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Impact of Ongoing Conflict and Pathways to Recovery in Sudan

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ABSTRACT

In response to the 2023 conflict in Sudan and its extensive socio-economic repercussions, this study investigates the resultant economic, poverty, and undernourishment impacts, using an economywide model for in-depth analysis at national and household levels. The study also seeks to identify effective recovery pathways that can mitigate the adverse impacts of the conflict, with a particular focus on the role of the agricultural sector. Key findings reveal significant economic contractions across all scenarios, with the GDP experiencing a reduction of up to 12% and 18% following estimates by the World Bank and the International Monetary Fund (IMF) for 2023. These estimates are included in an economywide framework, linked to a microsimulation module as major war scenarios, namely, Moderate decline & slow recovery and Sharp decline & rapid recovery, respectively. Poverty rates are projected to increase by 8 and 11.6 percentage points, affecting an additional 2.7 and 3.9 million people in the two scenarios, respectively. Undernourishment is also expected to rise significantly, with an increase of 3.9 and 6.0 percentage points, adding approximately 1.3 and 2.0 million people to those affected in the two scenarios, respectively. The analysis proposes recovery strategies that emphasize agricultural productivity, infrastructure investment, and social protection measures. By simulating enhanced agricultural productivity scenarios, the study suggests that poverty could decrease notably, with potential reductions in the poor population by as much as 1.9 million by 2028. This study underscores the urgency of coordinated policy efforts and international support to mitigate the adverse impacts of the conflict, providing a strategic roadmap for recovery initiatives aimed at sustainable development and stability in Sudan.

Keywords: Sudan conflict, Economywide impact, Recovery strategies, Agricultural productivity, External grants, Poverty and undernourishment.

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1 INTRODUCTION

1.1 Background

Sudan is one of the poorest countries in the world, ranked 172 out of 189 in the UN Human Development Index (HDI) in 2021 (UNDP, 2022). Nearly 22 million people (52.3 percent of the population in 2021) are classified as multidimensionally poor, while an additional 7.4 million people (17.7 percent of the population in 2021) are vulnerable to multidimensional poverty and 31 percent of the population are in sever multidimensional poverty (UNDP, 2022). Poverty is closely entwined with long-running domestic and regional inter-ethnic conflicts. In the assessment of multidimensional poverty, the most significant contributing factor is the standard of living, which accounts for 49.8 percent of overall deprivation. This is followed by education, contributing 29.2 percent, and health at 21.1 percent. These proportions underscore the varied impact of distinct dimensions on the extent of poverty (UNDP, 2023). Ethnic minorities, women, post-conflict communities and under-employed youth are particularly vulnerable groups, often with a history of exclusion and disenfranchisement.

The country's economy is mainly agricultural, based on rainfed crops and livestock production systems that have evolved to suit a hot and, mostly, arid landscape. Productivity levels are low compared with other LICs and East African neighbors. The livestock sector is one of the biggest in Africa, but production is predominately dependent on extensive, traditional pastoral or agro-pastoral systems. The mechanized rainfed sector is concentrated in the center of the country, but most crop farming is not mechanized and has very low productivity. There are large basin irrigation schemes along the Nile and some other river deltas in the northeast of the country, but there is little other irrigation and agriculture is predominantly rainfed. The country's high population growth rate places increasing pressures on the natural resource base, which is itself shrinking due to desertification, and driving urbanization at and accelerating rate.

Negative productivity growth has been a key challenge to achieving inclusive growth and poverty reduction. Productivity growth contracted on average by 3 percent between 2015 and 2019, due to various factors, including (i) poor infrastructure services, coupled with low and inefficient investment; (ii) low labor skills, particularly for youth and women; (iii) trade restrictions and isolation, which have compounded existing constraints to trade and limited growth overall; (vi) high level of informality, with an estimated 60 percent of the labor located in subsistence agriculture or low productivity livestock activities, and around 65 percent of Sudanese prime aged (25-54 years old) workers estimated to be engaged in the informal economy (UNDP, 2020a) ; (vi) external shocks (both global and climatic) as well as ongoing civil disturbances.

The recent conflict which erupted between the Sudanese Armed Forces (SAF) and the Rapid Support Forces (RSF) have exacerbated the economic situation further. Loss of lives, deprivation of assets, and disruption of income sources have occurred due to insecurity, extensive plundering, and property devastation. It started in Khartoum and swiftly spread to other regions, including Darfur and Kordofan. Despite numerous ceasefire declarations for humanitarian corridors, the fighting did not stop and recently extended to Al Gezira state which hosted 8 percent of the IDPs who came from Khartoum. As of December 31, 2023, Sudan, grappling with a severe internal displacement crisis, hosts over 9 million internally displaced persons (IDPs), which includes an estimated 3 million IDPs from before the conflict on April 15 and an additional 6 million due to armed clashes over nine months, representing the largest such crisis globally with about 13 percent of the world's IDPs (DTM Sudan, 2024).

The humanitarian circumstances arising from the armed conflict have reached a critical juncture, marked by substantial impediments in delivering healthcare services on a nationwide scale. This encompasses notable challenges such as the constrained availability of pharmaceuticals, medical resources, electrical power, and water infrastructure. In regions affected by conflict, approximately 70 percent of healthcare establishments exhibit non-functionality or operate at limited capacity, precipitating an overwhelming surge in the demand for healthcare services. Concurrently, there has been a prevalence of disease outbreaks, encompassing conditions such as measles, malaria, and acute flaccid paralysis, as documented by the World Health Organization (WHO, 2023). As of January 16, 2024, there have been reports of over 9,700 suspected cases of cholera, including 269 deaths, indicating a significant public health concern (UN-OCHA, 2024).

The repercussions of the ongoing conflict extend beyond immediate humanitarian concerns to significantly impact agriculture, domestic and external accounts, and the overall trajectory of GDP growth. The interconnectedness of these elements underscores the need for a nuanced comprehension, coupled with the formulation of evidence-based recommendations to guide policy reforms and strategic investments, ultimately fostering inclusive growth and recovery amidst ongoing conflict.

1.2 Observed effects of the ongoing conflict on the economy

The enduring conflict has far-reaching consequences for various sectors of the already struggling Sudanese economy. Armed conflict has exacerbated the deterioration of infrastructure in conflict-affected regions, affecting agricultural, services, and industrial production. Limited market accessibility, lack of security, and rampant looting have disrupted production and storage, impacting both domestic and international trade and causing shortages in various commodities. These unprecedented circumstances have led to a significant rise in food prices and a drastic devaluation of the Sudanese currency (WFP, 2023).

1.2.1 The agricultural sector

The armed conflict in Sudan has profoundly disrupted the agricultural sector, resulting in a considerable decline in production during the summer agricultural season. The repercussions extend to the winter season, with a pronounced impact on cultivation expected due to the war's direct and indirect influences. Key contributors to reduced production encompass scarcities in critical resources such as electricity, fuel, improved seeds, fertilizers, and finance. A survey conducted by Kirui et al. (2023) among smallholder farmers revealed that 44 percent of survivors were unprepared for the planting season, with 40 percent expressing no intention to plant later in the season. The primary reasons cited for not planting included the direct impact of conflict and insecurity (15 percent) and various indirect ramifications such as financial constraints (61 percent), lack of essential resources (13 percent), and unfavorable weather conditions (9 percent) (Kirui et al., 2023a).

Aligned with the anticipated shock to planted areas, a rapid assessment by the Food and Agriculture Organization (FAO) of the United Nations indicated a substantial reduction in cultivated areas, with total planted area declining by 15 percent compared to the previous year. Sorghum and millet, staple crops in the region, witnessed a decline in planted areas of 16 percent and 50 percent, respectively, leading to an estimated production reduction by 24 percent and 50 percent for sorghum and millet, respectively compared to the previous year (FAO, 2023). The livestock market also faced disruptions, primarily along routes throughout the country, impeding the movement of animals and disrupting trade. in addition, the forestry sector, particularly Gum Arabic production in states like Greater Darfur and Kordofan,

experienced a substantial decline in prices by nearly 60 percent, primarily attributed to export challenges resulting from the conflict, leading to reduced incentives for producers (Aljazeera, 2023).

1.2.2 The industrial sector

The industrial landscape of Sudan is concentrated in Khartoum and central states. In 2001, about two-thirds of manufacturing establishments were in Khartoum and a few provincial centers. Key regions contributing to manufacturing, including Khartoum, Gezira, Darfur, and Kordofan, accounted for 66 percent of the total manufacturing establishments (UNDP, 2016). The centralization in Khartoum was attributed to its accessible transportation and energy infrastructure, high population density, and availability of labor and markets. However, the ongoing conflict severely impacted the manufacturing sector, with the designated Minister of Industry reporting a 90 percent destruction of the sector as of December 2023 (EREM NEWS, 2023). Emergency plans involve relocating salvageable factories from Khartoum to secure states (EREM NEWS, 2023). The conflict has particularly disrupted agri-processing firms, leading to temporary or permanent closures of around two-thirds of such enterprises, while others operate at reduced capacities or have relocated to safer areas (Kirui et al., 2023). Critical components of the industrial sector, such as gold mining and oil production, have also been affected. Gold production during the conflict period is estimated at approximately 2 tons monthly, representing a significant decline from the 2021 production of 49.7 tons (SudanAkhbar, 2023b). On the other hand, the impact on oil production has been less pronounced than that on gold. However, satellite images indicate oil leakage at pumping station No. 5 in West White Nile state, suggesting potential disruptions to crude oil production in case of prolonged conflict. The crude oil processing has been adversely affected since the onset of the conflict, primarily due to the Rapid Support Forces' (RSF) control on Eljeili refinery in Khartoum. The situation was further compounded by the destruction of the Eljeili refinery in December 2023, which is expected to result in a prolonged period of recovery for crude oil processing.

1.2.3 The service sector

The service sector has experienced substantial impacts during the initial phase of the conflict, with diverse effects observed across its components. The banking sector, pivotal to the services and overall economy, faced significant shocks, especially given its concentration in Khartoum. Approximately 46 percent of bank branches were in Khartoum as of December 2021, with 61 percent of branches in Khartoum and other conflict-affected regions (CBoS, 2021). The ongoing conflict led to profound disruptions in banking infrastructure and payment systems. The Central Bank of Sudan's systems became inaccessible early in the conflict, hindering electronic payment services. While some banks have restored their systems, the electronic clearance system remains unrecovered, impacting inter-bank money transfers (UNICEF, 2023b). This disruption significantly affected liquidity, hindering the banking sector's capacity to provide finance (STPT, 2023).

The health and education sectors, constituting vital components of services, have also faced significant challenges. Conflict-affected states repurposed health centers and hospitals as military barracks, disrupting health services with 75 percent of health centers in the conflict affected states being closed. Limited availability of medicine, medical supplies, electricity, and fuel further impacted health services across the country. The education sector experienced a complete halt since the war's outbreak, and while attempts were made to reopen schools and universities in October 2023, challenges persisted. Schools in safe states were repurposed as shelters, and connection problems limited possibilities for online learning. In contrast, the transportation, accommodation, and restaurant services witnessed a

significant boom, driven by large-scale displacement from conflict-affected to safe states. The evacuation involved both individuals and products, with the sector thriving amid ongoing conflict. The total displacement of about 8 million people since April 15, 2023, has fueled this boom.

1.2.4 International trade

The ongoing conflict has inflicted significant repercussions on exports, with formidable impediments to the movement of export products from production zones to crucial export hubs, such as Port-Sudan. This difficulty is particularly pronounced for products originating from conflict-affected states. The persistent insecurity has led to severe disruptions in primary transportation routes linking central Sudan to Greater Kordofan and Greater Darfur regions, along with key exportation locations in the east and north of the country. The resultant disruption of routes has not only prolonged journey times but also substantially increased transaction costs for travel (Abushama et al, 2023). For instance, a journey covering 920 kilometers from Kosti to El Fasher took an astonishing eight days, underscoring the logistical challenges exacerbated by the conflict (FEWS NET, 2023). Additionally, the heightened risks of looting, route closures, and the scarcity of fuel have collectively escalated the costs associated with production and transportation. This confluence of challenges is anticipated to impact the competitiveness of Sudanese exports.

According to 2022 statistics, Sudan's export portfolio is comprised of gold (48 percent of exports), agricultural products (33 percent), livestock (15 percent), crude oil and oil products (0.9 percent), processed goods (0.5 percent) and other exports (CBoS, 2022). However, the conflict has precipitated a substantial decline in official gold exports, plummeting from approximately 11 tons, constituting 44 percent of overall exports in September of 2022, to two tons in the corresponding period of 2023 indicating an 80 percent decline (CBoS, 2021; UNICEF, 2023b; SudanAkhbar, 2023c). While agricultural exports are anticipated to decrease due to expected reductions in production and farmers' diminished intent to plant cash crops (Kirui et al., 2023), livestock exports have experienced growth. In 2023, Sudan successfully exported 2.7 million cattle, contributing nearly US$ 500 million in foreign currency a notable increase compared to the revenue generated from livestock exports in 2022 (CBoS, 2022; SudanAkhbar, 2023c).

Moreover, as per a vessel data analysis, crude oil exports have increased significantly, as the volume of shipments loaded at Port-Sudan witnessed a notable surge in May, marking its highest point in nearly two years. The daily load reached 154,839 barrels, signifying a substantial increase in comparison to the 77,419 barrels per day recorded in March 2023 (Energy Voice, 2023). This can be anticipated due to the restricted operation of the crude oil refinery and thus more crude oil must be exported.

On the import side, the conflict has inflicted a detrimental impact on Sudan's imports, forecasting significant reductions propelled by a deteriorating exchange rate, income reductions, foreign exchange shortage, and weakened financial capacity in the banking sector. Challenges such as logistics failure, infrastructure disruptions, and banking payment issues further compound the import predicament. Wheat, a predominantly import commodity, has experienced a substantial reduction in imports during the conflict compared to the previous year, declining from 336 to 359 thousand metric tons and from 550 to 166 thousand metric tons in the second and third quarters in 2023 compared to 2022 (FEWS NET, 2023; CBoS, 2022). The absence of control over cross-border illicit trade is expected to contribute to an upsurge in informal imports, especially from neighboring countries in the east and north of the country like the increase in smuggling during the war in Syria (Daher, 2019).

The pivotal role of agriculture as primary contributors to the economy remains undisputed. Elevations in productivity within the sector has the potential to bring about transformative effects, not only influencing economic expansion but also addressing fundamental challenges such as poverty mitigation, hunger alleviation, and the enhancement of overall dietary standards. Simultaneously, the influence of external grants on economic stability and growth introduces an additional layer of recovery, necessitating a comprehensive assessment of their potential effects on fiscal dynamics, investment patterns, and broader economic recovery.

1.2.5 Remittances

The large-scale internal displacement resulting from the war has profoundly affected over 8 million individuals (DTM, 2024), necessitating a significant reliance on remittances for consumption purposes. The increase in labor costs during the conflict corroborates that displaced individuals are depending on remittances, savings, or assistance for their consumption needs (Kirui et al., 2023; WFP, 2023). Anticipated remittance increases, albeit moderate, are expected due to the economic deterioration and livelihood challenges caused by the conflict. However, the abilities of remittances to increase are further constrained by migrants' characteristics and occupations, with low-skilled migrants not anticipated to make significant contributions (UNDP, 2020b).

