9 A model simulation using these assumptions for production and trade results in a 30.8 percent increase in the market price of wheat, from 470.8 SDG/kg to 616 SDG/kg (in 2021/2022 prices).

TABLE 5.4 Sudan model simulation results

	Sim. 0	Sim. 1	Sim. 2	Sim. 3	Sim. 4	Sim. 5
Production	384.2	367.2	359.3	426.0	412.0	429.4
	0.0%	–4.4%	–6.5%	10.9%	7.2%	11.8%
Imports	2,100.0	2,100.0	2,100.0	2,100.0	2,300.0	2,300.0
	0.0%	0.0%	0.0%	0.0%	9.5%	9.5%
Total supply	2,484.2	2,467.2	2,459.3	2,526.0	2,712.0	2,729.4
	0.0%	–0.7%	–1.0%	1.7%	9.2%	9.9%
Price (SDG/kg)*						
East	603.9	519.4	483.0	464.2	415.3	476.5
	0.0%	–14.0%	–20.0%	–23.1%	–31.2%	–21.1%
West	603.9	779.1	724.4	696.3	622.9	476.5
	0.0%	29.0%	20.0%	15.3%	3.1%	–21.1%
Average Sudan	603.9	611.7	560.8	539.1	482.4	476.5
	0.0%	1.3%	–7.1%	–10.7%	–20.1%	–21.1%
(Relative to 2022)	28.3%	29.9%	19.1%	14.5%	2.5%	1.2%
Consumption						
East	1,369.4	1,507.2	1,578.7	1,619.1	1,738.4	1,592.2
	0.0%	10.1%	15.3%	18.2%	27.0%	16.3%
West	983.7	830.5	751.8	771.8	830.8	992.7
	0.0%	–15.6%	–23.6%	–21.5%	–15.5%	0.9%
All Sudan	2,353.0	2,337.7	2,330.5	2,390.9	2,569.2	2,584.9
	0.0%	–0.7%	–1.0%	1.6%	9.2%	9.9%

Source: Authors' model simulations.

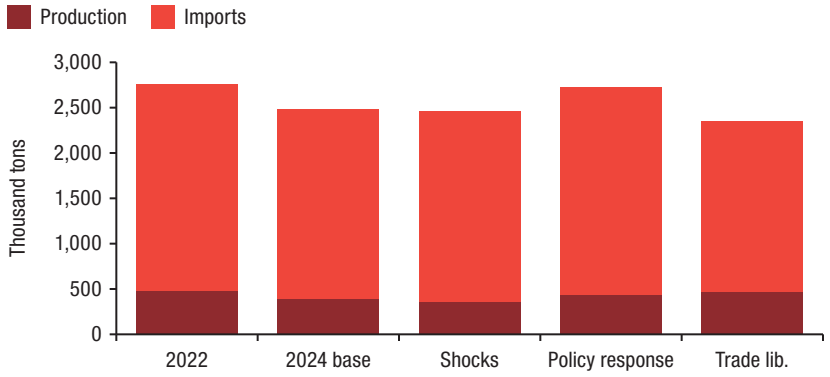
Note: * Percentage change relative to 2022. Quantities expressed in thousands of metric tons. Sim. 0 = 2022 base data; Sim. 1 = +50% marketing margin to western Sudan; Sim. 2 = -20% household incomes in western Sudan; Sim. 3 = Sim. 2 with +20% wheat productivity; Sim. 4 = Sim. 3 with +200K wheat imports; Sim. 5 = Sim. 4 with integrated domestic wheat markets.

household incomes in western Sudan, an estimate of the direct effects of the conflict on households and enterprises (Simulation 2).

The 50 percent increase in marketing costs to western Sudan raises market prices there by 29 percent, and because more of the wheat supply remains in eastern Sudan, market prices there fall by 14 percent. National average prices are essentially unchanged, increasing by only 1.3 percent. Given the reduction in wheat prices in eastern Sudan, where most of the country's wheat production occurs, national wheat production falls by 4.4 percent.[10] Wheat consumption increases by 10.1 percent in eastern Sudan but decreases by 15.6 percent in western Sudan; total wheat consumption in Sudan is almost unchanged, falling by 0.7 percent (Table 5.4 and Figure 5.8).

