# Mali

# ECONOMIC UPDATE

## Special Chapter

Strengthening Financial Resilience
of Pastoralists to Drought

**THE WORLD BANK**
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# 2023 MALI ECONOMIC UPDATE

## Special Chapter: Strengthening Financial Resilience of Pastoralists to Drought

**April 2023**

**THE WORLD BANK**
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# ABBREVIATIONS, ACRONYMS

| | | | | |
|---|---|---|---|---|
| AGHRYMET | Centre Régionale de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle | | GDP | Gross Domestic Product |
| | | | GFN | Gross Financing Needs |
| | | | GHG | Greenhouse Gas Emissions |
| BCEAO | Central Bank of West African States | | G5 | Group of Five (G5 Sahel countries) |
| CAD | Current Account Deficit | | IBDRFI | Index-based Disaster Risk Financing Instruments |
| CCDR | Country Climate and Development Report | | | |
| | | | IBLI | Index-based Livestock Insurance |
| CCKP | Climate Change Knowledge Portal | | IMF | International Monetary Fund |
| CEMAC | Economic and Monetary Community of Central African States | | IPCC | International Panel on Climate Change |
| | | | IPSS | Infrastructure Planning Support System |
| CFAF | Franc de la communauté financière en Afrique (Franc of the Financial Community of Africa) | | | |
| | | | KLIP | Kenya Livestock Insurance Program |
| | | | MFI | Multilateral Finance Institution |
| CIMA | Commission Régionale de Contrôle des Assurances | | MFMod | The World Bank's Macro-Fiscal Model |
| | | | NDVI | Normalized Difference Vegetation Index |
| CMDT | Compagnie Malienne pour le Développement des Textiles | | | |
| | | | NGO | Non-governmental Organization |
| CMIP | Coupled Model Intercomparison Project | | NPL | Non-performing Loan |
| | | | PAGT | Plan d'action 2022–2024 du gouvernement de la Transition |
| CPI | Consumer Price Index | | | |
| CREDD | Cadre Stratégique pour la Relance Économique et le Développement Durable | | PPP | Purchasing Power Parity |
| | | | RCP | Representative Concentration Pathway |
| | | | | |
| DRFI | Disaster Risk Financing and Insurance | | REER | Real Effective Exchange Rate |
| DRIVE | De-risking, Inclusion and Value Enhancement of Pastoral Economies in the Horn of Africa | | SDR | Special Drawing Rights |
| | | | SIIPE | Satellite Index Insurance for Pastoralists in Ethiopia |
| | | | | |
| DSA | Debt Sustainability Analysis | | SOE | State-owned Enterprise |
| ECF | Extended Credit Facility | | SSP | Shared Socioeconomic Pathway |
| ECOWAS | Economic Community of West African States | | VAT | Value Added Tax |
| | | | WAEMU | West African Economic and Monetary Union |
| FDI | Foreign Direct Investment | | | |
| GCM | General Circulation Model | | WFP | World Food Program |

# ACKNOWLEDGEMENTS

# EXECUTIVE SUMMARY

**This 2023 Economic Update for Mali is articulated in two chapters, plus a spotlight.** The first chapter presents the economic and poverty developments observed in the country in 2022 as well as the outlook from 2023 to 2025. This chapter is followed by a summary of the macroeconomic-poverty impact analyses for Mali in the World Bank Sahel Country Climate and Development Report (2022). Chapter Two offers a deep dive on the potential from using disaster risk financing and insurance instruments to reduce adverse socio-economic impacts of climate shocks. While the analysis is about the establishment of such instruments to protect a key sector such as pastoralism, which engages around 80 percent of Mali's households, their use can be extended to other sectors such as agriculture.

**GDP growth has been resilient in the face of ECOWAS sanctions, high food inflation, and parasite infestations affecting cotton production.** The Bank estimates that the growth reached 1.8 percent (National Institute of Statistics' estimate of 3.7 percent. Real GDP growth for 2022 will be updated as new data, particularly on agricultural output, become available) in 2022. Based on this estimate and the population growth, the Bank estimates that per capita income fell by 0.9 percent, leading to an increase in poverty incidence, while delaying fiscal consolidation. This resilient growth was underpinned by the recovery of food agriculture from exceptionally low 2021 levels as well as the resilience of gold mining and trade and telecommunications. In contrast, export agriculture – cotton production – declined by nearly 30 percent, reflecting parasite infestations and the combined effects of the ECOWAS trade embargo and Russia's invasion of Ukraine on fertilizer costs and availability.

**Annual average inflation increased to 9.7 percent in 2022 (3.9 percent in 2021), mainly driven by food inflation,** which accelerated to 13.9 percent as a result of persistent insecurity forcing the displacement of farmers, the ECOWAS sanctions disrupting trade networks, and elevated global food prices.

**To counter inflation across WAEMU countries, the Central Bank of West African States (BCEAO) raised policy interest rates by a cumulative 75 basis points in 2022** (to 2.75 percent for liquidity calls and 4.75 percent for the marginal lending facility). BCEAO's international reserves dropped to 4.4 months of imports at end-2022 from 5.8 months at end-2021. At the same time, inflation in the WAEMU region rose sharply to 7 percent (y/y) in December 2022, driven by food and energy costs. To bring inflation back to its target range of 1 to 3 percent and anchor inflation expectations, the BCEAO raised key policy rates by 25 bps in June, September, and December respectively.

**The fiscal deficit stabilized at an elevated level of 5 percent of GDP in 2022.** After declining due to the sanctions, tax revenues recovered during the second half of 2022, and increased by 1 percent on the year despite fuel tax expenditures (foregone fuel excise and oil customs revenue at 1.9 percent of GDP). Meanwhile, wages (8 percent of GDP) and security (6.2 percent of GDP) spending increased in 2022, crowding out public investment (4.3 percent of GDP). With limited access to external financing, the fiscal deficit was mainly financed through expensive domestic borrowing on the regional market.

**Domestic revenue mobilization is hindered by costly and inefficient tax expenditures.** VAT exemptions on some products go beyond those authorized under WAEMU directives. Other costly tax expenditures include ad-hoc VAT exemptions per project under establishment agreements or exemptions from excise taxes (TIPP) on petroleum imports in the mining sector. Rationalizing these tax expenditures will help boost domestic revenue while supporting economic efficiency.

**Total public debt accumulation accelerated in 2022 due to the enlarged financing needs.** At end-2022, Mali's total stock of public debt is estimated to have increased to 55.2 percent of GDP from 52 percent of GDP at end-2021. External public debt

decreased slightly to 28.5 percent of GDP at end-2022 from 29.3 percent of GDP at end-2021 following the reduction of new external financing, while domestic debt reached 26.7 percent of GDP in 2022.

**Domestic debt has risen sharply in recent years and is fueling debt vulnerabilities with rollover risks**. Domestic debt rose by 9.2 percentage points of GDP over 2020–22, which has led to increasing annual debt servicing costs (rose by 0.5 percentage points of GDP over 2020–22). Given the limited external financing options over the medium-term, Mali will continue to rely predominantly on domestic financing from the regional debt market in 2023–24. The government adopted in 2022 an ambitious program of domestic issuances with longer maturity, which will require strong communication efforts with the market.

**Growth is expected to rebound to 4 percent in 2023, and average 4.5 percent over 2024–25, supported by a continued recovery of agriculture and services.** GDP growth is projected to remain lower than the country's potential (5 percent) reflecting the uncertainty around the political transition, insecurity, and the reduced fiscal space for growth-enhancing public investments. Despite these bottlenecks, export agriculture (cotton) and services, particularly trade and hospitality, are expected to rebound in 2023 and support growth in the medium-term.

**Mali will need to strengthen domestic revenue mobilization and manage spending pressures to create fiscal space and support fiscal sustainability.** The fiscal deficit is projected to stabilize at 4.9 percent in 2023 with tax administration measures improving revenue but could further increase if projected external grants (0.4 percent of GDP) do not materialize. The fiscal deficit is expected to gradually converge to the WAEMU ceiling of 3 percent, while public debt will increase to 55.9 percent by 2025 before gradually declining.

**This outlook is subject to multiple downside risks, in particular related to the timeline of the political transition, insecurity, tighter financial market conditions, and climate shocks.** A significant risk that has emerged over the past 12 months is the rising cost of financing on the regional market given Mali's high domestic gross financing needs. Tighter monetary policy has translated into higher yields for 6–12-month T-bills and 5-year T-bonds for WAEMU countries. In the past couple of months, several WAEMU countries, including Mali, have had uncovered auction experiences. As of end March 2023, Mali has so far raised CFAF 116.3 billion (8.3 percent of annual target) on the regional market. The liquidity and rollover risks and subsequent public finance difficulties could weigh on the wider economy and the society, through reduced social spending and investment and potentially a further built-up of arrears.

**The Sahel region is among the world's most vulnerable to climate change while having some of the highest poverty rates.** According to the International Panel on Climate Change (IPCC), most climate scenarios show that temperatures in the Sahel will rise by at least 2°C between 2021 and 2040, while rainfall patterns are projected to become more irregular. The Sahel CCDR (covering Burkina Faso, Chad, Mali, Mauritania, and Niger) projects that by 2050 the 5 countries' annual GDP would be reduced by 7 to 12 percent with 13.5 million additional poor due to climate change-related shocks *if* urgent investments in climate adaptation are not taken. Mali's annual GDP could be reduced by 10.7 percent due to climate change by 2050.

**Mali has already been severely exposed to recurrent droughts, floods, and locust invasions with major economic and social impacts.** Between 1970 and 2020, Mali experienced at least 40 major shocks. Drought for instance, is estimated to have affected about 400,000 people per year and reduced crop-related agricultural income by US$9.5 million annually. Locust infestations in 1985–88 and 2003–05 destroyed millions of hectares of crops, however, the impact on people was not recorded.

**Recurrent droughts have contributed to changes in vegetation characteristics and composition in Mali.** According to a technical feasibility assessment, these changes are caused by low, erratic, and variable rainfall with widespread inter-annual negative precipitation anomalies. This is particularly prevalent in the north of the country within the Sahara and Sahelian bioclimatic regions. In recent years, drought coupled with overgrazing, has led to losses in savanna structure, vegetation cover, and productivity.

Whilst some risk management and financing initiatives exist which focus on crop farmers, pastoralists and agro-pastoralists are an often-overlooked group which are acutely vulnerable to the impact of climate shocks. Pastoralists are typically found in the arid and semi-arid zones in the north, where rainfall is less than 400 mm per year. Agro-pastoralists are concentrated in the south, where rainfall is higher than 400 mm per year. Pastoralists (and agro-pastoralists) are among the poorest and most vulnerable parts of the population. Their vulnerability arises from overexposure and a lower ability to cope and recover from the shocks they experience.

Disaster risk financing and insurance (DRFI) provides mechanisms that aim to reduce adverse socio-economic impacts of climate shocks. These mechanisms can provide timely and targeted finance in response to or in expectation of a shock. DRFI approaches include market-based instruments (e.g., insurance schemes, catastrophe bonds and swaps), contingent financing (e.g., credit) and budgetary tools (i.e., a dedicated reserve fund or contingency budget).

Around 15 percent of Mali's land area is fully suitable for Index-Based Disaster Risk Financing and Insurance (IBDRFI) for pastoralists, while another 10 percent might be suitable with further analysis. Collectively, these areas host 63 percent of the national livestock herd. The central part of the country is characterized by fully suitable units. "*Rangeland review*" areas, where both arable farming and livestock production co-exist, are mainly located in the central western regions, and would require further evaluation for suitability. There are also "*forage review*" areas, mainly located in the north, for which further analysis is needed to assess the scope of grazing areas for livestock production. Both rangeland and forage areas meet all the technical criteria for DRFI but need to be further reviewed with local stakeholders to confirm their suitability for extensive livestock herding. This is because the land use in the related regions is mixed and includes crops.

**TABLE E.1** Policy Options to Strengthen Macro-Fiscal Sustainability and Financial Resilience to Climate Shocks

| Policy Objectives | Policy Options (with estimated costs and gains) |
|---|---|
| **Feasible to implement in the short-term (1 year)** | |
| Enhancing effective and targeted social spending to the most vulnerable | • Increase the coverage and targeting mechanism of the social programs, particularly the program of emergency cash transfers introduced in the context of the pandemic, to provide income to the poorest households. The government should continue identifying eligible beneficiaries in remote rural areas. |
| Mainstreaming disaster-risk financing in Mali's development agenda | • Conduct a stakeholder dialogue to define the policy priorities and objectives of IBDRFI. This dialogue could be anchored to the 2021-25 National Plan for Drought and involve multiple ministries, insurers, regulators, pastoral associations, international organizations, and relevant development institutions |
| Improving management of the wage bill | • Consider, taking into account the social context, examining wages, bonuses, and the compensation and wage setting policy in the civil service to strengthen efficiency and equity of the wage bill. This could pave the way for a harmonized framework, while reducing the scope of special categories (i.e., bonuses and special advantages). |
| **Important to implement in the medium term (2 to 5 years)** | |
| Increasing domestic revenue mobilization | • Reduce VAT and customs duty exemptions under the Investment Code and Establishment Agreements outside the mining sector. This could provide up to 0.38 percent of GDP in additional tax revenues |
| | • Phase out the petroleum excise (TIPP) exemption on imports in the mining sector as part of a general review of the taxation of this sector. This could generate up to 0.19 percent of GDP of additional tax revenues |
| Strengthening public debt management | • Establish a structural program for the exchange of securities close to their final maturity for securities with longer maturities. This could also help strengthen communication with market participants. |
| Enhancing stakeholder awareness of Index-based disaster risk financing | • Carry out continuous capacity building and awareness raising to improve insurance companies' knowledge, understanding, and experience of crop and livestock index insurance. This could involve both the private and public sector as well as institutions involved in providing agro-meteorological, extension, and emergency response services. As IBDRFI would be a new solution, public and private sector capacity building could cover the mechanics of insurance, roles and responsibilities, product design, and pricing |

# 1

# ECONOMIC AND POVERTY DEVELOPMENTS AND OUTLOOK[1]

*While the economy has been dominated by low productivity sectors for a long time, Mali is facing new challenges to switch to higher and more inclusive growth.*

**Mali's economy experienced little structural change over the last three decades.** Agriculture and low-productivity services dominate the economic and employment landscape, while manufacturing remains limited and concentrated in agro-industries and cotton ginning, Exports are dominated by gold and cotton, exposing the economy to commodity-price and climatic shocks. GDP growth per capita stagnated during the last decade limiting progress in poverty reduction while human development indicators show mixed results.

**Insecurity and a weakened social contract have emerged as key bottlenecks for inclusive growth.** In combination with the absence of the State

in remote areas, this has increasingly disrupted service delivery. Political instability has also become a significant risk factor to growth as evidenced by the six-month Economic Community of West African States (ECOWAS) sanctions in 2022 in response to the government's decision to delay elections initially scheduled for February 2022. The sanctions were lifted in July 2022, only after the transitional government

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[1] This report covers economic and poverty developments in Mali. For global trends, forecasts, and analysis of major developments impacting the global and regional economy, refer to the World Bank's Global Economic Prospects report. The Commodity Markets Outlook offers analysis for major commodity groups, and Africa's Pulse, a publication of the Office of the Chief Economist in the World Bank Africa Region analyses the short-term economic prospects for the continent and current development challenges.

agreed with ECOWAS on a timetable leading up to a series of elections over the period 2023–2024.

## Recent economic and poverty developments

*In 2022, GDP growth slowed to 1.8 percent and inflation rose to an average of 9.7 percent due to limited investment and higher global food and energy prices.*

**GDP growth has been resilient in 2022 despite multiple shocks including ECOWAS sanctions[2], high food inflation, and parasite infestations affecting cotton production.** Real GDP growth is estimated to have reached 1.8 percent in 2022. The subdued performance was mainly supported by the recovery of food agriculture (7.6 percent growth) from exceptionally low 2021 levels as well as the resilience of gold mining (4.2 percent growth). Meanwhile, some service sectors i.e., telecommunications, trade, and public services, showed signs of resilience despite the sanction-induced disruptions to trade flows (Figure 1.1). In contrast, export agriculture – cotton production – declined by nearly 30 percent in 2022. Inflation increased to 10 percent in 2022, mainly driven by food inflation which accelerated to 13.9 percent as a result of insecurity forcing the displacement of farmers, the ECOWAS sanctions disrupting trade networks, and elevated global food prices due to the reverberations of the war in Ukraine. The surging food costs has also exacerbated food insecurity challenges with 1,8 million food insecure households estimated during the lean season (June-August) of 2022 (CILSS, 2022) end 2022.

**Public investment declined due to limited budget resources while private consumption growth decelerated in 2022 (Figure 1.2).** The retrenchment of public investment is linked to several factors: (i) limited fiscal resources as a result of the trade embargo, (ii) quasi-fiscal measures to contain food and energy inflation in the wake of the war in Ukraine, and (iii) reduced donor support affecting externally funded investment spending. Meanwhile, the decline of private investment is related to persistent uncertainty over the political climate and the normalization of mining foreign direct investments from exceptionally high 2021 levels. Private consumption experienced a timid growth consistent with the recovery of food agriculture and despite the frictions caused by the ECOWAS financial sanctions on remittance inflows.

*Low growth and high inflation in 2022 are linked to persistent insecurity and limited domestic agricultural supply, which disrupted agro-food processing activities.*

**Food agriculture recovered in 2022, as a result of favorable weather conditions, in contrast to cotton production.** The upturn is also linked to relative security improvements in the Central regions but was limited by reduced and more costly access to fertilizers in a context of global supply constraints. Remote sensing data between June and August 2022[3] indicate that rainfall was adequate for crop development in the major growing regions in southern and western parts. As a result, cereal output is projected to increase from 8.8 million tons in 2021 to 9.5 million tons in 2022, driven by rice and millet productions. In contrast, export agriculture—cotton production—is projected to have contracted by 29 percent in 2022. The decline of the country's second largest export is related to several factors including: (i) lower yields linked to insect infestation affecting 175,000 hectares of crops; (ii) limited access to fertilizers due to global

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[2]  ECOWAS and the West African Economic and Monetary Union (WAEMU) imposed economic and financial sanctions on Mali between January 9, 2022, and July 3, 2022. The sanction measures, triggered by the postponement of general elections, included: (i) the suspension of commercial transactions with the rest of ECOWAS except for essential goods, (ii) the suspension of financial transactions with the region, including access to the money and capital market, (iii) the freeze of public assets being held at the Central Bank and regional commercial banks (BCEAO), and (iv) the suspension of regional financial assistance, mainly from the ECOWAS Bank for Investment and Development (EBID) and West African Development Bank (WADB). The government was denied access to the regional bond market and to its assets at the regional Central Bank (BCEAO).

[3]  FAO GIEWS Mali Country Brief, October 2022.

**FIGURE 1.1** | Supply Side Contributions to GDP Growth Showed Resilience Despite Pressure from Sanctions

Supply side contribution to growth



Legend: Agriculture — Industry — Services — Net Taxes on Production — Growth

*Source*: INSTAT, BCEAO, WBG and staff calculations.

**FIGURE 1.2** | Public Investment Contributed Negatively to GDP Growth in 2022

Demand side contribution to growth



Legend: Private consumption — Government consumption — Public investment — Private investment — Net export — Change in inventories — Growth

*Source*: INSTAT, BCEAO, WBG and staff calculations.

supply bottlenecks; and (iii) increased fertilizer costs in relation to the war in Ukraine.

