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Distributional Consequences of Wheat Policy in Sudan

A Simulation Model Analysis

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ABSTRACT

Despite reforms in early 2021, including a devaluation of the currency and a liberalization of imports, there remain significant distortions in Sudan's wheat value chain, especially related to subsidized sales prices of flatbread. This flatbread subsidy, a key component of wheat policy, is not well-targeted. Calculations based on 2009 national household survey data and current 2021 prices and wheat supply show that urban poor households annually receive slightly less from this subsidy than urban non-poor households (18,900 and 20,800 SDG/capita). Rural poor households receive only 2,700 SDG/capita.

This paper presents the results of several simulations of a partial equilibrium model of Sudan's wheat economy that are designed to analyze the impacts of recent shocks and various policy options. Model simulations show that increased wheat imports, such as those financed by food aid, add to supplies for processing into wheat flour, flatbread, and other wheat products, resulting in lower prices for consumers and increased consumption, but also disincentives for production. A 300,000 ton increase in wheat imports, as occurred in early 2021, results in an 8 percent increase in wheat consumption and a 35 percent decline in the market price of non-flatbread wheat products. Production falls by 12 percent. Since flatbread prices are unchanged, wheat consumption of the urban poor, for whom flatbread is the major wheat product consumed, increases by only 4 percent.

Raising flatbread prices by 30 percent to reduce the size of the fiscal subsidy reduces total consumption of flatbread by 17 percent and sharply reduces wheat consumption and real incomes of the urban poor. All households suffer a loss of 41 to 45 percent in the value of flatbread subsidies received. The urban poor experience the largest decline in total consumption of wheat (14 percent) and in total income (11 percent). (The average total income loss for all households is only 3 percent.) Reducing the flatbread subsidy without a compensating income transfer would significantly reduce the welfare of the urban poor and likely threaten political stability.

Our results suggest that a combination of key wheat policies involving high levels of imports – including injection of food aid wheat into the economy in late 2020 – and subsidized flatbread will significantly benefit urban poor households. Nonetheless, the are important data gaps on several aspects of the wheat sector, including no recent nationally representative household expenditure survey data. In addition, greater transparency, including publication of quantities and prices of government purchases, sales of wheat and wheat flour, and quantities and prices of subsidized flatbread across the country has the potential to significantly increase the efficiency of the entire wheat sector.

As shown in this paper, Sudan's wheat policies in recent years, such as increased wheat imports, price subsidies in the wheat value chain, and low prices of flatbread, have in general favored consumers, to the detriment of producers. These interventions in the wheat value chain, especially those related to subsidies on flatbread, have especially large effects on the welfare of urban households, making these policies particularly politically sensitive. However, they have entailed high fiscal costs, threatening macro-economic stability and crowding out other possible investments to promote growth and poverty reduction. Careful policy analysis and ongoing monitoring of outcomes and new developments will be needed to help guide the important choices ahead.

1. INTRODUCTION

Wheat policy in Sudan has major implications for both household food security and political stability. Wheat and wheat bread are not only the major food staples of urban households in Sudan; they are also politically important as evidenced by large-scale protests following changes in the subsidized price of flatbread in recent years (Resnick 2021). To meet its multiple objectives of stabilizing wheat prices, providing incentives for domestic production, securing imports, and subsidizing poor consumers, government policies over the past several decades have included interventions throughout the wheat value chain, including controls on imports and on prices of wheat grain, wheat flour, and flatbread (D'Silva and Elbadawi 1988; Shugeiry 1990; Faki and Taha 2009). Wheat policy has become even more complicated since 2017, however, as high macro-economic inflation, rapid depreciation of the Sudanese pound, and substantial instability in the real exchange rate have created additional price distortions.

Earlier analysis of food aid in cash and in kind using 2009 data showed that these transfers were highly pro-poor in Sudan (Sahn and Younger 2016). This paper extends that analysis by using a partial equilibrium framework to examine the effects of the complex array of interventions on wheat and bread prices on household welfare (Coady et al. 2009; Schmidt et al. 2021). Our results suggest that the combination of key wheat policies (high levels of imports – including injection of food aid wheat into the economy in late 2020 – and subsidized flatbread) significantly benefits urban poor households, while taxing producers.

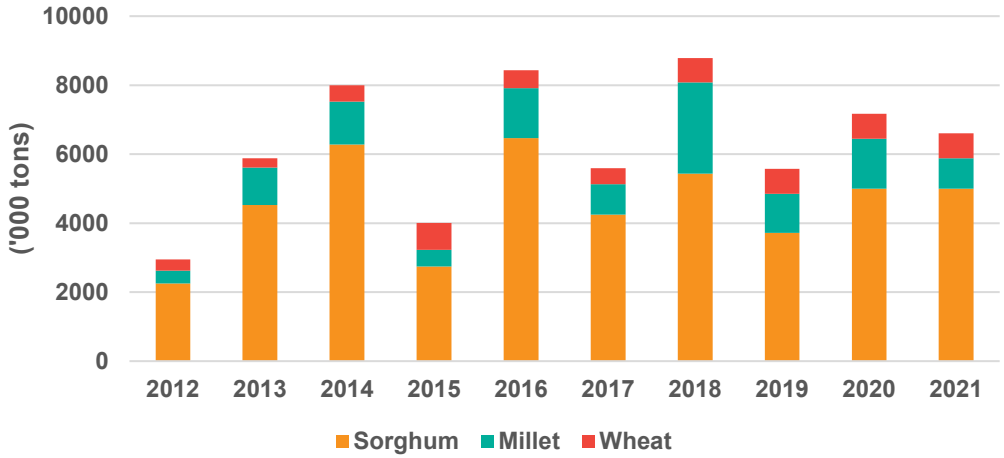
The plan of the paper is as follows. Section two presents an overview of Sudan's wheat sector, highlighting the structure of production, consumption, and trade, and then summarizes recent price and trade policies, describing domestic price movements relative to import parity (the full cost of imported wheat, including trade and transport margins). Section three covers the partial equilibrium wheat model constructed for this analysis, including consumption data and estimates for 2019 (the base year of the model), estimation of household wheat demand parameters, and the model equations. Results of simulations of production shocks, household income shocks, an exogenous increase in imports, and a reduction in the price subsidy on flatbread are presented and discussed in section four. The final section concludes and suggest areas for further research and analysis.

2. SUDAN'S WHEAT SECTOR: STRUCTURE AND POLICIES

2.1 Wheat Production, Trade, and Consumption

Wheat, the third largest cereal crop in terms of production in Sudan, is cultivated mainly on irrigated land in the northern half of the country. Production averaged 570,000 tons from 2012 through 2019, only one-eighth that of sorghum (4.57 million tons) and about half that of millet (1.16 million tons). Annual production of wheat, like other cereals in Sudan, varies substantially according to water availability, though the fluctuations in wheat production are not as great as those of millet, which is typically cultivated on non-irrigated land in the southern states (Figure 2.1).

Figure 2.1: Sudan cereal production, 2012-2021



Note: 2020 and 2021 are USDA (2021) estimates.
Source: FAOSTAT (2021) and USDA (2021).

Table 2.1: Food balance sheet for Sudan, 2018

	Wheat	Rice	Maize	Millet	Sorghum	Total Cereals
Production	595	30	45	2,647	4,953	8,270
Import Quantity	2,508	119	19	-	161	2,807
Stock Variation	344	19	-	1,372	163	1,898
Export Quantity	6	5	-	-	35	46
Domestic supply quantity	2,754	125	63	1,275	4,916	9,133
Feed	124	-	30	255	248	657
Seed	30	1	1	18	77	127
Losses	48	2	4	152	743	949
Processing	-	-	-	-	-	-
Other uses (non-food)	-	-	18	-	798	816
Residuals	-	-	-	-	-	-
Food	2,552	122	11	850	3,050	6,585
Per capita quantities						
Production (kg/capita/year)	61.0	2.9	0.3	20.3	73.0	157.5
Food supply (kcal/capita/day)	530.0	19.0	2.0	170.0	617.0	1338.0
Protein supply (g/capita/day)	15.9	0.4	0.1	4.9	18.2	39.3
Fat supply (g/capita/day)	1.6	0.04	0.01	1.5	5.9	9.1
Shares of cereals (percent)						
Production	7.2	0.4	0.5	32.0	59.9	100.0
Food supply	38.8	1.8	0.2	12.9	46.3	100.0
Calorie supply	39.6	1.4	0.1	12.7	46.1	100.0
Protein supply	40.4	0.9	0.1	12.4	46.2	100.0
Fat supply	17.7	0.4	0.1	16.5	65.3	100.0

Source: FAO (2021).

Wheat production accounts for only about 20 percent of wheat supply in most years, however – wheat imports since 2012 have ranged between 2.0 and 2.7 million tons per year, averaging 2.4 million tons per year.[1] Given these large-scale imports, wheat is the second largest source of calories in Sudan (530 calories/person/day), accounting for 20.6 percent of

[1] Sudan also exported 4,000 tons of wheat in 2013 and 6,000 tons in 2018, (USDA 2021 and FAO 2021).

the estimated 2,576 total calories consumed daily (Table 2.1). Sorghum is the leading source of calories: 617 calories/person/day, (24.0 percent of total calories). Other major sources of calories are sugar (296), milk (205), millet (170), and groundnuts and groundnut oil (160), (FAOSTAT 2021).

There are notable differences in the patterns of cereal consumption between rural and urban areas, however. Data from the 2009 National Household Budget Survey show that the value of total consumption of wheat products was 73 percent higher in urban areas than in rural areas, though the per capita value of consumption of wheat in the form of grain and flour was 40 percent less than in rural areas (Table 2.2). Wheat's importance relative to other cereals is far greater in urban areas, as well – the value of expenditures on wheat and wheat products accounted for 57 percent of the total value of cereal and cereal product consumption by urban households. In rural areas, in contrast, the combined share of other cereals and cereal products, including sorghum, millet, rice and other cereal products, was 65 percent, compared to only 35 percent for wheat and wheat products.