10 The model assumes that wheat production is a function of wheat prices in eastern Sudan.

FIGURE 5.8 Model simulation results for wheat production and imports, Sudan



Source: Authors' model simulations.

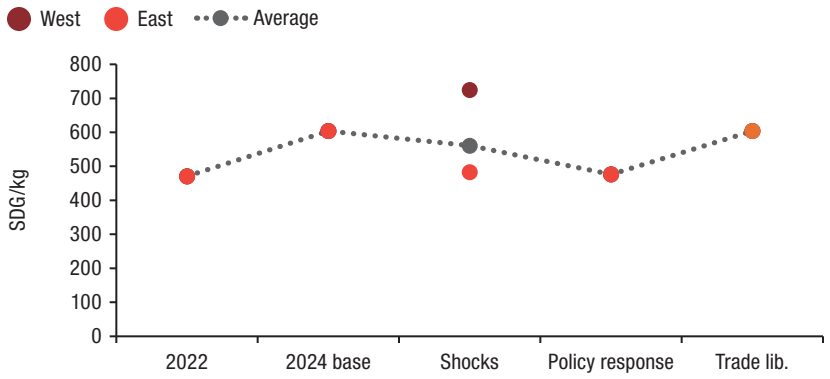
Note: The "shocks" simulation (Sim. 2, Table 5.1) includes higher marketing costs and lower household incomes in the West. The "policy response" simulation (Sim. 5, Table 5.1) includes both shocks from Sim. 2, a 20 percent productivity increase, 200,000 increase in imports, and integration of domestic markets.

The 20 percent reduction in exogenous household incomes in western Sudan results in a further reduction in wheat demand there (relative to Simulation 1). Wheat prices in western Sudan rise by only 20 percent relative to the base simulation, as compared to the increase of 29 percent in Simulation 1 (Figure 5.8). Wheat consumption in this area falls by 23.6 percent, an additional 8 percentage points relative to the decline in Simulation 1 (–15.6 percent). As in Simulation 1, with imports held fixed, the decline in consumption in western Sudan results in higher supplies in eastern Sudan, and consumption there increases by 15.3 percent relative to the base simulation (5.3 percentage points relative to Simulation 1) (Figure 5.8). Wheat prices in eastern Sudan fall by 20 percent (an additional 6 percentage points compared to Simulation 1).[11]

Simulations 3 through 5 explore the effects of potential policy measures to promote recovery of the wheat economy. In Simulation 3, we model a 20 percent increase in the productivity of wheat production, implicitly achieved through increased distribution of improved seeds and greater fertilizer use. Wheat production increases by 10.9 percent relative to the base

11 Note that because marketing margins are assumed to be a fixed value in terms of SDG/kg, in general, percentage price changes in western Sudan are not equal to percentage price reductions in eastern Sudan.

FIGURE 5.9 Model simulation results for wheat prices, Sudan



Source: Authors' model simulations.

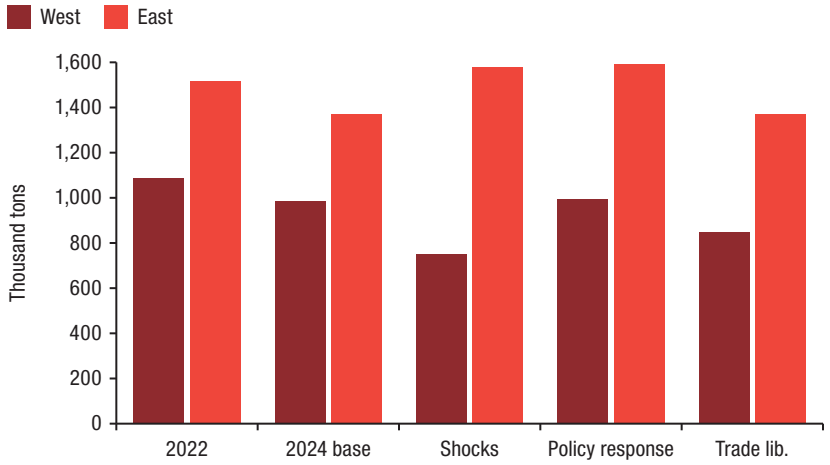
Note: "Shocks" simulation (Sim. 2, Table 5.1) includes higher marketing costs and lower household incomes in the West. "Policy response" simulation (Sim. 5, Table 5.1) includes both shocks from Sim. 2, a 20 percent productivity increase, 200,000 increase in imports, and integration of domestic markets.

simulation; national average wheat prices fall by 3.2 percentage points relative to Simulation 2 and by 10.7 percent relative to the base simulation; and national wheat consumption rises by 1.6 percent, as compared to a 1 percent decrease relative to the base in Simulation 2.