**Industrial activity was resilient in 2022 supported by the 2021 successful cotton campaign and a resilient gold mining sector.** The exceptionally high cotton production of 2021 led to a recovery in 2022 of cotton ginning, which relies heavily on domestic cotton input. At the same time, limited 2021 food agricultural production, combined with disruptions caused by the ECOWAS trade sanctions to supply networks in the region and global bottlenecks, created significant shortages of critical food commodity inputs. This limited the output of agro-food processing. Despite the ECOWAS sanctions, industrial gold mining is estimated to have also rebounded (4.7 percent growth) to 66 tons in 2022, as the mining sector provisioned adequate stocks of inputs prior to the sanctions and few new mines have come onstream. Artisanal mining is estimated to have stabilized around 6 tons in 2022 despite insecurity in the South while construction sector was hampered by the impacts of the trade embargo on cement costs and availability.

**The service sector was resilient to the ECOWAS embargo in 2022, supported by**

**telecommunication and public sector.** The continued increase of the public wage bill and new spending to offset the socioeconomic impacts of food and energy inflation contributed to the strong public sector performance. A few other service sectors showed signs of resilience including trade and transportation which benefited from the adoption of alternative trading corridors to circumvent the impacts of the embargo. In contrast, private and financial services particularly in tourism and hospitality were severely affected by the closure of air and land borders between Mali and ECOWAS member-countries (except with Guinea), leading to several airlines suspending their connection to Bamako. For airlines that still served the capital, the sanctions led to costly rerouting of traditional corridors**.**

*Despite lower tax revenue and increased security and wage spending, the fiscal deficit stabilized at an elevated level of 5 percent of GDP due to significant investment cuts.*

**Despite increased digitalization efforts in tax administration, total revenue and grants declined in 2022 due to the ECOWAS embargo on trade,**

**FIGURE 1.3** Sanctions Hindered the Recovering Industrial Output and Sales to Return to 2016–18 Levels after the Pandemic Low
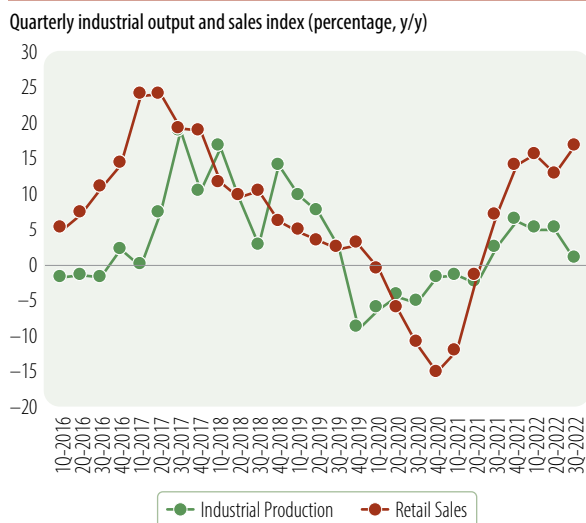
Quarterly industrial output and sales index (percentage, y/y)

Legend: Industrial Production, Retail Sales

*Source*: INSTAT, BCEAO, WBG and staff calculations.
*Note(s)*: 1/ Four-month moving average (4QMA) of quarterly growth (y/y) of industrial output and sales. Both series are indexed (2013=100).



**FIGURE 1.4** Food Inflation in Mali Exceeded the WAEMU Average in 2022
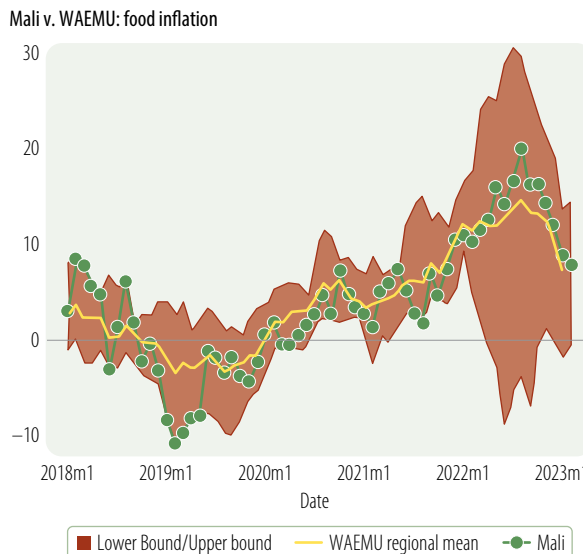
Mali v. WAEMU: food inflation

Legend: Lower Bound/Upper bound, WAEMU regional mean, Mali

*Source*: INSTAT, BCEAO, WBG and staff calculations.
*Note(s)*: 1/ Four-month moving average (4QMA) of quarterly growth (y/y) of industrial output and sales. Both series are indexed (2013=100).

**FIGURE 1.5** Monthly Inflation Peaked in August 2022, Mainly Driven by Food Inflation
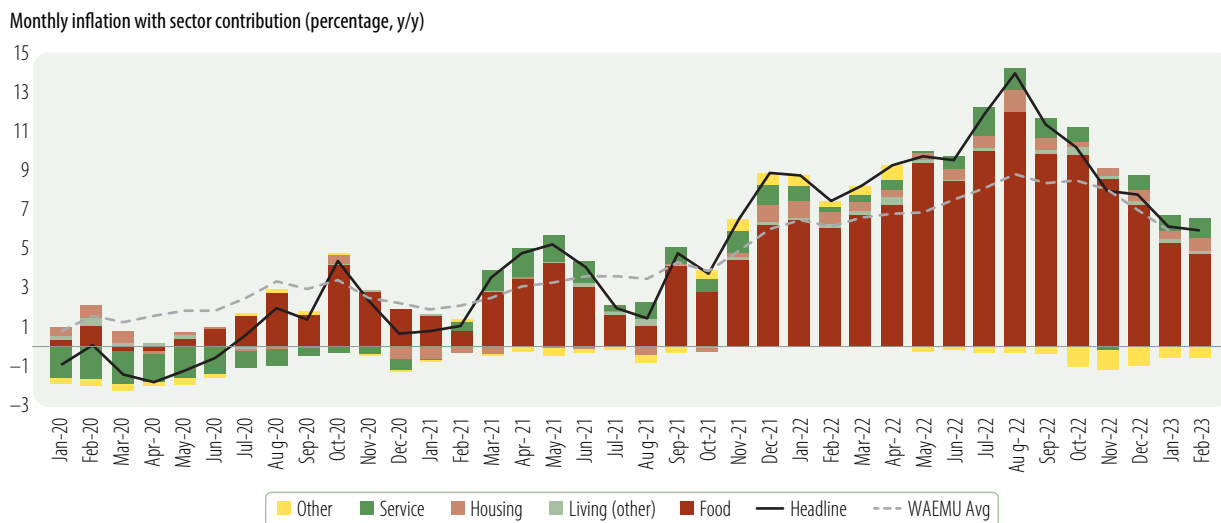
Monthly inflation with sector contribution (percentage, y/y)



Legend: Other, Service, Housing, Living (other), Food, Headline, WAEMU Avg

*Source*: INSTAT, BCEAO, WBG and staff calculations.
*Note(s)*: 1/ Four-month moving average (4QMA) of quarterly growth (y/y) of industrial output and sales. Both series are indexed (2013=100).

**international financial transaction, and limited revenue mobilization**. Due to the trade embargo, indirect taxes declined driven by VAT collections (fell from 5.7 percent of GDP in 2021 to 4.4 percent of GDP in 2022). Direct tax revenue performed relatively stable (5.1 percent of GDP) due to the recovery of business profits and the extension of electronic tax filing to medium and large enterprises in 2021. Tax revenue mobilization is still hindered by numerous exemptions and applications of inefficient and reduced

rates.[4] Meanwhile, external grants (projects and budget-related) continued to decline to 0.3 percent of GDP from 0.7 percent of GDP in 2021 as donor support has tightened in a context of heightened political uncertainty.

**The government's response to the food inflation crisis has also contributed to lower tax revenues in 2022.** To policy response included three categories of measures: (i) VAT and custom duty exemptions on major consumption items including rice, vegetable oil, wheat, cotton seedcakes with the goal of lowering producer prices, (ii) price controls of major staple food items effective through a memorandum of understanding with producers and (iii) food exports ban on major cereals with the objective of boosting domestic supply. Meanwhile, to offset the pass-through of global oil prices onto domestic pump prices and shelter real incomes, the government reduced customs and excise taxes on energy products in 2022. The quasi-fiscal measures are estimated by the government to cost around 12.8 percent of tax revenues (CFAF 215 billion) in 2022.

**The unfavorable revenue performance and the commitment to a gradual fiscal consolidation roadmap under the IMF ECF program led to contained spending in 2022.** Public expenditure declined to 24.4 percent of GDP in 2022. Meanwhile, current public spending stabilized around 15.9 percent of GDP in 2022, reflecting agreements with the trade unions that continued to drive up the wage bill since 2020. Security spending stabilized around 6.4 percent of GDP in 2022 (CFAF 704 billion). In contrast, capital spending experienced a significant decline, reaching 3.5 percent of GDP (CFAF 399 billion) in 2022 from 6.1 percent of GDP (CFAF 642 billion) in 2021 as a result of the larger current spending, lower externally funded capital spending, and the commitment to a gradual fiscal consolidation roadmap.

**The fiscal deficit remained high at 5 percent of GDP in 2022 despite social and security pressures.** The deficit was contained due to the commitment under the IMF ECF program[5] and limited financing options with (i) further retrenchment of donor support and (ii) the pausing of development assistance during the first half of 2022 in response to the ECOWAS sanctions. Despite the additional current spending needs, the fiscal deficit was contained in 2022 through cuts in capital expenditures. The deficit was financed predominantly through new issuances on the regional market, with limited external concessional loans.

*Public debt continued to rise in 2022 fueled by the higher fiscal deficit, with a growing share of expensive domestic debt as access to external concessional funding was limited.*

**The government was denied access to both regional and external financing during the first half of 2022 due to the ECOWAS financial sanctions.** This included a complete suspension of access to the regional bond market during the first half of 2022 which resulted in the cancellation of several debt issuance operations on the market (UMOA-titres). The government was also not able to honor its domestic and external debt service payments and the government issued a note to investors, highlighting their inability to process debt service payments despite sufficient resources. Following the lifting of the sanctions on July 3, 2022, the government moved quickly to clear all debt arrears to both domestic and external creditors and have since regained access to regional and external financing, during a moment

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[4]  A WAEMU directive (Directive 02-1998 further amended by Directive 02-2009) highlights the list of products eligible to the VAT exemptions, as well as the possibility of applying a reduced rate (between 5 and 10 percent) on an equally limited list. However, the VAT exemptions in place on some products in Mali (e.g., bread, baby bottles and teats, and agricultural inputs and equipment) go beyond those authorized by the WAEMU directive. There are also other costly tax expenditures such as VAT exemptions per project under establishment agreements or exemptions from excise taxes (TIPP) on the imports of petroleum products of companies in the mining sector during all phases of their projects (research, development, and exploitation). In a context of tight fiscal space, rationalizing these tax expenditures can help increase domestic revenue mobilization while supporting economic efficiency.

[5]  The ECF program 2019–2022 expired in August 2022, with only three out of the six reviews completed due to multiple events (COVID, coups and sanctions).

when regional market became increasingly saturated, and options of external financing limited.

**Total public debt accelerated in 2022 due to the enlarged financing needs.** At end 2022, Mali's stock of total public debt is estimated to have increased to 55.2 percent of GDP from 52 percent of GDP in 2021. The stock of domestic debt which increased substantially in recent years from 6.3 percent of GDP in 2014 to 22.7 percent of GDP in 2021 further accelerated in 2022, reaching 26.7 percent of GDP, as (i) interest costs on the rising portfolio of domestic debt continued to build up, (ii) financing needs remained high to tackle the social and security needs, and (iii) budget support from international donors has been subdued since the August 2020 coup. Meanwhile, external public and publicly guaranteed (PPG) debt decreased slightly to 28.5 percent of GDP at end 2022 from 29.3 percent of GDP at end 2021 due to the aforementioned reduction of external donor support since the August 2020 coup.

**The growing share of domestic debt in Mali's debt portfolio is fueling debt vulnerabilities with rollover risks**. The exceptional rise of domestic debt linked to (i) a retrenchment of donor support, (ii) larger spending needs in a context of multiple

shocks, and (iii) accommodative central bank policy with special COVID-financing windows, has led to increasing annual debt servicing costs, which rose by 0.5 percentage point of GDP over 2020–22. Given the limited external financing options over the medium-term, Mali will continue to rely predominantly on domestic financing from the regional debt market in 2023–24. To this end, the government adopted in 2022 an ambitious program of domestic issues with longer maturity, which will require strong efforts in terms of communication with the market. The recent BCEAO monetary tightening has further exacerbated refinancing risks on the regional debt and calls for a more proactive management of domestic debt.

*Despite a deterioration in the terms of trade, the current account deficit (CAD) narrowed in 2022 as the ECOWAS trade embargo kept imports low while cotton exports rebounded.*

**The sanctions-induced contraction of imports contributed to the narrowing of the CAD to 7 percent of GDP despite unfavorable terms of trade**. The CAD widened to 10 percent of GDP in 2021 on the back of deteriorating terms of trade and increased

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**FIGURE 1.6** | Reduced Yet Elevated Expenditures Brought the Fiscal Deficit to 5 Percent of GDP

Fiscal balance (percent of GDP)



■ Total revenue and grants  ■ Total expenditure  — Balance (RHS)
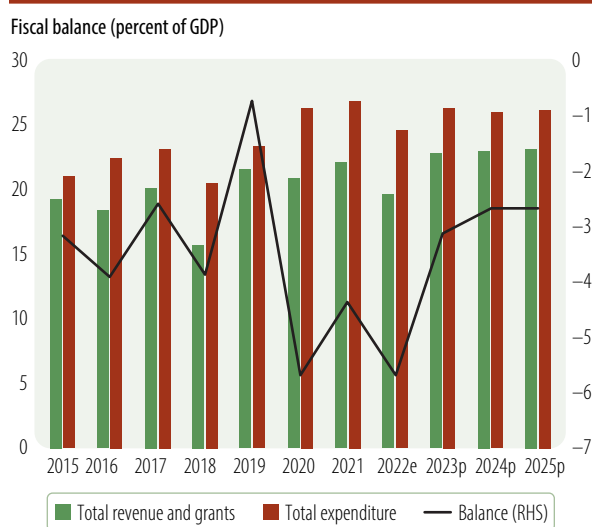
*Sources:* Government of Mali, IMF, WBG and staff calculations.

**FIGURE 1.7** | The Share of Domestic Debt Further Increased as Public Debt Reached a New High

Public debt stock (percent of GDP)



■ External debt  ■ Domestic debt  — Total debt stock

*Sources:* Government of Mali, IMF, WBG and staff calculations.

**FIGURE 1.8** Total Revenue and Grants Were Impacted by Tightened Donor Support and the ECOWAS Trade Embargo

Total revenue and grants: composition



Legend:
- Tax revenue
- Non-tax revenue
- Special funds and annexed budgets
- Grants
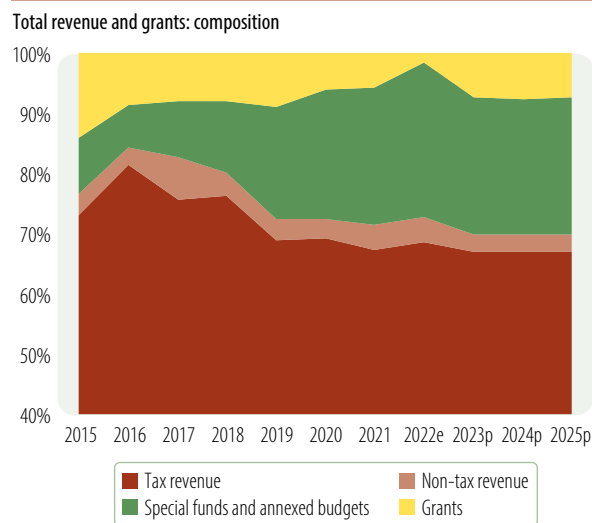
*Sources*: Government of Mali, IMF, WBG and staff calculations.

**FIGURE 1.9** While the Wage Bill Continued to Rise, Capital Spending Has Reduced Considerably in 2022

Total expenditures: composition



Legend:
- Wages and salaries
- Goods and services
- Transfer and subsidies
- Interest
- Capital spending
- Spedial funds and annexed budgets
- Net lending
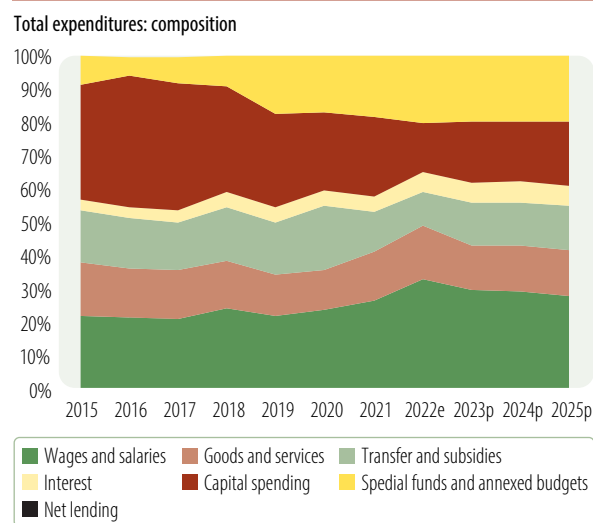
*Sources*: Government of Mali, IMF, WBG and staff calculations.

**FIGURE 1.10** Mali's Revenues Historically Exceeded the WAEMU Average and Continued to do so in 2022

Mali v. WAEMU: revenue_grants



Legend:
- Lower bound/Upper bound
- WAEMU regional mean
- Mali
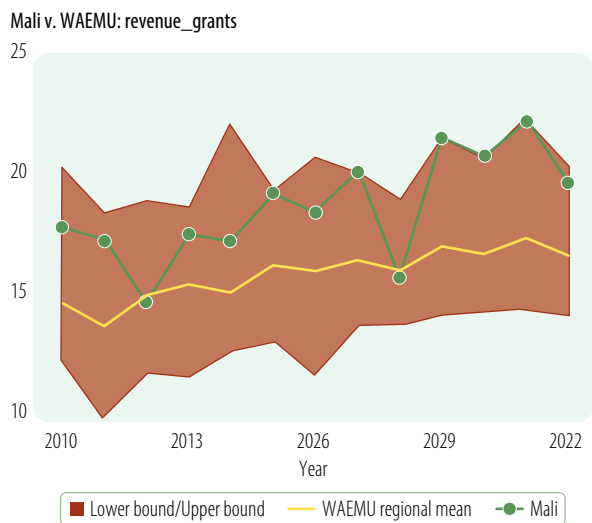
*Sources*: Government of Mali, IMF, WBG and staff calculations.