Table 2.2: Per capita cereal expenditures and total budget shares, 2009

	All Sudan		Urban		Rural	
	SDG	Share	SDG	Share	SDG	Share
Wheat flat bread	81.1	0.028	131.8	0.035	51.5	0.022
Other wheat bread	21.0	0.007	29.8	0.008	15.9	0.007
Wheat grain & flour	34.1	0.012	24.1	0.006	39.9	0.017
Total wheat products	136.1	0.047	185.7	0.049	107.2	0.046
Sorghum	54.5	0.019	35.0	0.009	65.8	0.028
Millet	60.3	0.021	21.1	0.006	83.1	0.036
Rice	15.7	0.005	16.2	0.004	15.4	0.007
Other[a]	48.7	0.017	67.6	0.018	37.6	0.016
Total cereals	315.2	0.110	325.6	0.086	309.2	0.133
Total expenditure	2,868.3	1.000	3,798.9	1.000	2,323.2	1.000

[a] Includes noodles, biscuits, pastries and other products.
Source: Calculated using data from Sudan National Household Survey, 2009.

2.2 Wheat Price and Trade Policies

Sudan's wheat policies have included major government interventions in prices and input costs throughout the wheat value chain from farm production of grain to milling into flour to baking into bread. Exchange rate policies and trade taxes have also influenced prices and incentives for production and consumption at every stage.

Over the fifty-year period from the mid-1950s to the early 2000's, government economic policy in Sudan has favored industry over agriculture. Average price distortions in agriculture, as measured by nominal rates of assistance (NRA), were consistently negative over the 1955 to 2004 period, though they were substantially less in magnitude in the 1999 to 2004 period. Nominal rates of assistance for wheat varied, however. From 1992 to 1997 (except for 1994), wheat production was taxed, as NRA's ranged from -24 to -75 percent (except for 1994). Later, from 2000 to 2003, wheat production was effectively subsidized, as NRA's ranged between 21 to 44 percent (Faki and Taha 2007, 2009).[2] Nonetheless, wheat production on irrigated land in the Gezira scheme in northern Sudan has been promoted in

[2] Unlike in Sudan, average nominal rates of assistance for wheat production elsewhere in Africa were very small: 4 percent between 1990 and 1994, 1 percent between 1995 and 1999, and -1 percent between 2000 and 2004 (Anderson and Valenzuela 2008).

an attempt to achieve food self-sufficiency, even though cotton cultivation would be more profitable.[3]

Since the independence of South Sudan in July 2011, which entailed a substantial loss of oil revenues for Sudan, rampant inflation and problems of an over-valued exchange rate have resulted in even more severe price distortions and led to several major policy reforms to correct macro-economic imbalances. Macro-economic distortions steadily increased over the period from 2013 to 2017, as domestic inflation raised the price level, as measured by the consumer price index, by 286 percent, while the nominal exchange rate depreciated by only 31.3 percent relative to the US dollar (from 5.09 to 6.68 SDG/USD) and domestic inflation in Sudan's major trading partners was relatively low. As a result, the real exchange rate, a measure of the relative price of tradable goods relative to non-tradables, appreciated by 44.6 percent between 2013 and 2017 in Sudan, a major deterioration in the average inflation-adjusted prices of tradable goods and profitability of production of these goods, including wheat.[4] The real exchange rate appreciation also spurred demand for imports, including imported wheat, and ultimately required restrictions on imports, in the form of import licenses, to limit the balance of payments deficit.

The effects of these distortions in the price of wheat on the rest of the value chain were complicated because of fixed administrative prices for sales of imported wheat to flour mills, for sales to bakers of the flour produced from that wheat, and for the (highly subsidized) price of the flatbread produced with the flour. The domestic market price of wheat grain was essentially equal to the world market price adjusted for transport costs in 2012 and 2013, averaging only 8 percent above the import parity price (calculated using the official exchange rate without import taxes). From 2014 to 2021, however, domestic wholesale prices for wheat grain fluctuated widely relative to import parity prices calculated using the official exchange rate (Figure 2.2),[5] though special exchange rates for priority imports kept local currency costs of imported wheat low.

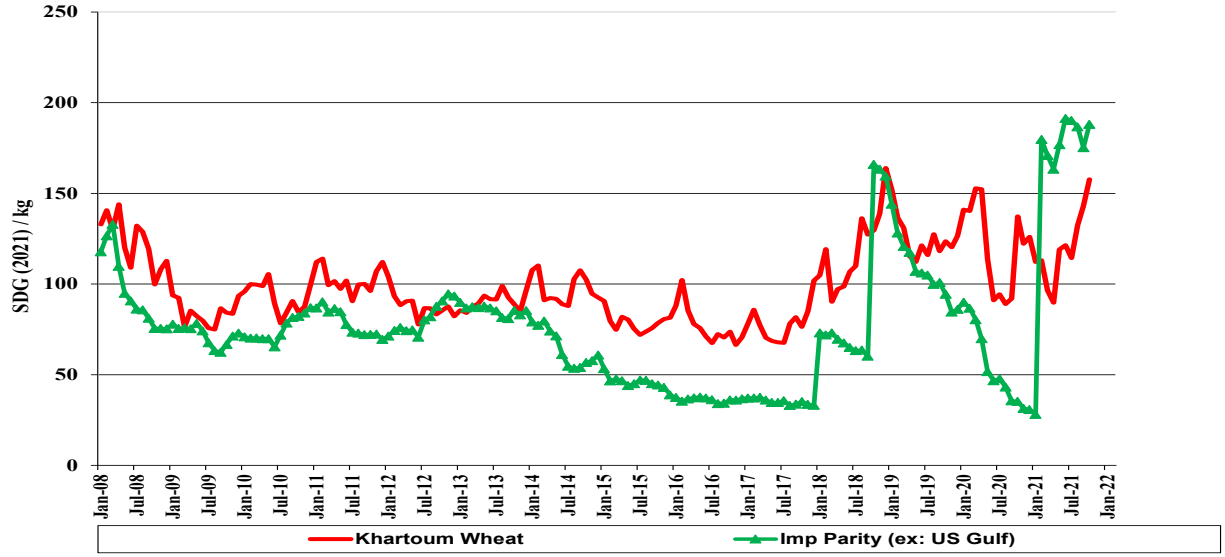
For example, in early 2015, importers were able to obtain foreign exchange for wheat imports at a special exchange rate of about 4.0 SDG/USD, a subsidy of about 2.0 SDG/USD relative to the official exchange rate of 6.0 SDG/USD. (The subsidy was even larger – 3.5 SDG/USD – in comparison with the parallel market rate of more than 7.5 SDG/USD (Siddig and Grethe 2015).) The system of multiple exchange rates, which began in 1972, persisted until early 2020. The previous year, in April 2019, the official rate was set at 45 SDG/USD, but the government budget accounts still used the old (September 2018) exchange rate of 18.0 SDG/USD, the customs duty rate was set at SDG 15/USD, and fuel imports used an exchange rate of 6.7 SDG/USD (Gray 2021).

[3] Using domestic resource analysis, Hassan et al. (2000) found that wheat yields at 1996 prices in the Gezira scheme would need to increase by more than 50 percent to compete with cotton in terms of economic returns. See also Hassan and Faki (1993) and Faki et al. (1995).

[4] The simple real exchange rate measure used here is ER*USCPI/CPI, where ER is the nominal exchange rate (SDG/USD), USCPI is the US Consumer Price Index, and CPI is Sudan's Consumer Price Index. The real exchange as calculated by the IMF is measured using an estimate of a trade-weighted average prices of Sudan's major trading partners converted to a common currency (e.g. the U.S. dollar) using nominal exchange rates divided by the consumer price index in Sudan. By this latter measure, Sudan's real exchange rate appreciated by 24.4 percent between 2007 and 2018 (IMF 2020).

[5] Figure 2.2 presents prices in real terms (deflated by the consumer price index) in order to show changes in the relative prices of imported and domestic wheat in one figure. As illustrated in Annex Figure 2.1, the change in nominal prices over time caused by overall macro-inflation is far greater than the changes in relative prices highlighted in Figure 2.2.

Figure 2.2: Domestic and import parity real (2021) prices of wheat, 2008-2021



Source: World Food Programme (2021), IMF (2021), World Bank (2021) and authors' calculations.