1.3 Objectives

The objective of this report is to assess the impact of the changes triggered by the ongoing conflict, while exploring the possibilities of recovery considering increases in agricultural productivity and changes in external grants. The impact of these assessments is measured by means of changes in poverty, undernourishment, and economywide growth indicators. Specifically, the work will draw on IFPRI's RIAPA framework to:

1. Simulate the impacts of the ongoing conflict on economic growth and income distribution across rural and urban population.
2. Assess the differential impacts alternative recovery scenarios including increases in agricultural productivity on poverty, undernourishment and economywide growth, to inform identification and prioritization of areas of reform and investments for inclusive growth, and
3. Simulate changes in external grants and assess their potential impact as part of the recovery pathways for Sudan.

The remainder of the report is organized as follows. Section 2 presents the analytical framework used for the assessment of three objectives. Section 3 describes the simulation scenarios including the development of a counterfactual against which the war and recovery scenarios are compared. Section 4 presents and discusses the results, while section 5 concludes and provide policy recommendations.

2 THE ANALYTICAL FRAMEWORK

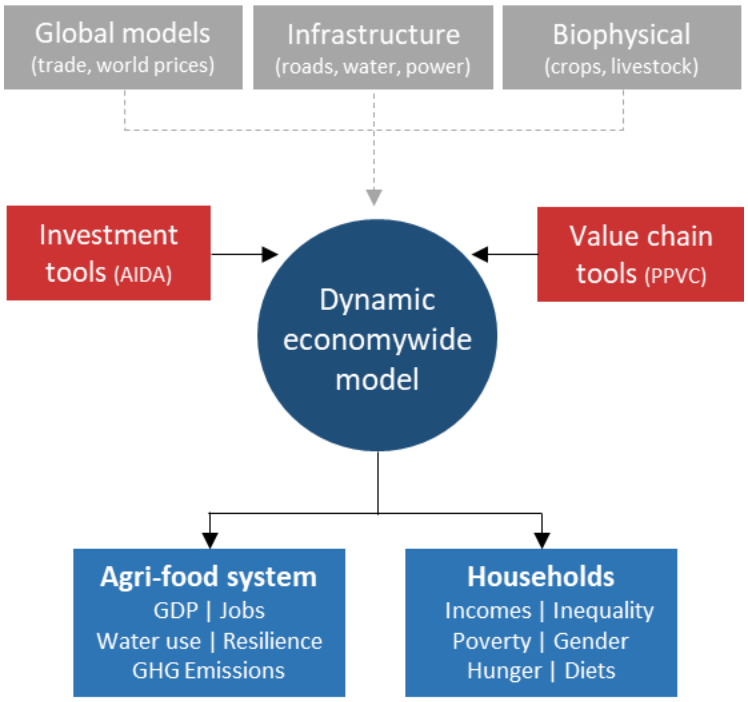
IFPRI's Rural Investment and Policy Analysis (RIAPA) system is used. **RIAPA** is IFPRI's primary tool for economywide analysis. The RIAPA model is an analytical tool used to assess the economy-wide impacts of policies and investments. It is designed to help policymakers understand the trade-offs associated with policy choices in agricultural and rural investment and to better grasp the linkages within the agrifood system (AFS) and between AFS and other sectors of the economy.

The RIAPA model uses detailed representations of the economy depicted within Social Accounting Matrices (SAMs), which enable analysts to measure impacts throughout the AFS and its interconnectedness with the broader economy. This includes analyzing how policies affecting farmers can have spillover effects on input supply, trade, agro-processing, or food service sectors and vice versa. One of RIAPA's key features is its ability to capture macro-micro linkages, which means it can interpret how economy-wide changes will affect individual households and people. This is especially valuable for assessing the implications of various shocks or interventions on poverty, diet quality, and women's inclusion, using survey-based microsimulation models linked to the core computable general equilibrium (CGE) model (Figure 1).

At the center of RIAPA is a Computable General Equilibrium (CGE) model that uses nested production structure, imperfect substitution of traded commodities, and linear expenditure systems of consumer demand. It models consumer and producer behaviors, respectively with utility and profit maximization, adjusting prices for market equilibrium. The dynamic version considers exogenous factors like population growth and urbanization, influencing labor supplies, while sectoral capital accumulation is endogenously determined based on past investments (Diao and Thurlow, 2012).

For this study, the RIAPA model is calibrated to a 2021 SAM for Sudan, providing a detailed breakdown of factors such as capital, labor, and cropland, while allowing for their reallocation across sectors. The model considers the profound impact of international trade on sectoral growth, examining both import competition and export opportunities. In relation to household livelihoods, the RIAPA model recognizes significant variability across regions, distinguishing among representative households. These distinctions are critical for comprehending the dynamics of distributional changes, especially considering variations across locations and endowments. To enhance its accuracy, the model is intricately linked to a microsimulation module, drawing insights from a national household survey.

Figure 1: Modules of the RIAPA modeling system



Source: Authors' configuration based on Diao and Thurlow (2012).

The assumptions shaping the macroeconomic balance in the model are notable, covering the current account, government fiscal balance, and savings/investment accounts. These assumptions, including a fixed exchange rate for maintaining the current account balance, highlight the significance of export-oriented sectors like high-value agriculture. The model adopts a recursive dynamic approach, running simulations for several years. This extended timeframe allows the model to capture the nuanced interplay of exogenous factors, such as demographic shifts and technological changes. Capital accumulation is a key facet, determined endogenously with a focus on the previous period's investment, considering the sectors' current shares of gross operating surplus. In essence, the CGE model stands out for its holistic approach to understanding distributional changes. It achieves this by dissecting growth patterns across sectors and subnational regions, considering the intricate interplay in factor and product markets. This comprehensive perspective, coupled with its explicit definition of the growth–poverty relationship ex ante, enables the model to effectively capture and contrast distributional outcomes associated with economic growth across diverse sectors. More details about the model structure, assumptions and equations are provided in the open access documentation by Diao and Thurlow (2012).

The RIAPA framework incorporates several add-on modules for specifying simulation parameters and adding depth to standard CGE model results. They also track specialized outcome indicators including production and employment outcomes, natural resource use, and greenhouse gas emissions. In addition, various survey-based microsimulation modules are incorporated to track welfare outcomes, including **poverty and inequality**, diet costs and the **ReDD** index, and the **WIST** indicator.

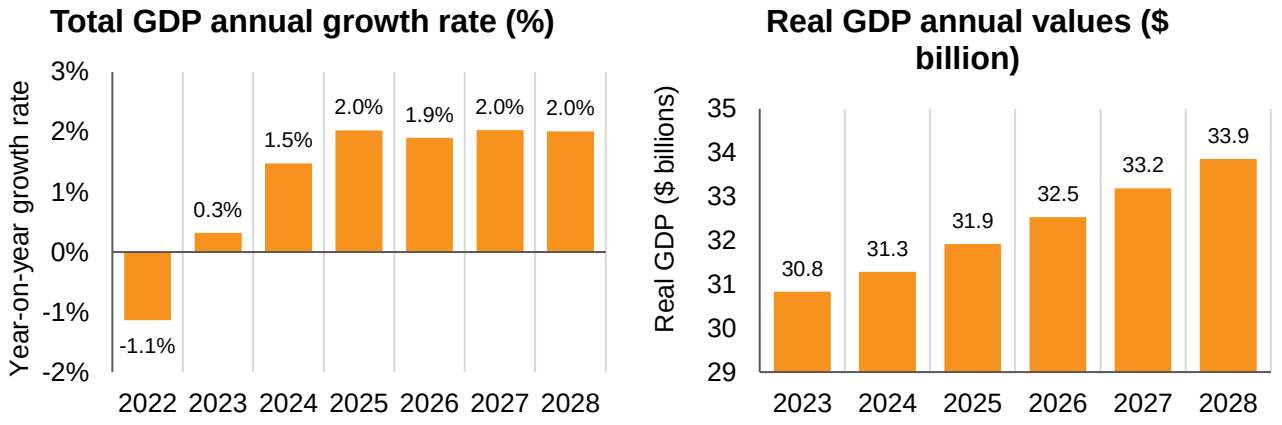
3 DESCRIPTION OF THE SIMULATIONS

This section provides a detailed description of the simulation scenarios depicting the impact of the ongoing conflict as well as providing suggestions for economic recovery via improvements in agricultural productivity and changes to the flow of external grants. The first subsection focusses on the pre-conflict counterfactual (baseline) scenario, which will be used as a benchmark for assessing the impact of the conflict on the economy. Subsequently, the war scenarios are described starting with the World Bank's post-conflict projections (hereafter the Moderate decline & slow recovery scenario) and the International Monetary Fund (IMF) projections, hereafter, Sharp decline & rapid recovery war scenario. Finally, potential recovery scenarios are described including agricultural productivity centered scenarios and external grant centered scenarios.

3.1 Baseline (counterfactual) scenario

Under this scenario, it is assumed that the pre-conflict circumstances continue throughout the period covered (2021-2028). This implies that the April 15th, 2023, conflict had not happened, however, it captures the pre-conflict economic shocks including the October 2021 coup and its implications. We base this on the World Bank's projected GDP growth rates prior to the conflict's onset, as depicted in Figure 2. According to this counterfactual scenario, GDP was expected to grow by an average of 1.6 percent each year between 2023 and 2028. In addition, population and labor force supply was expected to grow by an average of 2.5 percent per year throughout the same period based on the UN (2023) statistic division's projections. In per capita terms, GDP in Sudan was already expected to decline between 2023 and 2028, even before the outbreak of the conflict.

Figure 2: Outlook of Sudan GDP based on World Bank pre-conflict estimates (2022 -2028)



Source: World Bank (2023a).

Public sector statistics are also guided by the World Bank estimates with total public revenues and expenditure as percentage of GDP on average through (2020-2025) amounting to 8.8 percent and 13.2 percent, respectively, and average of general government deficit amounting to 4.3 percent as percentage of GDP on average though the same period (Table 1).

Table 1: Public sector indicators as percentage of GDP (percent, 2020-2025)

Indicators	2020	2021	2022	2023	2024	2025	Average
Expenditures	10.7	10.8	11.7	12.5	13.4	13.7	13.2
Revenues	4.8	10.5	10	10.5	11	11.2	8.8
General government balance	-5.9	-0.3	-1.7	-2.0	-2.4	-2.5	-4.3
General government debt	281.4	215.6	183.6	167.3	157.9	149.5	171.2

Source: World Bank (2023c).

In this hypothetical scenario, projections were formulated shortly before the onset of the conflict, with the World Bank forecasting a 1.1 percent economic contraction in 2022. This projection contrasted with a more pronounced contraction of 1.9 percent in 2021, attributable to the coup, protests, and shut-downs, as well as a hiatus in external inflows that significantly affected both the services and industry sectors. The economic downturn persisted in 2022, albeit to a lesser extent, owing to the sustained interruption in external inflows, elevated taxes and fees, persistent civil disturbances, and logistical disruptions in the business environment.

Anticipated fiscal trends for 2023 reveal a notable disjunction between projected government revenues and expenditures, indicating a complex financial landscape. Despite the expectation of government revenues falling short of the planned figures for 2023, government expenditure is poised to surpass both the initially envisaged expenditure for the same year and the actual expenditure recorded in 2022 (Table 3).

Table 2: Fiscal sector forecast 2019-2025 (percent of GDP)

Indicators	2020	2021	2022	2023	2024	2025
Overall Balance	-5.9	-0.3	-1.7	-3.5	-3.0	-2.6
Primary Balance	-5.9	-0.3	-1.4	-3.5	-2.9	-2.5
Total Revenues and Grants	4.8	10.5	10.0	5.1	6.0	6.8
Tax Revenues	3.8	4.8	5.8	3.4	3.6	4.0
Taxes on Goods and Services	2.6	3.4	3.7	1.6	1.5	1.8
Direct Taxes	0.7	0.7	1.2	0.6	0.6	0.6
Taxes on International Trade	0.5	0.6	0.9	0.5	0.7	0.7
Other Taxes	0.0	0.0	0.0	0.7	0.8	0.8
Non-Tax Revenues	0.8	4.6	4.2	1.5	2.2	2.6
Grants	0.2	1.1	0.1	0.0	0.0	0.0
Expenditures	10.7	10.8	11.7	8.6	9.0	9.4
Current Expenditures	9.9	9.5	11.0	8.2	9.2	9.0
Wages and Compensation	2.9	2.2	3.5	3.2	3.7	3.5
Goods and Services	0.7	1.5	2.5	2.2	2.6	2.4

Indicators	2020	2021	2022	2023	2024	2025
Interest Payments	0.0	0.0	0.3	0.0	0.1	0.1
Current Transfers	6.3	5.8	4.8	2.8	2.8	3.0
Social Assistance	4.8	4.2	2.9	1.6	2.0	2.3
Other Current Transfers	1.5	1.6	1.9	1.2	0.8	0.7
Capital Expenditures	0.1	0.6	0.4	0.2	0.2	0.2

Source: World Bank (2023c)

3.2 Ongoing conflict scenarios

The purpose of these scenarios is to simulate the impacts of the current conflict on the economy governed by initial projections of the changes at the overall GDP and supported by detailed information depicting the changes in the domestic and external accounts at the detailed sectoral level. Two magnitudes of the war impact at the overall GDP level are considered including estimates by the World Bank and the IMF. There are two other larger estimates of GDP decline in 2023 suggested by the International Food Policy Research Institute (IFPRI) and Sudan's Ministry of Finance and Economic Planning (MoFEP), which are not considered in this report (see Siddig et al., 2023; AsharqNewsSUD, 2023 for more details about them). Considering the World Bank and IMF estimates, the focus of this study is on the repercussions of such a decline on income levels and household consumption as well as the prevalence of poverty and undernourishment. These implications can be used as proxy of income, poverty and undernourishment impacts of larger or smaller estimates of GDP contractions in 2023.

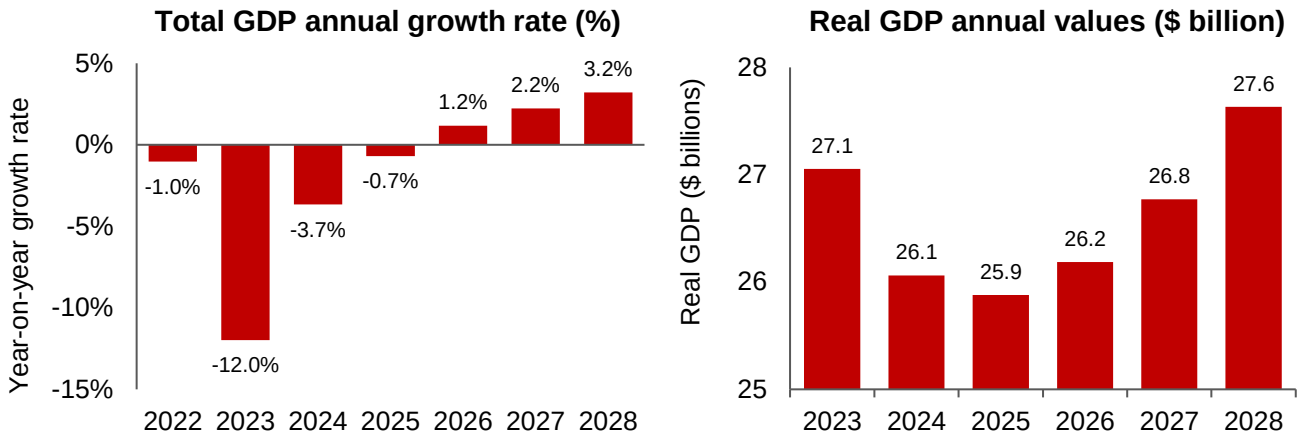
In the remining parts of this study, reference to the two estimates (scenarios) will be made as follows: the "**Moderate decline & slow recovery**" scenario is the scenario referring to the World Bank estimates and the "**Sharp decline & swift recovery**" scenario referring to the IMF estimates. These scenarios diverge primarily because of their different views on the inflow of resources during the war and the economic weight of the Khartoum state. The IMF suggests that Khartoum contributes about 60 percent to the national GDP, while the World Bank estimates it to be between 35 percent and 40 percent. The World Bank also factors in the resilience of a significant informal sector, which could soften the blow of GDP contraction. The adaptability of this sector could also lessen the severity of the economic downturn. Additionally, the private sector's experience in coping with past crises suggests it has already started adapting to current challenges. Observations indicate that businesses have moved to areas of the country less affected by the conflict, allowing them to continue operations. This movement reflects the private sector's resilience amidst conflict, providing a more complex and potentially less dire economic outlook.