**FIGURE 1.11** Government Spending Converged to the Increasing WAEMU Average in 2022

Mali v. WAEMU: expenditure



Legend:
- Lower bound/Upper bound
- WAEMU regional mean
- Mali
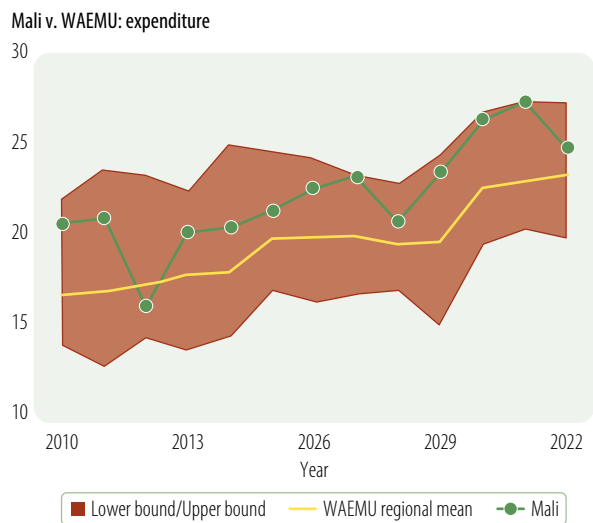
*Sources*: Government of Mali, IMF, WBG and staff calculations.

import demand. Merchandise imports contracted and are estimated to have reached 28 percent of GDP in 2022 from 28.6 percent of GDP in 2021 mainly due to the ECOWAS sanctions and the normalization of some import flows (mining equipment). Due to global infla-

tionary pressures, food, and oil imports—exempted from the ECOWAS sanctions—increased by 2.4 percent of GDP and 0.3 percent of GDP respectively in 2022 but were offset by declines in other imports (chemicals, cars, equipment) affected by the trade embargo.

Current account balance (percent of GDP)



Mercantile trade (net) · Service trade (net) · Primary income (net)
Transfers (net) · Current account balance

*Sources*: BCEAO, DSA, INSTAT, UMOA titres, IMF, WBG and staff calculations.
*Note(s)*: [a] Monthly commodity prices and terms of trade, all indexed (2012m6 = 100). TOT information available until end 2022.

FIGURE 1.13 | The Terms of Trade Deteriorated as Global Commodity Prices Climbed

Commodity prices and Terms of Trade (TOT)



Terms of trade · Gold · Cotton · Oil

*Sources*: BCEAO, DSA, INSTAT, UMOA titres, IMF, WBG and staff calculations.
*Note(s)*: [a] Monthly commodity prices and terms of trade, all indexed (2012m6 = 100). TOT information available until end 2022.

**Exports recovered in 2022, supported by the successful cotton campaign of 2021 and a resilient mining sector.** Mercantile exports increased to 26.8 percent of GDP in 2022 from 24.5 percent of GDP in 2021 as a result of the recovery of cotton exports (1.4 percent of GDP increase in 2022) in relation to the 2021 successful cotton campaign, and higher gold exports (1.3 percent of GDP increase in 2022) which continue to benefit from high international prices and the coming onstream of a few mining fields. Remittance inflows are estimated to have declined and stabilized around US$1,025 million (around 5 percent of GDP) in part due to the financial frictions induced by the suspension of financial flows imposed by ECOWAS sanctions.

**The financial account deteriorated significantly in 2022 with reduced official external flows.** The financial and capital account balance increased to 9.4 percent of GDP in 2021 due to exceptional FDI inflows in the mining sector (5.5 percent of GDP) and the IMF SDR allocations (1.3 percent of GDP), which were offset by private capital income outflows (1.8 percent of GDP). However, the financial account balance declined to 4.5 percent of GDP in 2022, due to lower private direct investments

(a decline of 1.1 percent points of GDP) in a context of high political uncertainty and clouded economic prospects, as well as lower external official flows particularly project (a decline of 0.6 percentage points of GDP) and budget support-related (decline of 0.2 percentage points) financial inflows. The external position deteriorated as a result in 2022, leading to an overall negative balance of payments (–2.5 percent of GDP), and contributing to the erosion of regional reserves at the BCEAO.

*Following the onset of an international monetary policy tightening, the regional central bank BCEAO raised the policy rate gradually in 2022 to counter inflation pressures.*

**Policy rates increased by 75 bps in 2022**. The gross international reserves of BCEAO declined from 5.8 months (end 2021) to 4.4 months of imports (end 2022). To bring inflation back to its target range of 1–3 percent and anchor inflation expectations, the BCEAO raised key policy rates by 25 bps in June, September, and December respectively. The minimum interest rate for tenders for liquidity injections was raised from 2 percent to 2.75 percent. The mon-

**FIGURE 1.14** | The REER Remained Relatively Stable Compared to the Nominal Exchange Rate's Upturn

Nominal exchange rate (CFAF per USD) and REER[a]



REER (LHS) — XOF (RHS)
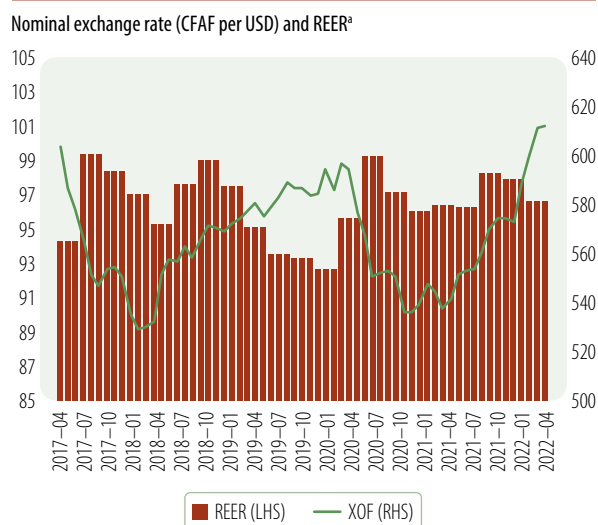
*Sources*: BCEAO, DSA, INSTAT, UMOA-titres, IMF, WBG and staff calculations.
*Note(s)*: [a] Index for REER (2013=100), exchange rate is expressed as XOF/USD, available until 2022Q2.

**FIGURE 1.15** | The Sectoral Distribution of Loans in the Banking Sector Did Not Change in 2022

Sectoral composition of loans[a]



Retail, wholesale and hospitality | Manufacturings | Other industries
Transport and ICT | Other services | Agriculture
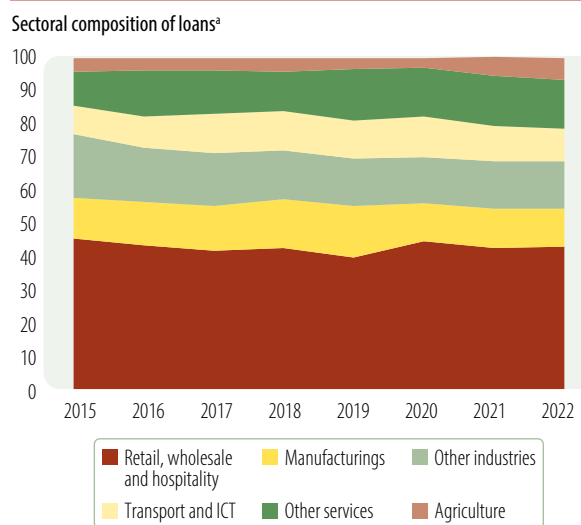
*Sources*: BCEAO, DSA, INSTAT, UMOA-titres, IMF, WBG and staff calculations.
*Note(s)*: [a] Information on the use of private credits as of 2022Q3.

etary tightening is necessary to contain inflation and the deterioration of external stance. It however could give rise to the liquidity risk.

**The banking sector so far remains sound, despite the adverse effects of the ECOWAS sanctions, while credits to the economy is projected to have decelerated in 2022**. As of June 2022, gross non-performing loans (NPLs) increased slightly to 10.3 percent (from 9.8 percent at end 2021) of total loans. The temporary regulatory forbearance on NPL classification and provisioning related to repayment difficulties due to COVID-19 and postponement of debt service falling due was suspended in December 2021 but helped contain the impact of the pandemic on asset quality. The banking sector was also impacted by the 2022 sanctions, which contributed to a concentration of loans to the state-owned cotton company (CMDT) to finance the agricultural campaign during the first half of 2022. The loans have however been repaid following the lifting of the sanctions, with limited impacts on banks' asset quality. Lending remains highly concentrated in sectors such as retail trade and hospitality, relatively more affected by recent shocks. Credit growth to the economy is estimated to have decelerated in 2022 (7.6 percent).

*Poverty has sharply increased in 2022 due to negative GDP per capita growth and high inflation, especially of food, which accounts for a large consumption share of the poor.*

Poverty in Mali, measured at the international extreme poverty line of $2.15 PPP a day, is estimated to have increased by 3.2 percentage points between 2021 and 2022. Correspondingly, this has led to an increase in the number of extreme poor from 3.5 to 4.3 million people by end 2022 (Figure 1.16). After a projected drop in the poverty rate to 12.4 percent in 2019, its lowest level for the period 2018-2022, poverty increased by 2.2 percentage points in 2020 due to a decline in agricultural production and the adverse effects of the COVID-19 resulting in widespread job losses and a sharp decline in labor income. The increase in poverty after 2019 continued in 2021 and 2022 due to the economic crisis linked to country's political instability, a drought in 2021, and the adverse effects of the Russia's invasion of Ukraine which has led to low growth and high inflation. The same trend is observed for the national poverty rate measured by the proportion of people living below the national poverty line. In fact, the national

poverty rate has increased from 42.1 percent in 2018 to 46.9 percent in 2022 (2022 poverty rate is a projection based on 2018 survey data based on economic growth) after a decrease at 38.1 percent in 2019. Rising food prices disproportionally affect poorer households as the average share of food expenditure in household budgets of the bottom 40 percent (60 percent) is slightly higher than the average for the overall population (58 percent). The effective rate of inflation faced by the bottom income quintile is 10 percent higher than the inflation rate faced by the top quintile.

**Growth in Mali is not estimated to have been pro-poor during the 2018–2022 period.** In fact, growth on average was likely negative over the period for all households. However, as shown by the growth incidence curve between 2018 and 2022 (Figure 1.17), the rate of decline was likely greater for the poorest deciles, i.e., just over 40 percent of bottom population, remained around the mean growth (just under 6 percent) for better off, and less than the mean growth for richest three deciles.

**Despite some recovery in agricultural growth in 2022, poverty is estimated to have increased.** The growth rate of real GDP per capita fell from 1.5 percent in 2019 to –4.3 percent in 2020 and

remained negative until 2022 with a rate of –1.3 percent. This significant decline is due to the health crisis, low growth in agriculture, which was partly affected by the security situation, and later to the war in Ukraine. While all sectors seem to have been affected by the adverse effects of COVID-19 with negative real GDP per capita growth rates in 2020, the agricultural sector was the least affected in 2022. However, even if this sector remains the one where the majority of the active population is concentrated, the high inflation (nearly 10 percent) recorded in 2022 led to a drop in the relative income of households and therefore an increase in poverty. Figure 1.18 and Figure 1.19 show that the majority of the Malian population works mainly in the agricultural sector, except for those in the three wealthiest deciles. The proportion of individuals working in this sector decreases from over 82 percent in the three poorest deciles to less than 20 percent in the richest decile. Unsurprisingly, poor households derive most of their income from the agricultural sector but in lower proportions than employment, reflecting the relative low productivity of the agricultural sector.

**Households have been negatively affected by high inflation.** The inflation is mainly driven by

FIGURE 1.16 | The Increase in Poverty Rate Was Driven by a High CPI and a Decline in Real GDP Per Capita

Poverty Trends in poverty, GDP growth and Inflation



Real GDP per capita
Nominal Ag GDP per capita
CPI
Poverty ( int'l, RHS)
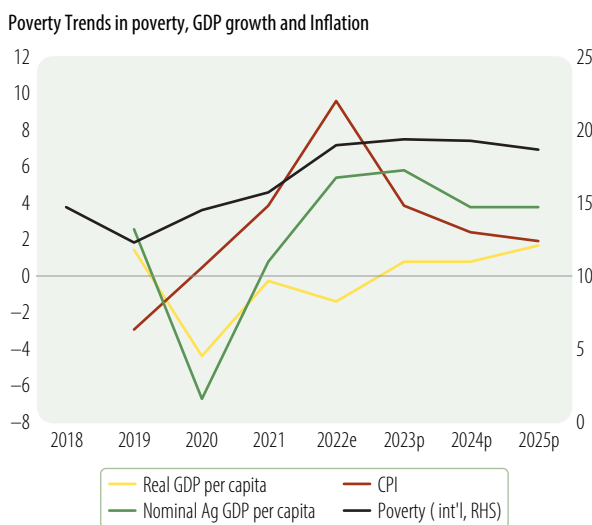
*Source*: EHCVM 2017-2018, WDI, staff projection and estimates.

FIGURE 1.17 | The Poorer Population Was Exposed More Strongly to Negative Mean Growth

Growth Incidence Curve



Percentile of income distribution in 2018

Growth rate 2018—2022
Mean growth 2018—2022
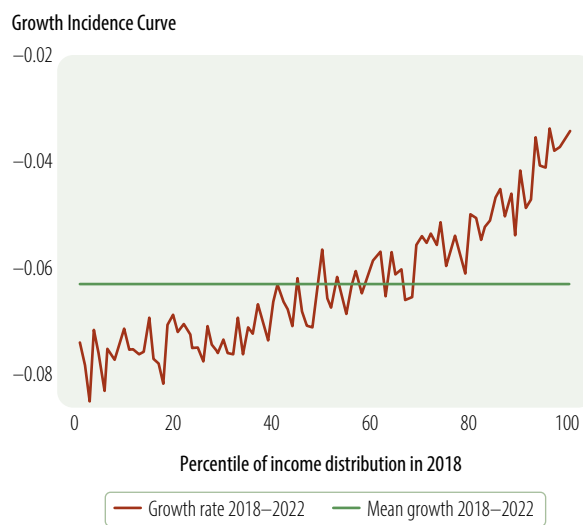
*Source*: EHCVM 2017-2018, WDI, staff projection and estimates.

**FIGURE 1.18** Services Offer Most of the Employment to the Highest Income Classes

Employment by Sector and Welfare Decile
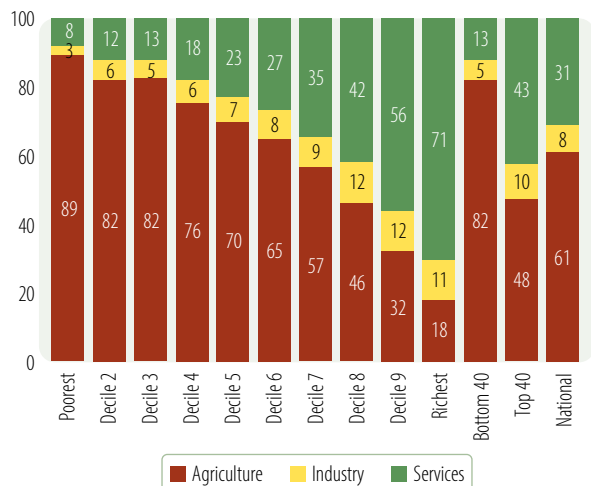


Source: EHCVM 2017-2018, WDI, staff projection and estimates.

**FIGURE 1.19** Agriculture Generates More than Half of the Income, Only in the 5 Poorest Deciles

Income by Sector and Welfare Decile
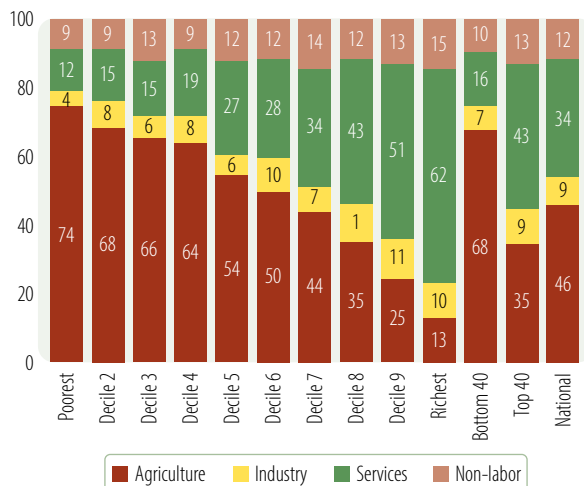


Source: EHCVM 2017-2018, WDI, staff projection and estimates.

**FIGURE 1.20** Given Higher Consumption, the Wealthiest Households Were Most Impacted by Rising Inflation

Household Specific Inflation Rates
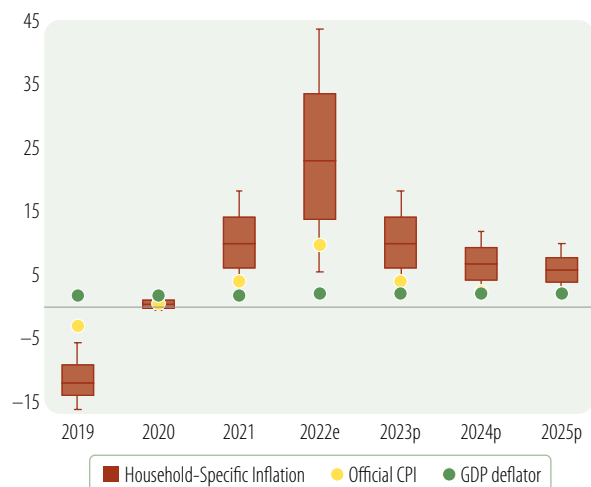


Source: EHCVM 2017-2018, WDI, staff projection and estimates.

rising cost of food (nearly 14 percent in 2021–2022 against 3.7 percent for non-food inflation). As households spend a slightly higher share of their income on food, poverty has increased following inflation. Moreover, inflation as measured by the CPI was much higher than the GDP deflator[6] which was stable during the period at around 2 percent, implying that household purchasing power lagged far behind what would be suggested by the growth in real GDP. To assess the true impact of rising prices on household wellbeing, an inflation index is constructed for each household, based on food and non-food inflation (measured by the CPI), weighted by the household's own consumption shares (Figure 1.20).[7]

**Greater diversification of the economy could help achieve more sustainable poverty reduction**. A significant portion of households (over 10 percent) living around the poverty line work in the service sector. The evolution in this sector could also affect poverty depending on how it affects households around this poverty line. The distribution of employment and income by sector and by welfare decile shows that greater diversification is likely to improve the well-being of the population.

---

6 The price of gold and raw cotton would be influential in the GDP deflator, but not at all in the CPI.

7 This household-specific weighting has little overall impact on poverty reduction, the main impact is adjusting household real consumption using inflation rather than assuming it grows proportional to real GDP.

## Economic and poverty outlook

*The economy is projected to rebound in 2023 before converging towards its potential level in 2024–25, supported by a recovery of export agriculture and services.*

**The economy is expected to rebound in 2023 with real GDP growth projected at 4 percent.** This remains lower than the country's potential output growth (5 percent) reflecting a few medium-term considerations: (i) the uncertainty around the political transition which lowers private investment prospects, (ii) persistent insecurity and its disruptive incidence on agriculture and service delivery, and (iii) the reduced fiscal space for growth enhancing public investments over 2023–25. Despite these bottlenecks, export agriculture (cotton) and services particularly trade and hospitality are expected to rebound in 2023 and will support growth in the medium-term. Annual inflation is projected to fall to 5 percent in 2023 due to the recovery of food agriculture and will normalize towards the regional target of 2 percent by 2025. High concentration of banks' lending and sovereign exposures exacerbates risks in an environment of tighter monetary policy. Cost of borrowing became more expensive during a moment when the country has limited options other than the increasingly saturated regional market.