Major price reforms in late 2018 and in early 2021 involved large increases in the sales price of flour to bakeries and in the price of subsidized flatbread. The huge increase in the sales price of flat bread from 1.0 to 3.0 SDG for a 70 gram loaf (from 14.3 to 42.9 SDG/kg) in December 2018 led to massive street protests that contributed to the downfall of the Bashir regime several months later in April 2019. The sales price of wheat flour to bakeries was also increased at the same time, limiting the impact on profits of bakeries. The estimated total subsidy on bread actually increased in nominal terms from 7.7 SDG/loaf (110.0 SDG/kg) in November 2018 to 21.6 SDG/loaf (308.6 SDG/kg) in December 2018 (Table 2.3). In percentage terms, however, the subsidy fell slightly, from 35 to 33 percent of the cost of bread at the bakery level.[6]

Table 2.3: Flatbread subsidies, 2018-2021

	Financial cost, SDG/kg		Unsubsidized cost, bread, SDG/kg	Sales price, bread, SDG/kg	Subsidy on bread, %
	Flour	Bread			
November 2018	2.6	14.0	22.0	14.3	34.9
December 2018	6.9	31.5	63.5	42.9	32.5
March 2020	2.6	17.8	22.0	14.3	34.9
April 2020	3.8	23.3	32.9	21.4	34.9
January 2021	5.1	42.6	38.8	28.6	26.4
February 2021	12.3	43.6	86.8	50.0	42.4
August 2021	12.3	55.2	108.2	71.4	34.0

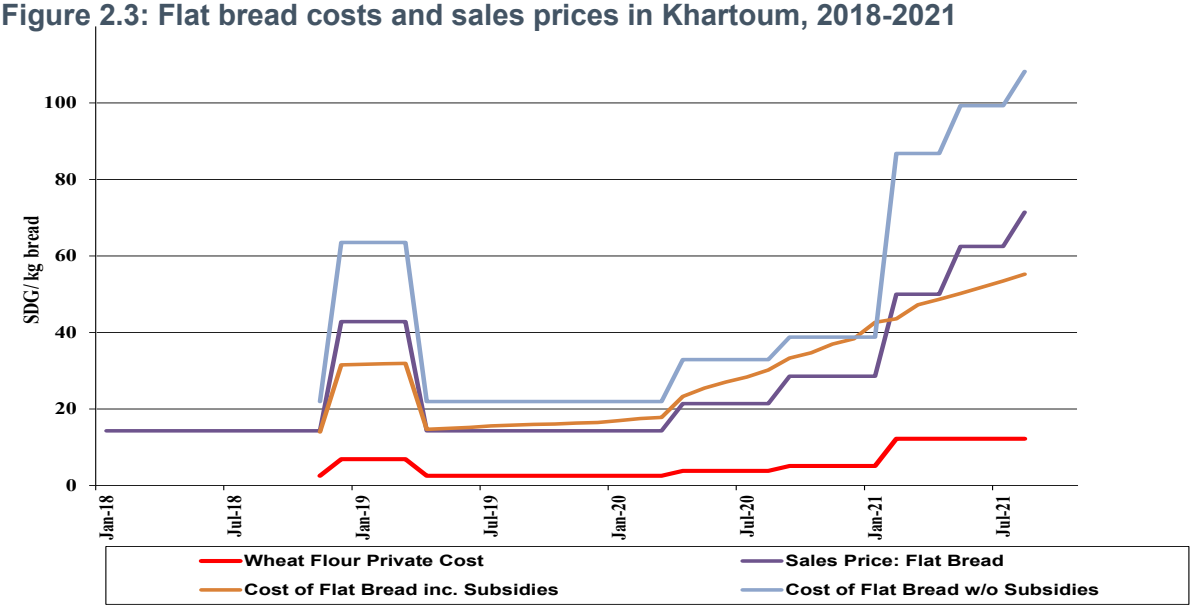
Source: Khartoum Bakers Association data, various news articles and authors' calculations.
Note: Flour is 76.6 percent of the weight of a flat bread loaf, based on data provided by the Khartoum Bakers Association. Thus, the cost of wheat flour in August 2021 is calculated as 0.766 times the subsidized sales price of wheat grain (16 SDG/kg), i.e. 12.3 SDG/kg.

Under the new government, the subsidized price of flat bread was again lowered to 1.0 SDG/loaf until April 2020, when it was raised to 1.5 SDG/loaf, (Figure 2.3). Five months later, in September 2020, the price was increased yet again, to 2.0 SDG/loaf. In early

[6] Note that these figures are estimates of the financial subsidy. They do not measure the full economic costs using international prices.

February 2021, as part of major economic reforms, the foreign exchange market was liberalized and the exchange rate, formerly fixed at 55 SDG/USD, depreciated sharply to an average for the month of 377.5 SDG/USD. The sales price of flat bread was increased to from 2.0 SDG for a 70 gram loaf to 5.0 SDG/loaf, i.e. by 80 percent. The price of wheat flour also rose substantially so that the estimated subsidy on flat bread rose from 26.4 percent in January 2021 to 42.4 percent in February 2021.[7]

Figure 2.3: Flat bread costs and sales prices in Khartoum, 2018-2021



Source: Khartoum Bakers Association data, various news articles and authors' calculations.

In real terms, (i.e. nominal prices adjusted for inflation using an index of the price of a basket of consumer prices), the price of costs and prices in August 2021 were similar to their levels of December 2018 just after a major increase in the nominal cost of flour and sales price of bread. The real price of flour was only 1.6 percent below its price in December 2018, while the real price of flatbread was 7.7 percent below its December 2018 price (Table 2.4).

Table 2.4: Flatbread subsidies in real terms (2021 SDG*), 2018-2021

	Financial cost, SDG/kg		Unsubsidized cost, bread, SDG/kg	Sales price, bread, SDG/kg	Subsidy on bread, %
	Flour	Bread			
November 2018	3.9	21.3	33.4	21.7	34.9
December 2018	9.7	44.5	89.6	60.4	32.5
March 2020	3.2	22.5	27.7	18.0	34.9
April 2020	4.6	27.6	39.1	25.4	34.9
January 2021	5.1	42.6	38.8	28.6	26.4
February 2021	10.7	38.0	75.6	43.5	42.4
August 2021	9.6	43.1	84.5	55.8	34.0
Change between Dec 2018 and Aug 2021 in real terms, percent	-1.6	-3.1	-5.7	-7.7	4.4

Source: Khartoum Bakers Association data, various news articles and authors' calculations.
Note: * Real prices calculated using a consumer price index with January 2021 = 100.

[7] Note that, in value terms, wheat flour represents only 19.6 percent of the value of flat bread in traditional bakeries and 20.3 percent in modern bakeries. Other major costs for traditional bakeries include yeast (18.2 percent), direct labor (22.1 percent), indirect costs (13.3 percent), and net profit (11.7 percent).

The policy of fixed nominal prices of flat bread in a context of high overall inflation has resulted in large variations in profits for bakeries, but there are mitigating factors. First, wheat flour costs at subsidized prices are only about 20 percent of the sales value of flat bread. Second, it is possible to mix lower quality, less expensive flour, e.g., sorghum flour, in the bread or to produce slightly smaller loaves. Third, medium and large bakeries often produce other products for which sales prices are not controlled, so the profits of the enterprise do not depend solely on the profitability of flat bread. Finally, in the short run, the bakeries may not be covering their medium-term costs of replacing their capital, such as ovens. Many small bakeries reportedly have gone out of business in the last year, however.

3. SUDAN WHEAT MODEL: STRUCTURE AND PARAMETERS

3.1 Household Consumption of Wheat and Wheat Products

No recent national household survey data on quantities consumed or prices of wheat and wheat products are available. Thus, we constructed estimates of demand for wheat products by various household groups using data on household expenditures from the most recent national household survey data available, that of the National Baseline Household Survey (NBHS) of 2009 and wheat prices over time from the Food and Agriculture Organization of the United Nations (FAO 2021a). The national average retail price of wheat in 2009 was calculated as the wholesale price of wheat grain in Khartoum in 2009 plus an assumed 30 percent margin. Prices of other wheat products were estimated using assumed ratios of each product to the national average wheat grain price. Quantities of wheat consumption of each product in 2009 were then calculated using 2009 survey values (in SDG) divided by the estimated prices. We then used the estimated quantity share of each product in 2009 and the total wheat food use in 2021 from USDA (2021) estimates of wheat supply and utilization to estimate quantities of wheat consumption of each product in 2021.

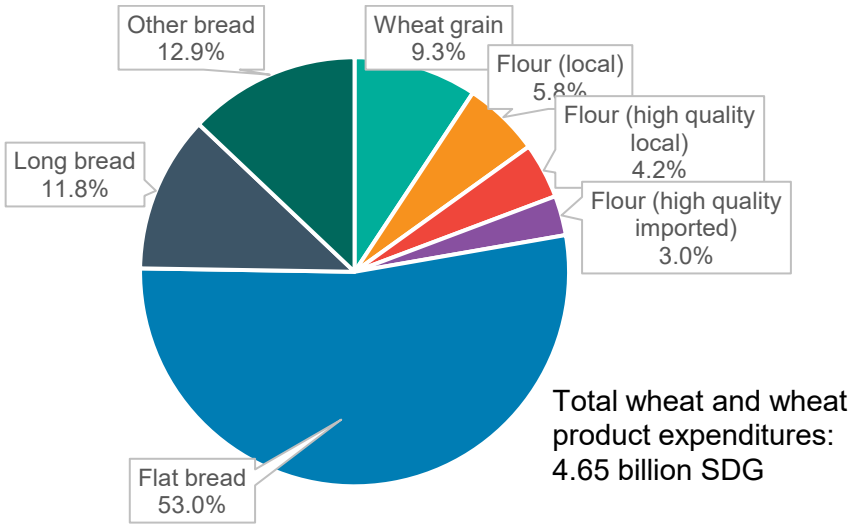
Table 3.1 Estimated consumption of wheat products, 2009 and 2021

	2009 (NBHS)					2021
	Expenditure, SDG millions	Assumed price-ratio	Price,[a,b] SDG/kg	Consumption,[c] '000s mt	Quantity shares	Consumption,[d] '000s mt
Wheat grain	432.7	1.00	1.56	277.0	0.114	309.0
Flour (local)	269.1	1.20	1.87	143.6	0.059	160.1
Flour (high quality local)	194.7	1.40	2.19	89.0	0.037	99.3
Flour (high quality imported)	139.0	1.60	2.50	55.6	0.023	62.0
Bread	3616.8	1.24	1.94	1863.7	0.767	2078.6
Flat bread	2465.5	0.91	1.43	1725.8	0.711	1924.8
Long bread	549.8	3.00	4.69	117.3	0.048	130.9
Other bread[e]	601.5	18.70	29.21	20.6	0.008	23.0
Total	4652.4	n.a.	n.a.	2429.0	1.000	2709.1

Source: NBHS 2009 data, FAO (2021a) price data; USDA (2021) supply estimates and authors' estimates.
Notes: n.a. = not applicable.
[a] Price of wheat grain in 2009 estimated as Khartoum retail price multiplied by adjustment factor (1.3) to reflect average national prices.
[b] Prices of other wheat products are calculated using assumed ratios of each product to the national average wheat price.
[c] Quantity of wheat consumption of each product calculated using 2009 survey values (in SDG) divided by estimated prices.
[d] Quantity of wheat consumption of each product in 2021 estimated as total wheat food use times the estimated share of each product in 2009.
[e] Sliced bread and buns.