The 200,000-ton increase in imports in Simulation 4 increases national supply and national wheat consumption by 9.2 percent above the base level. Average wheat prices fall to 20.1 percent below the base level (that is, 9.4 percentage points below the price level in Simulation 3). Prices in eastern Sudan fall to 31.2 percent below the simulation price, while prices in western Sudan are only 3.1 percent above the base level, despite the increased marketing margins. Consumption of wheat in western Sudan is only 15.5 percent of the base level.

Simulation 5 models an integrated market like that which existed in 2022 (removing the 50 percent increase in marketing margins to western Sudan of Simulations 1–4), while keeping the lower household incomes in western Sudan of Simulation 2, the productivity shock of Simulation 3, and the higher import volumes of Simulation 4. In this scenario, wheat prices in both regions are 21.1 percent below the price level in the base simulation, that is, 10.1 percentage points higher than in eastern Sudan (Simulation 5) and 18 percentage points higher than in western Sudan (Simulation 5) (Figure 5.9). Wheat consumption thus increases by 16.4 percentage points

FIGURE 5.10 Model simulation results for wheat consumption by region, Sudan



Source: Authors' model simulations.

Note: The "shocks" simulation (Sim. 2, Table 5.1) includes higher marketing costs and lower household incomes in the West. The "policy response" simulation (Sim. 5, Table 5.1) includes both shocks from Sim 2, a 20 percent productivity increase, 200,000 increase in imports, and integration of domestic markets.

relative to Simulation 4 in western Sudan, but it falls by 10.7 percentage points relative to Simulation 4 in eastern Sudan (Figure 5.10). The results of Simulations 4 and 5 suggest that increases in imports generally remain the most effective means of reducing market prices and raising consumption. For western Sudan, however, restoring market flows of wheat from eastern Sudan can lead to even greater positive impacts on consumption.

Finally, Simulation 6 (Table 5.5) shows the impact of a trade liberalization in which private imports are allowed, up to the point at which the domestic price equals the simulated base market price of 2024, namely 604 SDG/kg in 2021/2022 prices (Simulation 0). Assuming no change in the other assumptions of Simulation 2, production falls from 359,000 tons in Simulation 2 to 336,000 tons in Simulation 6, a 6.5 percent decline. Imports increase by 19.1 percent relative to those in Simulation 2 due to lower market prices. Wheat consumption increases by approximately the same percentages in eastern Sudan (15.3 percent) as in western Sudan (15.9 percent). Thus, trade liberalization has major benefits for consumers, as lower prices spur additional consumption.

TABLE 5.5 Model simulation results for wheat trade liberalization, Sudan

	Sim. 0	Sim. 2	Sim. 6
Production (thousand tons)	384.2	359.3	336.0
	–	–	–6.5%
Imports (thousand tons)	2,100.0	2,100.0	2,500.8
	–	–	19.1%
Total supply (thousand tons)	2,484.2	2,459.3	2,836.8
	–	–	15.4%
Price (SDG/kg)*			
East	–	–	–20.0%
West	–	–	–20.0%
All Sudan	–	–	–20.0%
Consumption (thousand tons)			
East	1,369.4	1,578.7	1,820.6
	–	–	15.3%
West	983.7	751.8	871.6
	–	–	15.9%
All Sudan	2,353.0	2,330.5	2,692.2
	–	–	15.5%

Conclusion

As key components of Sudan's food economy, cereal production and markets have changed dramatically in the last 10 years due to conflict-related disruptions, as well as earlier changes in government policy. In parts of Sudan, particularly Darfur and surrounding regions, the conflict has prevented many farming activities and greatly reduced domestic production. In many other areas of the country, however, the planting and harvesting of cereal crops have not been significantly disrupted, though marketing costs have risen substantially.