**The CAD is projected to remain elevated at 6.2 percent of GDP in 2023, before gradually declining.** Import demand is projected to rebound in 2023 with the full resumption of commercial trade with the ECOWAS region and higher demand for oil and food imports alongside lower global prices. The terms of trade are also expected to improve in 2023 as oil prices decelerate. This will be offset by a decline of cotton and gold exports in 2023 consistent with the unsuccessful 2022 cotton farming campaign and the expected transition in the productive capacity of some mines. Remittance inflows are projected to rebound in 2023, with the absence of exceptional financial frictions linked to the ECOWAS sanctions. The CAD is expected to gradually decrease to 4.7 percent of GDP by 2025 following the easing of oil prices. Meanwhile, with the political uncertainty, external capital and financial inflows are projected to remain moderate in 2023 but expected to slowly pick up over 2024–25.

*The fiscal deficit will remain high in 2023 but is expected to gradually return to the regional ceiling of 3 percent of GDP consistent with the fiscal consolidation roadmap.*

**The fiscal deficit is projected to stabilize at 4.9 percent in 2023 with tax administration reform measures improving revenue, before gradually converging to the WAEMU ceiling of 3 percent.** This is consistent with the spending programming in the 2023–25 medium-term expenditure framework. Tax revenue is expected to recover in 2023 with higher economic growth, the reduction of exceptional tax expenditures, and the extension of electronic tax filings. Spending is projected to be reprioritized towards capital investment, while the wage bill is expected to stabilize in 2023 before experiencing a modest decline over 2024–25. The retrenchment of donor support left the country with limited external financing options. Financing needs are projected to grow to 12.1 percent of GDP in 2023 and will need to be predominantly covered by domestic borrowing on the regional market. Following the fiscal consolidation roadmap, the deficit should continue to decline to 3 percent of GDP by 2025, supported by programmed fiscal policy reforms and continued improvement in expenditure efficiency. Public debt will increase to 56 percent of GDP by 2025.

*Poverty is expected to decline only modestly over the medium term as inflation remains elevated at least in 2023 and GDP growth remains below potential.*

**Poverty is expected to slightly decline over the next 3 years; however, growth is not expected to be pro-poor.** Growth is expected to be 4 percent in 2023 and 2024, with a real GDP per capita growth rate of 0.9 percent for each year. Given relatively high inflation in 2023, poverty is expected to slightly increase to around 19.5 percent in 2024, before declining to 18.8 percent in 2025 thanks to a higher growth rate (1.8 percent) and lower inflation. Growth projections are expected to be moderate in the three sectors (agriculture, indus-

try, and services) mostly between 2.9 and 4.5 percent. Household welfare is expected to decline for all deciles of households in 2023 and have limited change in 2024 (Figure 1.21 Poorer households have experienced stronger negative growth rates and are projected to benefit less from future growth). Growth in 2025 is expected to resume with higher growth in services, but this growth is not expected to be pro-poor, resulting in a very slight decline in poverty over the medium term.

*This outlook is subject to multiple downside risks, in particular related to the timeline of the political transition, insecurity, tighter financial market conditions, and climate shocks.*

**The outlook remains subject to significant risks on the timeline of the political transition, the security crisis, and climatic shocks.** Further delays in the electoral timetable could trigger another round of economic sanctions and further reduce external grants and loans that support development spending in the budget. A heightened political uncertainty would also hang over private investment including FDI and financial flows and growth. Meanwhile, rising insecurity in

the Center continues to hang over agricultural and pastoral activities in the Northern regions. In 2022,

**FIGURE 1.21** Poorer Households have Experienced Stronger Negative Growth Rates and are Projected to Benefit Less from Future Growth

Household welfare growth by decile and year
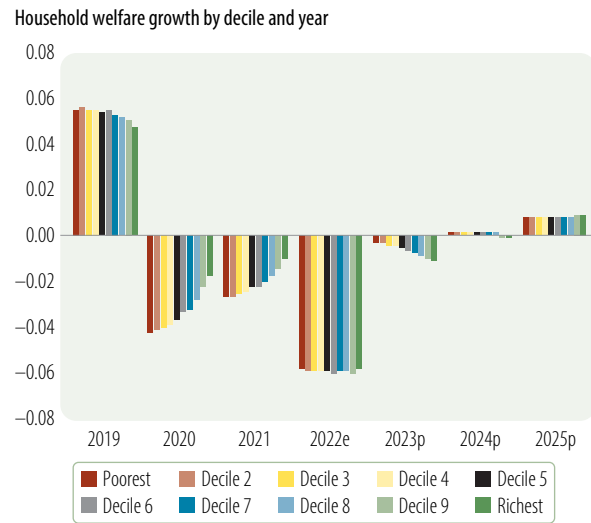


*Source*: EHCVM 2017-2018, WDI, staff projection and estimates.

**FIGURE 1.22** Russia's Invasion of Ukraine at end-February 2022 Marks the Turning Point for Government Bond Yields in WAEMU
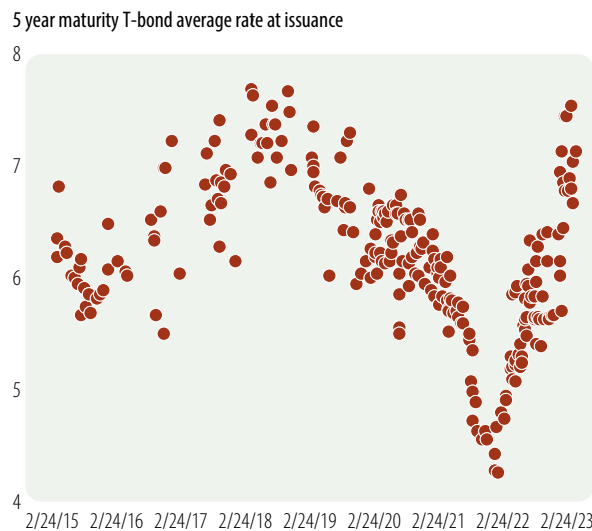
5 year maturity T-bond average rate at issuance



*Sources*: BCEAO, DSA, INSTAT, UMOA-titres, IMF, WBG and staff calculations.
*Note(s)*: Projected gross financing needs (GFN) for 2023 based on latest DSAs.

**FIGURE 1.23** The Share of Domestic Gross Financing Needs is the Highest in Mali among WAEMU Peers
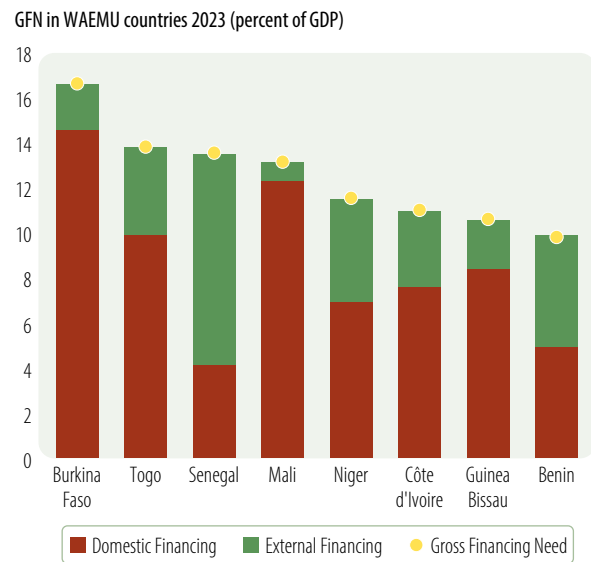
GFN in WAEMU countries 2023 (percent of GDP)



*Sources*: BCEAO, DSA, INSTAT, UMOA-titres, IMF, WBG and staff calculations.
*Note(s)*: Projected gross financing needs (GFN) for 2023 based on latest DSAs.

violent incidents accelerated in the country, with growing numbers of reported fatalities. Importantly, violence now affects agricultural strongholds in the Center region.

A significant risk that has emerged over the past 12 months is the rising cost of financing on the regional market given Mali's high domestic gross financing needs. Tighter monetary policy has translated into higher yields for 6–12-month T-bills and 5-year T-bonds for WAEMU countries. In the past couple of months, several WAEMU countries, including Mali, have had uncovered auction experiences. As of end March 2023, Mali has so far raised CFAF 116.3 billion on the regional market, corresponding only to 8.3 percent of the annual target (CFAF 1409 billion). The country even cancelled a bond issue (March 22, 2023) on the regional market.

The liquidity risk and subsequent public finance difficulties could weigh on the wider economy and the society, urging a timely and high-quality fiscal consolidation. Given the limited source of affordable financing (external and domestic), fiscal consolidation is eminent with emphasis on the spending efficiency and domestic resource mobilization. Without a timely and high-quality fiscal consolidation, government could be forced to cut outlays starting from non-essential spending, such as current transfers and subsidies (to key utility companies that are SOEs, and to local governments) and investment, which may further impact basic service delivery especially in non-capital area and impact growth. A more severe spending cut affecting the wage bill payment could add to social tensions. The government could potentially run further arrears to suppliers or overdraft from commercial banks, disturbing business activities and crowding out credits to the economy.

## Spotlight: Sahel Country Climate and Development Report

*This spotlight summarizes the key macroeconomic-poverty impact analyses for Mali in the Sahel Country Climate and Development Report (CCDR) covering Burkina Faso, Chad, Mali, Mauritania, and Niger.*[8]

Burkina Faso, Chad, Mali, Mauritania, and Niger are among the world's most vulnerable to climate change[9] while having some of the highest poverty rates. Sustaining economic growth to reduce poverty is already a challenge in the Sahel with growth volatile and subject to multiple shocks, notably political instability, insecurity, as well as climatic shocks, including frequent and intense droughts and floods. According to the IPCC, most climate scenarios show that temperatures in the Sahel will rise by at least 2°C in the near term (2021 to 2040) while rainfall patterns are projected to become more irregular, with sudden oscillations between very wet and very dry years. The Sahel CCDR projects that by 2050 the 5 countries' annual GDP would be reduced by between 7 to 12 percent with 13.5 million additional poor due to climate change-related shocks *if* urgent investments in climate adaptation are not taken.

However, the CCDR shows that adaptation measures can substantially reduce the economic losses and that there are significant opportunities for resilient growth and lower-carbon development in the Sahel. With judicious pro-climate policies and investments in priority areas, Mali and the other Sahel countries can stimulate growth, bolster resilience and reverse environmental degradation and

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[8] G5 Sahel Country Climate and Development Report (CCDR), World Bank, September 2022. The World Bank Group's CCDRs are new analytical reports from the World Bank Group analyzing the linkages between growth, development and climate change. CCDRs build on data and rigorous research and identify main pathways to reduce GHG emissions and climate vulnerabilities, including the costs and challenges as well as benefits and opportunities from doing so. The reports suggest concrete, priority actions to support the low-carbon, resilient transition. As public documents, CCDRs aim to inform governments, citizens, the private sector and development partners and enable engagements with the development and climate agenda. CCDRs will feed into other core Bank Group diagnostics, country engagements and operations.

[9] According to several global indices, including the Notre Dame Global Adaptation Initiative (ND-GAIN) Country Index which summarizes a country's vulnerability to climate change in combination with its readiness to improve resilience. Countries are ranked from 1 (lower risk) to 182 (higher risk). Mali is ranked 170 (high risk).

## BOX 1.1: IMPACT CHANNELS - MODELING THE LINK BETWEEN CLIMATE CHANGE AND THE ECONOMY

The modelling of impact channels used country-specific climate scenarios and biophysical effects models to estimate economic damages for each channel. The damages were introduced as shocks into a macro-structural model developed for each country to estimate impact on GDP and other macroeconomic aggregates. The six impact channels modelled are as follows (*for further details see Annex 3.4*):

1. **Rainfed crop yields.** *Agricultural productivity shocks:* Impact on annual crop yields, based on crop yield responses to changes in temperature and precipitation.
2. **Heat stress and labor productivity.** *Labor productivity shocks:* Impact on labor productivity due to heat stress on outdoor work in the agriculture, industry, and service sectors
3. **Heat-related human health shock.** *Health shocks on labor productivity*: Impact on total labor productivity from health shocks (disease) due to temperature changes.
4. **Livestock yields.** *Livestock productivity shocks*: Impact due to heat stress on animals and reduced availability of pastures to graze due to temperature and precipitation changes.
5. **Inland flooding.** *Capital damages due to precipitation changes*, considering floodplains, design flood events, spatial distribution of capital, and run-off dynamics.
6. **Roads and bridges.** *Capital damages to road and bridges* due to temperature and precipitation changes, and flooding effects across paved, gravel, and dirt roads.

maximize the benefits of climate action for the poor. The costs of inaction are far greater than the costs of action. While the fiscal capacity to invest in adaptation measures is limited, there are opportunities for expanding the use of risk financing instruments. One such opportunity to strengthen the country's financial resilience to drought is explored in Chapter 2.

*All climate scenarios predict an increase in mean temperature in Mali, while there is more uncertainty on precipitation.*

**There is considerable uncertainty on global emission trajectory and differences across different climate models.** The CCDR models the economic and poverty impact of climate change through six impact channels for each country for the period 2021–2050. To account for uncertainty, the CCDR models the impact of climate change for each of the five countries under six different emission scenario and climate model combinations ("climate scenarios") and presents estimates of economic and poverty impacts under four of them: (i) pessimistic (higher temperature increases and larger precipitation changes); (ii) optimistic (lower temperature increases and smaller precipitation changes); (iii) wet (largest precipitation

increases); (iv) and dry (smallest (or decrease) precipitation changes). *See Annex 3.4 for details.*

**All climate scenarios predict an increase in mean temperatures in Mali, with the size and structure of the economy affecting the nature and magnitude of the impacts of climate change.** Mean temperature increases by 2050 are 0.8°C and 1.7°C under the optimistic and pessimistic climate scenarios, respectively. The majority of climate scenarios predict an increase in precipitation.[10] Under the wet climate scenario, precipitation increases by 24 percent; however, under the dry climate scenario, precipitation declines by 7 percent. All other scenarios predict increases in precipitation. For each country, three baseline growth scenarios (where the economy is not subject to impacts of further climate change) were developed: low, medium, and high growth.[11]

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[10] Higher precipitation does not necessarily mean greater water availability, since simultaneous higher temperatures can cause higher evaporation.

[11] The low-growth scenario is one of stagnation or a minimal increase in per capita income, characterized by increased fragility, conflict and violence (FCV) with no structural transformation and high population growth. The medium-growth scenario is based on historical episodes of sustained growth performance, with increase

**FIGURE 1.24** Mali Could Lose between 6.4 and 10.7 Percent of GDP by 2050

G5 Sahel Annual GDP loss by 2050 from climate change with no adaptation



Wet and Optimistic Climate Scenarios
Dry and Pessimistic Climate Scenarios

*Source*: G5 Sahel CCDR.

**FIGURE 1.25** High Annual Variability in Climate Shocks Increases Volatility of Growth

Mali: Annual livestock yield shocks with no adaptation



- - - Dry Annual  - - - Wet Annual  ——Dry 5-yr Avg  ——Wet 5-yr Avg

*Source*: G5 Sahel CCDR.

*Large GDP losses, growth volatility and significant increases in poverty and inequality are expected from climate change shocks if no adaptation measures are taken.*

**In the Sahel, large economic output losses are expected from climate change, with losses increasing over time.** The losses are significantly higher under the dry and pessimistic climate scenarios. By 2050, annual GDP could be reduced by 7 to 12 percent across the Sahel if no adaptation measures are taken. Figure 1.24 shows the annual GDP loss as the percentage deviation from the baseline GDP by 2050. Importantly, these estimates are likely to underestimate the impact from climate change because not all impact channels are included and because they do not include the magnifying effects of climate-induced changes in ecosystems, increases in conflicts, and migration shifts.

**By 2050, annual GDP in Mali would be reduced by 6.4 percent under the wet and optimistic scenarios and 10.7 percent under the dry and pessimistic scenarios by 2050** (Figure 1.26). Under the wet and optimistic climate scenarios, the largest negative impacts come via the heat-labor productivity channel (annual GDP loss of –4.2 percent

by 2050) and the roads and bridges channel (annual GDP loss of –3.6 percent by 2050), and there is a positive impact via the livestock yields channel. Under the dry and pessimistic climate scenarios, all channels yield negative impacts, with the largest from the heat-labor productivity channel (annual GDP losses of –6 percent by 2050), followed by the livestock yields channel. *Results are presented for the medium-growth baseline scenario, other scenarios are in the Annex 3.4.*

**Large annual variability in the shocks to rainfed crop and livestock yields pose additional challenges for the agriculture sector and food security.** Figure 1.25 shows livestock yield shocks under dry and wet climate scenarios. In one year, the shock can be large and positive, while in the next it can be large and negative. Even if across the entire period the net impact is small, the volatility creates challenges for households and the wider economy and contributes to food insecurity.

in labor productivity and some structural transformation. The higher-growth scenario has a growth rate 50–100 percent higher than the medium-growth scenario with significant structural transformation, reduction in FCV and realization of the demographic dividend.

**FIGURE 1.26** | Lower Labor Productivity Due to Heat Stress and Damages to Roads and Bridges Drive GDP Losses under a Wet and Optimistic Climate Scenario

Mali: Annual GDP loss from climate change with no adaptaion (wet and optimistic)



Legend:
- Rainfed crops yield
- Livestock yield
- Labor productivity (Heat stress)
- Labor productivity (Health impacts)
- Flooding
- Roads and Bridges
- ● Total GDP Impact

*Source*: G5 Sahel CCDR.
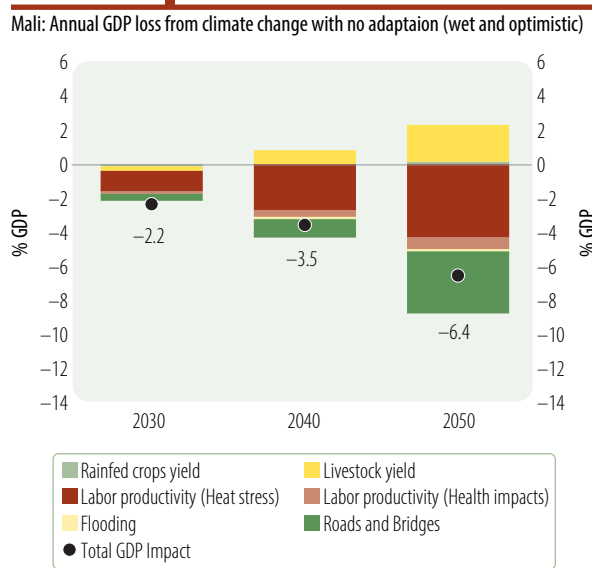
**FIGURE 1.27** | Lower Labor Productivity Due to Heat Stress and Lower Livestock Yields Drive GDP Losses under a Dry and Pessimistic Climate Scenario

Mali: Annual GDP loss from climate change with no adaptaion (dry and pessimistic)



Legend:
- Rainfed crops yield
- Livestock yield
- Labor productivity (Heat stress)
- Labor productivity (Health impacts)
- Flooding
- Roads and Bridges
- ● Total GDP Impact

*Source*: G5 Sahel CCDR.
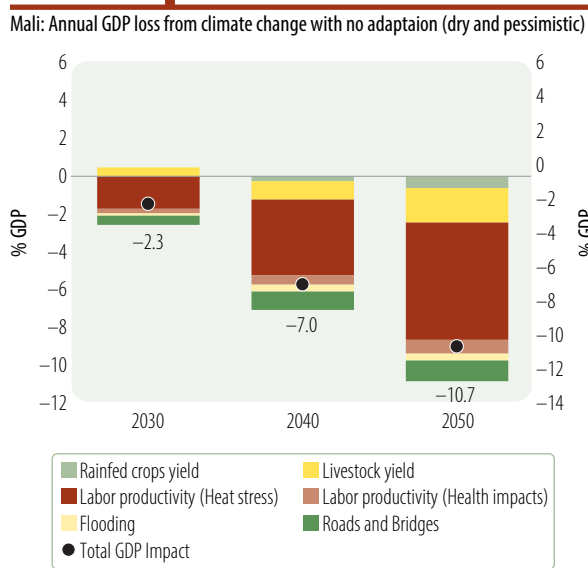
**The challenge of reducing poverty in the Sahel given high population growth rates will be exacerbated by climate change.** By 2050 there could be an increase in the poverty rate of the G5 Sahel countries from 27 percent projected under the medium-growth baseline scenario (no climate change) to 29 percent under the wet and optimistic scenarios and 34 percent under the dry and climate pessimistic scenarios. This translates to an additional 4.1 to 13.5 million people falling into poverty. In Mali, by 2050, the poverty rate will increase relative to the medium-growth baseline by 2.3 percentage points under the wet and optimistic scenarios and 4.7 percentage points under the dry and pessimistic climate scenarios, which translates to an additional 2.21 million people falling into poverty.