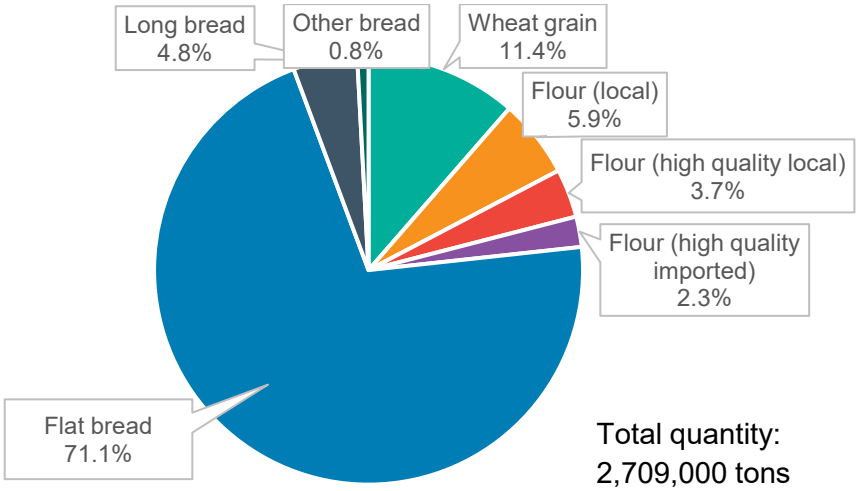
Data from NBHS (2009) indicate that expenditures on flatbread accounted for 53.0 percent of total expenditures on wheat and wheat products (Table 3.1 and Figure 3.1). Long bread and other bread accounted for 11.8 and 12.9 percent of expenditures, respectively. Wheat grain and various grades of flour accounted for the remaining 22.5 percent of expenditures. Using estimated prices and wheat contents, the estimated share of flatbread in total quantity of wheat consumed is even larger (71.1 percent). The shares of wheat food use for long bread and other bread totals only 5.6 percent. The shares of wheat grain and other wheat products in the total quantity of wheat consumed are nearly the same as their expenditure shares, though.

Figure 3.1: Wheat and wheat product expenditures, 2009, by product category, percentage share



Source: NBHS (2009) data.

Figure 3.2: Estimated quantity of wheat and wheat product consumption, 2021, by product category, percentage share

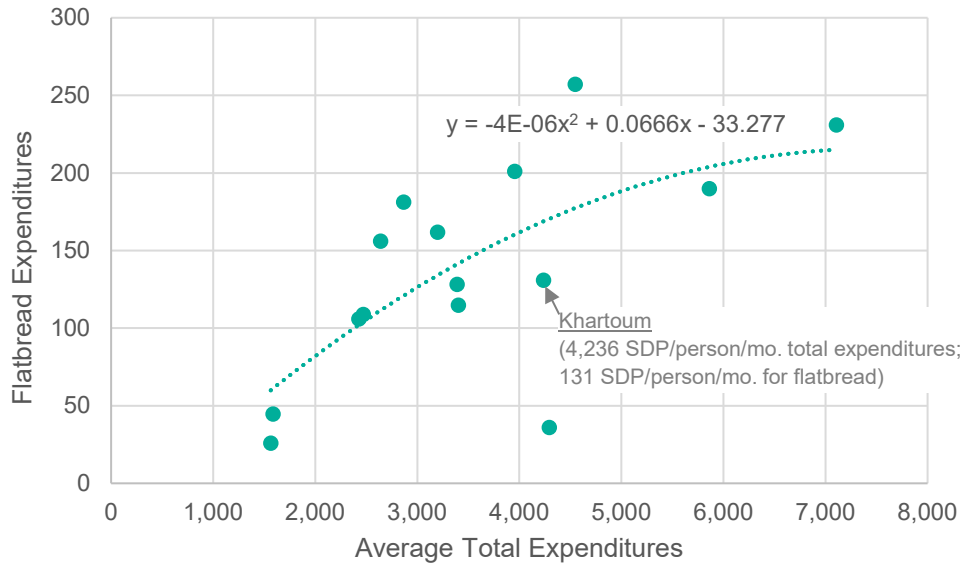


Source: Authors' estimates from NBHS (2009) and other data.

3.2 Wheat Demand Parameters

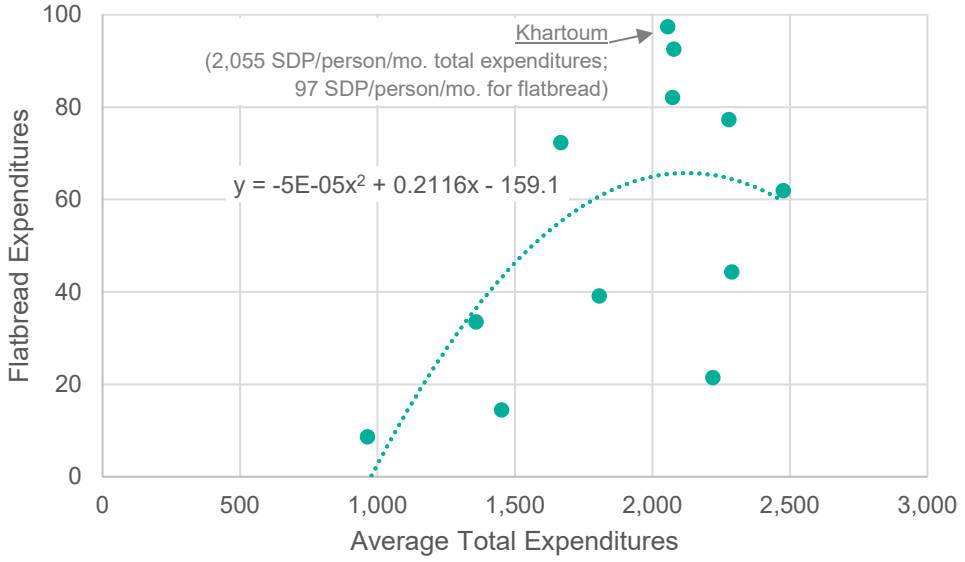
Individual household records from nationally representative household surveys that include quantities of consumption or values of expenditures on individual wheat and cereal products are not available. Since data on wheat consumption by individual households was not available, we used rural and urban average per capita expenditures on food commodities by state. As shown in Figures 3.3 and 3.4, flatbread consumption rises as average total per capita expenditures increases, but marginal consumption of flatbread declines.

Figure 3.3: Urban per capita flat bread expenditures in Sudan (2009), based on state averages, SDP/person/month



Source: Authors' calculations from NBHS (2009) data.

Figure 3.4: Rural per capita flat bread expenditures in Sudan (2009), based on state averages, SDP/person/month



Source: Authors' calculations from NBHS (2009) data

To calculate elasticities of demand for flatbread, we first estimated aggregate quadratic Engel functions of the form:

$$Q_i = \alpha + \beta_1 * Exp_i + \beta_2 * Exp_i^2 + \varepsilon_i,$$

where Q_i = per capita quantity consumed in region i,
Exp_i = total expenditures per capita in region i,
ε_i is the error term for region i, and
α, β_1 and β_2 are estimated parameters.

Expenditure elasticities then were calculated using the fitted value of commodity expenditures at mean household expenditures per capita for each of the household groups.[8,9] The resulting expenditure elasticities range from 0.543 to 0.885, with a weighted national average 0.677 (Table 3.2). For the model simulations, we assume a slightly higher expenditure elasticity for other wheat products (including wheat grain, wheat flour, other bread and pastries) of 0.80. The weighted average for total wheat and wheat products (including flatbread and "other" wheat products) is 0.712, somewhat higher than the 0.572 total wheat expenditure elasticity estimated by Abdelrahman (1990) using time series national averages for all of Sudan before the independence of South Sudan.[10]

Table 3.2: Demand elasticities for wheat and wheat products in Sudan

Commodity / Household Group	Expenditure	Own-Price	Cross-Price
Flatbread			
Urban poor	0.885	-0.885	0.177
Urban non-poor	0.708	-0.708	0.142
Rural poor	0.679	-0.679	0.136
Rural non-poor	0.543	-0.543	0.109
All Sudan	0.677	-0.677	0.135
Other wheat products (all households)	0.800	-0.800	0.160
Total wheat	0.712	-0.712	0.142
Total wheat – All Sudan (including South Sudan) (Abdelrahman 1990)	0.572	-0.351	-0.119

Source: Abdelrahman (1990); authors' calculations.

4. IMPACTS OF EXOGENOUS SHOCKS AND POLICY CHANGES ON SUDAN'S WHEAT ECONOMY

4.1 Model Structure

For this analysis, we utilize a simple partial equilibrium model of Sudan's wheat economy following Dorosh (2001), Coady et al. (2009), and Schmidt et al. (2021) to estimate the effects of supply and income shocks, as well as the impact of policy changes on wheat consumption, government subsidies, and household welfare. The model disaggregates wheat consumption by household group, as well as by product – wheat grain and flour, flatbread, and other bread and wheat products. We assume an integrated wheat market for

[8] The calculations for rural households do not include data from Red Sea, West Darfur, and South Darfur, which have extremely high total per capita expenditures.

[9] Calculated from NBHS (2009) data, Annex Table 3.1 presents descriptive statistics of the household groups. Annex Figure 3.2 presents expenditures disaggregated by cereal category for rural and urban households. Annex Figure 3.2 presents the share of the total household budget made up by cereal categories for rural and urban households. Annex Figure 3.4 presents the share of the total household budget made up by cereal categories for three ordered welfare categories of households.