Regional differences in production and consumption patterns have long existed in Sudan, largely driven by water availability. The current conflict has added an important additional regional dimension to the picture, one that shifts with the ebbs and flows of military control over cities and surrounding agricultural areas. Wheat production in Aj Jazirah, a state largely under RSF control in 2023/2024, was only 144,000 tons, 59 percent below the five-year (2018/2019–2022/2023) average of 353,000 tons. At 104,000 tons, wheat production in the SAF-controlled Northern state was only 29 percent below its previous five-year average. Sorghum production in East, Central, and West Darfur fell by 91 percent, from a five-year average of 719,000 tons to only 58,000 tons (see Figure 5.2).

Consistent with the decline in production (and limited wheat imports), market prices of both wheat and sorghum increased sharply from 2021 to 2024. Wheat prices rose particularly fast in 2024 in Al Fashir and El-Obeid in western Sudan, where they increased more than fivefold compared to early 2023, reflecting increased marketing costs from Port Sudan and other parts of eastern Sudan to markets in western Sudan. Overall, sorghum prices rose less than wheat prices but nonetheless surged by the end of 2024 in most markets.

Wheat market model simulations suggest that the disruption of regional wheat markets due to conflict in 2023 had significant adverse effects on wheat consumption. In the absence of this conflict-induced shock to marketing costs, wheat consumption could have been 10 percentage points higher in western Sudan, assuming wheat imports were allowed to increase to meet demand at import parity prices. Moreover, when domestic market prices are higher than import parity levels, increasing the volume of wheat imports to reduce domestic prices to import parity levels can generally be an effective means of reducing market prices and raising consumption.

In the short term, if war continues, humanitarian aid flows will still be needed to help meet food security needs, since households in conflict areas will likely lack the purchasing power to acquire sufficient food in the market. In the medium term, rebuilding market infrastructure could help to lower marketing costs and thus help raise the incomes of net wheat-consuming households. In addition, these investments in market infrastructure would likely raise the incomes of urban households and all farm households that produce a marketable surplus of other crops.

TABLE 5.A1 Sudan wheat model equations

Production:	X = X0 * (P/P0)^es
Supply:	QS = X * (1 – loss) + M
Seed use:	QSD = seed * X
Feed use:	QF = feed * QS
Household demand:	QD(h) = QD0(h) * ((P/P0) ^ ey(h)) * (Y(h)/Y0(h)) ^ ey(h)
Household incomes:	Y(h) = Y0(h) * yshock(h)
Regional prices:	P("west") = P("east") * (1+marg)
Equilibrium:	QS = QSD + QF + ∑h QD(h)
Endogenous variables:	Exogenous variables:
M = Imports [exogenous]	QD0(h) = Base-level demand (consumption) by household h
QD(h) = Demand (consumption) by household h	P0 = Base domestic price
QF = Feed use	X0 = Base-level production
P = Domestic price	Y0(h) = Base-level household income
S = Total supply	
X = Production	
Y(h) = Household income	
Parameters:	
es = Own-price elasticity of wheat supply	
ed(h) = Own-price elasticity of wheat demand for household h	
ey(h) = Income elasticity of demand for household h	
feed = Feed use as a share of total supply	
loss = Seed, feed, and storage as a percentage of domestic production	
marg = Percent marketing margin between region 1 and region 2	

Source: Authors.

TABLE 5.A2 Sudan wheat model, base data and simulation, 2024

	2022	USDA 2024	Sim. 0 2024
Production	477	400	384
	–	–16.2%	–19.5%
Imports	2,276	2,400	2,100
	–	5.4%	–7.7%
Total supply	2,753	2,800	2,484
	–	1.7%	–9.8%
Per capita supply (kgs)	58.4	55.9	49.6
	–	–4.1%	–15.0%
Wheat price (SDG/kg)*	470.8	–	603.9
	–	–	28.3%
Consumption	2,605	2,654	2,353
	–	1.9%	–9.7%

Source: USDA (2024), FAO (2025), and authors' model simulations.

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