**Inequality will increase and climate change will have a heterogeneous spatial effect in the Sahel with higher poverty impacts in rural areas**, including in some of the most vulnerable border communities in Chad, Niger, and Mali. Given the large negative impacts of climate change on poverty and the challenge to fully adapt, expanding adaptive safety nets and other poverty reduction programs will be critical.

*The results highlight that accelerating economic growth with significant investments in adaptation and climate resilience is essential for Mali and the rest of Sahel.*

**Growth and structural transformation will make the economy more resilient to climate shocks.** Agriculture is more affected by droughts, floods, and extreme heat than other sectors so a shift to industry and services would reduce the impact of climate change. Moreover, the richer a country is, the more resources the government, firms, and households will have to invest in adaptation and to cope with adverse climate-related shocks. Finally, economic growth is essential to "offset" economic losses from climate change and to enable the increase in GDP per capita needed to reduce poverty.

**The benefits of adaptation outweigh the costs:** The CCDR modelled potential adaptation interventions for three of the impact channels: (i) expanded irrigation for rainfed crops; (ii) improvements in livestock feed practices; and (iii) and investments in climate resilient road and bridges. The analyses show that damages from climate change can

be significantly reduced even with partial adaptation. In Mali the loss from climate change is 10.7 percent of GDP by 2050 without adaptation and only 6.7 percent of GDP with partial adaptation (i.e., the three interventions modelled). *See Annex 3.4 for more details.*

**To accelerate resilient growth in the context of climate change, the G5 Sahel CCDR identifies measures, policies, and investments in five priority areas:** (i) Institutions; (ii) Climate Financing and Risk Mitigation; (iii) Energy (which highlights the opportunity to develop in a low-carbon pathway by making the most of the region's large renewable energy potential while meeting increased demands of a larger economy); (iv) Landscapes (integrated management of natural capital agriculture, water and environment); and (v) Cities (resilient urban development). Chapter 2 presents options in the second of these, specifically looking into strengthening the country's financial resilience to drought.

# 2

# STRENGTHENING FINANCIAL RESILIENCE OF PASTORALISTS TO DROUGHT

**For a country with limited domestic resources stretched among competitive needs, climate finance and the private sector must provide significant funding to achieve development goals.** Disaster risk financing and insurance (DRFI) provide mechanisms that aim to reduce socio-economic impacts of climatic shocks, while protecting key sectors with timely support. This section of the 2023 Mali Economic Update focuses on the establishment of such instrument for pastoralists, a sector that accounts for about 15 percent of GDP. However, the following discussion abstracts from political economy and fragility considerations linked to the interrelations between agro-pastoral activities, climate change and competition over natural resources and conflicts. First, the chapter provides an overview of the relevance of financial protection against drought to the sector. Then it presents how index-based drought risk

financing solutions have been adopted in other African countries such as Kenya and Ethiopia. After a section focusing on the results of a feasibility assessment of the socio-economic, technical, and operational conditions of an IBDRFI system in Mali, the final part outlines some policy options that could be considered when developing such scheme to protect the most vulnerable pastoral households in the country.

## Why financial protection from drought shocks is relevant for pastoralists in Mali

**Mali is severely exposed to recurrent droughts, floods, and locust invasions.** Between 1970 and 2020, Mali experienced at least 40 major shocks. While floods occurred 26 times, droughts occurred

only nine times, but the latter had a more significant impact—affecting over 14 million people (Figure 2.1). Drought is estimated to have affected about 400,000 people per year and reduced crop-related agricultural income by US$9.5 million annually. By 2030, these figures may rise to 650,000 and US$35 million, respectively.[12] Locust infestations in 1985–88 and 2003–05 destroyed millions of hectares of crops, however, the impact on people was not recorded. Given challenges with data collection, impacts of natural disasters, including those induced by climate change and variability, are often underestimated.

**Agriculture as a whole is highly exposed to drought risk. This includes the livestock sector, which is one of the most important economic sectors in Mali and among the largest in the region**. Around 70% of the Malian population is engaged in agriculture, most of whom in crop farming. As the vast majority of farms is rainfed, farmers are particularly vulnerable to droughts. Livestock farmers are also very exposed. The livestock sub-sector accounts for 40 percent of primary sector GDP and around 15 percent of the national GDP. Around 85 percent of farmers raise livestock, and the sector generates income for about 30 percent of the population (about six million people). Among the ECOWAS countries, Mali has the second largest herd of livestock after Nigeria.[13] There were an estimated 60.1 million heads of livestock in Mali in 2019, excluding poultry.[14] This national herd is largely composed of goats (43 percent), sheep (31 percent) and cattle (20 percent), while camels, donkeys, horses, and pigs comprise the remaining 6 percent. Livestock is also a significant export sector, with cattle export revenue accounting for 3 percent of total exports in 2021, and most livestock exported to Côte d'Ivoire, Ghana, and Senegal.

**Pastoralists and agro-pastoralists remain an often-overlooked yet acutely drought-vulnerable group.** Pastoralists (i.e., those that raise livestock as the primary means of economic activity) are typically found in the arid and semi-arid zones in the north, such as in Tombouctou, Gao, and Kidal, where rainfall is less than 400 mm per year. Agro-pastoralists (i.e., those that grow crops and raise livestock) are concentrated in the south, where rainfall is higher than 400 mm per year. Pastoralists (and agro-pastoralists)

Number of people affected by disasters between 1970 and 2022 in Mali
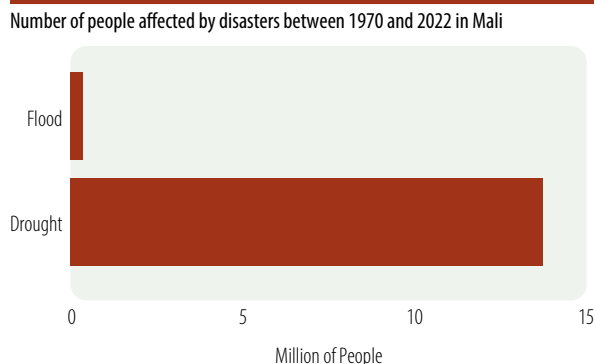


*Source*: G5 Sahel CCDR.

are among the poorest and most vulnerable parts of the population. Typically, the poorest are the most severely affected by climate-related natural disasters. Their vulnerability arises from overexposure and a lower ability to cope and recover from the shocks they experience.[15]

**The pastoralists' plight is reflected by the historic multi-year droughts that led to major food crises.** While extensive grazing practices in the low-precipitation regions in the central north can be productive, droughts invariably lead to reduced forage and water availability. This reduces livestock productivity and can result in significant losses of productive assets, income, and wealth. Over the past five decades, the most severe droughts leading to major food crises occurred in 1972–74, 1983–85, 2002–04, 2011–12, and 2015–18.[16] These major droughts have

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[12]  World Bank Group (2019). Disaster Risk Profile Mali.

[13]  Based on FAOSTAT data for 2019, Mali has a larger herd than Niger in terms of head of livestock (60.1 versus 50.6 million). However, Niger has a larger number of tropical livestock units (20.9 vs. 18.4 million in Mali). Food and Agriculture Organization (FAO) (2021). FAOSTAT Data.

[14]  FAO (2021).

[15]  Hallegatte, S., A. Vogt-Schilb, M. Bangalore, and J. Rozenberg (2017). Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters. Climate Change and Development. Washington, D.C.: World Bank.

[16]  World Bank Group (2022a). G5 Sahel Region Country Climate and Development Report. CCDR Series. Washington, D.C.: World Bank.

adversely impacted water resources, agriculture, human livelihoods, food security, GDP, and livestock. During the Sahelian droughts of the 1970s and 1980s, thousands of pastoralists searching for water and forage for their animals migrated southward into countries such as Burkina Faso, Côte d'Ivoire, Ghana, and Nigeria. This led to significant numbers of animals perishing. For example, around 40 percent of livestock was lost in Mali during the 1972–74 drought.

**Droughts can also lead to conflict, or exacerbate existing conflicts, as pastoralists migrate into regions being used by others, such as cropping zones or rangelands.** The escalation of Jihadist insurgencies from 2017 onward has increased ethnic tensions and violence, especially in the central regions, and has exacerbated the vulnerability of pastoralists. The loss of productive assets and looting linked to violence and security incidents have resulted in the disruption of markets and livelihoods for households in affected areas. To cope with the effects of droughts, pastoralists have resorted to fleeing their drought-stricken villages in search of alternative water and pasture resources. While mobility is an effective strategy for pastoralists to protect their assets, especially during droughts, it can lead to conflicts with farmers in sedentary agricultural production systems. In many cases, pastoralists often opt for quick sales of their animals at low prices to buy food as a primary coping strategy. This is detrimental, as it depletes key assets that are difficult to recover after droughts, thus increasing households' vulnerability to the next drought.

**As the CCDR spotlight shows, looking forward, variation in rainfall will be a bigger driver of uncertainty in livestock yields than variation in projected temperature.**[17] Climate change scenarios for Mali project mean temperature increases by 2050 of 0.8°C and 1.7°C under the optimistic and pessimistic climate scenarios, respectively.[18] The majority of climate scenarios predict an increase in precipitation. Under the wet climate scenario, precipitation increases by 24 percent and there is a positive livestock yield shock. However, under the dry climate scenario, precipitation declines by 7 percent and there are generally negative livestock yield shocks, whose magnitude increases over time as pastures become dryer.

By 2050, the reduction in livestock yields in the dry scenario is expected to be around 15 percent in Mali.

## How index-based drought risk financing for pastoralists works

**Disaster risk financing and insurance (DRFI) provide mechanisms that aim to reduce adverse socioeconomic impacts of potential crises.** These mechanisms can provide timely, targeted finance in response to or in expectation of a shock. Drought risk financing and insurance is becoming an integral part of climate risk management strategies as a key component of financial protection planning in low- and middle-income countries. DRFI approaches include market-based instruments (e.g., insurance schemes, catastrophe bonds and swaps), contingent financing (e.g., credit) and budgetary tools (i.e., a dedicated reserve fund or contingency budget). These approaches are all designed to increase financial resilience to climate-related shocks, linking response actions to pre-defined financial resources and disbursement mechanisms for timely intervention. In this way, DRFI can lead to rapid and cost-effective preparation, recovery, and reconstruction efforts. Some of the benefits of DRFI include the following (context dependent):

- Crowding in private sector capital and investment to develop resilience and adaptation mechanisms
- Reducing public budget uncertainty and volatility, which can be detrimental to economic growth[19]
- Reducing the cost of droughts through timely response
- Decreasing households' reliance on negative coping mechanisms

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[17] World Bank Group (2022a).

[18] Based on a moderate projection scenario. World Bank Group (2022b). Climate Change Knowledge Portal. Country Profile Mali.

[19] Museru, M., F. Toerien, and S. Gossel (2014). The Impact of Aid and Public Investment Volatility on Economic Growth in Sub-Saharan Africa. World Development (Vol. 57, pp. 138–147).

## BOX 2.1: SATELLITE NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI)

The NDVI is a relative indicator of green vegetation cover or vigor obtained by measuring the difference between near infra-red and reflectance. Higher NDVI values indicate denser cover or healthier vegetation and vice versa. In the context of operational NDVI-based IBDRFI products for pastoralists, the NDVI is used as a proxy for forage availability, since during a normal wet year/season, vegetation has a higher NDVI than during a drought year/season.

While alternative satellite indices of drought exist such as satellite rainfall estimates and soil moisture products, the NDVI is currently the most widely used operational systems indicator for drought early warning, monitoring, and index insurance in African rangelands. This is because of the well-established relationship between the NDVI and the vegetation condition, which is in turn directly related to forage resources available for livestock.

- De-risking pastoralists' production, leading to better investment and risk management decisions and access to credit

**Index-based DRFI (IBDRFI) solutions have been developed and adopted by pastoralists in several Sub-Saharan African countries to provide payouts in the event of developing drought conditions.** Key features of these solutions are the regular monitoring of forage availability and payouts to pastoralists and other value chain actors in the event of conditions that are threatening the survival of livestock. Satellite observations are used to measure forage levels (Box 2.1), which are used to calculate potential payouts using pre-defined rules. When a payout is determined, it is then made to pastoral groups or individual households often using mobile payment systems to maximize access, speed, and transparency.

**IBDRFI can prevent loss of productive assets (i.e., animals), thus reducing economic losses and protecting households from falling into poverty traps.** Replacing lost assets (or dead livestock) is significantly more expensive than preventing loss (or death) through timely intervention (Figure 2.2). In Kenya, a study found that it is three times more expensive to restock a core herd of sheep and goats following a drought than to keep animals alive through feeding during drought events.[20]

**IBDRFI can complement and build on traditional informal risk sharing practices, thus generating widespread benefits.** These practices can support households that will have incurred losses after drought events, but these practices may not offer sufficient protection. For example, among the Fulani people (also called Peul or Fulbe in West Africa),

**FIGURE 2.2** A Cost-Benefit Snapshot of IBDRFI for Small-Scale Agricultural Producer
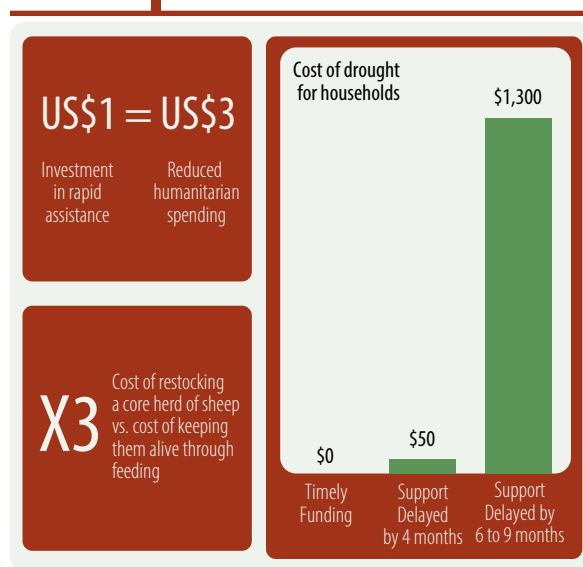


*Source*: Clarke, D. and R.V. Hill (2013).[a]
[a] Clarke, D. and R.V. Hill (2013). Cost-Benefit Analysis of the African Risk Capacity Facility. Vol. 1292. International Food Policy Research Institute.

wealthier households may lend some livestock to a poorer, drought-affected household, allowing them to keep the offspring of the borrowed animals to build their own stock. This practice has been adapted and institutionalized by several international development organizations but may come under strain in the event of covariate shocks. While such traditional schemes can help some pastoralists to replenish their herd, they don't provide asset protection—e.g., preventing livestock mortality through early, targeted pay-outs. IBDRFI can complement such mechanisms to effectively deal

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[20] Venton, C.C. (2018). The Economics of Resilience to Drought. Washington, D.C.: USAID.

with systemic shocks, such as severe droughts, that are likely to have a widespread impact, with benefits for pastoralists, the private sector, and the government:

- *For pastoralists:* Pastoralists can receive financial support earlier compared to traditional insurance schemes or humanitarian aid to protect their livestock; this can avoid catastrophic impacts and enable better herd management.

- *For the private sector:* IBDRFI initiatives can crowd-in investments from the private sector and from donors to improve financial literacy and financial infrastructure; this is a prerequisite for the Implementation of index-based livestock insurance (IBLI).

- *For governments:* IBDRFI initiatives can minimize governments' fiscal exposure to drought events through advance planning; this allows for early responses and more cost-effective funding to mitigate the impact of droughts and to reduce the need for humanitarian aid.

**Since 2010, several IBDRFI solutions for pastoralists have been developed and implemented across Sub-Saharan Africa.** This includes micro-level retail insurance products, macro-level social livelihoods protection coverage, scalable safety net programs, and sovereign-level drought risk financing solutions (also Box 2.2). Examples include the following:

- IBLI is a micro-level retail insurance product that has been sold and scaled-up by local insurance companies across northern Kenya and southern Ethiopia since 2010 and 2012, respectively; as of 2020 it covered over 25,000 policyholders in the two countries.[21]

- The Kenya Livestock Insurance Program (KLIP) is a macro-level social livelihood protection scheme that was launched in 2015 by the Government of Kenya with technical support from the World Bank Group and the International Livestock Research Institute; as of 2020, it covered 18,000 households.[22]

- The Satellite Index Insurance for Pastoralists in Ethiopia (SIIPE) program was launched in 2017 and implemented by the World Food Program (WFP) and the Somali regional government; as of 2019, the program covered around 28,000 beneficiaries.[23]

- In Zambia, a livestock insurance scheme, similar to SIIPE was launched by the Ministry of Fisheries and Livestock in partnership with WFP and the International Fund for Agricultural Development; it targets 5,000 livestock keepers across the country.[24]

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[21] International Livestock Research Institute (2022). Index-Based Livestock Insurance.

[22] World Bank Group (2018). Kenya's Pastoralists Protect Assets from Drought Risk with Financial Protection. Feature Story.

[23] World Food Programme (2019). Ethiopia, Satellite Index Insurance for Pastoralists (2017–2019): Impact Evaluation.

[24] Zambian Business Times (2020). Index-based Livestock Insurance Launched.

## Impacts and lessons learned from Kenya and Ethiopia

IBDRFI initiatives implemented in Kenya and Ethiopia have produced valuable lessons and evidence on the positive impacts for governments and pastoral communities (Table 2.1). These initiatives also provide a proof of concept, with different implementation schemes tailored to the country's specific needs. The implemented schemes range from commercial insurance programs with various premium subsidy levels to government-funded macro-level social livelihood protection programs that target the most vulnerable pastoralists. The experience of Kenya and Ethiopia has led to strong demand for IBDRFI from several countries across Sub-Saharan Africa, and it has increased interest from development partners in response to this demand.

**The IBDRFI solutions for pastoralists are still evolving in response to lessons learnt and growing demand from new countries.** While there are schemes in East Africa, new programs can utilize the vast knowledge accumulated over the last decade to further improve the existing solutions. The new solutions can be tailored to the local context, including pastoral systems, and become an integral part of broader risk management, resilience building, and pastoral development policy frameworks. The interventions used in East Africa took account of the risk of conflict between pastoralists (both within the country and between countries), the political economy, and the levels of financial inclusion in each country. Specific lessons can be learned from the IBDRFI programs implemented in Kenya and Ethiopia:

- These programs generated considerable social and welfare benefits for pastoralists who insured their livestock.