[10] For the model simulations, we assume that own-price elasticities of demand for wheat are equal to the negative of the expenditure elasticities and cross-price elasticities of wheat demand for changes in sorghum prices are equal to 0.20 times the expenditure elasticities.

Sudan, in which the price of flatbread (set by the government) is exogenous and the percentage changes in the endogenous prices of other wheat products are the same for all households across the country.[11] This model, which is focused on the wheat sector, does not capture changes in other parts of the economy, however, as would be the case if a multi-market or general equilibrium model were employed.

Table 4.1: Sudan wheat model equations

Production:	$X = X0 * (P/P0)^{ES}$
Supply of Wheat Grain:	$QS = X_i * (1 - loss) + \underline{M}$
Feed Use:	$QF = feed * (X0 + M)$
Household Demand:	$QD_{j,h} = QD0_{j,h} * (P_j / P0_j)^{ED(j,h)} * (Y/Y0)^{EY(j,h)}$, j = flour, flat bread, other wheat products
Price of Flatbread:	$Pj = \underline{Pj}$, j = flat bread
Cost of Wheat Products:	$C_j = \alpha_j P + k$, j = flour, other wheat products
Household Incomes:	$Y_h = Y0_h + (P X_h - P0 * X0_h)$
Equilibrium:	$QS_i = \sum_h \sum_j QD_{j,h} + QF_i$ j = flour, flat bread, other wheat products

Endogenous variables:
- $D_{j,h}$ = demand (consumption) by household h
- QF = feed use
- P = domestic price
- S = total supply
- X = production
- C = cost of production
- Y_h = household income

Exogenous variables:
- M = imports [exogenous]
- $D0_{j,h}$ = base level demand (consumption) by household h
- P0 = base domestic price
- X0 = base level production
- $Y0_h$ = base level non-wheat household income

Parameters:
- ES = own price elasticity of supply of wheat
- $ED_{j,,h}$ = price elasticity of demand of commodity j with respect to prices of j for household h
- $EY_{j,h}$ = income elasticity of demand of commodity j for household h
- $feed_i$ = feed use as a share of total supply
- loss = seed, feed, and storage as a percentage of domestic production

Note: Quantities of flatbread and all other wheat products are expressed in wheat grain equivalents.

Table 4.1 lists the equations and variables in the model. Wheat supply is a function of current prices with a constant own-price elasticity of supply. Household demand for wheat for each of the four household groups (urban poor, urban non-poor, rural poor and rural non-poor) is a function of household incomes and prices. Household incomes include incomes from wheat production along with an exogenous non-wheat income component. The domestic price of wheat is determined by total supply and demand, where total demand includes the sum of household demands of flatbread and other wheat products, expressed in wheat equivalents.

4.2 Model Simulation Results

Simulation 1 models the effects of a 300,000 metric ton reduction in wheat imports (essentially undoing the policy of increased food aid imports in 2021), leading to a reduction in overall supply and higher wheat prices for wheat grain, flour, and bread (other than flat bread for which the price is fixed). Simulation 2 shows the impacts of an exogenous 10 percent decrease in household incomes similar to the negative shocks that hit Sudan's economy due to recent political crises and ongoing COVID-19 pandemic shocks. In Simulation 3, we model the effects of an exogenous negative 10 percent wheat productivity

[11] Econometric evidence (Abay et al., forthcoming) suggests that there is a high degree of co-movement (co-integration) of wheat prices across markets in Sudan (though markets in Darfur are less-well integrated with those in the rest of the country). Note that the percentage change in the cost of producing flatbread and the percentage change in the price of the third group of products (other bread and wheat products) differ from the percentage change in the price of wheat / wheat flour because total costs of production of flatbread and other bread include costs of non-wheat inputs, as well.

shock caused by water shortages or pests. Simulation 4 models the effects of a 30 percent increase in the price of flat bread – a policy option designed to reduce the fiscal cost of subsidies. Simulation 5 shows the combined effects of Simulations 1 and 4, a policy that limits the foreign exchange cost of imports and still reduces the magnitude of the flatbread subsidy to some extent.

Simulation 1, the 300,000 ton reduction in wheat imports from 2.1 million tons to 1.8 million tons, results in a decline in the total supply of wheat and a 54.2 percent increase in the market price wheat (Tables 4.2 and 4.3). Higher wheat prices spur a 131.9 percent (100,500 ton) increase in wheat production, however, so that overall wheat supply declines by only 6.9 percent. Consumption of non-flatbread wheat products falls by 27.5 percent, but with flatbread prices fixed, consumption of flatbread actually increases by 1.8 percent, in part due to 5.5 percent higher incomes for the rural non-poor, who are the major wheat producers in the country.

Simulation 1 also sheds light on the effects of the increase in food aid wheat in 2021. Thus, a 300,000 ton increase in imports relative to a base level of imports of 1.8 million tons raises total supply by 7.5 percent (comparing the base level as a percentage of the simulation 1 level), despite a 12.2 percent reduction in domestic wheat production. Prices of wheat grain are 35.1 percent lower. Total wheat consumption of the urban poor and non-poor rises by 3.9 and 6.7 percent, respectively, and flatbread consumption of these groups remains unchanged. Total incomes of rural non-poor households fall by 5.2 percent, however, as lower wheat prices reduce their income from wheat production.

In Simulation 2, the exogenous 10 percent decrease in household incomes leads to a 1.8 percent reduction in demand for wheat and wheat products and an equivalent decline in total supply of 1.9 percent (53,800 tons). Wheat producer prices fall by 22.7 percent and average consumer prices of all wheat products together (including flatbread) fall by 64.7 percent. Lower incomes also lead to a 7.3 percent decline in the consumption of flatbread (equivalent to 140,300 tons of wheat). With total demand for flatbread falling more than total wheat supply (7.3 percent as compared with 1.9 percent), the amount of grain left over for other wheat products actually increases by 11.7 percent.

The negative 10 percent productivity shock on wheat production in Simulation 3 has smaller price effects – a price rise of only 8.7 percent because the yield loss is partially offset by a supply response to higher market prices. Given higher wheat prices, domestic production declines by only 7.7 percent. Moreover, since domestic production is only 25.2 percent of total supply in the 2021 base scenario, total supply falls by only 1.9 percent. Wheat producer prices rise by 8.7 percent, contributing to a 6.5 percent reduction in demand for non-flatbread wheat products.

In Simulation 4, the 30 percent increase in the price of flatbread from 71.4 to 92.8 SDG/kg has a large negative effect on flatbread consumption (which falls by 16.7 percent). Lower flatbread consumption increases the quantity of wheat available for other forms of consumption, however, resulting in a 30.6 percent drop in the producer price of wheat and a 32.3 percent increase in the quantity of non-flatbread wheat products. Wheat production also falls sharply by 10.4 percent, and total supply and demand decline by 2.6 percent.

Table 4.2: Wheat sector outcomes (simulation results)

	Baseline, 2021	Sim 1, lower imports	Sim 2, income shock	Sim 3, production shock	Sim 4, increased flatbread price	Sim 5, lower imports, increased flatbread price
Production, '000 mt	725.0	825.5	671.2	669.1	649.6	717.7
Share of supply	*0.252*	*0.309*	*0.238*	*0.237*	*0.232*	*0.280*
Imports, '000 mt	2,150.0	1,850.0	2,150.0	2,150.0	2,150.0	1,850.0
Share of supply	*0.748*	*0.691*	*0.762*	*0.763*	*0.768*	*0.720*
Supply, '000 mt	2,875.0	2,675.5	2,821.2	2,819.1	2,799.6	2,567.7
Seed, '000 mt	36.6	41.6	33.8	33.7	32.8	36.2
Feed, '000 mt	129.4	120.4	127.0	126.9	126.0	115.5
Food, '000 mt	2,709.1	2513.5	2660.4	2658.5	2640.9	2416.0
Consumption, '000 mt	2,709.1	2,513.5	2,660.4	2,658.5	2,640.9	2,416.0
Grain, Flour, '000 mt	630.4	457.4	704.1	589.7	833.8	646.8
Share of consumption	*0.233*	*0.182*	*0.265*	*0.222*	*0.316*	*0.268*
Flatbread, '000 mt	1,924.8	1,944.5	1,784.5	1,924.9	1,603.7	1,611.4
Share of consumption	*0.711*	*0.774*	*0.671*	*0.724*	*0.607*	*0.667*
Other Bread, '000 mt	153.8	111.6	171.8	143.9	203.5	157.8
Share of consumption	*0.057*	*0.044*	*0.065*	*0.054*	*0.077*	*0.065*
Prices (SDG/kg)						
Grain (producer price)	177.1	273.0	137.0	192.5	122.8	171.2
Percent change relative to baseline	*0.0*	*54.2*	*-22.7*	*8.7*	*-30.6*	*-3.3*
Flatbread	62.5	62.5	62.5	62.5	81.3	81.3
Percent change	*0.0*	*0.0*	*0.0*	*0.0*	*30.0*	*30.0*
Wheat products, average	192.1	111.0	67.8	88.9	69.5	92.7
Percent change	*0.0*	*-42.2*	*-64.7*	*-53.7*	*-63.8*	*-51.8*
Cost of flatbread	260.1	333.6	229.3	271.9	218.5	255.6
Percent change	*0.0*	*28.3*	*-11.8*	*4.5*	*-16.0*	*-1.7*
Flatbread, unit subsidy	197.6	271.1	229.3	271.9	218.2	255.3
Percent change	*0.0*	*37.2*	*16.1*	*37.6*	*10.4*	*29.2*

Source: Model simulations.

Finally, in Simulation 5, wheat imports are reduced by 300,000 tons to approximately match the overall decline in wheat demand resulting from the 30 percent increase in flatbread prices examined in Simulation 4. Given the reduction in both supply and demand, producer prices of wheat are almost unchanged, falling by only 3.3 percent. Disincentive effects on production, likewise, are minimal – production falls by only 1.0 percent. Higher prices of flatbread again lower flatbread consumption (by 16.7 percent). The average price of wheat products rises by 13.7 percent, and total wheat consumption falls by 2.5 percent.