3.2.1 Moderate decline and slow recovery scenario (lower contraction in 2023 and slower recovery afterwards)

In this scenario, the World Bank post conflict projections are compared to those in the baseline (pre-conflict projections). These estimates suggest a decline in Sudan's GDP by 12 percent (Ezemenari et al., 2023). In 2023, an anticipated substantial contraction in economic output underscores a pronounced economic downturn, attributable to the prevailing war. While the economic contraction in 2024 and 2025 is less severe, registering -3.7 and -0.7 percent, respectively, it signifies a continued decline,

albeit at a mitigated pace (Figure 3). The subsequent year, 2026, witnesses a modest recovery, denoted by a GDP growth of 1.2 percent, which increases to 2.2 and 2.3 percent in 2027 and 2028, respectively. This positive trajectory hints at a potential security stabilization and improvement in economic conditions.

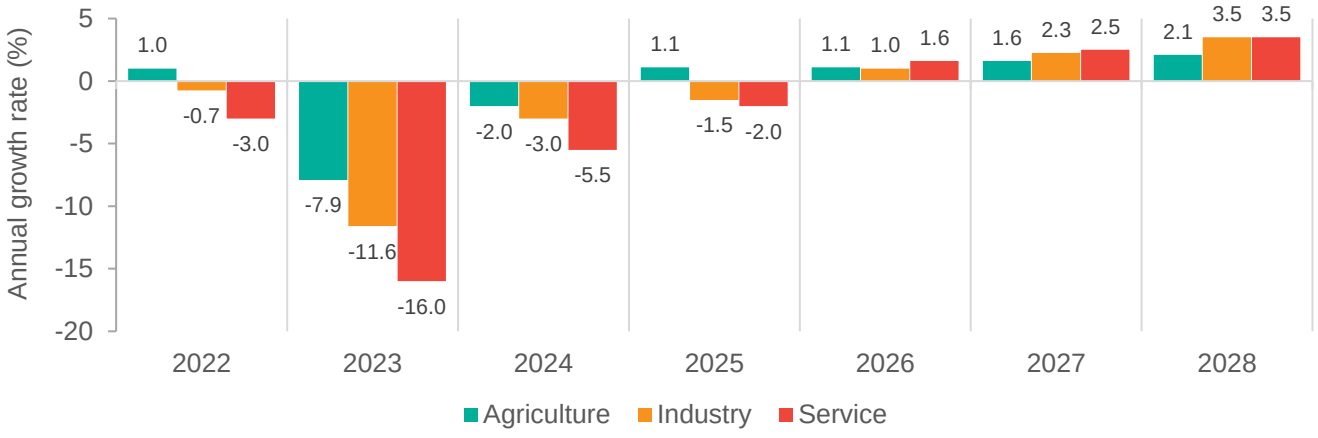
Figure 3: Annual real GDP growth rates (2022 -2028) and values (2020-2028) in the Moderate decline & slow recovery war scenario



Source: World Bank (2023b).

In 2023, a substantial contraction of -7.9 percent is anticipated in the agriculture sector, signaling significant challenges that may impact productivity due to the conflict. This contraction moderates in 2024 to -2 percent before the sector makes a remarkable turnaround as projected for 2025, where agriculture is expected not only to rebound but to achieve growth at 1.1 percent. This positive momentum is forecasted to continue between 2026 and 2028, with the sector expected to register a further growth of 1.1, 1.6 and 2.1 percent in the three years respectively. These growth projections between 2025 and 2028 suggest a robust recovery and potential stabilization in the agriculture sector, demonstrating its resilience and adaptability (Figure 4).

Figure 4: Annual GDP growth rates for agriculture, industry, and service (2022 -2028) in the Moderate decline & slow recovery scenario



Source: World Bank (2023c).

On a different trajectory, the industry sector is expected to face a more prolonged recovery. In 2023, it is projected to witness a substantial contraction of -11.6 percent, indicating the severity of challenges affecting industrial activities. Although the pace of contraction is expected to lesser in 2024 and 2025 with a decline of -3.0 and -1.5 percent, respectively, the sector is anticipated to fully emerge from negative growth only in 2026, posting a growth rate of 1 percent to be followed by subsequent growth rates of 2.3 percent and 3.5 percent, respectively in 2027 and 2028. The expected delayed recovery in the industry sector suggests lingering challenges or structural adjustments necessary for a comprehensive rebound. Meanwhile, the services sector, which is projected to contract with a growth rate of -16 percent in 2023, is expected to experience a relatively slower recovery. By 2024, the contraction is anticipated to lessen to -5.5 percent, and by 2025, the sector is projected to further improve with a contraction of only -2 percent. The recovery for the service sector is first achieved in 2026 with a growth rate of 1.6 percent, which will be followed by 2.5 percent and 3.5 percent growth in 2027 and 2028, respectively.

In this envisaged scenario, it is posited that the conflict persists until 2024, concluding in the early months of the year. However, the interruption in donor financing, extending well into 2024, ensues due to the necessity for an extended period to negotiate agreements among various stakeholders and establish a new government, compounded by the gradual pace of reform implementation. This projection presupposes the continuation of negotiations, akin to the pre-coup era, resulting in a prolonged delay in the establishment of a civilian government due to the time required for consensus-building.

These dynamics are anticipated to impede the pace of recovery. The Moderate decline and slow recovery war scenario envisages a more measured and gradual recovery during this transitional phase, attributing the deceleration to challenges in coordination and absorption capacity. Furthermore, the scenario postulates the persistence of the war into the early part of 2024, albeit remaining localized. In this context, economic centers are assumed to manage to function to some extent despite the ongoing conflict.

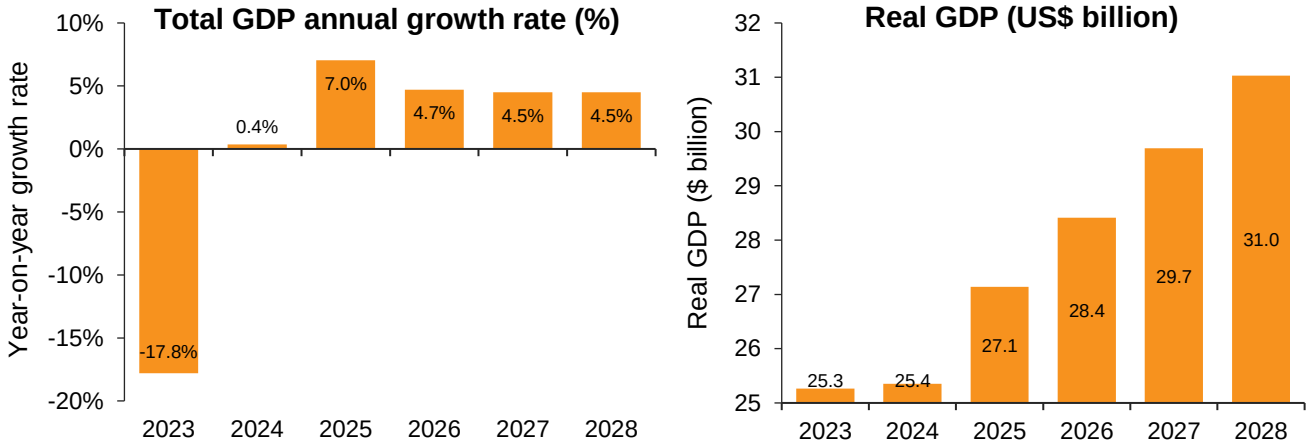
3.2.2 Sharp decline and rapid recovery scenario (deeper contraction in 2023 but faster recovery afterwards)

The Sharp decline & rapid recovery war scenario delineates a trajectory of accelerated recovery, distinctively contrasting with the Moderate decline & slow recovery war scenario. Nevertheless, it is premised on the assumption that the initial repercussions of the conflict exert a more pronounced influence on the GDP in 2023. The scenario posits a swift consensus and the establishment of a transitional government, thereby expediting reengagement. This rapid reengagement is envisioned to instill heightened confidence among development partners, consequently eliciting increased external inflows, both from the public and private sectors. This heightened support is anticipated to underpin a comparably robust resurgence and growth. Furthermore, the scenario assumes the cessation of hostilities at the onset of 2024.

According to the Sharp decline & rapid recovery scenario, the GDP is anticipated to undergo a significant contraction of -18 percent in 2023. However, a positive shift is expected in 2024 with a modest growth of 0.3 percent, and this upward trajectory is projected to strengthen further in 2025 with a substantial growth of 7.0 percent followed by 4.7, and 4.5 percent in the subsequent years. Looking at the GDP in current prices, the values stand at US$ 25.3 billion in 2023, US$ 25.4 billion in 2024, and US$

27.1 billion in 2025. In essence, while 2023 indicates a considerable economic decline, subsequent years forecast a positive trend, particularly highlighted by notable growth in 2025 which shows a faster recovery compared to the Moderate decline & slow recovery scenario (Figure 5 in comparison to Figure 3).

Figure 5: Annual real GDP growth rates and values (2023-2028) in the Sharp decline & rapid recovery Scenario



Source: IMF-WEO (2023).

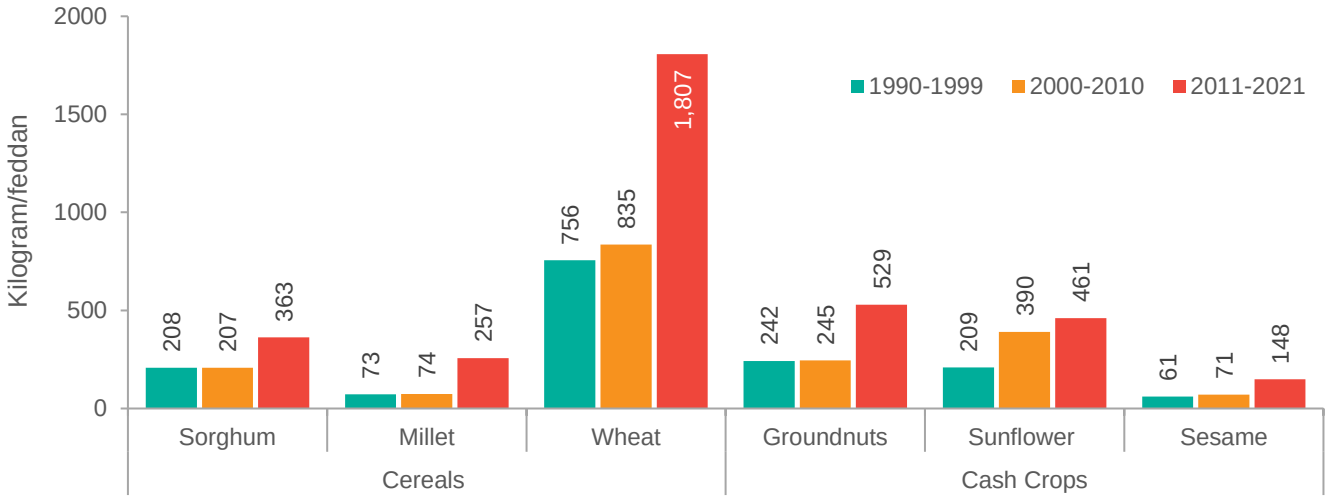
3.3 Accelerated recovery scenarios

3.3.1 Agricultural productivity bounce-back

Agriculture plays a central role in Sudan's economy, serving as its backbone and holding crucial importance in terms of contribution to GDP, employment, and livelihoods as well as the food security. During the last decade, its contribution to GDP was second after the services sector, amounting to 26.1 percent in 2021, while services sector contributed 51.7 percent (CBoS, 2021). Nevertheless, the agricultural sector contributes significantly to employment as 47.4 percent of labor work in the sector (PRSP, 2021). And it also stands as the primary employer of skilled labor, with approximately 36 percent of them engaged in agriculture, in contrast to 11 percent employed in the services sector (Elbadawi et al., 2023).

Sudan's agricultural landscape encompasses three distinct crop production systems: irrigated, mechanized rainfed, and traditional rainfed farming systems. Approximately, 88 percent of the national cultivated area is dedicated to dryland farming, contributing significantly, around 75 percent, to the production of national food grains with two-thirds of the population engaging in or rely on dryland farming as the main source of economic activity (Elbadawi et al., 2022). However, Sudan’s agriculture is characterized by low land and labor productivity. Although the agricultural productivity of crops has increased during the past three decades (Figure 6), yet it is far below productivity of peer countries (Elbadawi et al., 2023; Alhelo et al., 2023).

Figure 6: Crop productivity (kilograms/feddan) by decade (1990–2021)



Source: Alhelo et al. (2023).

A pivotal factor contributing to low agricultural productivity in Sudan is the underutilization of key inputs crucial for enhancing productivity, notably the insufficient application of fertilizers and improved seeds. This issue is compounded by a lack of education and training in contemporary agricultural practices, hindering the adoption of efficient techniques (Alhelo et al., 2023). Moreover, inadequate investment in agricultural research and development restricts the availability of advanced crop varieties and technologies that can bolster productivity. The sector is further challenged by the impact of climate change and unpredictable weather patterns, resulting in adverse effects on crop yields and subsequent reductions in productivity. Limited access to credit and financial services poses a significant constraint, impeding farmers' capacity to invest in modern technologies and improve overall farming practices. Additionally, inappropriate pricing policies, exemplified by subsidies or price controls, introduce distortions to market signals, leading to inefficiencies in resource allocation within the agricultural sector. Addressing these multifaceted challenges necessitates comprehensive interventions, encompassing increased education, targeted research and development, climate-resilient strategies, enhanced financial access, and nuanced pricing policies tailored to optimize agricultural productivity in the Sudanese context.

In addition to that, forests and livestock sectors in Sudan contribute significantly to the broad agricultural sector, employment, and international trade. Sudan's position as the world's leading producer of raw gum Arabic, accounting for over 80 percent of global production, is integral not only to its agricultural sector but also to its economic resilience and environmental sustainability. This vital commodity, primarily harvested from Acacia senegal and Acacia seyal trees, forms the backbone of livelihoods within the expansive "gum Arabic belt." This area stretches over 520,000 km² and includes some of the poorest regions of Sudan, supporting a significant portion of the population and livestock. Gum Arabic is pivotal due to its extensive use across diverse industries, such as food, pharmaceuticals, cosmetics, and textiles, making it essential for Sudan's integration into global markets (World Bank, 2020).

The production of gum Arabic in Sudan has shown promising growth, it amounted to 77.3 thousands ton in 2021 compared to 57 thousands ton in 2020 (CBoS, 2021). Despite these gains, the sector faces multiple challenges such as outdated harvesting and processing technologies, inadequate extension services, and limited research and development funding (World Bank, 2020).