**TABLE 2.1** | IBDRFI Solutions Implemented under KLIP and their Impact

| **1** **Protect Government Budget** | *Risk transferred to the private sector* | | • Premium payment reduced public financial burden in case of drought <br> • Predictable and budgeted expenditures allow better resource allocation and harmonization with complementary initiatives | US$10 million payouts since inception made by the private sector |
|---|---|---|---|---|
| **2** **Expand Markets** | *Public subsidies and investment in infrastructure* | | • Public sector premium guarantees regular income <br> • Investment in infrastructure attracts the private sector to provide more services <br> • More awareness on the product increases the potential for retail sales | IBLI coverage expanded from 3 to 8 countries <br><br> Number of IBLI policies increased from 4 thousand to over 20 thousand |
| **3** **Protect Vulnerable People** | **Good Seasons** | *Reduced drought risk* | Intensification: Increased investments in higher–returns production strategies <br> • Strategic livestock sales when prices are high <br> • Increased investments in veterinary services <br> • Reduced precautionary savings | Greater income |
| | **Drought Seasons** | *Reduced income loss during drought* | Less reliance on detrimental coping strategies during drought <br> • Less distress selling of productive assets <br> • Less skipping meals during drought <br> • Maintained investments in human capital | Improved post-drought economic and welfare outcomes |
| | | *Payments in anticipation of drought* | Early action to mitigate the impact of drought <br> • Destocking in anticipation of price and resource shocks <br> • Early purchase of inputs to sustain remaining herd during the coming drought | |

*Source*: Adapted from Fava, F. et al (2021).[a]

[a] Fava, F., Jensen, N., Sina, J., Mude, A., Maher, B. (2021). *Building financial resilience in pastoral communities in Africa*: lessons learned from implementing the Kenya Livestock Insurance Program (KLIP). Washington, D.C.: World Bank Group.

- Payouts influenced pastoralists' decision-making strategies on purchasing livelihood protection and livestock inputs.
- A public-private partnership model can be an effective way of crowding in private sector capacity, transferring risk to the private sector, and stimulating market expansion.
- Government leadership and direct investment can be effective if associated with a strong partnership with the private sector, with clearly defined roles and incentive structures.
- A mechanism for long-term public commitment needs to be established to guarantee the stability of the scheme.
- Premium subsidies for scaling up and consolidating the scheme are important, but should be associated with smart targeting mechanisms and private sector incentives for market development and expansion.
- Financial education on insurance, awareness creation and capacity strengthening at all levels are fundamental and require sufficient resources for such schemes to achieve sustainability.
- Accurate insurance product design is critical to create trust and achieve the desired impact, as is having a robust data infrastructure for product quality assessment and comparison.
- Establishing effective payout delivery channels to ensure guaranteed and timely payments is essential and requires dedicated strategies and mechanisms.
- Engaging with stakeholders to tailor products to specific agro-ecological and socio-economic contexts, and evolving environmental conditions is necessary throughout the entire program implementation cycle.
- Implementation is as important as technical design: digital premium collection, e.g., using mobile money, is crucial to achieve the desired development impact, build trust, and ensure the sustainability of the program.
- Scaling up IBDRFI initiatives requires strong coordination and harmonization of different drought risk management instruments to optimize their financing mechanisms, targeting

approaches, and data and management infrastructure.

**Lessons to date highlight significant challenges in implementing IBDRFI in extensive pastoral regions, particularly in terms of financial sustainability and effective product distribution**. The experience of ongoing and previous schemes shows a need to identify new low-cost distribution channels for IBDRFI in East Africa.[25] The DRIVE project (see below) aims to develop these channels to distribute and operate products through aggregators and groups. In addition, the IBDRFI experiences in Kenya and Ethiopia have demonstrated the need for parallel investments in resilience-building and market development for pastoral communities. Insurance by itself cannot build drought resilience and protect livelihoods.

**Overall, evidence from operational insurance programs suggests significant benefits from IBDRFI instruments.** These include mutual benefits between the public and private sectors, and positive outcomes for the welfare and livelihoods of pastoralists during crisis and non-crisis periods. The experiences and lessons from East Africa remain relevant and very useful in several ways for any future interventions in Mali and the Sahel in general. However, intervention design should consider Mali's specific context, particularly the impact of conflict on pastoralists, the political economy, and the level of financial inclusion.

**The World Bank is supporting a major IBDRFI initiative in East Africa for pastoral communities, which could provide valuable lessons for Mali and the Sahel.** In 2022, the governments of Djibouti, Ethiopia, Kenya, and Somalia, with the support of the World Bank, launched the De-risking, Inclusion and Value Enhancement of Pastoral Economies in the Horn of Africa (DRIVE) project. The project's aim is to improve adaptation to the impacts of climate change, while improving access to financial services (such as credit and savings), access to commercial livestock markets for pastoral communities, and inclusion for women and other marginalized groups. The program comprises two interlinked components:

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[25] Fava, F. et al. (2021).

- *Enhancing financial resilience to climate shocks:* DRIVE will co-finance a range of financial services in Ethiopia, Kenya, and Somalia, including IBLI, savings and digital payments accounts (such as mobile money); this is complemented by financial literacy and awareness campaigns to improve pastoralists' understanding and knowledge of financial services.
- *Commercializing livestock production:* DRIVE will link pastoralists to markets, exporters, and processes, enabling them to sell high-quality livestock through a formal livestock value chain; women-owned and youth-owned businesses will be specifically supported for this.

**DRIVE is designed to increase the financial resilience of pastoralists through public private partnership.** This includes domestic and international insurance markets, financial service providers, and governments. The program builds on experiences and lessons learnt globally, particularly to achieve scale and develop a sustainable IBDRFI scheme. The regional nature of DRIVE focuses on reducing costs by sharing public goods, insurance products and infrastructure, which in turn can support scale. The private sector's involvement can help achieve sustainability. This involves prioritizing productive pastoralists who have the capability and capacity to contribute to premiums. The project offers useful insights on how to design and plan an IBDRFI program for Mali and the Sahel. A feasibility study has been conducted to this end, and the following sections provide key findings and recommendations.

## Key findings of a feasibility assessment for Mali

**A feasibility assessment was performed to inform the development and implementation of policies to increase the resilience of pastoralists in Mali against severe drought shocks.**[26] The assessment considered socio-economic (potential demand and value), technical (i.e., product design), and operational factors to design and implement IBDRFI solutions in Mali. The feasibility study found that, with targeted investments and supportive policies, Mali's extensive

pastoral systems could benefit from an IBDRFI initiative targeting pastoralists. A scenario analysis provides an initial illustrative indication of the costs of a hypothetical IBDRFI scheme based on historical data.

*Socio-economic feasibility of an IBDRFI scheme rests on the prominence of pastoralism and its exposure to droughts.*

**The socio-economic feasibility assessment concluded that two conditions necessary for the development of an IBDRFI scheme are in place.** *First*, the livestock sector is highly important to the Malian economy. Around 80 percent of households are involved in rearing livestock. While agro-pastoralism is practiced by most of the population, the national livestock herd is almost equally split between pastoralists (45 percent) and agro-pastoralists (55 percent). *Second*, droughts have typically led to recurrent food security crises in Mali, affecting the pastoral regions significantly. While there is limited data on the costs of droughts to the livestock sector, indicative evidence shows that costs can be extremely high (Section 2.1). The pastoral areas may expect annual losses as high as 3.7 percent of the rangeland production and up to 20.6 percent in 100 years.[27]

*Fifteen to 25 percent of Mali's land, which host 63 percent of national livestock, might be suitable for an IBDRFI product depending on rangeland review.*

**The technical feasibility assessment found that recurrent droughts have contributed to changes in vegetation characteristics and composition in Mali.** This part of the assessment analyzed the design requirements for an accurate index and trigger mechanism, as well as possible solutions. Critical for this is

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[26] Fava, F., R. Banerjee, N. Kahiu, A. Maiga, F. Lung, N. Jensen, T.F. Dicko, and J. Plevin (2023). Strengthening Financial Resilience to Drought: A Feasibility Study for an Index-Based Drought Risk Financing Solution for Pastoralists in Mali. Washington, D.C.: World Bank Group. This and the next section draw on this study.
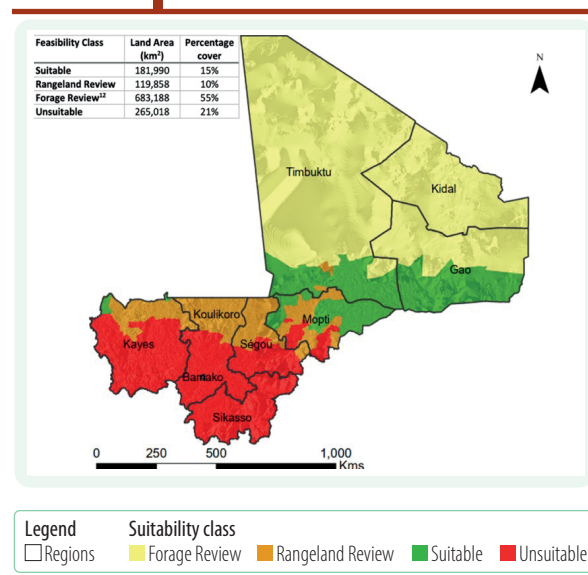
[27] Fava et al. (2023).

to understand the changes in vegetation. These are caused by low, erratic, and variable rainfall with widespread inter-annual negative precipitation anomalies. This is particularly prevalent in the north of the country within the Sahara and Sahelian bioclimatic regions.[28] In recent years, drought coupled with overgrazing has led to degraded savanna structure, vegetation cover, and productivity. This has subsequently led to steppe-like characteristics, or bare and unproductive land in extreme cases.

Around 15 percent of Mali's land area is fully suitable for an IBDRFI product for pastoralists, while 10 percent is suitable but requires rangeland review (Figure 2.3). Collectively, these areas host 63 percent of the national livestock herd. The central part of the country is characterized by fully suitable units. Rangeland review units are mainly in the central western regions, and forage review units are located mainly in the north. Both rangeland and forage units meet all the technical criteria but need to be further reviewed with local stakeholders to confirm their suitability for extensive livestock herding. This is because the land use in these regions is mixed and includes crops.

**FIGURE 2.3** | Technical Feasibility of IBLI Design in Mali



| Feasibility Class | Land Area (km²) | Percentage cover |
|---|---|---|
| Suitable | 181,990 | 15% |
| Rangeland Review | 119,858 | 10% |
| Forage Review[12] | 683,188 | 55% |
| Unsuitable | 265,018 | 21% |

Legend — Suitability class
Regions | Forage Review | Rangeland Review | Suitable | Unsuitable

*Source*: Fava, F. et al (2023).
*Note*: The 55 percent for forage review can be misleading as it is the result of unit-level aggregation of the index. While an entire unit can fall withing the forage review class, this does not mean that the whole area within that unit is feasible. In reality, a large portion of the land falling in this class is unsuitable because of low signal intensity (unable to reliably detect vegetation cover separately from other types of natural land cover, e.g., desert).

*Low non-life insurance, low financial literacy, and ongoing security risks constitute key operational obstacles to IBDRFI solutions in Mali.*

**The operational feasibility assessment explored the conditions required to implement effective, scalable, and sustainable IBDRFI solutions.** This assessment looked at some of the main ingredients for an insurance market and insurance products to be launched, which include the regulatory environment, institutional capacity, financial literacy, insecurity, and the demand for insurance among pastoralists.

**Mali is a member of the regional insurance control commission CIMA.** CIMA (Commission Régionale de Contrôle des Assurances) is a confederation of 14 countries in West Africa (all members of WAEMU and CEMAC) whose aim is to foster cooperation among the countries' insurance sectors and encourage the development of national insurance markets. CIMA also supports the creation of enabling environments in each of its markets, as well as ensuring regulatory harmonization. Mali has a conducive regulatory environment, which is supervised and regulated by CIMA and Direction des Assurances.

**Mali has low non-life insurance penetration (0.32 percent of the national GDP), which is significantly lower than in many other CIMA members.** This is due to the lack of a culture of insurance purchase, poor understanding of the benefits of insurance, high levels of poverty, and the insecurity situation in the country.[29] Nevertheless, there are five major insurance groups that dominate Mali's insurance market and one industry association, the Comité des Compagnies d'Assurances du Mali, whose aim is to lobby the government to create more awareness of insurance through advertising campaigns for the general population.

**Low financial literacy in Mali's pastoral areas and generally low levels of financial inclusion are a significant barrier, indicating the need for significant investments.** Financial literacy is a prerequisite to stimulate informed demand and establish

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[28] Cotillon, S. E., and G.G. Tappan (2016). Landscapes of West Africa: A Window on a Changing World.
[29] AXCO (2020). Country Information Mali.

a local market for insurance schemes. Well-designed sensitization campaigns can improve financial literacy among pastoralists, while insurance and extension agents can be trained through capacity building. In addition, a stronger overall institutional and private sector capacity is required to support large commercial insurance or social livelihood protection initiatives. Financial inclusion has grown between 2017 and 2021 due to increased mobile money services but it remains still relatively low. For example, in 2021 only 44 percent of Malian adults owned a financial account (up from 35 percent in 2017).[30] This is still limiting opportunities to improve access to adjacent financial services (savings, credit, and insurance).

**A few initiatives have been launched by private insurers together with mobile money providers although mobile money penetration remains low in rural areas.** Mobile phone penetration in Mali was over 60 percent (about 11 million people) in 2016, but the use of mobile money is still mainly limited to urban areas. The penetration rate in rural areas is thought to be around 30 percent.[31] The telecommunication sector in Mali is currently dominated by Orange and Malitel. Though both operators cover most of the country, they have a limited presence in the northern regions of Tombouctou, Gao and Kidal due to security issues. Both Malitel and Orange offer distribution options for an IBDRFI product. Malitel enabled humanitarian cash transfers during the 2012 security crisis, while Orange partnered with insurance providers. Among the initiatives is Sini Tonon, a mobile savings product, and Tin Nogoya, a micro insurance product offered in partnership with NSIA Assurances au Mali. Tin Nogoya provides life, disability and maternal health cover, it is targeted at women, who tend to be marginalized in the insurance market in Mali.[32]

**Mali has some experience of agricultural insurance, but most products aim at crop insurance while agro-meteorological capacity is still limited.** A few international development organizations have supported the launch of agricultural insurance schemes in Mali. Inclusive Guarantee launched Sahel Crop Insurance (Assurance Récolte Sahel), aimed at establishing index-based insurance products that cover drought risks. NISA Assurances previously

partnered with Inclusive Guarantee to provide credit bundled with livestock agricultural insurance. OKO, an insurtech, provides weather-index insurance for rice and onions in partnership with SUNU Assurances and Orange Money. The National Meteorological Service (Direction Nationale de la Météorologie or Meteo Mali) is responsible for collecting, archiving, and analyzing basic agro-meteorological data. However, gaps in meteorological observation networks persist, causing bottlenecks in providing actionable climate information services nationally.

**Several international organizations are involved in bridging data gaps, each of which can provide an entry point for IBDRFI initiatives.** The Climate Change Agriculture and Food Security program, the International Research Institute for Climate and Society and others are working on the Enhancing National Climate Services initiative. This involves supporting Meteo Mali and AGHRYMET, the regional center of excellence, to overcome data gaps and provide high-quality climate information.[33] Action Contre la Faim, a non-governmental organization (NGO), has established a pastoral surveillance system in the region to monitor pasture biomass through satellite data and surface water resources via ground surveys. While several national and regional actors have the capacity to handle agro-meteorological and remote-sensing data, their experience in using these services for insurance purposes is very limited.

**Microfinance providers, NGOs and international organizations have shown a keen interest in supporting bundled IBDRFI products in Mali.** Access to credit remains a challenge for farmers, with only one of Mali's main banks providing financial services related to agricultural development. Microfinance institutions (MFIs) play a significant role at the

30  Demirgüç-Kunt, A., L. Klapper, D. Singer, and S. Ansar (2022). The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19. Washington, D.C.: World Bank.
31  GSMA (2017). The Potential of Mobile for Rural Energy Access in Mali.
32  AXCO (2020).
33  Hansen, J., A. Rose, and D. Dinh (2017). World Met Day: Partnering with National Meteorological Services to Support Farmers in Africa.

smallholder level. There were about 30 active MFIs in 2017, serving a client base of 1.1 million people, many of whom live in remote rural areas. SNV, the Dutch development agency, plays a significant role in generating awareness among agro-pastoralists and pastoralists, and in improving access to financial institutions. Such organizations would be able to offer an entry point for an IBDRFI initiative in Mali.

**Chronic episodes of insecurity in some pastoral regions can be an operational risk factor for IBDRFI programs in Mali and the wider Sahel.** Increasing insecurity and conflict in certain parts of the country pose a challenge for investment and to attract the private sector's involvement. This needs to be considered when planning a product's launch. Early implementation of IBDRFI is recommended in more secure areas to allow programs to be customized for the local context before expansion to other parts of the country. However, so far the security situation has not significantly deterred private-sector organizations from launching insurance services.

**IBLI schemes can play a significant role in conflict management and reduction.** By using IBLI, pastoralists' ability to mitigate shocks can avoid the use of conflict-prone strategies and can lead to increased use and strengthening of informal networks (such as co-operatives, and savings and credit schemes). Informal risk-sharing practices should not be discouraged, as their absence could heighten the risk of conflict. Inclusion is key here too, as certain groups being perceived as being aided over others could lead to grievances and fuel conflict. While IBLI schemes are designed to maintain livestock productivity, increases in herd sizes and their impact on resources such as land and water could also increase the risk of conflict.

**Overall, the operational assessment shows that implementation in pastoral regions might be challenging due to the lack of infrastructure and the prevailing security situation.** The regulatory environment, private sector experience in agricultural index insurance, good telecommunication, and digital financial service networks, and the strong presence of NGOs, international organizations, and pastoral associations are all positive factors for IBDRFI operational implementation. However, the overall institutional capacity is too weak to support large IBDRFI

initiatives while pastoral regions need major investment to stimulate demand for insurance and its use in resilience building. Limited satellite data handling capacity and the absence of a national electronic registration system to support beneficiary targeting and product distribution are other relevant gaps that need to be addressed.

*The IBDRFI scheme may be adjusted according to the needs and characteristics of the pastoralists as well as the objectives of the scheme.*

**Given the high cost of climate shocks, countries with limited fiscal capacity such as Mali are unlikely to be able to mitigate against shocks through government intervention alone.** As a result, it is essential for Mali to crowd in the domestic and international private (insurance) sector to manage some of the financial implications of shocks that the country experiences. Different options could be explored to develop a program of IBDRFI for pastoralists in Mali, which aim to achieve different objectives. Although the different approaches would be based on the same underlying principles and products, they would require different public policies and investments (in the enabling environment and premium financing).

**The illustrative scenarios below provide two options, differentiated by the wealth of targeted pastoralists.** Options A supports relatively wealthier pastoralists, who may be able to contribute to the costs of insurance, thus stimulating investment from insurers and pastoralists. Option B supports the most vulnerable pastoralists as a form of social protection through a large scale publicly funded scheme. These two scenarios draw from the experiences of Kenya and Ethiopia, where ongoing initiatives have demonstrated positive impacts on pastoralists' welfare and income, private sector development, and management of government budgets and contingent liabilities. The two options should not be considered as mutually exclusive alternatives, but rather could they be pursued in parallel to meet different objectives.