Table 4.3: Household consumption of wheat and wheat products (simulation results), '000 mt

	Baseline, 2021	Sim 1, lower imports	Sim 2, income shock	Sim 3, production shock	Sim 4, increased flatbread price	Sim 5, lower imports, increased flatbread price
Grain, flour	630.4	457.4	704.1	589.7	833.8	646.8
Urban poor	31.8	22.5	35.9	29.7	42.6	32.6
Urban non-poor	196.2	138.7	221.5	183.5	262.9	201.5
Rural poor	41.9	29.9	47.1	39.2	55.9	43.0
Rural non-poor	360.6	266.2	399.6	337.3	472.5	369.6
Flatbread	1,924.8	1,944.5	1,784.5	1,924.9	1,603.7	1,611.4
Urban poor	267.5	267.5	243.7	267.5	212.1	212.1
Urban non-poor	887.4	887.4	823.6	887.4	737.0	737.0
Rural poor	145.0	146.2	134.5	145.0	120.8	121.2
Rural non-poor	625.0	643.5	582.8	625.1	533.8	541.1
Other bread	153.8	111.6	171.8	143.9	203.5	157.8
Urban poor	7.8	5.5	8.8	7.2	10.4	8.0
Urban non-poor	47.9	33.9	54.0	44.8	64.1	49.2
Rural poor	10.2	7.3	11.5	9.6	13.6	10.5
Rural non-poor	88.0	65.0	97.5	82.3	115.3	90.2
Total wheat	2,709.1	2,513.5	2,660.4	2,658.5	2,640.9	2,416.0
Urban poor	307.0	295.4	288.3	304.4	265.0	252.7
Urban non-poor	1,131.4	1,060.0	1,099.1	1,115.6	1,064.0	987.7
Rural poor	197.1	183.5	193.1	193.7	190.3	174.8
Rural non-poor	1,073.6	974.7	1,080.0	1,044.7	1,121.6	1,000.8
Flatbread, as share of total wheat consumption	0.711	0.774	0.671	0.724	0.607	0.667
Urban poor	0.871	0.905	0.845	0.879	0.800	0.839
Urban non-poor	0.784	0.837	0.749	0.795	0.693	0.746
Rural poor	0.735	0.797	0.696	0.748	0.635	0.694
Rural non-poor	0.582	0.660	0.540	0.598	0.476	0.541

Source: Model simulations.

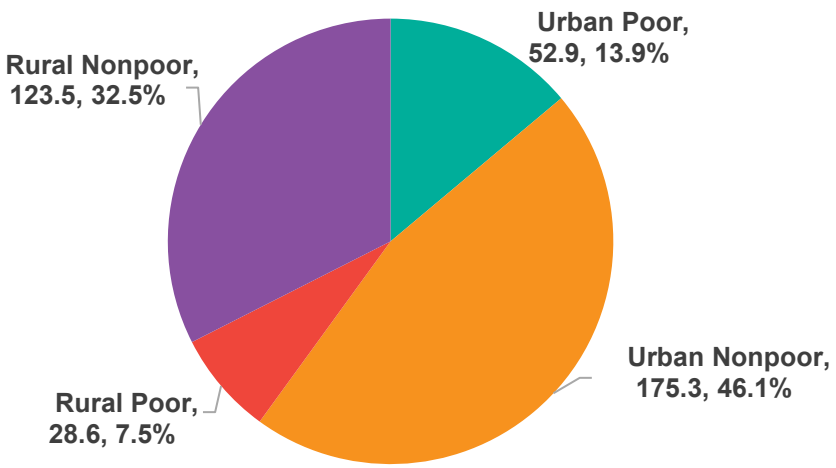
4.3 Magnitude and Incidence of Wheat Subsidies

As discussed above, administratively determined prices of wheat imports, wheat flour, and flatbread, have resulted in price distortions and subsidies in the wheat value chain in Sudan. Ultimately, these policies have a major effect on the market prices of wheat and wheat flour, major elements in determining the cost of flatbread and the total financial subsidy for flatbread, calculated as the estimated cost of producing flatbread minus the sales price of flatbread.[12] In the base data for 2021, the cost of flatbread is estimated to be 260.1 SDG/kg, 188.7 SDG/kg greater than the subsidized sales price of flatbread (71.4 SDG/kg). According to the estimates of 2021 household consumption of wheat products calculated based in part on shares of consumption from the 2009 household survey, the largest shares of the subsidy are captured by the urban and rural non-poor (defined as those in the upper 60 percent of households ranked by per capita expenditure), who receive an estimated 46.1 and 32.5 percent of the total subsidy, respectively. Urban and rural poor households receive an estimated 13.9 and 7.5 percent of the total subsidy, respectively (Figures 4.1 and 4.2).

[12] The economic cost of flatbread could be calculated using an estimated import parity price of wheat instead of the open market wheat price as in the financial subsidy calculation. However, as discussed in Section 2, there was relatively little distortion in the domestic wheat grain price relative to import parity in mid-2021.

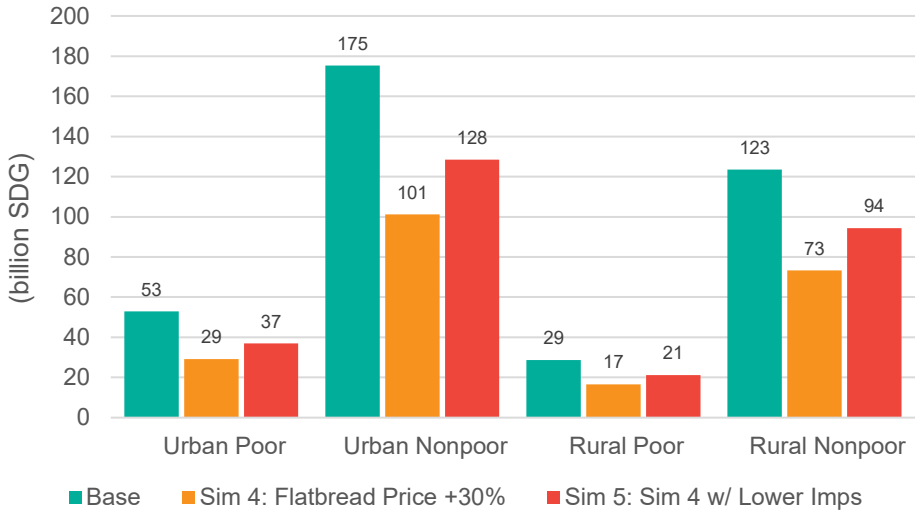
Nonetheless, the estimated subsidy as a share of household income,[13] is far higher for the urban poor (23.5 percent) than for the urban non-poor (8.6 percent) or the rural non-poor (7.8 percent). In per capita terms, annually the urban poor receive subsidies estimated at 18,900 SDG per person, similar to the estimates of 20,800 and 14,600 SDG per person for the urban and rural non-poor (Figure 4.3). According to these estimates, the rural poor receive only 2,700 SDG/person in flatbread subsidies – 12.9 percent of the per capita subsidy received by the urban non-poor.

Figure 4.1: Distribution of flatbread subsidies by household group,, 2021 baseline (model estimates)



Source: Sudan Wheat Model data.
Note: The values in the labels are the value of subsidy in SDG billion and the percentage share of the total subsidy received by the household group.

Figure 4.2: Total value of flatbread subsidies by household group, 2021 (simulation results)



Source: Sudan Wheat Model simulations.

[13] This calculation assumes that real per capita incomes of poor households increased by the same percentage as real GDP/capita between 2009 and 2021. See Annex Table 3.1.

Table 4.4: Flatbread subsidies (simulation results)

	Baseline, 2021	Sim 1, lower imports	Sim 2, income shock	Sim 3, production shock	Sim 4, increased flatbread price	Sim 5, lower imports, increased flatbread price
Flatbread price, SDG/kg	62.5	62.5	62.5	62.5	81.3	81.3
percent change relative to baseline	*0.0*	*0.0*	*0.0*	*0.0*	*30.0*	*30.0*
Cost of flatbread, SDG/kg	260.1	333.6	229.3	271.9	218.5	255.6
percent change	*0.0*	*28.3*	*-11.8*	*4.5*	*-16.0*	*-1.7*
Subsidy on flatbread, SDG/kg	197.6	271.1	166.8	209.4	137.3	174.3
percent change	*0.0*	*37.2*	*-15.6*	*6.0*	*-30.5*	*-11.8*
Value of subsidy, bn SDG						
Urban poor	52.9	72.5	40.7	56.0	29.1	37.0
Urban non-poor	175.3	240.6	137.4	185.9	101.2	128.5
Rural poor	28.6	39.6	22.4	30.4	16.6	21.1
Rural non-poor	123.5	174.4	97.2	130.9	73.3	94.3
Total	380.3	527.1	297.7	403.1	220.2	280.9
'000 USD	*1266.8*	*1755.8*	*991.7*	*1342.8*	*733.3*	*935.7*
Annual value subsidy / person, '000 SDG						
Urban poor	18.9	26.0	14.6	20.1	10.4	13.2
Urban non-poor	20.8	28.5	16.3	22.0	12.0	15.2
Rural poor	2.7	3.7	2.1	2.8	1.5	2.0
Rural non-poor	14.6	20.6	11.5	15.5	8.7	11.1
Total	12.5	17.3	9.8	13.3	7.2	9.2
USD/person	*41.7*	*57.7*	*32.6*	*44.2*	*24.1*	*30.8*
Value of subsidy as share of income						
Urban poor	0.235	0.322	0.200	0.249	0.129	0.164
Urban non-poor	0.086	0.118	0.075	0.092	0.050	0.063
Rural poor	0.038	0.052	0.033	0.040	0.022	0.028
Rural non-poor	0.078	0.104	0.070	0.083	0.048	0.060
Total	0.083	0.112	0.073	0.088	0.048	0.061
Share of subsidy, by household group						
Urban poor	0.139	0.138	0.137	0.139	0.132	0.132
Urban non-poor	0.461	0.456	0.462	0.461	0.460	0.457
Rural poor	0.075	0.075	0.075	0.075	0.075	0.075
Rural non-poor	0.325	0.331	0.327	0.325	0.333	0.336
Total	1.000	1.000	1.000	1.000	1.000	1.000