With Sudan being home to one of the largest livestock populations in Africa, and recent statistics show a modest increase from 109.9 million heads in 2020 to 110.5 million in 2021 (CBoS, 2021), livestock is a vital component of Sudan's economy. Nomadic pastoralism is the primary method used for livestock production in Sudan, characterized by the extensive movement of livestock across vast natural rangelands. This system, while dominant due to the abundance of rangelands, results in lower productivity as the constant movement yields more muscular and less fattened animals, consequently affecting meat quality (World Bank, 2020). Sudan's livestock sector, despite its vast potential, faces significant productivity challenges that stem from a combination of infrastructural deficiencies, outdated practices, and limited access to resources. The dominant system of nomadic pastoralism, while culturally integral, has constrained productivity growth due to reliance on traditional methods and local breeds that do not yield high outputs. Additionally, the degradation of rangelands has led to frequent conflicts over land and has blocked crucial animal migration routes, further exacerbating the situation. The lack of quality feed, compounded by insufficient veterinary services and a shortage of skilled labor due to the migration of qualified personnel seeking better opportunities in other location within the country and abroad, severely impacts livestock health and productivity. Moreover, systematic information necessary for strategic planning and development is scarce, hindering effective management and growth of the sector (World Bank, 2020).

Sudan is recognized as one of the countries that are most susceptible to climate change and its variable impacts. Recent decades have witnessed a marked increase in the frequency of droughts along with significant rainfall variability, exerting considerable pressure on the country's rainfed agricultural and pastoralist systems (Siddig et al., 2020). The country contends with specific climatic challenges including elevated temperatures, escalated water demand, and constrained land and water resources. These factors collectively pose substantial risks to the agricultural sector's stability and the broader food systems, threatening their sustainability. The variability and extremity in weather patterns, such as irregular rainfall and more frequent droughts, directly impact crop yields and the reliability of agricultural outputs. This instability leads to significant economic repercussions, as fluctuations in agricultural productivity can disrupt food markets as well as livelihoods (Siddig et al., 2020). The goal of this scenario is assessing the impacts of recovering all conflict-driven agricultural yield losses by 2026 on poverty, hunger, diet quality, jobs and economywide growth, to inform identification and prioritization of areas of reform and investments for inclusive growth. IFPRI's Sudan SAM covers 19 primary agricultural sectors or commodities. The scenario examines the role of enhanced productivity in the agricultural sector's recovery process. It acknowledges that widespread underutilization and destruction of capital have impacted all sectors due to the conflict. However, the agricultural sector is expected to exhibit relatively less damage in terms of its land and capital resources, attributed to the predominantly urban nature of the conflict. This differential impact highlights the potential resilience and quicker recovery of agriculture compared to other sectors, underscoring its critical role in post-conflict economic regeneration.

Drawing insights from countries like Syria and Yemen, the recovery process in the vital economic sectors is expected to be gradual, emphasizing the complex challenges caused by conflict in the different sectors. However, based on the impact of the war in comparator countries, the agricultural sector is the most resilient sector in face of conflict (Figure A1). In Sudan, the agricultural sector has a great potential in leading recovery after conflict.

In the context of the Moderate decline & slow recovery scenario, agriculture emerges as a key player in driving recovery. Despite experiencing a significant contraction of 7.9 percent in 2023, the agriculture

sector shows remarkable resilience, rebounding with growth of 0.9 percent in 2024 and further expanding by 1.1 percent in 2025. This recovery is attributed to the sector's ability to adapt, implement reforms, and benefit from improved conditions post-conflict.

On the other hand, the industrial sector faces a more prolonged recovery, with a substantial contraction of -11.6 percent in 2023. Although the pace of contraction moderates to -0.4 percent in 2024, the sector only fully emerges from negative growth in 2025, posting a growth rate of 1 percent. This slower recovery indicates persistent challenges within the industrial sector due to the distortions in factories which were highly centralized in Khartoum state, the epicenter of the fighting.

However, according to the Moderate decline & slow recovery scenario, the services sector experiences a more protracted recovery compared to agriculture and industry. Despite significant contractions of -16 percent in 2023, -2.3 percent in 2024, and -1.6 percent in 2025, this sector lags in bouncing back. Displacement, migration, and the severe impact on banking, health, and education services contribute to the prolonged recovery of the services sector. The damage to critical infrastructure (such as the 2 bridges which were destroyed in Khartoum), including communication networks, airports, and business services, further impedes the quick restoration of normalcy.

In an alternative scenario geared toward faster recovery, such as the Sharp decline and rapid recovery war scenario, the emphasis lies in the country's swift mobilization of resources, including bilateral assistance, domestic mobilization, and foreign investments. These elements play a critical role in extensive rebuilding efforts and the overall promotion of recovery. The speedy resolution of the conflict and the establishment of a stable government are central components, necessitating efficient collaboration among stakeholders, encompassing both military and civilian entities, to facilitate swift decision-making. The formation of a transitional government is imperative for instilling confidence and expediting critical reforms. The overarching objective is to prompt international re-engagement swiftly, attracting substantial financial support and investments. Timely rehabilitation of infrastructure and vital sectors, coupled with comprehensive revitalization of businesses, serves to mitigate the adverse impacts of the conflict. Effective governance, complemented by transparent regulations, becomes instrumental in attracting investments and fostering sustained economic growth.

3.3.2 External grants scenarios

After the transformative events of the 2018 revolution and the termination of Omar al-Bashir's three-decade’s rule, the establishment of a transitional government marked a pivotal phase in Sudan's engagement with the international community. The year 2020 saw notable developments, including Sudan's removal from the United States’ list of State Sponsors of Terrorism (SSTL) in December and the clearance of arrears to the World Bank and African Development Bank (AfDB) in March and May 2020, respectively. A pivotal development occurred on May 17, 2020, when a development partner conference in Paris aimed to promote international investment in Sudan (IMF, 2021a).

In response to the need for economic stabilization and the laying of foundations for sustainable inclusive growth, the transitional government (TG) formulated a home-grown reform program. This initiative, supported by the IMF, materialized through a request for a Staff-Monitored Program (SMP) in June 2020. The reforms encompassed measures to stabilize the economy, shift from fuel subsidization to a market-oriented economy, and introduce direct social assistance, exemplified by the Sudan Family Support Program, with a primary aim of reducing poverty. Fiscal, public financial management, and monetary and exchange rate reforms were integral components of these efforts.

By the second review of the SMP in June 2021, the TG demonstrated satisfactory implementation of the benchmarks, making it eligible for an upper credit tranche with the IMF and establishing a commendable track record of economic reforms. A Poverty Reduction Strategy Paper (PRSP) was concurrently developed, paving the way for Sudan's entry into the Heavily Indebted Poor Countries (HIPC) decision point. Subsequently, the TG sought a 39-month arrangement under the Extended Credit Facility, aligning its goals with the pursuit of the HIPC Completion Point and the framework for inclusive growth outlined in the PRSP.

Building on the outlined developments, it is crucial to underscore that, creditors representing an impressive 76 percent of the net present value (NPV) of eligible debt, have affirmed their commitment to providing their allocated portion of debt relief under the HIPC Initiative (IMF, 2021c). Moreover, in conjunction with the successful clearance of arrears, Sudan became eligible to access an estimated US$ 2 billion in International Development Association (IDA) financing (IMF, 2021b). These designated funds are poised to play a pivotal role in supporting policy reforms and initiatives directed at fostering entrepreneurship among women and youth, enhancing critical road infrastructure, expanding electricity accessibility, and contributing to investments in key sectors such as agriculture, water supply, natural resource management, human capital, and support for displaced populations (IMF, 2021b).

Despite these positive developments, a significant setback occurred three months after reaching the HIPC decision point with a military takeover on October 25, 2021. This event led to the freezing of all negotiations between international financial institutions (IFIs) and the military government regarding HIPC and associated development assistance. Nevertheless, before the conflict, efforts persisted to reach a political agreement that would restore civilian governance, with the potentially reigniting discussions about HIPC and the development grants the Sudanese transitional government could receive. Therefore, stopping the war and formulating a civilian transitional government might be associated with a resume of negotiations regarding the suspended development grants.

This hypothetical scenario explores the different impacts of external grants in a context where the political landscape shifts towards reconciliation and a civilian-led government. The scenario is analyzed through three distinct approaches: first, by evaluating the impact when these grants are predominantly invested in rehabilitation, infrastructure development, and essential services such as electricity and water supply; second, by considering the grants being primarily allocated to social protection, especially cash transfers, as an extension of the Family Support Program initiated during the transitional government; and third, by examining the outcome when grants are distributed between social protection and infrastructural investment. Each approach offers insights into how external financial support can be strategically utilized in different sectors to support the nation's development and recovery.

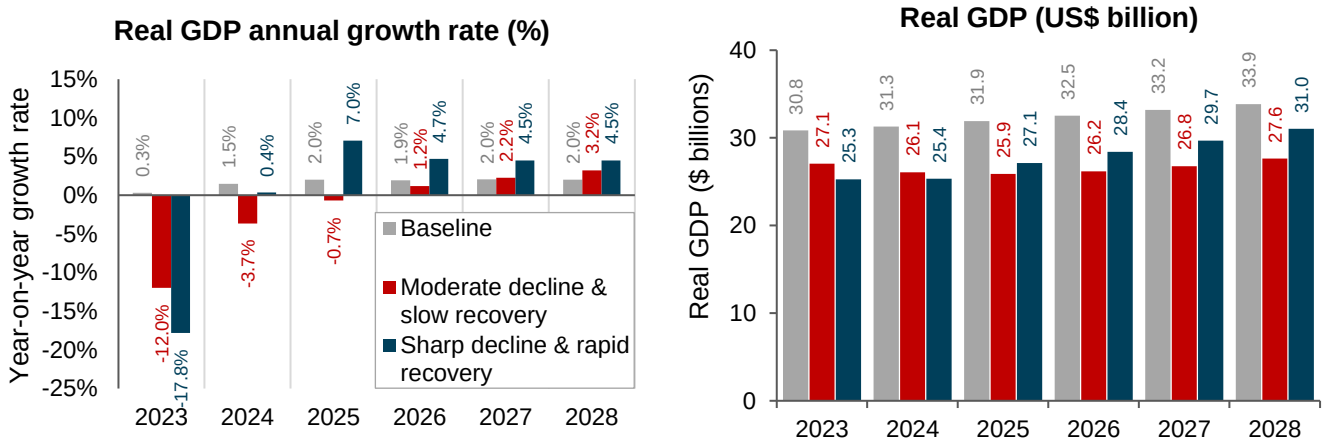
4 RESULTS AND DISCUSSION

4.1 Impact of the conflict on economic growth

The trajectory of Sudan's economic growth, as depicted in Figure 7, illustrates the profound impact of conflict on national economic performance. The baseline scenario, which represents the anticipated growth pattern in the absence of conflict, indicates modest yet positive growth rates leading into 2023. This scenario was abruptly upended by the advent of war on April 15, 2023, necessitating a recalibration of expectations by the World Bank and the IMF labeled as "Moderate decline & slow recovery" and "Sharp decline & rapid recovery" scenarios, respectively.

In 2023, the baseline scenario predicted a real GDP growth of 0.3 percent, which was quickly negated by a marked contraction, as represented by the World Bank's estimate of a 12.0 percent decrease and the IMF's more dire prediction of a 17.8 percent reduction in growth. This contraction far exceeds the anticipated growth and is indicative of the immediate economic shock induced by the conflict. The data for 2024 demonstrates a continuation of economic decline, with the GDP value falling significantly short of the baseline projection of 31.3 billion US dollars to reach only 25.3 billion according to the World Bank and 26.1 billion as per IMF estimations. This discrepancy highlights the enduring impact of the conflict and the challenges to economic recovery.

Figure 7: Simulated annual real GDP growth rates and values (2023-2028)



Source: Results of Sudan RIAPA Framework.

As we progress through the estimates, the years 2025 to 2027 show gradual, albeit inconsistent, recovery from the fall of 2023. The World Bank and IMF estimates suggest a slow reversion towards positive growth, although remaining below the baseline predictions. This pattern reflects the resilience of the Sudanese economy and the gradual adaptation to the prevailing conditions of conflict. The projections for 2028 present a cautious yet noteworthy return to growth, with the World Bank and IMF forecasting a GDP close to the baseline figures at 27.6 and 31.0 billion US dollars, respectively. The positive growth rates across all scenarios signal a potential stabilization and adaptive recovery of the Sudanese economy despite the ongoing challenges. The estimations shown in Figure 7 thus conveys a dual narrative: the immediate and severe economic ramifications of conflict, followed by a period of adjustment and partial recovery. The variance between the baseline scenario and the revised projections underscores

the critical need for robust economic planning and the consideration of external shocks in economic forecasting.

In summary, the quantitative analysis of Sudan's real GDP growth and values between 2023 and 2028 underscores the resilience of the economy in the face of conflict-induced adversity. The data encapsulate a broader narrative of an economy in flux, contending with the ramifications of war while exhibiting a capacity for recovery and adaptation over time.

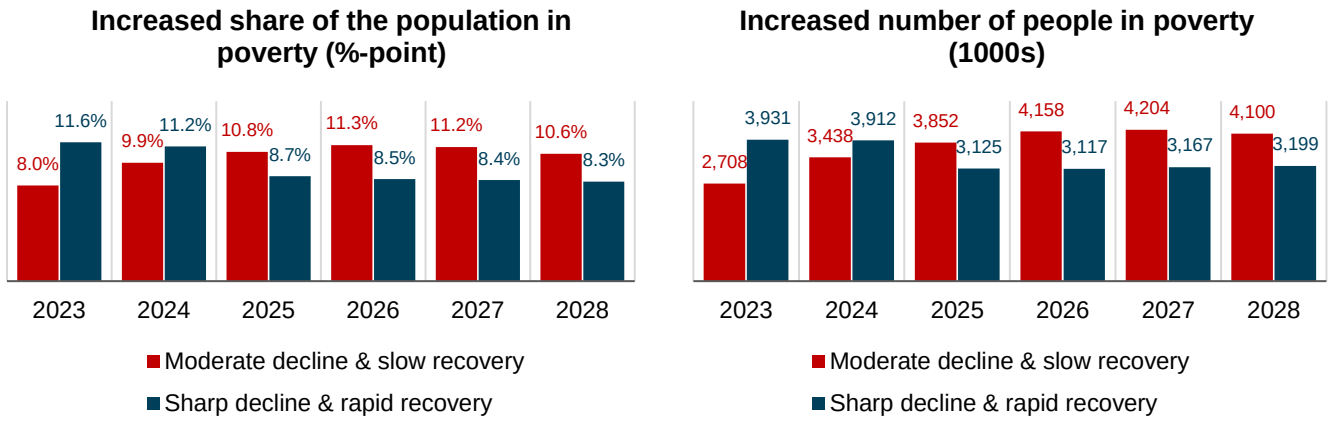
4.2 Impact of the conflict on poverty

Figure 8 presents estimates of the projected impact of the ongoing conflict on poverty levels in Sudan, differentiated by the scenarios forecasted by the Moderate decline and slow recovery and the Sharp decline and rapid recovery, scenarios. These estimations are benchmarked against a pre-conflict baseline, enabling a quantifiable analysis of the conflict's repercussions on socio-economic conditions.

In the immediate aftermath of the conflict's inception in 2023, both the Moderate decline & slow recovery and the Sharp decline & rapid recovery scenarios indicate a substantial increase in the proportion of the population living in poverty. The Moderate decline & slow recovery scenario reflects an increase of 8.0 percentage points, while the Sharp decline & rapid recovery scenario denotes a rise of 11.6 percentage points compared to the pre-conflict baseline. This abrupt elevation in poverty levels corresponds to an additional 2,708,000 and 3,931,000 individuals falling below the poverty threshold, according to the World Bank and IMF estimates, respectively.