**Option A: a micro-level retail scheme to stimulate demand for the insurance product whilst incentivizing insurance providers to enter the**

**market and invest.** Individual pastoralists would be the policyholders, who could benefit from a subsidy (e.g., 50 percent of the premium value for a limited number of animals) to encourage take-up. The level of public sector support for subsidies would be set to balance budget availability with affordability and demand, aiming to increase the size of the market to achieve economies of scale. Whilst the private sector would be expected to invest in the market, additional public support would be required such as in data and financial education. These costs should be weighed against the range of benefits outlined above such as protecting pastoral households from sliding into poverty from drought-induced livestock losses, improving access to inputs and credit, and stimulating private investments in the value chain to improve livestock production and marketing.

**Option B: a macro-level social protection program to protect the most vulnerable pastoral households and complement humanitarian responses to protect pastoralists' assets and livelihoods during the early stages of droughts.** As a macro-level program, the insured policyholder would be the government department or agency on behalf of the pre-selected pastoralists that own a small number of livestock but are unable to pay premiums. A high level of public sector support is required for full or high subsidies, awareness creation, and parallel investments to crowd in private sector investment. Targeting and registering pastoralists are therefore critical steps—working with government agencies and distributors, such as local authorities, pastoralists groups, and community and pastoral leaders to identify potential beneficiaries. Again, such costs would be weighed against benefits such as increasing government budget stability, avoiding negative coping mechanisms, and reducing the overall cost of losses and associated social and economic impacts through early intervention to reduce livestock deaths.

## Policy options and next steps

While several lessons learned from programs in other Sub-Saharan African countries could be useful to develop an IBDRFI scheme, the assessment proposed specific follow-up actions for Mali.

### *Stakeholder engagement and policy support*

1.  **Establish a national dialogue or policy round-table discussions on IBDRFI implementation options**
    *   *Defining the policy priorities and objectives of IBDRFI and evaluating all options* should be the primary objective of this dialogue. The dialogue should be anchored to the 2021–25 National Plan for Drought and involve multiple ministries (i.e., Livestock and Fisheries, Information and Digital Economy, and Economy and Trade), insurers, regulators, pastoral associations, international organizations, and development institutions with an interest and experience in implementing IBDRFI.
    *   *A technical working group* could be established as a complementary measure to address the technical aspects of the initiative to inform the decision-making process.

2.  **The government should invest in capacity building and awareness for insurance actors and pastoralists**
    *   *Continuous capacity building and awareness raising* should be carried out to improve insurance companies' knowledge, understanding, and experience of crop and livestock index insurance. This should involve both the private and public sector as well as institutions involved in providing agro-meteorological, extension, and emergency response services. As IBDRFI would be a new solution, public and private sector capacity building should cover the mechanics of insurance, roles and responsibilities, product design, and pricing.
    *   *To improve knowledge among farmers and pastoralists*, existing organizations working in pastoral areas can support awareness creation and financial literacy for micro and meso-level or social protection products. This should include farmer and pastoralist organizations, extension workers as well as insurers, banks, and microfinance institutions. Engagement with these organizations should occur as early as possible to understand pastoralists' needs and expectations regarding a livestock insurance product.

## Priority pre-operational activities and considerations

1. **Improve data collection in collaboration with the government and NGOs**
   - *There is limited data on drought-induced losses* suffered by the pastoral community and the related impact on livelihoods. This could be rectified by requesting updated information on the impact of drought on the pastoral community from government entities and NGOs or by conducting in-depth engagements with various stakeholders in the field.
   - *To improve data handling capacity among key actors*, institutions such as AGHRYMET, Action Contre la Faim, and African Risk Capacity should be engaged to build local capacity, particularly on the collection and management of livestock-related data.

2. **Ensure that product design takes the local pastoral context into account**
   - *Product development options* should be adapted to pastoral production systems in central Mali that are dominated by agro-pastoralism. This may entail a comprehensive characterization of pastoral land use and mobility patterns, especially in regions that need to be reviewed further before launching a product.
   - *Stakeholder engagements* can provide a better understanding of the feasibility of IBLI schemes in regions subject to review.

3. **Design financial protection considering the possible environmental impact**
   - *Reduced grazing pastures and increased herd sizes* can result in over-grazing, which could perpetuate the ongoing risk of desertification and increase pressure on already scarce resources. In turn, this may increase the risk of conflict breaking out over land—particularly for Mali, where natural capital is in decline. IBDRFI could further exacerbate the risk of conflict by expanding herd sizes (as pressure on existing resources increases).
   - *As there is a reduced need to hold excess stocks to manage risks,* IBDRFI may lead, alternatively, to pastoralists consolidating smaller herds of healthier and more productive an-

imals. The evidence in this area is limited but growing. Results from a study in the Horn of Africa region found that herds protected under IBLI often decrease in size due to better connections to markets.
   - *Any initiative in Mali should learn from the growing body of global evidence*, while engaging with local experts, to ensure that the IBDRFI program includes appropriate incentives to limit potential overgrazing and encourage sustainable rangeland management practices. Design considerations could include clear targeting and design of premium subsidies to reduce the incentives to increase herd sizes as well as linkages with education, investment in value chains and linking pastoralists to markets.

4. **Consider and identify conflict mitigation approaches for all IBDRFI options**
   - *The insecurity situation* in some pastoral and agro-pastoral areas can be a material risk factor in implementing IBDRFI programs. This should be considered during the planning and product design phases by identifying conflict mitigation mechanisms to improve social cohesion between farmers and nomadic pastoralists.
   - *To support product design*, detailed engagements should be carried out with stakeholders with prior knowledge of inter and intra-community dynamics. Even though IBDRFI schemes have been implemented in insecure parts of East Africa, the implementation stage should carefully consider security-related constraints in the demand, supply, and scaleup of the product.

5. **Prioritize affordable access and broad distribution for successful uptake**
   - *Premium financing for micro-level IBDRFI as well as meso- and macro-level schemes* should be explored to make policies affordable while ensuring sustainability in the long term and providing constructive incentives and signals to inform risk management decisions and investments. Distribution should consider bundling IBDRFI with existing services, such as digital financial services.

- *Financial inclusion*: Improved mobile network coverage and available use cases make mobile money a viable digital distribution option, which can support access, transparency, and timeliness of payouts. Mobile money can enable access to other formal financial services (such as savings and credit), given pastoralists' low use of banks and microfinance institutions.

6. **Make insurance a component of broader strategies and toolkits for agricultural risk management, financial inclusion, and disaster risk financing**
   - *IBDRFI product development should not be pursued in isolation.* Instead, it should be part of a comprehensive approach to risk management and adaptation. Insurance schemes can be a critical tool to improve financial inclusion as well as investment, financial security, and resilience. IBDRFI schemes should aim to improve access to finance for resilience by promoting insurance distribution through digital financial services, regional risk pools, or microfinance institutions.
   - *IBDRFI should deal with residual risks*, which cannot be mitigated through other means, or should directly finance early intervention in the face of risks. A range of risk management tools should be used to manage different layers of risks. These can include the avoidance or selection of certain agricultural practices, investment in inputs and markets, pastoralist education, and financial risk management tools.
   - *A national disaster risk financing strategy* could be developed to manage the broad set of risks that Mali is facing. The strategy would aim to quantify the risks and prioritize the most important ones. Correspondingly, it would identify the types of risk financing instruments and distribution mechanisms that could be developed and adopted to increase the resilience of households, businesses, and the government to shocks and disasters.

7. **Review government expenditure on emergency responses to inform IBDRFI cost-benefit analyses**
   - *This is a necessary step to inform the decision-making process* to select potential IBDRFI options for a detailed review, which should include a cost-benefit analysis. The analysis should assess the government's role in providing a subsidy or complementary investments in micro-, meso- and macro-level schemes and their harmonization with existing drought risk management efforts.
   - *The review should consider alternative subsidy options* and evaluate the trade-offs from a cost-benefit perspective, including long-term financial sustainability and governance aspects.

# 3

# ANNEX

## Selected economic indicators for Mali, 2019–2025

| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|
| | | | **Estimates** | | **Projections**[a] | | |
| **National income and prices** – *annual percentage change, unless indicated otherwise* | | | | | | | |
| Real GDP | 4.8 | −1.2 | 3.1 | 1.8 | 4.0 | 4.0 | 5.0 |
| Real GDP per capita | 1.7 | −4.1 | 0.1 | −1.3 | 0.9 | 0.9 | 1.8 |
| Agriculture | 4.1 | −4.8 | 2.2 | 1.7 | 5.0 | 5.0 | 5.0 |
| Industry | 3.7 | −0.1 | 0.7 | 3.0 | 6.0 | 4.0 | 4.0 |
| Services | 5.2 | 1.4 | 4.9 | 1.5 | 2.4 | 3.3 | 5.4 |
| Private Consumption | 3.8 | 1.9 | 5.0 | 2.0 | 3.0 | 3.0 | 4.4 |
| Government Consumption | 4.0 | 4.5 | 11.2 | 7.1 | 4.1 | 2.1 | 2.1 |
| Gross Fixed Investment | 6.3 | −1.2 | 3.8 | −10.4 | 7.4 | 9.1 | 7.8 |
| Gross Fixed Investment – Private | −0.6 | −3.0 | 5.4 | −4.3 | 5.6 | 11.9 | 11.9 |
| Gross Fixed Investment – Public | 10.0 | 0.6 | 2.2 | −16.9 | 9.7 | 5.8 | 2.7 |
| CPI (year-average) | −2.9 | 0.5 | 3.9 | 9.7 | 5.0 | 2.5 | 2.0 |
| CPI (EOP) | −3.3 | 0.7 | 8.9 | 7.7 | 4.0 | 2.5 | 2.0 |
| **Money and credit** – *annual percentage change unless otherwise indicated* | | | | | | | |
| Exchange Rate (to US$, average) | 586 | 575 | 554 | 622 | … | … | … |
| Exchange Rate (to US$, EOP) | 590 | 539 | 580 | 619 | … | … | … |
| REER | −4.2 | 0.4 | 1.0 | … | … | … | … |
| Broad money | 9.0 | 22.2 | 9.9 | 7.5 | 8.1 | 8.2 | 7.1 |
| Credit to economy | 2.2 | 5.3 | 6.0 | 7.5 | 8.5 | 8.2 | 7.1 |
| Credit to the government | −36.6 | 70.3 | 63.2 | 10.8 | 8.0 | 4.8 | 2.1 |

*(continued on next page)*

*(continued)*

| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|
| | | | **Estimates** | | **Projections**[a] | | |
| **Public finance and debt** | | | | | | | |
| Total expenditure | 23.1 | 26.1 | 27.1 | 24.6 | 25.6 | 26.2 | 24.4 |
| Total revenue and grants | 21.5 | 20.7 | 22.2 | 19.5 | 20.7 | 22.2 | 21.4 |
| Overall balance (incl. grants) | −1.7 | −5.5 | −5.0 | −5.0 | −4.9 | −4.0 | −3.0 |
| Overall balance (excl. grants) | −3.6 | −6.6 | −5.7 | −5.3 | −5.3 | −5.4 | −4.2 |
| Primary Fiscal Balance | −0.7 | −4.2 | −3.6 | −3.5 | −3.1 | −2.0 | −1.1 |
| Total public debt | 40.6 | 47.3 | 51.9 | 55.2 | 55.1 | 55.6 | 55.9 |
| External public debt | 26.5 | 29.8 | 29.2 | 28.5 | 25.6 | 25.3 | 25.5 |
| Domestic public debt[b] | 14.1 | 17.5 | 22.7 | 26.7 | 29.6 | 30.3 | 30.4 |
| **External Accounts** | | | | | | | |
| Export Growth (%, yoy) | 6.1 | 17.0 | 1.2 | 6.4 | −0.1 | −0.1 | −0.1 |
| Import Growth (%, yoy) | 7.8 | −3.2 | 22.2 | 6.7 | 4.6 | 4.6 | 4.6 |
| Exports, Goods and Services | 25.7 | 29.6 | 27.5 | 27.3 | 25.4 | 23.8 | 22.1 |
| Imports, Goods and Services | 38.0 | 36.3 | 40.5 | 40.4 | 39.4 | 38.7 | 37.6 |
| CAD (incl. current transfer) | −7.5 | −2.3 | −10.0 | −7.0 | −6.2 | −5.5 | −4.7 |
| Net FDI (% change) | 5.0 | 3.1 | 5.5 | 4.4 | 3.2 | 3.1 | 2.9 |
| Terms of Trade (% change) | 1.1 | 63.6 | −13.4 | −6.0 | 7.5 | 1.6 | 3.5 |
| **Population, Employment and Poverty** | | | | | | | |
| Population, total (millions) | 19.7 | 21.2 | 21.9 | 22.6 | 23.3 | 24.0 | 24.8 |
| Unemployment Rate | 7.2 | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 |
| Population Growth (annual %) | 3.0 | 3.0 | 3.0 | 3.0 | 2.9 | 2.9 | 2.9 |
| International poverty rate ($1.9 in 2011 PPP)[c] | 15.7 | 17.6 | 175.9 | 19.1 | 19.6 | 19.5 | 18.8 |
| **Other memo items** | | | | | | | |
| GDP nominal (CFAF billions) | 10,125 | 10,053 | 10,635 | 11,371 | 12,180 | 12,989 | 13,960 |
| GDP nominal (US$ billions) | 17.3 | 17.5 | 19.2 | 20.5 | 21.9 | 23.4 | 25.2 |

*Sources*: Government of Mali, WEO, WDI, KNOMAD, IMF and World Bank Staff estimates and projections.
*Note*: 1/ The macroeconomic projection has factored in downside risks from the war in Ukraine. 2/ Includes BCEAO statutory advances, government bonds, treasury bills, and other debts. From 2021 onwards includes SDR allocation in the amount of CFAF 142 billion (1.3 percent of GDP) on-lent from the BCEAO. 3/ Calculations based on 2018 EHCVM. Nowcast: 2019–2021. Forecasts are from 2023 to 2025. Projection using neutral distribution (2018).

## Note on Mali's 2023 Budget Law

This note provides an overview of the approved budget for 2023 as per the 2023 Budget Law (Loi des Finances) with comparisons to the projections in the revised budget for 2022 as estimates for 2022 actual/executed budget figures are not yet available. Percentage increases are all in nominal terms.

### A. Context of budget adoption and key assumptions

- **The 2023 budget is underpinned by the transitional government's priorities in a** challenging socioeconomic context with persistent insecurity. It is anchored to the country's development strategy (CREDD 2019–2023) and the transitional government's action plan (PAGT) for 2022–2024. Spending priorities in the PAGT fall under four broad categories: (i) improving security across the country; (ii) implementing political and institutional reforms; (iii) organizing general elections; and (iv) promoting good governance and social cohesion.

- **The 2023 budget assumes a robust GDP growth rate of 5.1 percent for 2023 (versus WB projection of 4 percent)** while assuming

that global inflationary pressures (oil and food prices) will ease in 2023, consistent with the IMF's World Economic Outlook (January 2023 Update). The 2023 budget projects an annual average inflation rate of 2.5 percent for 2023 (versus WB projection of 4 percent). The GDP growth projection is a bit optimistic and depends on the agriculture sector accelerating its recovery in 2023. The inflation projection seems low considering that security-linked supply bottlenecks are still significant.

*B. Revenue and expenditure*
*Total revenue including grants is projected to increase by 10.9 percent to reach 18.6 percent of GDP (CFAF 2199.9 billion) in 2023.*

- **Tax revenue is expected to grow by 17.9 percent to reach 15.5 percent of GDP (CFAF 1,897.1 billion) in 2023.** The significant increase is driven by the following: (i) the expected economic recovery with real GDP growth projected at 5.1 percent in 2023; (ii) the introduction of new excise taxes; (iii) the increase of excise rates on a few items; (iv) increased taxation of the informal sector; (v) the intensification of digitalization efforts at the tax office; and (vi) the taxation of electronic trade. The budget does not provide details on the expected revenue gains from each tax measure but collectively they are expected to generate around 0.6 per-

cent of GDP in additional tax revenue. Moreover, tax expenditures, which were unusually high in 2022 at ~0.5 percent of GDP, should decline in 2023. The overall ambitious increase in tax revenue may be difficult to realize as some of the announced reforms are likely to be delayed. Non-tax revenue are projected to increase by 17.0 percent in 2023 due to land revenue but remains limited at 0.1 percent of GDP.

- **In contrast, grants are projected to decline by 17.5 percent in 2023 to 0.7 percent of GDP (CFAF 83.9 billion)** due to a retrenchment of donor support and the retirement of several donor-financed programs.

*Public spending is projected to increase by 9.4 percent to reach 23.7 percent of GDP (CFAF 2,895.9 billion) in 2023.*

- **The overall increase is driven by the wage bill, which is projected to increase by 8.3 percent to reach 8 percent of GDP (CFAF 978.5 billion) in 2023.** This is consistent with the harmonization of the salary grids agreed with the trade unions in 2021. Debt service is also set to accelerate by 14.2 percent in 2023 to 1.6 percent of GDP—significantly above the pre-pandemic level of 0.9 percent of GDP in 2019—reflecting higher financing needs and a growing share of (relatively expensive) treasury bonds in Mali's debt portfolio. As a result, current

expenditure is projected to grow by 13.3 percent in 2023 to 17.2 percent of GDP in 2023. Meanwhile, capital expenditure, which has experienced significant cuts over 2020–2022 (average decline of 5.3 percent per year), is projected to grow by 7.9 percent in 2023 to 5.6 percent of GDP; however, it remains below the pre-pandemic level of 6.5 percent of GDP in 2019.

- **Capital expenditure is likely to be reduced should the revenue projections not materialize.** In a context of recurrent shocks, the government has introduced a fiscal shock absorbing mechanism through a 20 percent retention (0.3 percent of GDP in 2023) on all investment and transfer credit lines.
- **In preparation for the 2023–24 elections, the 2023 budget allocates significant resources to the electoral process (0.6 percent of GDP or CFAF 79 billion).**
- **Education spending is projected to increase significantly by 21.7 percent to 4.4 percent of GDP (CFAF 541.4 billion) in 2023.** Health expenditures are projected to increase by only 7.2 percent, remaining at 1.3 percent of GDP (CFAF 163.7 billion) in 2023. These increases are linked to the rising wage bill in both sectors, counteracting the retrenchment of some donor-financed projects in the two sectors. **Agriculture expenditure, including subsidies to farmers, are set to accelerate by 22.7 percent in 2023**, consistent with the projected recovery of agricultural output.
- **Security spending is set to decline after years of increase.** The sustained increase to military spending, which began with the adoption of the military and security programming laws in 2016, is projected to come to an end in 2023. The security budget is set to decrease by 7.3 percent to 5.4 percent of GDP (CFAF 656.9 billion) in 2023, which partly reflects the unusually high allocation to the sector in 2021–2022 due to the acquisition of new military equipment.