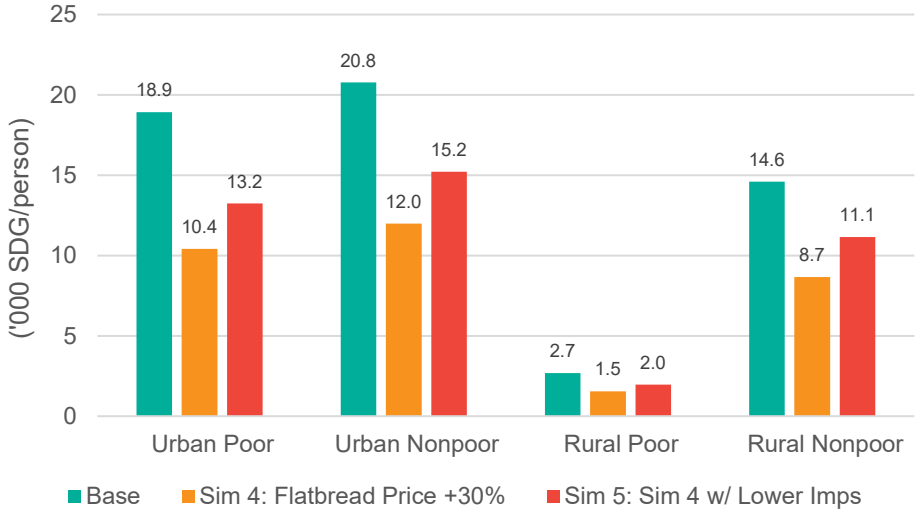
Source: Model simulations.

As shown in Table 4.4, a decrease in imports (Simulation 1) results in a large increase in the financial subsidy because open market wheat prices rise, raising the cost of flatbread. The unit subsidy thus increases by 37.2 percent and the total value of the subsidy across all households rises by 38.6 percent. This is a slightly higher percentage than the percentage gain in the unit subsidy because the quantity of flatbread consumption increases by 1.0 percent in this simulation.

The negative income shock modeled in Simulation 2 reduces the open market price of wheat and thereby lowers the unit subsidy by 15.6 percent. Because the production shock in

Simulation 3 has a relatively small effect on total wheat supply and market prices, the change in the unit subsidy (6.0) is likewise small.

Figure 4.3: Annual per capita flatbread subsidies by household group, 2021 (simulation results)



Source: Sudan Wheat Model simulations.

Increasing the flatbread price (Simulation 4) has a direct impact on the unit subsidy, as well as the more indirect effect through the lowering of the market price of wheat by 30.6 percent and cost of producing flatbread by 16.0 percent. Thus, a 30 percent increase in the price of flatbread leads to a 30.5 percent decrease in the unit subsidy and a 42.1 percent reduction in the total size of the subsidy to 220.2 billion SDG, equivalent to 7,200 SDG/person annually ($24.1/person).

Finally, in Simulation 5, a reduction in the volume of wheat imports combined with the increased flatbread price raises the unit subsidy relative to that in Simulation 4, though it remains 11.8 percent less than in the base simulation. This policy, which saves foreign exchange and reduces fiscal costs, results in a low annual subsidy per person (9,200 SDG/person), but significantly lower wheat consumption (-10.8 percent relative to the base simulation).

5. SUMMARY AND POLICY IMPLICATIONS

For several decades, Sudan has implemented various wheat policies designed to boost production, to enhance food security of poor households, and to stabilize food supply and prices. In addition to major investments in irrigation in the Gezira scheme to increase production of wheat, cotton, and other crops, successive Sudan governments have financed large subsidies along the wheat value chain., In particular, very low official prices of flatbread, which have benefitted urban households more than rural, have, nonetheless, significantly enhanced the food security of urban poor households, which contributed to political stability.

Managing this complex system of interventions requires periodic adjustments in administrative prices and quantities of wheat imports, domestic wheat grain, wheat flour, and flatbread. Moreover, in recent years, substantial macro-inflation has made the task even

more difficult, requiring more frequent changes, not only to prices along the wheat value chain, but also to exchange rates. The liberalization of the foreign exchange market in February 2021 greatly reduced exchange rate distortions at that time. However, as long as there is a fixed administrative price for flatbread, further regular adjustments in the prices along the wheat value chain will be necessary. In any case, greater transparency regarding open market and administratively set prices along the value chain could shed light on the size of the distortions and likely improve the efficiency of wheat and wheat product markets. In this regard, publishing administrative prices on government web sites, along with quantities of grain and flour bought and sold would be a major first step.

The model simulations presented in this paper highlight the substantial instability in market prices built into a system that ensures flatbread supply by bakeries at the official price. Measures designed to enhance profitability of bread production, such as providing supplies of flour at a subsidized price, result in increased instability in the non-controlled market prices of wheat and wheat flour. This price instability in non-controlled markets is especially large in Sudan because wheat used for flatbread production accounts for about 70 percent of total wheat supply and use.

The model simulations also show that increases in government imports of wheat, such as those enabled by food aid, have substantial benefits for consumers by lowering market prices of wheat and wheat flour. At the same time, lower market prices also reduce production incentives for wheat producers. The arguments in favor of consumers in this classic tradeoff, known as the “food policy dilemma” (Timmer 2010), may be even stronger in the future, however, as water shortages and climate change make cultivation of wheat less profitable than alternative higher-value crops, such as vegetables and fruits.

Nonetheless, the available data suggest that there is abundant scope for improving the targeting of flatbread subsidies. Estimates of household consumption of flatbread and other wheat products suggest that over half of the value of wheat subsidies is captured by non-poor households (defined as the upper 60 percent of the per capita expenditure distribution). Replacing some of the flatbread subsidy with cash transfers and better targeting of the subsidy only to poorer households would reduce handling costs and the need to subsidize importers, millers, and bakers along the wheat value chain. In the current high inflation environment, however, any effective cash transfer program would require regular increases in the size of the cash transfer to offset the effects of inflation. Accurate targeting of either cash or in-kind transfer programs would also require updated household survey data – a high priority, not only for understanding wheat markets, but for better informed designs of development and poverty reduction policies and programs.

Making frequent, timely adjustments to cash transfers of the appropriate magnitudes is likely to be administratively difficult, however, so a policy of increased use of cash transfers would likely face substantial opposition from consumers. Nonetheless, gradual steps to reduce the volume of wheat used in subsidized bread, to lower the per unit cost of the flatbread subsidy, and, in parallel, to initiate a targeted cash transfer program that could increase domestic market stability as well as reduce fiscal costs may be feasible.

Finally, it is important to emphasize that there are significant uncertainties in the data and in the many approximations made in estimating levels of wheat consumption in 2021 for this analysis. Thus, the calculations of the impact of subsidies and other simulation results presented in this paper should be interpreted as indicative of the broad magnitudes of the effects, and not as exact figures. Further work is needed to refine the data, parameters, and

equations of the simulation model and to conduct additional sensitivity analyses. In addition to the need for more recent household survey data, econometric estimates of additional demand parameters, including measures of the cross-price effects of prices of other goods on household demand for wheat, would enable investigation of a broader range of shocks. More broadly, a full specification of supply and demand across the agricultural sector in a multi-market model or general equilibrium framework could be used to investigate consequences of various agricultural policies and shock on growth and poverty, as well as on nutritional outcomes.

As shown in this paper, external shocks to the wheat sector and changes in wheat policy have large effects on wheat consumption and household welfare in Sudan. Policies in recent years, such as increased wheat imports, price subsidies in the wheat value chain, and low prices of flatbread, have in general favored consumers, to the detriment of producers. These interventions in the wheat value chain, especially those related to subsidies on flatbread, have especially large effects on the welfare of urban households, making these policies particularly politically sensitive. Moreover, they have entailed high fiscal costs, threatening macro-economic stability and crowding out other possible investments to promote economic growth and poverty reduction. Careful policy analysis and ongoing monitoring of outcomes and new developments will be needed to help guide the important choices ahead.