As the timeline extends from 2024 to 2028, the impact on poverty levels remains pronounced, albeit with some fluctuations. The Moderate decline & slow recovery scenario's projections suggest a gradual decrease in the percentage-point increase of poverty from its peak in 2023, reaching an additional 10.6 percentage points above the baseline by 2028. In contrast, the Sharp decline & rapid recovery scenario presents a less optimistic outlook, with a slight resurgence in poverty levels in 2026 and 2027 before a decrease in 2028. However, it is important to note that both scenarios predict persistent and elevated poverty levels throughout the period of analysis.

Figure 8: Simulated impact of the conflict on poverty rates and population



Source: Results of Sudan RIAPA Framework.

The absolute numbers provided in Figure 8 further elucidate the human dimension of these projections. Despite year-on-year variations, both the Moderate decline & slow recovery and Sharp decline & rapid recovery scenarios indicate an increase in the number of people in poverty relative to the baseline throughout the period. By 2028, the slow recovery and rapid recovery projections estimate that there will be an additional 4,100,000 and 3,199,000 people living in poverty, respectively.

The data in Figure 8 serve as a stark reminder of the profound and sustained impact that conflict can have on the most vulnerable populations. The divergence between the Moderate decline & slow recovery and Sharp decline & rapid recovery scenarios also highlights the inherent uncertainties in projecting socio-economic outcomes in conflict settings, reflecting different methodological approaches and underlying assumptions.

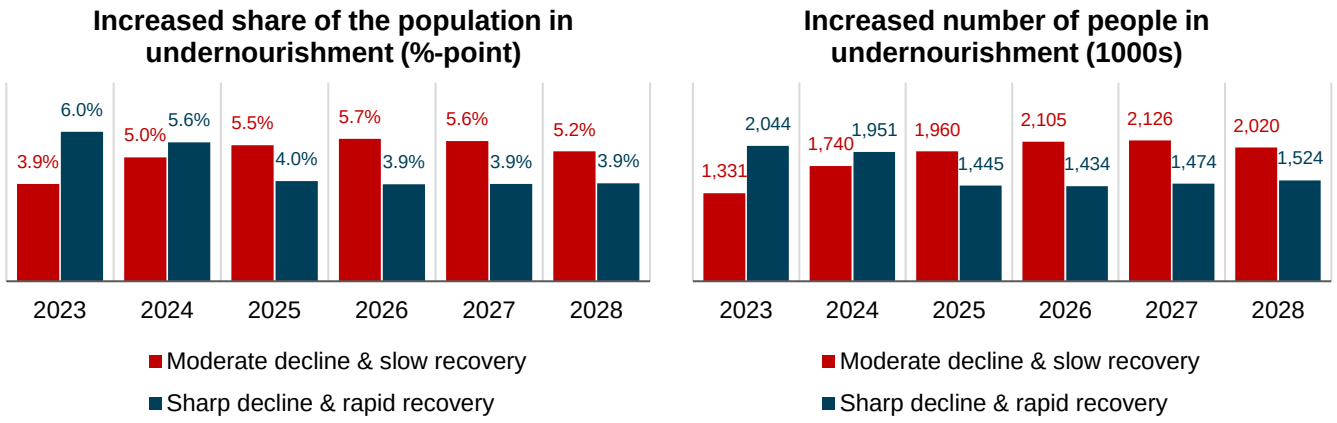
In conclusion, the projected increases in both the percentage and absolute number of people living in poverty in Sudan, because of the conflict, underscore the critical need for targeted policy interventions. These findings advocate for the international community's engagement and the mobilization of humanitarian and development aid to mitigate the socio-economic fallout of the conflict and support the resilience of affected populations.

4.3 Impact of the conflict on undernourishment

Figure 9 quantitatively depicts the escalation of undernourishment in Sudan's population as a direct consequence of the conflict, comparing the projected increments against a pre-conflict baseline. Each of the Moderate decline & slow recovery and Sharp decline & rapid recovery scenarios reflect increased prevalence of undernourishment due to the ongoing crisis. In 2023, the first year of conflict, the Moderate decline & slow recovery scenario shows an increase of 3.9 percentage points in the undernourishment rate relative to the baseline, equating to an additional 1,331,000 individuals experiencing undernourishment. The Sharp decline & rapid recovery scenario outcome is more severe, with a 6.0 percentage point increase and an additional 2,044,000 individuals affected.

The projection trends from 2024 to 2028 illustrate the protracted nature of the conflict's impact on food security. While both scenarios indicate a slight decrease in the percentage point increase from the peak in 2023, the rates remain significantly elevated above the baseline throughout the period. In particular, the Moderate decline & slow recovery estimates reveal a consistent 3.9 percentage point increase from 2025 to 2028, while the Sharp decline & rapid recovery scenario suggests a slight variation with a minimum of 3.9 percentage points in 2026 to a maximum of 5.7 percentage points in 2025.

Figure 9: Simulated impact of the conflict on undernourishment rates and population



Source: Results of Sudan RIAPA Framework.

Correspondingly, the absolute numbers of undernourished individuals remain alarmingly high under both scenarios, with the slow recovery projecting an increase of 1,524,000 individuals by 2028, and the rapid recovery projecting a higher increase of 2,020,000 individuals. These figures represent a significant proportion of the population enduring inadequate nutrition, with consequences for health, productivity, and overall societal well-being.

The disparities between the Moderate decline & slow recovery and Sharp decline & rapid recovery estimates may be attributed to differing GDP estimates and assumptions about the conflict's impact. However, both sets of projections serve as a somber reflection of the conflict's detrimental effects on food security.

In summation, Figure 9 underscores the critical issue of undernourishment because of conflict, demonstrating not only the immediate crisis but also the enduring challenge to food security over a protracted period. The persistent increase in both the proportion and absolute number of undernourished individuals calls for sustained humanitarian efforts and strategic interventions aimed at mitigating the adverse effects of conflict on the population's nutritional status.

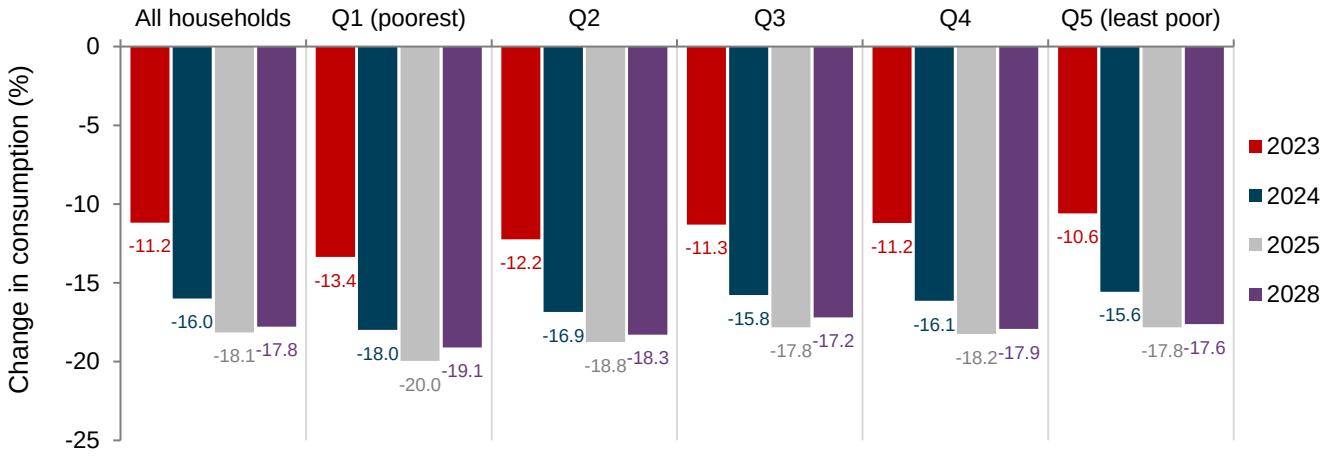
4.4 Distributional impact of the conflict

Figure 10 presents the model results on the differential impact of the conflict, as captured by the Moderate decline & slow recovery scenario, on the per capita private consumption spending across various household income groups in Sudan from 2023 to 2028. The deviations from the no-conflict expectations offer a nuanced understanding of the conflict's distributional effects.

In the initial year of the conflict, 2023, all household groups experienced a substantial drop in consumption, with the poorest quintile (Q1) being the hardest hit, registering a decline of 13.4 percent. This trend suggests that conflict exacerbates pre-existing vulnerabilities, disproportionately affecting those already at an economic disadvantage. The decline in consumption for the richest quintile (Q5), while less severe, still marked a significant deviation of -10.6 percent from the no-conflict scenario. As the conflict's effects pervade the economy over the subsequent years, lower-income households (Q1 and Q2) remain the worst affected, with consumption declines ranging from -18.0 percent to -19.1 percent in 2024, marginally improving by 2028 but still reflecting a persistent shortfall of -17.6 percent to -18.3 percent

for Q1 and Q2 respectively. The data underscores the enduring economic strain placed on these demographics, suggesting that recovery efforts must prioritize the most vulnerable to address these deepening inequities.

Figure 10: Simulated impact of the conflict on annual change in per capita private consumption spending in the Moderate decline & slow recovery



Source: Results of Sudan RIAPA Framework.

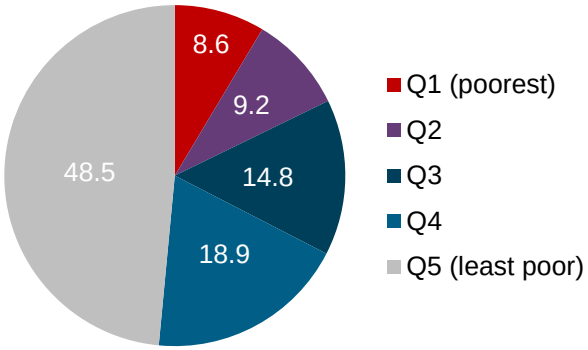
Middle- and higher-income groups (Q3, Q4, and Q5) also face a persistent decline in consumption spending, although the extent is relatively smaller compared to the lower-income groups. Notably, the middle-income group (Q3) shows a -11.3 percent change in 2023, with a slight recovery by 2028 to -17.2 percent, indicating that while all segments of the population are affected by the conflict, the impact is regressive, with poorer households bearing a heavier burden. The highest income group (Q5) exhibits the most resilience with a consumption reduction of -15.6 percent in 2023, which slightly recovers to -17.6 percent by 2028. This pattern points to a certain degree of financial buffer that higher-income households might possess, which mitigates the full impact of the conflict on their consumption patterns. In aggregate, the annual changes in consumption across all households indicate that the conflict has precipitated a broad-based economic contraction, with the magnitude of the impact inversely related to the household's income level. The data illustrates a pronounced and sustained downturn in consumption for all quintiles throughout the projected period, with only marginal recoveries that do not revert to pre-conflict expectations.

In summary, Figure 10 clearly demonstrates that the distributional impact of the conflict in Sudan has led to significant and lasting declines in private consumption spending across all income groups, with lower-income households experiencing the most severe effects. This evidence is pivotal for policymakers, highlighting the need for tailored fiscal policies and social protection measures to support the most economically vulnerable populations and to foster equitable recovery in the wake of the conflict.

The additional findings provided in Figure 11 elucidates the distribution of consumption losses among different income quintiles of households in Sudan during the years 2023-24. It contextualizes the proportional impact illustrated in Figure 10 by detailing the absolute terms of consumption losses across the income spectrum. During the initial years of the conflict, the higher-income households (Q5), while experiencing a lower percentage decline in consumption spending as shown in Figure 10, nonetheless

account for the largest share of total consumption losses at 48.5 percent. This significant proportion is attributable to their higher initial levels of consumption. The absolute reduction in consumption for this quintile represents nearly half of the total losses, indicating that while the impact of the conflict is felt across all economic strata, the actual monetary losses are heavily skewed towards the wealthier households due to their larger consumption base.

Figure 11: Simulated share of total household consumption losses during 2023-24 (percent)



Source: Results of Sudan RIAPA Framework.

The second-largest share of consumption losses is observed in the second poorest quintile (Q2), constituting 18.9 percent of the total. This indicates a substantial impact on lower-middle-income households, suggesting that these households, despite their smaller initial consumption levels compared to Q5, face a significant reduction in their purchasing power. The middle-income quintile (Q3) and the second richest quintile (Q4) bear 14.8 percent and 9.2 percent of the total consumption losses, respectively. These figures corroborate the regressive nature of the conflict's impact, with middle-income households shouldering a disproportionate burden of the downturn compared to their share of total consumption. Finally, the poorest quintile (Q1), while profoundly affected on a percentage basis as evidenced in Figure 9, accounts for the smallest share of total consumption losses at 8.6 percent. This dichotomy between the relative and absolute impacts of the conflict on consumption highlights the complex and multi-dimensional nature of economic hardships faced by different income groups.

In summary, Figure 11 provides a critical perspective on the absolute distribution of consumption losses during the conflict years, illustrating that higher-income households experience the largest actual decreases in consumption, whereas lower-income households, although less affected in absolute terms, suffer more in relative terms. This layered understanding is pivotal for informing targeted economic policies designed to mitigate the conflict's adverse effects and to support equitable recovery efforts that consider both the proportional and absolute hardships experienced by households across the income distribution.

4.5 Impacts of the accelerated recovery scenarios

Considering the significant economic downturn induced by the conflict that began on April 15, 2023, various recovery scenarios have been developed to explore potential strategies for the revitalization of

Sudan's economy. These scenarios, while theoretical, are grounded in practical measures that can be taken to mitigate the adverse effects of the conflict. Accordingly, four recovery scenarios are developed as follows:

Agricultural Bounce-Back Scenario: This scenario assumes a rapid recovery of agricultural yields to pre-conflict levels by 2026, overcoming all conflict-driven losses. It posits that through targeted policy interventions aimed at enhancing agricultural productivity, such as the provision of improved seeds, fertilizers, and access to irrigation, alongside the rehabilitation of agricultural land damaged by the conflict, Sudan can swiftly restore its food production capacity.

Infrastructure Investment Scenario: This scenario outlines a structured investment of $1 billion in infrastructure, with disbursement spread over three years: 20 percent in 2024, 40 percent in 2025, and the remaining 40 percent in 2026. The investments are earmarked for rebuilding and upgrading critical infrastructure, including transportation networks, utilities, and communication systems, thus facilitating trade, improving market access, and attracting foreign investment.

Cash Transfers Scenario: Here, the distribution of $1 billion in direct cash transfers is proposed, with a significant front-loading of 80 percent in 2024, followed by 20 percent in 2026. This scenario is based on the premise that direct financial support to households can alleviate immediate poverty and stimulate consumer spending, leading to a multiplier effect in the local economy.

Combined Scenario of Cash and Infrastructure Investment: The combined scenario integrates elements of the previous two, allocating 25 percent of funds to cash transfers and 75 percent to infrastructure investment. This mixed approach aims to balance immediate relief to individuals with long-term structural enhancements that lay the groundwork for sustainable economic growth.

Each scenario has distinct implications for recovery dynamics. The agricultural scenario prioritizes food security and the restoration of livelihoods for a large segment of Sudan's population reliant on agriculture. The infrastructure investment scenario has a longer-term horizon, potentially catalyzing broad-based economic development. The cash transfers scenario is designed to address immediate needs and stimulate economic activity. Finally, the combined scenario seeks to leverage the benefits of both liquidity infusion and capital development.

Assessing these scenarios provides a comprehensive framework for recovery, illustrating the trade-offs and synergies between different policy choices. The effectiveness of each scenario will ultimately depend on the implementation capacity, the extent of the conflict's damage, and the prevailing socio-economic conditions. Nonetheless, the analysis underscores the potential of targeted interventions to foster resilience and support the recovery of the Sudanese economy in the aftermath of the conflict.

4.5.1 Impacts of the accelerated recovery scenarios on GDP

Figure 12 delineates the anticipated ramifications of the conflict on Sudan's real GDP, contrasting the war scenario as represented by the Moderate decline & slow recovery scenario with four recovery scenarios, each incorporating the effects of an agricultural bounce-back. The recovery scenarios present the economic trajectory with the assumption of full agricultural recovery by 2026, overlayed with additional targeted interventions, and are compared against the Moderate decline & slow recovery scenario to quantify the potential for post-conflict economic rehabilitation.

The Moderate decline & slow recovery scenario—herein referred to as the war scenario—portrays a gradual post-conflict economic recovery without the implementation of targeted recovery strategies. It

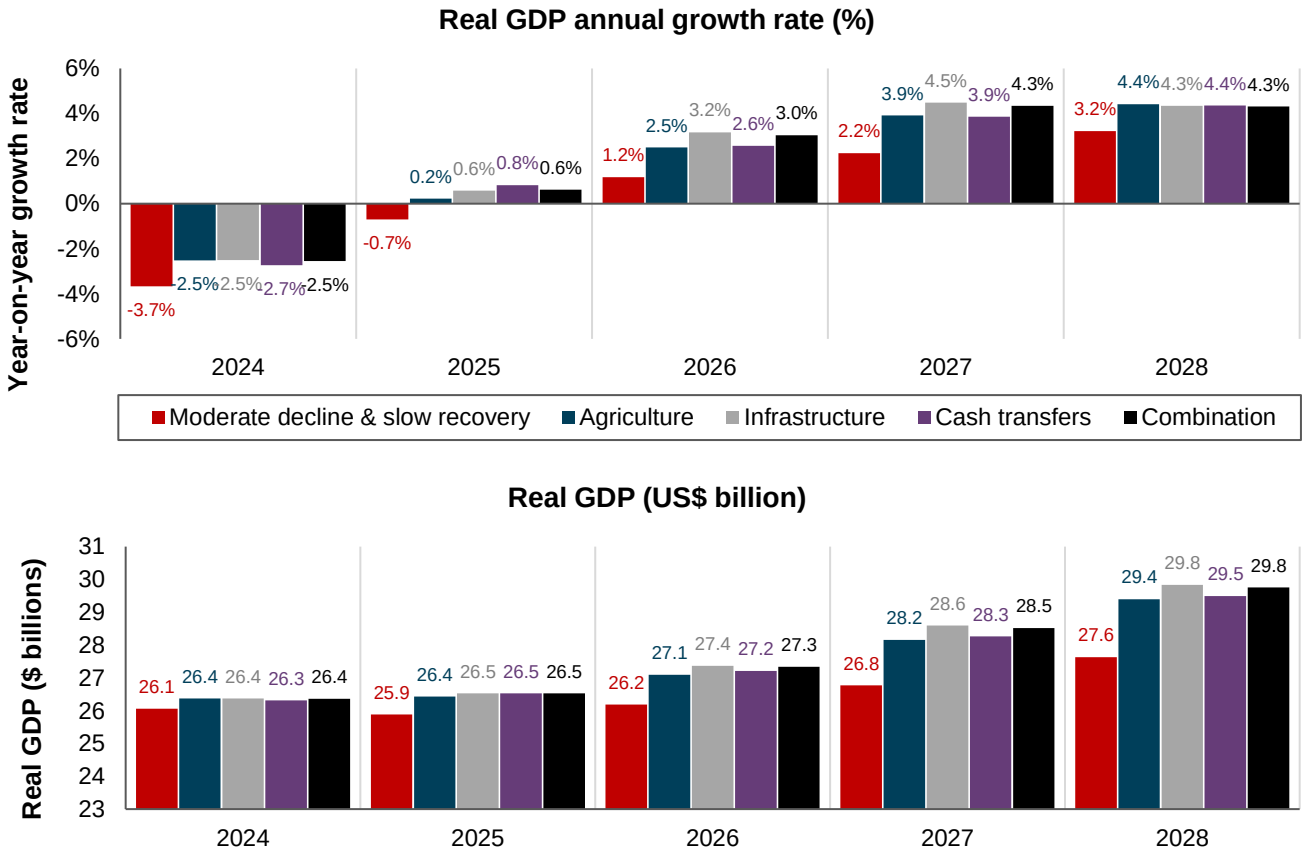
reflects a GDP contraction of 3.7 percent in 2024, with a slow uptrend in growth, culminating in a 3.2 percent increase by 2028. The corresponding GDP value is anticipated to rise from 26.1 billion US dollars in 2024 to 29.4 billion US dollars in 2028. This scenario sets the benchmark for assessing the additional benefits of the recovery strategies.

Overlaying the agricultural bounce-back, the recovery scenarios show varying degrees of accelerated economic growth. The Agricultural scenario itself forecasts a modest initial growth of 0.2 percent in 2024, ramping up to 3.4 percent by 2028, signifying the sector's central role in the economy and its recovery potential. The GDP value under this scenario mirrors this upward trajectory, reaching 29.5 billion US dollars by 2028. When infrastructure investment is combined with agricultural recovery, the forecast shows an initial growth rate lower than that of the cash transfers scenario in 2024 but surpasses it thereafter, achieving a growth rate of 4.4 percent by 2028—the highest among all scenarios. This underscores the profound, compounding impact of infrastructure development on economic growth, with the GDP value reflecting this positive trend, reaching 29.8 billion US dollars by the end of the forecast period.

The Cash transfers scenario, juxtaposed with agricultural recovery, projects the most immediate impact with an 0.8 percent growth rate in 2025, suggesting that liquidity injections can provide a significant short-term stimulus. By 2028, its growth rate aligns with the Agricultural scenario, highlighting the transient nature of cash transfers' effects compared to other forms of investment, with a final GDP value of 29.5 billion US dollars.

Finally, the combination scenario, which assumes a synergistic approach of cash transfers and infrastructure investments on top of agricultural recovery, projects a balanced growth pattern, with an initial growth of 0.6 percent in 2024, eventually reaching 4.3 percent by 2028. This culminates in the GDP value rising to 29.8 billion US dollars, matching the infrastructure scenario's outcome by 2028. This indicates that a multifaceted approach to recovery, blending short-term relief with long-term investments, may provide a robust pathway to sustainable economic growth.

Figure 12: Simulated real GDP growth rates and values in the Moderate decline & slow recovery and other recovery scenarios (2024-2028)



Source: Results of Sudan RIAPA Framework.

The comparative analysis reveals that while each recovery scenario improves upon the war scenario, the infrastructure investment and the combination scenarios provide the most pronounced long-term growth. The cash transfers scenario, despite its strong start, offers less sustained growth, reinforcing the necessity for recovery measures that extend beyond immediate relief.

In conclusion, Figure 12 offers a comprehensive projection of Sudan's economic recovery post-conflict, evidencing the critical nature of strategic interventions in agriculture, infrastructure, and direct financial support. These scenarios serve as a pivotal resource for policymakers to evaluate the relative impacts of various recovery initiatives, with the goal of not only restoring the economy to its pre-conflict state but also ensuring its robust and sustained growth thereafter.

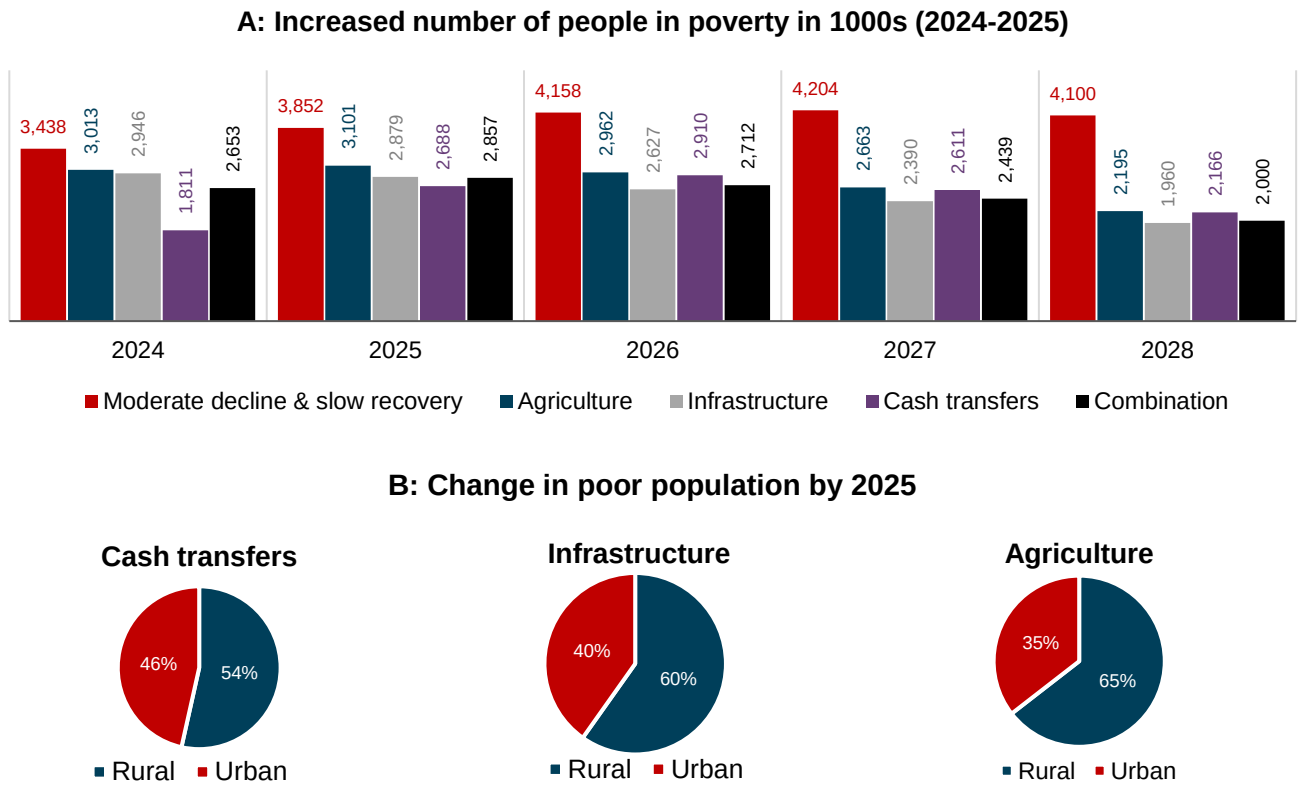
4.5.2 Impacts of the accelerated recovery scenarios on poverty

Figure 13 depicts the impact of the conflict and subsequent recovery scenarios on the incidence of poverty in Sudan between 2024 and 2028. The graph provides a quantification of the additional number of individuals projected to fall into poverty under the Moderate decline & slow recovery scenario as well as under agricultural recovery, infrastructure investment, cash transfer, and combined recovery scenarios (panel A). Furthermore, it breaks down the change in the poor population by 2025 due to cash transfers and infrastructure investments, highlighting the rural-urban divide (panel B).

Panel (A) segment of Figure 13 shows a substantial increase in poverty across all scenarios in 2024, with the Moderate decline & slow recovery scenario resulting in the highest surge, adding approximately 3,438,000 individuals to the poverty count. The recovery scenarios all show a reduction in the poverty levels relative to the war scenario, demonstrating the potential of targeted interventions in mitigating the adverse impacts of the conflict. In 2025, the agriculture scenario shows a marked reduction in the number of individuals in poverty, indicating the critical role of agricultural productivity in supporting livelihoods and reducing poverty, especially in rural areas. The infrastructure investment and cash transfers scenarios also contribute to poverty alleviation but to a lesser extent, suggesting that while infrastructure development has longer-term benefits, immediate cash support provides essential short-term relief. The Combined scenario, integrating both infrastructure and cash transfers, offers a more balanced approach, reducing poverty by harnessing the strengths of both immediate and sustained interventions.

By 2028, the gap between the Moderate decline & slow recovery scenario and other recovery scenarios narrows, but a clear distinction remains, with the Combined scenario leading to the smallest number of individuals in poverty, followed by the Agriculture and Infrastructure scenarios.

Figure 13: Simulated impact of the war and recovery scenarios on poor population (2024-2025)



Source: Results of Sudan RIAPA Framework.

Panel (B) of Figure 13 further disaggregates the impact of the Cash transfers and Infrastructure investment scenarios on the rural and urban poor populations by 2025. The Cash transfers scenario shows a

near-equal distribution of poverty alleviation between rural and urban areas, with 54 percent of the reduced poverty occurring in urban areas. This suggests that cash transfers as a recovery measure can bridge the rural-urban divide in the short term. Conversely, the Infrastructure investment scenario has a more pronounced effect on rural poverty reduction, with 60 percent of the impact being observed in rural regions. This aligns with the understanding that infrastructure development can facilitate agricultural and economic activities in rural areas, which are often more severely affected by poverty. The Agriculture scenario indicates a predominant impact on rural poverty, with 65 percent of the poor population reduction by 2025 occurring in rural areas. This underscores agriculture as a vital sector for rural development and poverty reduction.

In conclusion, Figure 13 underscores the varied efficacy of different recovery strategies in mitigating poverty in Sudan, shaped by the unique challenges and needs of urban and rural populations. The findings highlight the importance of a multi-faceted approach to poverty reduction that incorporates both immediate relief measures and long-term investments to ensure inclusive and sustainable development post-conflict. Targeted interventions, especially in agriculture and infrastructure, are shown to be essential components of a comprehensive recovery framework that can address both the immediate needs and the structural causes of poverty.

5 CONCLUSIONS

5.1 Summary

The conflict in Sudan, erupting in 2023, precipitated a crisis with deep-reaching impacts across all sectors of the nation's economy, most notably within the agricultural, industrial, and service sectors. Utilizing the RIAPA model, this report analyzes the economic shockwaves of the conflict, delineating their effects on economic growth, poverty escalation, undernourishment proliferation, and sectoral disruptions. The analysis aims to not only quantify the adverse impacts but also to chart a course for recovery by simulating various intervention scenarios. Through the RIAPA economy-wide framework, the report illuminates the dire economic conditions while spotlighting strategic recovery pathways that could potentially reverse the downward spiral and set Sudan on a path to recovery and growth.

5.2 Major findings

The 2023 conflict in Sudan had a profound human toll, substantially exacerbating poverty and hunger nationwide. Between 8-10 percent of Sudan's population, equating to approximately 3-4 million individuals, were driven into poverty due to the conflict, while hunger afflicted an additional 4-6 percent of the population, translating to 1-2 million people. Our analysis indicates a grim future if interventions are not implemented; without decisive action, the reduction in poverty and hunger will remain below one million.

To expedite recovery, agricultural revitalization has been identified as a critical lever. By restoring agricultural productivity to pre-conflict levels, an estimated 1.9 million people could be lifted out of poverty by 2028, underlining the sector's pivotal role in the country's socioeconomic restoration. Furthermore, the role of financial aid and infrastructure investment in recovery must be carefully balanced. Immediate cash transfers are crucial for a direct and swift reduction in poverty and hunger. However, investments in infrastructure, despite their delayed benefits, promise more significant, long-term improvements starting from 2026 onwards.

These findings underscore the necessity for targeted strategies that prioritize both immediate relief and sustained development to foster a resilient recovery from the conflict's impacts. The following is a summary of the main messages based on these findings:

Economic Deterioration: The conflict has led to a significant downturn in Sudan's GDP, unraveling years of economic progress. Notably, the agricultural sector, despite its resilience, suffered setbacks that threaten food security and livelihoods. The industrial and service sectors experienced even more pronounced contractions, severely hampering production capacities and service delivery.