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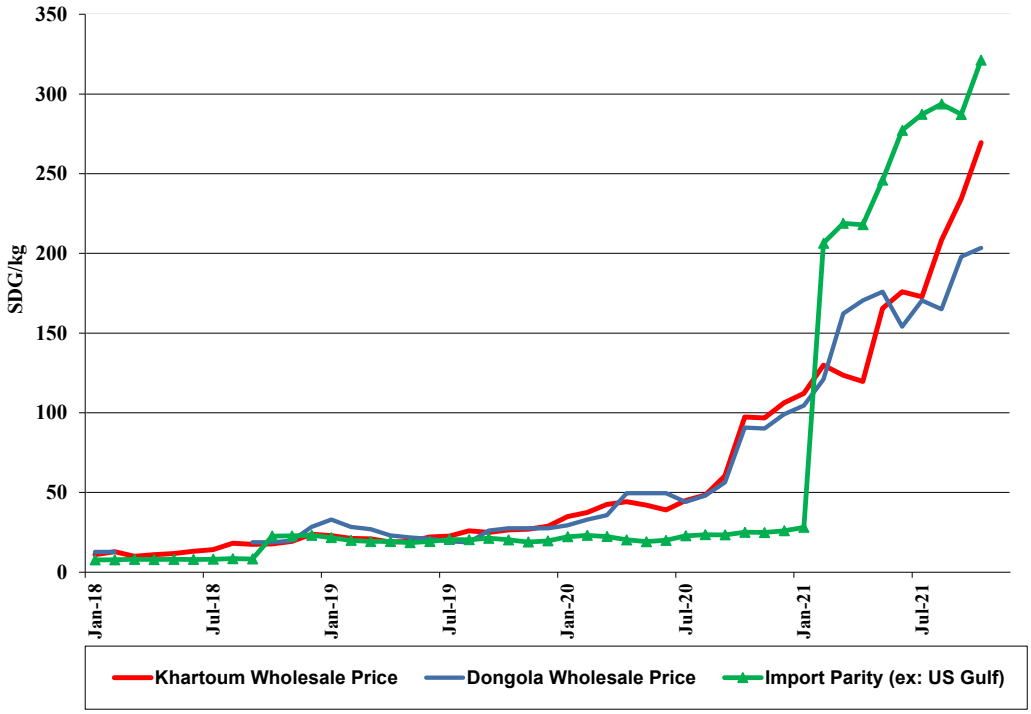
ANNEX

Annex Figure 2.1: Domestic and import parity prices of wheat for Sudan, 2018-2021



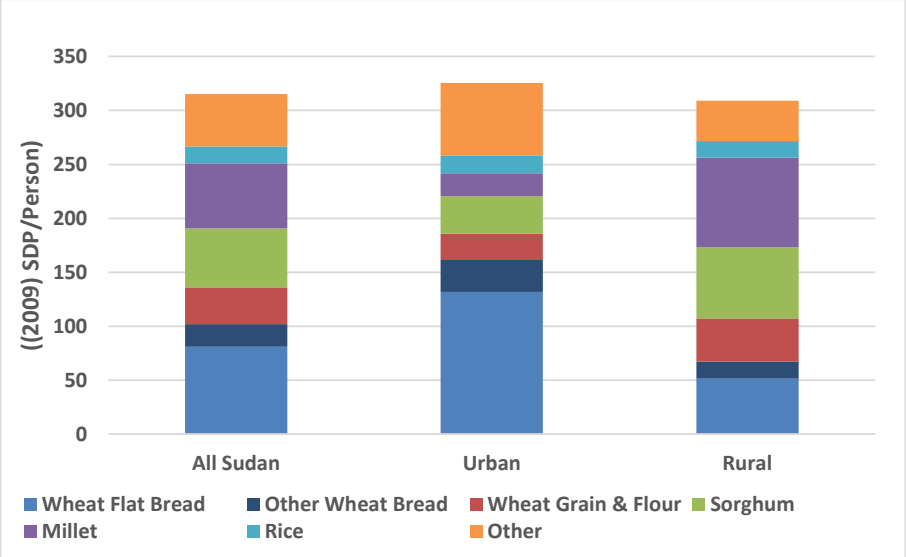
Source: FAO (2021), IMF (2021), World Bank (2021) and authors' calculations.

Annex Table 3.1: Monthly expenditures by household group, 2009

	Population (millions)	Total expend-iture (million SDG)	Total expend-iture per person (SDG/ person)	Food expend-iture per person (SDG/ person)	Cereal expend-iture per person (SDG/ person)	Food budget share	Cereal budget share
Urban Poor	2.79	229.1	82.0	50.1	14.7	0.611	0.179
Urban Non-poor	8.44	2065.0	244.7	141.6	32.2	0.579	0.132
Rural Poor	10.71	765.2	71.4	45.7	12.4	0.640	0.173
Rural Non-poor	8.46	1611.7	190.5	122.6	31.9	0.644	0.167
Total Sudan	30.41	4671.0	153.6	94.1	23.5	0.613	0.153

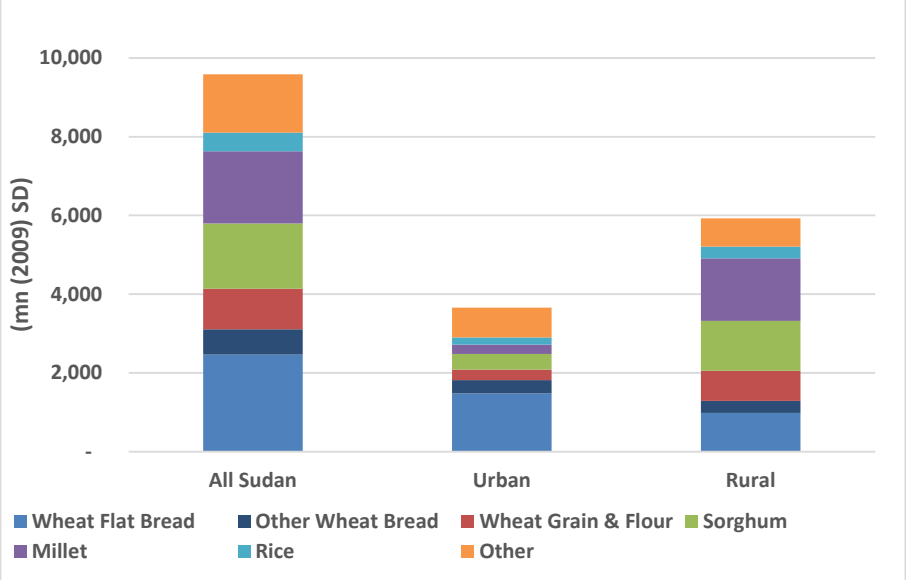
Source: Calculated from NBHS (2009) data.
Notes: Exchange Rate 2009: 2.21 SDG/USD.
GDP/capita 2009: 1,163.8 USD = 97.0 USD/month.
Average Household Total Expenditures per capita = 153.6 SDG/month = 69.5 USD/month.

Annex Figure 3.1: Urban and rural household cereal expenditures per capita, 2009



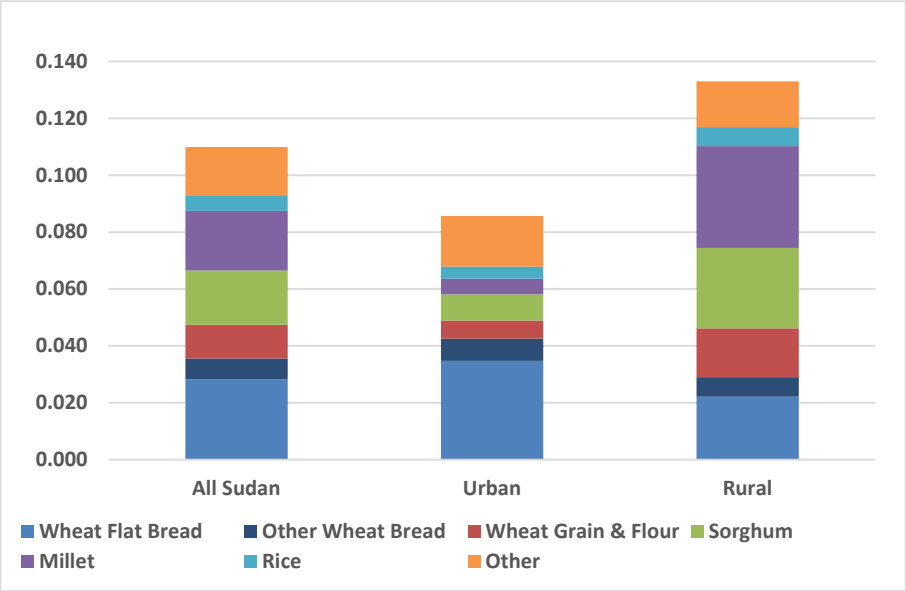
Source: Calculated using data from Sudan NBHS, 2009.

Annex Figure 3.2: Urban and rural household cereal expenditures, 2009



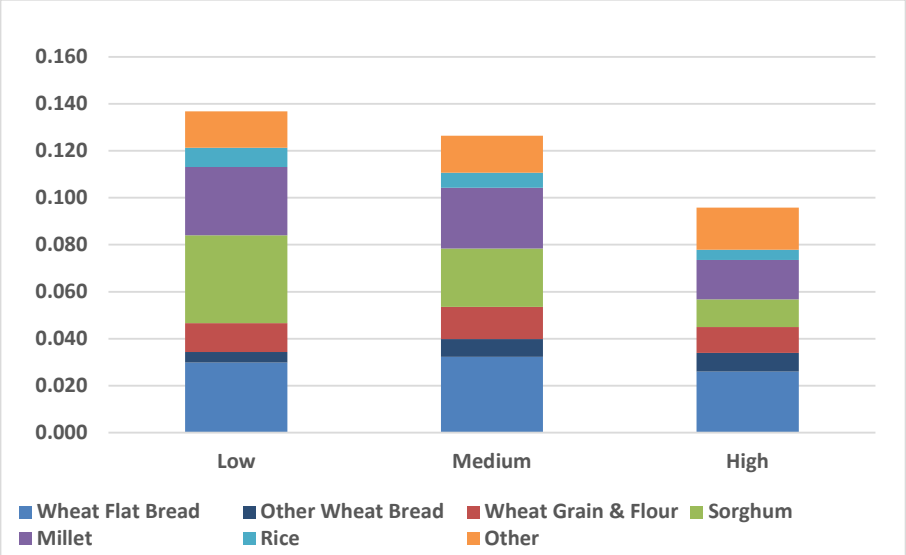
Source: Calculated using data from Sudan NBHS, 2009.
Notes: The Sudan NBHS (2009) data suggests very high millet consumption, mainly in rural areas. Rough calculations of quantity shares suggests that millet consumption is slightly less than sorghum consumption. However, the FAO production data suggests sorghum production and consumption may be at least two times that of millet.

Annex Figure 3.3: Urban and rural household cereal budget shares, 2009



Source: Calculated using data from Sudan NBHS, 2009.

Annex Figure 3.4: Cereal budget shares by household welfare group, 2009



Source: Calculated using data from Sudan NBHS, 2009.

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