Humanitarian Crisis: The repercussions of the conflict have propelled millions into poverty and undernourishment, unraveling the social fabric and escalating the urgency for humanitarian interventions. The detailed simulations underscore that without targeted and immediate action, the trajectory towards recovery remains bleak, with long-lasting impacts on Sudan's most vulnerable populations.

Sectoral Insights: The resilience of the agricultural sector amidst conflict underscores its critical role in Sudan's economy and recovery process. However, the findings also highlight significant challenges within the industrial and service sectors, necessitating comprehensive strategies for rehabilitation and growth.

Recovery Pathways: The analysis revealed that targeted interventions in agricultural productivity, combined with strategic infrastructure investments and robust social protection measures, can significantly alter the post-conflict recovery trajectory. These interventions not only promise to lift millions out of poverty but also to stimulate economic activity across sectors.

5.3 Recommendations

Comprehensive Agricultural Support: Enhance agricultural productivity through concerted efforts aimed at increasing access to essential inputs and modern farming techniques. Efforts for enhancing agricultural productivity and fostering agricultural contribution to economic recovery could include the following:

- Enhancing supply chains for critical agricultural inputs. This could be achieved by developing specialized distribution networks that are resilient to conflict disruptions, ensuring that essential inputs like seeds, fertilizers, and animal feed reach all regions, including those affected by instability. In addition, it can be fostered by partnering with local and international organizations to set up input supply hubs in strategic locations, reducing the distance that farmers and pastoralists need to travel to access necessary resources.
- Introducing tailored agricultural training and extension services, which could be achieved among other ways via creating online platforms and mobile applications to disseminate agricultural advice and real-time market information, helping farmers and pastoralists make informed decisions about planting and selling.
- Adopting climate-resilient agricultural practices as suggested by (Siddig et al., 2020). This could be achieved by implementing water-saving irrigation techniques such as drip irrigation and rainwater harvesting systems to maximize the efficiency of water use in agriculture and increasing investments in research focused on the development and dissemination of drought-tolerant crop varieties.
- Fostering sector-specific policies and financial support. Major sectors such as gum Arabic and livestock have the potential to accelerate the recovery. By facilitating access to finance and credit facilities, especially for smallholder farmers, processers, and pastoralists, they can invest in processing technologies that add value locally, hence reducing the export of raw materials and increasing the profitability of products. Such reforms should also aim at creating a more favorable business environment for agricultural investments and innovations.

Strategic Infrastructure Rehabilitation: Prioritize the reconstruction of critical infrastructure with an emphasis on enhancing connectivity, reliability of utility services, and access to markets. This approach should foster an environment conducive to economic activity and attract both domestic and foreign investment. Efforts of rehabilitation could include the following:

- Prioritizing the rehabilitation, restoration, and upgrade of roads and transport networks, which could start by identifying key destruction by the ongoing conflict as well as bottlenecks in rural road networks that existed before the conflict started and prioritizing upgrades that facilitate the smooth transport of agricultural and industrial goods.

- Developing robust market infrastructure by establishing agricultural logistics hubs that include processing facilities to add value locally before agricultural products are marketed, enhancing profitability for farmers. This could also be enhanced by improving connectivity and utility services, upgrading electrical grid connections for rural and agricultural areas to support new agricultural technologies and value-added processing equipment, and expanding telecommunications infrastructure and enabling better access to mobile and internet services that can support digital marketplaces and agricultural advisories.
- Encouraging domestic and foreign investments through the tax breaks or grants for investments in agricultural infrastructure projects and establishing public-private partnership models specifically designed to fund and manage infrastructure projects that support the agricultural sector, ensuring that investments are sustainable and beneficial to all stakeholders involved.

Expanding Social Protection: Broaden and deepen social protection programs to provide immediate relief to the affected populations. Cash transfer programs, in particular, should be restored and scaled up to bolster household incomes, stimulate demand, and contribute to poverty alleviation. Efforts for expanding social protection could include the following:

- Restoring, scaling up, and diversifying cash transfer programs by linking them to agricultural productivity and to direct support for emergency needs. They can be used for providing funds specifically for purchasing agricultural inputs to not only support household incomes but also boost agricultural productivity, which is crucial during and after conflicts. Cash transfers could also include emergency funds specifically designed to address urgent needs such as healthcare, housing, and basic sustenance.
- Involving local communities in projects aimed at rebuilding agricultural infrastructure (e.g., roads, irrigation systems, and storage facilities) and reconstructing and maintaining local markets, health centers, and schools. This not only provides employment but also helps in the long-term recovery of agricultural productivity and restore critical community services, addressing both economic and social dimensions of the conflict's impact.
- Establishing food security programs that deliver food aid directly to the most affected families, with particular focus on nutritionally vulnerable populations such as children. This intervention can mitigate the pre- and post-conflict spread of undernourishment.

Integrated Policy Framework: Develop an integrated policy framework that synergizes efforts across sectors. This framework should facilitate coordination between agricultural revitalization, infrastructure development, and social protection initiatives to maximize impact and ensure a holistic recovery process. To achieve this, the following steps can be adopted:

- Establishing a central coordination body that includes all stakeholders across-sectors including representatives from agriculture, infrastructure, social protection, finance, and government to ensure all recovery initiatives are aligned with national economic recovery goals.
- Implementing a real-time data collection system that monitors the progress of recovery initiatives, using metrics aligned with economic recovery and social impact goals and creating an adaptive management framework that allows for periodic assessment and real-time adjustments to strategies based on monitoring data and emerging challenges.

- Reviewing and harmonizing existing policies, regulations, and laws to remove barriers to integrated recovery efforts, such as conflicting land use and water rights policies that impede agricultural and infrastructural development as well as implementing regulations that encourage building resilience through sustainable practices, such as mandating the use of durable and environmentally friendly materials in construction and incentivizing the adoption of smart agricultural practices.

5.4 Caveats

The strategic recommendations for Sudan's recovery from the 2023 conflict are subject to certain caveats due to limitations in data and methodology:

Limited Information for Specific Industries: The analysis presented largely relies on aggregated data, assuming uniform impacts across various subsectors within agriculture, industry, and services. This generalization is based on the World Bank's analyses and may not accurately reflect the nuanced realities of each sector.

Rudimentary Investment Targeting: The proposed cash transfers and investment strategies are based on existing patterns of targeting and sectoral flows. The assumption that cash transfers will lead to an immediate agricultural rebound and that infrastructure investments will follow historical patterns may not fully consider the complexities and evolving dynamics post-conflict.

These caveats highlight the need for a cautious interpretation of the projected outcomes and emphasize the importance of gathering more granular data to refine recovery strategies. It is also critical to remain flexible in investment targeting, adapting to the changing economic landscape and the specific needs that emerge during the recovery process.

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REFERENCES

Alhelo, Alzaki; Siddig, Khalid; and Kirui, Oliver K. 2023. The architecture of the Sudanese agricultural sector and its contribution to the economy between 1990 and 2021. IFPRI Discussion Paper 2191. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136725

Aljazeera. 2023. What does Sudan's crisis mean for the gum Arabic industry? What does Sudan's crisis mean for the gum arabic industry? | Agriculture News | Al Jazeera

AsharqNewsSUD. 2023. Statement of Minister of Finance and Economic Planning in Sudan on the economic costs of the conflict. https://twitter.com/AsharqNewsSUD/status/1728373267075944712?s=20

CBoS (Central Bank of Sudan). 2021. Annual report. Chapter_8.pdf (cbos.gov.sd)

CBoS (Central Bank of Sudan). 2022. Economic and Financial Statistical Review – Q42022. بنـــك السودا ن (cbos.gov.sd)

Daher, Joseph. 2019. Syria's manufacturing sector: the model of economic recovery in question. European University Institute. Research Project Report (May 2019). MED_2019_08.pdf (eui.eu)

Diao, X.; Pauw, K.; Raouf, M.; Siddig, K.; and Thurlow, J. 2023. Sudan's agrifood system: Structure and drivers of transformation. SSSP Working Paper 9. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136809

Diao, X. and Thurlow, J. 2012. A recursive dynamic computable general equilibrium model. In Strategies and priorities for African agriculture: Economywide perspectives from country studies, ed. Xinshen Diao, James Thurlow, Samuel Benin, and Shenggen Fan. Chapter 2. Pg. 17-50. https://www.ifpri.org/publication/recursive-dynamic-computable-general-equilibrium-model

DTM Sudan (Displacement Tracking Matrix). 2023. International Organization for Migration (IOM), Nov 30, 2023. DTM Sudan Weekly Displacement Snapshot 14. IOM, Sudan. https://dtm.iom.int/terms-and-conditions https://dtm.iom.int/terms-and-conditions

DTM Sudan (Displacement Tracking Matrix) 2024. Monthly Displacement Overview (February 2024). DTM Sudan - Monthly Displacement Overview (February 2024) - Sudan | ReliefWeb

Elbadawi, Ibrahim; Elbashir, Abdalrazig; Osman, Abdelrahman; Elobaid, Amir; Alhelo, Alzaki; Suliman, Kabbashi. 2022. Sudan's Challenges and Opportunities: A Renaissance Project for Sudan: From Poor Agriculture to Agro-Industrial Growth and Sustainable Development. Economic Research Forum. PRR 40. 1659257696_282_6382995_prr40 (1).pdf

Ezemenari, K.M., Ouedraogo, A., Guo, F., Osman, E.A.M., Rahasimbelonirina, A., Adoho, F.M. 2023. Sudan Economic Update: Missed Opportunities Amidst Deepening Fragility (English). Sudan Economic Update Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/099540409212319137/IDU0f37ed18102619046f80a9740379de7348107

Energy Voice. 2023. Oil exports rise during Sudan war as pipeline left unscathed Oil exports rise during Sudan war as pipeline left unscathed (energyvoice.com) Oil exports rise during Sudan war as pipeline left unscathed (energyvoice.com)

EREM NEWS. 2023. The war in Sudan is destroying the industrial sector. حرب السودان تتسبّب في تدمير القطاع الصناعي حرب السودان تتسبّب في تدمير القطاع الصناعي (eremnews.com)

FAO Food and Agriculture Organization of the United Nations. 2023. The Sudan: Rapid assessment on the summer season agricultural performance. The Sudan: Rapid assessment on the summer season agricultural performance (fao.org)

FEWS NET (Famine Early Systems Network). 2023. Sudan Food Security Outlook. High needs to persist amid continued conflict and below-average harvests. High needs to persist amid continued conflict and below-average harvests | FEWS NET

IMF (International Monetary Fund). 2023. World Economic Outlook data portal, International Monetary Fund (IMF). April 2023 and October 2023 updates. https://www.imf.org/en/Publications/WEO/weo-database/. Accessed on November 28, 2023.

IMF (International Monetary Fund). 2021a. Sudan: Second Review Under the Staff-Monitored Program and Request for Extension-Staff Report; and Statement by the Executive Director for Sudan. IMF Staff Country Reports. Sudan: Second Review Under the Staff-Monitored Program and Request for Extension-Staff Report; and Statement by the Executive Director for Sudan (imf.org)

IMF (International Monetary Fund). 2021b. Sudan: Enhanced Heavily Indebted Poor Countries (HIPC) Initiative-Decision Point Document. IMF Staff Country Reports. Sudan: Sudan: Enhanced Heavily Indebted Poor Countries (HIPC) Initiative-Decision Point Document (imf.org)

IMF (International Monetary Fund). 2021c. Sudan: Request for a 39-Month Arrangement Under the Extended Credit Facility-Press Release; Staff Report; and Statement by the Executive Director for Sudan. IMF Staff Country Reports. Sudan: Request for a 39-Month Arrangement Under the Extended Credit Facility-Press Release; Staff Report; and Statement by the Executive Director for Sudan (imf.org)

Kirui, Oliver; Siddig, Khalid; Ahmed, Mosab; Abushama, Hala; and Seyoum, Taffesse. 2023. Impact of the ongoing conflict on smallholder farmers in Sudan: Evidence from a nationwide survey. Sudan SSP Working Paper 17. Khartoum, Sudan: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.137064

IPC (Integrated Food Security Phase Classification). 2023. Sudan: IPC Acute Food Insecurity Snapshot | October 2023 – February 2024 SUDAN: Intense conflict, organized violence, economic decline leave 17.7 million people in high levels of acute food insecurity | IPC - Integrated Food Security Phase Classification (ipcinfo.org)

IOM (International Organization for Migration). 2023. Up to 300,000 Sudanese Displaced by Latest Surge in Fighting. Up to 300,000 Sudanese Displaced by Latest Surge in Fighting | International Organization for Migration (iom.int)

Kirui, Oliver K.; Siddig, Khalid; Abushama, Hala; and Taffesse, Alemayehu Seyoum. 2023b. Armed conflict and business operations in Sudan: Survey evidence from agri-food processing firms. Sudan SSP Working Paper 11. Khartoum, Sudan: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136835

Kirui, Oliver; Siddig, Khalid; and Ahmed, Mosab O. M; Abushama, Hala; Taffesse, Alemayehu. 2023a. Impact of the Ongoing Conflict on Smallholder Farmers in Sudan: Evidence from an Emergency National Telephone Survey. Sudan SSP Working Paper 17. Khartoum, Sudan: International Food Policy Research Institute (IFPRI). (forthcoming)

Siddig, Khalid; Stepanyan, Davit; Wiebelt, Manfred; Grethe, Harald;and Zhu, Tingju. 2020. Climate change and agriculture in the Sudan: Impact pathways beyond changes in mean rainfall and temperature, Ecological Economics, Volume 169, 106566, ISSN 0921-8009,https://doi.org/10.1016/j.ecolecon.2019.106566.(https://www.sciencedirect.com/science/article/pii/S0921800918316458)Siddig, Khalid; Raouf, Mariam; and Ahmed, Mosab O. M. 2023. The economy-wide impact of Sudan's ongoing conflict: Implications on economic activity, agrifood system and poverty. Sudan SSP Working Paper 12. Khartoum, Sudan: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136843

STPT (Sudan Transparency and Policy Tracker). 2023. The banking system during and after the war. Challenges and policy recommendations. https://sudantransparency.org/the-banking-system-during-and-after-the-war-challenges-and-policy-recommendations/

Sudan Akhbar. 2023a. The minister of finance and economic planning reveals a shocking number of the cost of the war. وزير المالية يكشف عن رقم صادم لخسائر السودان جراء الحرب - اخبار السودان (sudanakhbar.com)

Sudan Akhbar. 2023b. Satellite images show an oil leak west of the White Nile. شاهد.. صور الاقمار الصناعية تظهر تسريب نفطي غرب النيل الأبيض - اخبار السودان (sudanakhbar.com)

Sudan Akhbar. 2023c. Sudan announces the export of 2.7 million heads of livestock. السودان يعلن تصدير 2.7 مليون رأس من الماشية - اخبار السودان (sudanakhbar.com)

Sudan dependent. 2023. The Council of Ministers sets a date for opening universities and schools in Sudan. مجلس الوزراء يحدد موعدا لفتح الجامعات والمدارس في السودان (sudanindependent.com)

Sudan Tribune. 2023. Gold production in Sudan dwindles to two tons due to ongoing conflict. Gold production in Sudan dwindles to two tons due to ongoing conflict - Sudan Tribune

Randriamamonjy, J.; Raouf, M.; and Siddig, K. 2023. A 2019 nexus social accounting matrix for Sudan. SSSP Working Paper 6. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136701

UN (United Nations). 2023. United Nations Population Division, Data Portal. https://population.un.org/dataportal/data/indicators/52,50,51,72,49,22,24,66,65/locations/729/start/2019/end/2050/table/pivotbyindicator (accessed on November 28, 2023.

UNDP (United Nations Development Program) 2022. HUMAN DEVELOPMENT REPORT 2020 The Next Frontier: Human Development and the Anthropocene. https://hdr.undp.org/content/human-development-report-2020

UNDP (United Nations Development Program). 2006. Macroeconomic Policies for Poverty Reduction: The Case of Sudan. Macroeconomic policies for poverty reduction: Macroeconomic policies for poverty reduction: The case of Sudan | United Nations Development Programme (undp.org)

UNDP (United Nations Development Program). 2020a. COVID-19 SOCIO-ECONOMIC IMPACT ASSESSMENT FOR SUDAN (April 2020). Sudan-COVID-19-socio-economic-impact-analysis---26-April-2020.pdf (undp.org)

UNDP (United Nations Development Program). 2020b. The Potential of Sudanese Diaspora Remittances. The Potential of Sudanese Diaspora Remittances | United Nations Development Programme (undp.org)

UNICEF (United Nations Children's Fund). 2023a. 19 million children in Sudan out of school as conflict rages on – UNICEF, Save the Children. 19 million children in Sudan out of school as conflict rages on – UNICEF, Save the Children

UNICEF (United Nations Children's Fund). 2023b. CONFLICT ON THE FISCAL SITUATION AND SERVICE DELIVERY. The Impact of Sudan's Armed Conflict on the Fiscal Situation and Service Delivery.pdf (unicef.org)

UN-OCHA (Office for the Coordination of Humanitarian Affairs). 2024. Sudan Humanitarian Update 21 January 2024. SUDAN_20240121_Humanitarian Update_21January2024_FINAL (1).pdf

WFP (World Food Program). 2023. WFP Market Monitor - Sudan: September 2023. https://reliefweb.int/report/sudan/wfp-market-monitor-sudan-september-2023

WHO (World Health Organization). 2023. Sudan health emergency - Situation Report No. 3. WHO-Sudan-conflict-situation-report-30-September-2023.pdf

World Bank. 2020. Sudan - Agriculture Value Chain Analysis (English). Washington, D.C. World Bank Group. http://documents.worldbank.org/curated/en/731741593616746051/Sudan-Agriculture-Value-Chain-Analysis

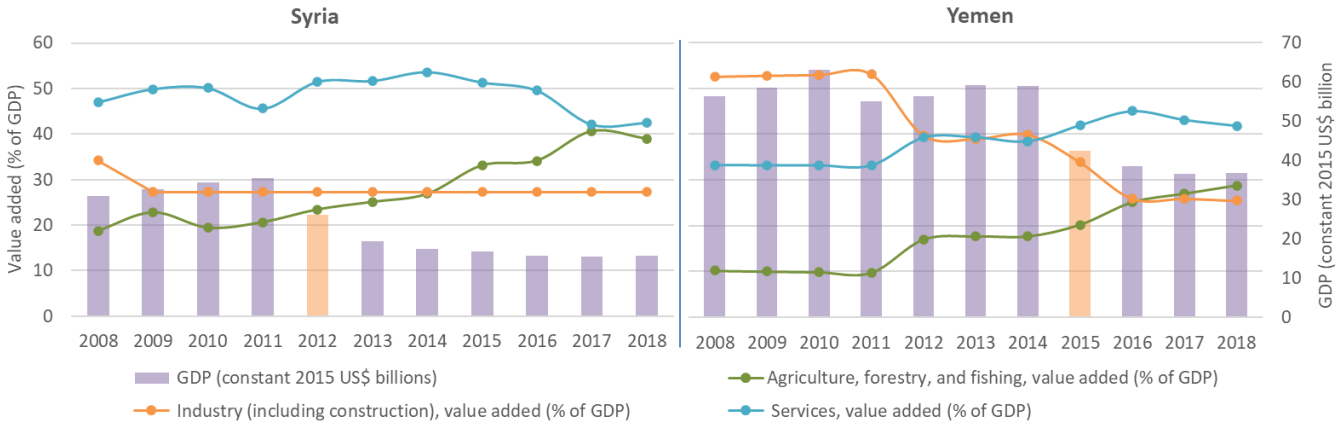
World Bank. 2023a. World Development Indicators (April 2023 update). The World Bank. https://databank.worldbank.org/source/world-development-indicators

World Bank. 2023b. World Development Indicators: October 2023 update. The World Bank. https://databank.worldbank.org/source/world-development-indicators

World Bank. 2023c. Sudan Economic Update: Missed Opportunities Amidst Deepening Fragility. © Washington, DC. http://hdl.handle.net/10986/40450 License: CC BY-NC 3.0 IGO.

APPENDIX

Figure A 1: GDP and sectoral contributions in Syria and Yemen before and after conflicts



Source: World Bank (2023a).

Table A 1: Model Indices, Variables and Parameters

Indices			
c	Commodities and activities	h	Representative households
f	Factors (land, labor, and capital)	t	Time periods
Exogenous parameters (Greek characters)			
α^p	Production function shift parameter	θ^v	Value-added share of gross output
α^q	Import function shift parameter	π	Foreign savings growth rate
α^t	Export function shift parameter	ρ^p	Production function substitution elasticity
β	Household marginal budget share	ρ^q	Import function substitution elasticity
γ	Non-monetary consumption quantity	ρ^t	Export function substitution elasticity
δ^p	Production function share parameter	σ	Rate of technical change
δ^q	Import function share parameter	τ	Foreign consumption growth rate
δ^t	Export function share parameter	υ	Capital depreciation rate
ε	Land and labor supply growth rate	φ	Population growth rate
θ^i	Intermediate share of gross output	ω	Factor income distribution shares
Exogenous parameters (Latin characters)			
ca	Intermediate input coefficients	pwm	World import price
cab	Current account balance	qfs	Total factor supply
cd	Domestic transaction cost coefficients	$qgov$	Base government consumption quantity
ce	Export transaction cost coefficients	$qinv$	Base investment demand quantity
ci	Capital price index weights	rf	Factor foreign remittance rate
cm	Import transaction cost coefficients	sh	Marginal propensity to save
cpi	Consumer price index	tf	Factor direct tax rate
cw	Consumer price index weights	th	Personal direct tax rate
ga	Government consumption adjustment factor	tm	Import tariff rate
gh	Per capita transfer from government	tq	Sales tax rate
pop	Household population	ts	Household specific sales tax rate
pwe	World export price	wh	Net transfer from rest of world
FSAV	Foreign savings	rw	Government foreign transfer receipts
NFI	Net foreign incomes	CA	Current account balance
NFA	Net foreign assets	N	Investment demand for sectoral goods
(TE –TM)	Trade balance	P	Market price
Endogenous variables			
AR	Average capital rental rate	QG	Government consumption quantity
FS	Fiscal surplus (deficit)	QH	Household consumption quantity
IA	Investment demand adjustment factor	QI	Investment demand quantity
PA	Activity output price	QK	New capital stock quantity
PD	Domestic supply price with margin	QM	Import quantity
PE	Export price	QN	Aggregate intermediate input quantity
PM	Import price	QQ	Composite supply quantity
PN	Aggregate intermediate input price	QT	Transaction cost demand quantity
PQ	Composite supply price	QV	Composite value-added quantity
PS	Domestic supply price without margin	WD	Sector distortion in factor return
PV	Composite value-added price	WF	Economywide factor return
QA	Activity output quantity	YF	Total factor income
QD	Domestic supply quantity	YG	Total government revenues
QE	Export quantity	YH	Total household income
QF	Factor demand quantity	X	Exchange rate
R	Government tax revenues		

Source: Sudan CGE model, adapted from Diao and Thurlow (2012).

Table A 2: Model Equations

Prices	
$PM_{ct} = pwm_c \cdot (1 + tm_c) \cdot X + \sum_{c\prime} PQ_{c\prime t} \cdot cm_{c\prime c}$	1
$PE_{ct} = pwe_c \cdot X_t - \sum_{c\prime} PQ_{c\prime t} \cdot ce_{c\prime c}$	2
$PD_{ct} = PS_{ct} + \sum_{c\prime} PQ_{c\prime t} \cdot cd_{c\prime c}$	3
$PQ_{ct} \cdot (1 - tq_c) \cdot QQ_{ct} = PD_{ct} \cdot QD_{ct} + PM_{ct} \cdot QM_{ct}$	4
$PX_{ct} \cdot QX_{ct} = PS_{ct} \cdot QD_{ct} + PE_{ct} \cdot QE_{ct}$	5
$PN_{ct} = \sum_{c\prime} PQ_{c\prime t} \cdot ca_{c\prime c}$	6
$PA_{ct} \cdot QA_{ct} = PV_{ct} \cdot QV_{ct} + PN_{ct} \cdot QN_{ct}$	7
$cpi = \sum_{ch} cw_{ch} \cdot PQ_{ct} \cdot (1 + ts_{cht})$	8
Production and trade	
$QV_{ct} = \alpha_{ct}^p \cdot \sum_f \left(\delta_{fc}^p \cdot QF_{fct}^{-\rho_c^p}\right)^{-1/\rho_c^p}$	9
$WF_{ft} \cdot WD_{fct} = PV_{ct} \cdot QV_{ct} \cdot \sum_{f\prime} \left(\delta_{f\prime c}^p \cdot QF_{f\prime ct}^{-\rho_c^p}\right)^{-1} \cdot \delta_c^p \cdot QF_{fct}^{-\rho_c^p - 1}$	10
$QN_{ct} = \theta_c^i \cdot QA_{ct}$	11
$QV_{ct} = \theta_c^v \cdot QA_{ct}$	12
$QA_{ct} = \alpha_c^t \cdot \left(\delta_c^t \cdot QE_{ct}^{\rho_c^t} + (1 - \delta_c^t) \cdot QD_{ct}^{\rho_c^t}\right)^{1/\rho_c^t}$	13
$\frac{QE_{ct}}{QD_{ct}} = \left(\frac{PE_{ct}}{PS_{ct}} \cdot \frac{(1 - \delta_c^t)}{\delta_c^t}\right)^{1/(\rho_c^t - 1)}$	14
$QQ_{ct} = \alpha_c^q \cdot \left(\delta_c^q \cdot QM_{ct}^{-\rho_c^q} + (1 - \delta_c^q) \cdot QD_{ct}^{-\rho_c^q}\right)^{-1/\rho_c^t}$	16
$\frac{QM_{ct}}{QD_{ct}} = \left(\frac{PD_{ct}}{PM_{ct}} \cdot \frac{(1 - \delta_c^q)}{\delta_c^q}\right)^{1/(1 + \rho_c^t)}$	17
$QT_{ct} = \sum_{c\prime} (cd_{cc\prime} \cdot QD_{c\prime t} + cm_{cc\prime} \cdot QM_{c\prime t} + ce_{cc\prime} \cdot QE_{c\prime t})$	18
Incomes and expenditures	
$YF_{ft} = \sum_c WF_{ft} \cdot WD_{fct} \cdot QF_{fct}$	19
$YH_{ht} = \sum_f \omega_{hf} \cdot (1 - tf_f) \cdot (1 - rf_f) \cdot YF_{ft} + gh_h \cdot pop_{ht} \cdot cpi + wh_h \cdot X$	20
$PQ_{ct} \cdot (1 + ts_{cht}) \cdot QH_{cht} = PQ_{ct} \cdot (1 + ts_{cht}) \cdot \gamma_{ch} + \beta_{ch} \cdot \left((1 - sh_h) \cdot (1 - th_h) \cdot YH_{ht} \cdot pop_{ht}^{-1} - \sum_{c\prime} PQ_{ct\prime} \cdot (1 + ts_{cht}) \cdot \gamma_{c\prime h}\right)$	21
$QI_{ct} = IA_t \cdot qinv_c$	22
Incomes and expenditures continued	
$QG_{ct} = ga_t \cdot qgov_c$	23
$YG_t = \sum_h th_h \cdot YH_{ht} + \sum_f tf_f \cdot YF_{ft} + \sum_c (tm_c \cdot pwm_c \cdot QM_{ct} \cdot X + tq_c \cdot PQ_{ct} \cdot QQ_{ct}) + \sum_{ch} ts_{cht} \cdot Qh_{ct} \cdot pop_{ht}$	24
Equilibrium conditions	
$qfs_{ft} = \sum_c QF_{fct}$	25
$QQ_{ct} = \sum_{c\prime} ca_{cc\prime} \cdot QN_{c\prime t} + \sum_h QH_{cht} \cdot pop_{ht} + QG_{ct} + QI_{ct} + QT_{ct}$	26
$\sum_c pwm_c \cdot QM_{ct} + \sum_f (1 - tf_f) \cdot rf_f \cdot YF_{ft} \cdot X_t^{-1} = \sum_c pwe_c \cdot QE_{ct} + \sum_h wh_h + cab_t$	27
$YG_t = \sum_c PQ_{ct} \cdot QG_{ct} + \sum_h gh_h \cdot pop_{ht} \cdot cpi + FS_t$	28
$\sum_h sh_h \cdot (1 - th_h) \cdot YH_{ht} + FS_t + cab_t \cdot X_t = \sum_c PQ_{ct} \cdot QI_{ct}$	29
Capital accumulation and allocation	
$AR_{ft} = \frac{YF_{ft}}{qfs_{ft}}$	30

$$QK_{fct} \cdot \left(\sum_{c\prime} PQ_{c\prime t} \cdot ci_{c\prime}\right) = \left(\frac{QF_{fct}}{qfs_{ft}} \cdot \frac{WF_{ft} \cdot WD_{fct}}{AR_{ft}}\right) \cdot \left(\sum_{c\prime} PQ_{c\prime t} \cdot QI_{c\prime t}\right) \quad 31$$

$$QF_{fct+1} = QF_{fct} \cdot (1 - \upsilon) + QK_{fct} \quad 32$$

Land and labor supply, technical change, population growth, and other dynamic updates

$$qfs_{ft+1} = qfs_{ft} \cdot (1 + \varepsilon_f) \quad 33$$

$$\alpha^p_{ct+1} = \alpha^p_{ct} \cdot (1 + \sigma_c) \quad 34$$

$$pop_{ht+1} = pop_{ht} \cdot (1 + \varphi_h) \quad 35$$

$$ga_{t+1} = ga_t \cdot (1 + \tau) \quad 36$$

$$cab_{t+1} = cab_t \cdot (1 + \pi) \quad 37$$

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$$R = \sum_i (tc_i.\ P_i.Q_i + tm_i.pwm_i.M_i\ + te_i.pwe_i.E_i)\ + \sum_h (ty_h Y_h) + \sum_f (tf_f W_f \overline{VS_f}) \quad 39$$

$$R = \sum_i (P_i G_i) + FS \quad 40$$

$$I_t = \sum_h s_h Y_{ht} + FS_t + ER_t FSAV \quad 41$$

$$\overline{FSAV} + \sum_h hw_h + rw = \sum_i pwm_i M_{it} - \sum_i pwe_i E_{it} \quad 42$$

$$I.\varepsilon_i = P_i.N_i \quad 43$$

$$CA = TE - TM - NFI = S - I = \Delta NFA \quad 44$$
Where $TE = \sum_i pwe_i E_{it}$ and $TM = \sum_i pwm_i M_{it}$

$$S = \sum_h (s_h Y_h) + FS \quad 45$$

$$Y_h = \sum_{if} (\delta_{hf}\ (1 - tf_f) W_f.V_{if}) + hw_h \quad 46$$

$$R + rw = \sum_i (P_i G_i) + FS \quad 47$$

$$NFI = \sum_i hw_h + rw \quad 48$$

Source: Sudan CGE model, adapted from Diao and Thurlow (2012).