### C. Fiscal deficit, gross financing and public debt

- **The fiscal deficit is projected to stabilize at an elevated level of 5 percent of GDP in 2023 with a planned return to the WAEMU ceiling of 3 percent of GDP by 2025.** The budget highlights the government's commitment to the gradual fiscal adjustment agreed under the IMF 2019–2022 ECF program.
- **Gross financing needs are projected to increase by 10.3 percent to 12.1 percent of GDP (CFAF 1,486.6 billion) in 2023 due to higher amortization spending.** Amortization spending is set to accelerate in 2023, reaching 6.4 percent of GDP, driven mainly by domestic debt amortization with the maturation of a significant volume of treasury bonds.
- **To finance these needs, the budget projects an acceleration of debt issuance on the regional market,** increasing from 9.6 percent of GDP (CFAF 1092.9 billion) in 2022 to 11.1 percent of GDP (CFAF 1,358.8 billion) in 2023. The growing use of domestic financing is linked to the reduced access to external financing with project/program loans declining from 1.9 percent of GDP in 2022 to 0.7 percent of GDP in 2023. Projected WB financing for 2023 will be limited (0.2 percent of GDP), while no IMF financing has been budgeted.
- **Public debt is projected to remain stable at 55.8 percent of GDP.**

## Microsimulation model to account for sectoral growth and food/non-food inflation

This note describes the methodology used to account for the heterogenous effects of growth and inflation on poverty projections using the latest household budget survey. For economic growth, the methodological framework decomposes the contributions to household consumption of each worker in a household according to their sector of economic activity. It then uses nominal per capita sectoral growth rates to estimate a household-specific nominal growth rate of per capita consumption. Regarding inflation, the framework separately considers food and non-food CPI inflation with households' shares of food and non-food consumption to determine a household-specific measure of inflation.

**FIGURE 3.1** Key Fiscal Indicators in the Revised Finance Law 2022 and the Finance Law 2023 (percent of GDP)
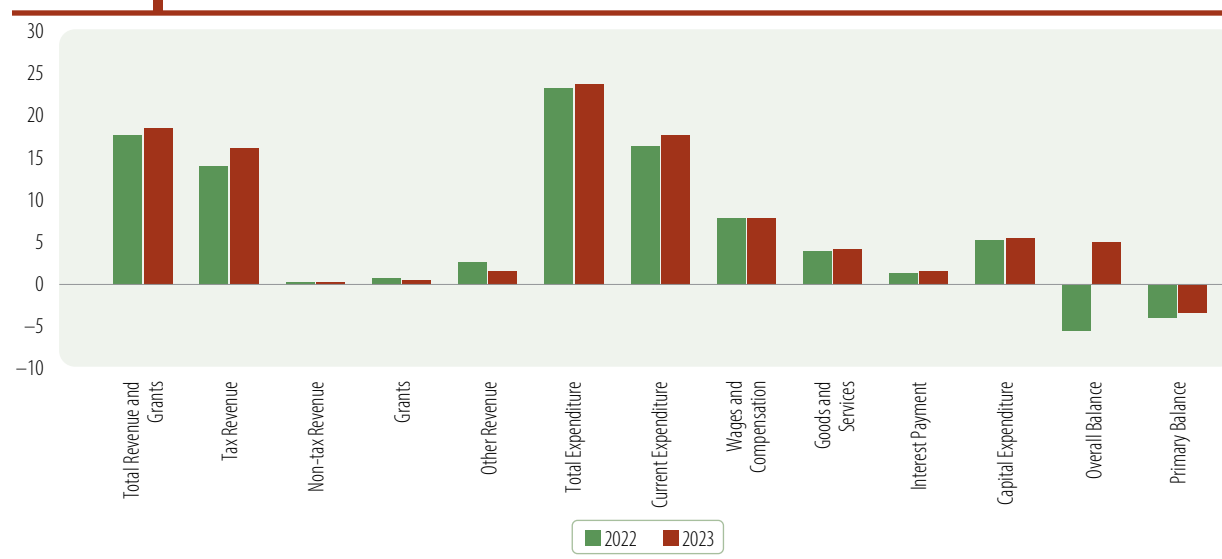


**TABLE 3.1** Key Fiscal Indicators in the Revised Budget Law 2022 and the Budget Law of 2023

| | Revised Budget 2022(a) | Budget Law 2023 | |
|---|---|---|---|
| | % GDP | % GDP | Diff (% GDP) |
| **Nominal GDP (CFAF billions)** | | | |
| **Total revenue and grants** | **17.8** | **18.6** | **0.8** |
| Tax revenue | 14.1 | 15.6 | 1.5 |
| Non-tax revenue | 0.1 | 0.1 | 0.0 |
| Grants | 0.9 | 0.7 | −0.2 |
| Other revenue | 2.7 | 1.7 | −1.0 |
| **Expenditure** | **23.2** | **23.7** | **0.5** |
| Current Expenditure | 16.3 | 17.2 | 0.9 |
| Wages and compensation | 7.9 | 8.0 | 0.1 |
| Goods and services | 4.1 | 4.2 | 0.1 |
| Interest payments | 1.5 | 1.6 | 0.1 |
| Capital expenditures | 5.3 | 5.6 | 0.3 |
| Externally financed | 2.2 | 2.3 | 0.1 |
| Domestically financed | 3.1 | 3.4 | 0.3 |
| Others | 1.8 | 0.9 | −0.9 |
| **Overall fiscal balance (incl. grants)** | **−5.3** | **−5.0** | **0.2** |
| Primary balance | −3.8 | −3.4 | 0.4 |
| **Public debt** | **55.9** | **55.8** | **0.1** |
| Domestic public debt | 29.3 | 29.0 | −0.3 |
| External public debt | 26.6 | 26.8 | 0.2 |

*Source*: 2023 Budget Law and staff calculation.
*Note*: (a) These are projections in the revised law. The actual budget execution levels for 2022 are not yet available.

**TABLE 3.2** | Functional Composition of Total Budgeted Spending (%)

| Sector | Revised Budget 2022(a) | Budget Law 2023 |
|---|---|---|
| Public administration | 29.7 | 28.2 |
| Defense | 16.1 | 14.7 |
| Public safety and order | 10.7 | 7.9 |
| Economic affairs (includes agriculture) | 14.5 | 17.4 |
| Environment | 1.6 | 1.4 |
| Public housing and collective equipment | 1.3 | 2.1 |
| Health | 5.8 | 5.7 |
| Culture and entertainment | 0.9 | 0.8 |
| Education | 16.8 | 18.7 |
| Social protection | 2.7 | 3.1 |

*Source*: 2023 Budget Law.

### Household per capita nominal consumption projection

Projecting per capita consumption (in nominal terms) can be carried out in seven steps. $C_h$, $T_h^s$, $Y_h^L$, and $Y_h^N$ be household-level consumption, transfers sent, labor incomes, and non-labor incomes, respectively. First, household total labor income, $Y_h^L$, is deduced from its assumed budget constraint: $C_h + T_h^s = Y_h^L + Y_h^N$. Second, the following Mincer equation $\log(Y_h^L) = X_h \beta_h + \varepsilon_h$ is estimated on the sample of average workers within each household. $Y_h^L$ denotes the household labor income per worker, $X_h$ is a vector of covariates averaged across workers (age, education, etc.), and $\varepsilon_h$ is an error term. Third, the estimated model is used to predict individual labor incomes for everyone in the survey. Fourth, workers are classified by their primary employment sector to construct total sectoral incomes for each household. Fifth, the share of each income component is estimated as the ratio of component income to total income. Let $\hat{S}_h^A$, $\hat{S}_h^I$, $\hat{S}_h^S$, and $\hat{S}_h^N$ be the estimated share of incomes from agriculture, industry, services, and non-labor for household $h$, respectively. Let $g^A$, $g^I$, $g^S$, and $g^N$ ($\alpha^A$, $\alpha^I$, $\alpha^S$, and $\alpha^N$) be the corresponding nominal per capita sectoral growth rates between $t$ and $t'$ (pass-through rates). Sixth, the per capita consumption growth rates for each household, $\hat{g}_h$, is equal to the weighted average of component growth rates, that is $\hat{g}_h = \sum_{k \in \{A,I,S,N\}} \hat{S}_h^k * \alpha^k * g^k$. Finally, the projected nomi-

nal per capita consumption of each household in $t'$ is given by: $c_{h,t'}^n = c_{h,t} * (1 + \hat{g}_h)$.

### Deflating the projected nominal consumption

Separately, to consider food and non-food inflation, the methodology deflates each household projected per capita nominal consumption by a household-specific inflation rate. This household-level inflation rate depends on the household's food and non-food consumption shares. Let $\pi^f$ and $\pi^{nf}$ be the food and non-food CPI inflation between $t$ and $t'$. The household-level inflation rate is then given by:

$$\pi_h = \frac{(1 + \pi^f)(1 + \pi^{nf})}{(1 + \pi^{nf}) S_h^f + (1 + \pi^f)(1 - S_h^f)} - 1$$

where $S_h^f$ denotes the share of food consumption. Hence, the projected welfare aggregate, that is, the deflated projected per capita consumption for every household in $t'$ is:

$$c_{h,t'} = \frac{c_{h,t'}^n}{1 + \pi_h}.$$

### Projecting poverty

Finally, poverty projections can be derived based on the projected welfare aggregate and the poverty line for the latest available survey. The framework uses realized (projected) macroeconomic growth rates and inflation rates for nowcasting (forecasting) poverty in

**TABLE 3.3** | Climate Scenarios Modeled

| Climate Scenario | Description |
|---|---|
| SSP3–7.0 Average - Pessimistic scenario | Ensemble average of SSP3–7.0 GCMs -> Higher temperature increases and larger precipitation changes compared to Intermediate and Optimistic scenarios |
| SSP2–4.5 Average - Intermediate scenario | Ensemble average of SSP2–4.5 GCMs -> Higher temperature increases and larger precipitation changes compared to Optimistic scenario but lower than Pessimistic scenario |
| SSP1–1.9 Average – Optimistic scenario | Ensemble average of SSP1–1.9 GCMs -> The lowest temperature increases among the scenarios and smaller precipitation changes than Intermediate and Pessimistic scenarios |
| Dry scenario | 10th percentile of mean precipitation change across SSP3–7.0 and SSP5–8.5 GCMs -> The driest among all the scenarios (i.e., smallest (or decrease) precipitation changes) |
| Wet scenario | 90th percentile of mean precipitation change across SSP3–7.0 and SSP5–8.5 GCMs -> The wettest among all the scenarios (i.e., largest (increase) precipitation changes) |
| Hot scenario | 90th percentile of mean temperature change across SSP3–7.0 and SSP5–8.5 GCMs -> The highest temperature increases among all the scenarios |

2022 (in 2023–2025). To the extent that nominal sectoral growth of household income is lower than the household-specific inflation, the standard of living of the household will be in jeopardy, even if there is overall economic growth.

## Modeling of climate change impacts

### Climate Scenario Modeling Details

The emission scenarios and climate models were provided by the World Bank's Climate Change Knowledge Portal (CCKP) for 29 General Circulation Models (GCMs) from the Coupled Model Intercomparison Project 6 (CMIP6) suite of IPCC model outputs. On the CCKP, each GCM has up to five combinations of Shared Socioeconomic Pathway (SSP) and Representative Concentration Pathway (RCP) emissions scenario runs. These include SSP 1-RCP 1.9, 1–2.6, 2–4.5, 3–7.0, and 5–8.5. For each GCM-SSP combination, CCKP provided a modeled history from 1995 to 2014 (the baseline) and projections from 2015 to 2100, for monthly mean temperature and precipitation. CCKP also rectified each projection to a common 1x1 degree grid for the globe. The CCDR may refer to two generations of CMIP due to data availability constraints. While long-term GHG emissions in the RCP8.5 are considered overly pessimistic, the CMIP5 climate change scenarios with RCP8.5 provide a useful (and not implausible) worst-case climate change scenario, which would be consistent with continued GHG emissions and high climate change sensitivity. It is worth noting that the scenarios are not necessarily particularly "dry," "wet" or "hot," but rather represent scenarios that are among the dryer, wetter, or hotter of the ensemble of scenarios. These scenarios were selected to capture extremes, and by extension the range of climate impacts.

## BOX 3.2: IMPACT CHANNEL AND ADAPTATION MODELING DETAILS

### 1. Rainfed crop yields

**Impact Modelling:** The effects of water availability and temperature changes for each of the GCM-SSP combinations are analyzed using crop yield models and combined for 6–8 representative crops (including sorghum, millet, maize, cowpeas, cotton, groundnuts) for each country that are selected based on their relevance in terms of harvested area, production, and export value. Crop-specific temperature thresholds are calibrated to the climatic conditions of each country. This means that when temperatures exceed those thresholds, yields fall based on a damage function.

The resulting shocks to crop yield by crops are aggregated to a single shock to agriculture revenues based on the share of the total value of agricultural production that each crop represents. The spatial disaggregation of the crop production analysis corresponds to ½ degree x ½ degree grid cells, which is the resolution of the climate data available.

The baseline annual crop yield is calculated by putting into the crop yield model the average historical temperature and precipitation to calculate the annual crop yield for each of the crops. The temperature and precipitation for each year for each of 6 climate scenarios are then used in the crop yield model to calculate the annual crop yield for each of the crops. The difference in total crop value from the baseline is the shock, expressed in percentage terms.

**Adaptation Intervention Modelling**[a]**:** Expanded irrigation: (1) rehabilitation of irrigation infrastructure for cash crops; and (2) construction of new shallow groundwater-based irrigation for smallholders for cash crops and food crops.

- Benefits: Increase water availability for rainfed crops that would have been reduced as a result of changes in precipitation.
- Costs: US$8,200 per ha for 243,000 ha of rehabilitation, and US$4,700 for 1.8M ha of shallow groundwater-based smallholder irrigation in total for G5 Sahel.

### 2. Heat stress and labor productivity

**Impact Modelling:** Impacts are based on a method/model that quantifies the percentage of a typical working hour that a person can work based on wet bulb globe temperatures (WBGT), which measures heat stress from temperature and humidity. The impacts intensify for labor types that are outdoors and with more intense physical work. Workers are split into indoors and outdoors and it is assumed that those who work indoors are not affected by heat. This likely underestimates the impacts of heat stress as some indoor workers—especially those not in temperature-controlled environments—may be affected.

The baseline annual labor productivity is calculated by putting into the WBGT model the average historical temperature and precipitation to calculate the annual labor productivity for each of the three sectors. The temperature for each year for each of 6 climate scenarios are then used in the model to calculate labor productivity. The difference in labor productivity from the baseline is the shock, expressed in percentage terms.

This approach is consistent with the recently released study by Purdue University: Saeed, Wajiha, Thomas Hertel, Qinqin Kong, and Matthew Huber. 2022. "Heat Stress in Human Labor and Poverty: The Case of West Africa."

### 3. Heat-related human health shocks

**Impact Modelling:** The effects are estimated using a statistical model that relates temperature increases to increased morbidity due to vector-borne diseases (malaria, dengue, diarrhea, and respiratory and cardiovascular heat-related diseases). The resulting output corresponds to country-scale annual impacts on total labor productivity for each climate scenario. Changes in morbidity are calculated using country-specific years-of-life lost data gathered from the Institute of Health Metrics and Evaluation global health dataset.

The baseline annual labor productivity for the whole economy calculated by using the average historical temperature and precipitation to calculate the annual labor productivity for the whole economy. The temperature for each year for each of 6 climate scenarios are then used in the model to calculate labor productivity. The difference in labor productivity from the baseline is the shock, expressed in percentage terms.

The approach follows the method outlined in: Roson, Roberto, and Martina Sartori. 2016. "Estimation of Climate Change Damage Functions for 140 Regions in the GTAP 9 Database." Journal of Global Economic Analysis 1 (2): 38.

### 4. Livestock yields

**Impact Modelling:** The effects under each climate scenario are analyzed using a grass yield model to impact feed availability, which affects the main ruminants (cattle, goats, and sheep); and animal-specific temperature-humidity thresholds to impact the productivity of ruminants, chicken, and swine. The effect on feed availability introduces a great deal of variability in this shock—livestock productivity is low in the baseline, so has considerable room to increase during wetter years when pasture productivity is high. The resulting shocks to livestock yield by species are aggregated to a single shock to agriculture revenues based on the share of the total value of livestock production that each species represents. The spatial disaggregation of the analysis corresponds to ½ degree x ½ degree grid cells, which is the resolution of the climate data available.

The baseline annual livestock yield is calculated by putting into the livestock yield model the average historical temperature and precipitation to calculate the annual livestock yield for each of the animals. The temperature and precipitation for each year for each of 6 climate scenarios are then used in the livestock yield model to calculate the annual livestock yield for each of the animals. The difference in total livestock revenue value from the baseline is the shock, expressed in percentage terms.

**Adaptation Intervention Modelling**[a]**:** Two livestock feed measures: (i) purchasing crop residues from in-country crop production to use as feed; and (2) investment in establishing fodder banks.

- Benefits: To partially compensate for the reduced feed from pastures as a result of changes in temperature and precipitation. Annex Figure 1–13 shows the livestock yield shocks with adaptation.

- Costs: US$48–70 per ton of residue (depending on residue mix by country) and US$10 per ton for fodder banks. Quantity varies according to scenario.

### 5. Inland flooding

**Impact Modelling:** The analysis relies on projected changes in the return interval of precipitation events from the CCKP between current conditions and future projections, which are translated to runoff using a flooding model. CCKP provided gridded changes in precipitation recurrence intervals for four periods (2010–2039, 2020–2049, 2036–2065, and 2071–2100) and under two emissions scenarios in the CMIP5 climate model ensemble: RCP4.5 and RCP8.5. The two sets of changes from CCKP are developed from the full ensemble of GCMs within each emissions scenario, so the flooding results reflect the broad trend across climate models at each emissions level. The methodology considers shocks to three types of assets: built-up capital (i.e., any hard piece of infrastructures such as roads, bridges, and buildings), agricultural capital and agricultural land.

The approach to generate these shocks distributes capital in two stages—first using 9-km gridded GDP data, and then to a finer scale using 100-meter gridded land cover data. Although these finer scale land cover data allowed us to identify capital within the floodplain, those data do not provide the productivity of that capital (i.e., whether the grid cell includes a residential home or factory). Because the flood plain is likely to contain lower productivity capital, we dampen the shocks by 50 percent as inputs to CC-MFMod. This factor produces a conservative estimate of inland flooding impacts.

The baseline flooding impacts use baseline recurrence intervals to calculate damages to capital and agricultural land. The recurrence interval changes (i.e., events become more/less frequent) from CCKP for each period and under each of the two RCPs are then used in the model to calculate flood impacts. The difference in flood impacts from the baseline is the shock, expressed in percentage terms.

### 6. Roads and bridges

**Impact Modelling:** The effects under each climate scenario are analyzed using the Infrastructure Planning Support System (IPSS), also used in the World Bank study Enhancing the Climate Resilience of Africa's Infrastructure. This model analyzes impacts to paved, gravel, and dirt roads; culverts; and bridges, based on stressor-response functions that relate temperature and precipitation changes to repair and reconstruction costs, and traffic delays resulting from road and bridge disruption.

This channel assumes that no proactive, anticipatory measures are taken to protect the roads and bridges network; it is assumed that the additional maintenance is not done so that the impact translates into a reduction in the capital stock of roads and bridges which then affects economic output. A factor of 0.5 is used to translate maintenance costs to reduction in capital stock to recognize that in the absence of maintenance, the infrastructure may still be partially usable. This factor produces a conservative estimate of damages.

**Adaptation Intervention Modelling**[a]**:** Proactive adaptation requiring investments to make roads and bridges network climate resilient. Proactive measures vary depending on the road surface and stressor.
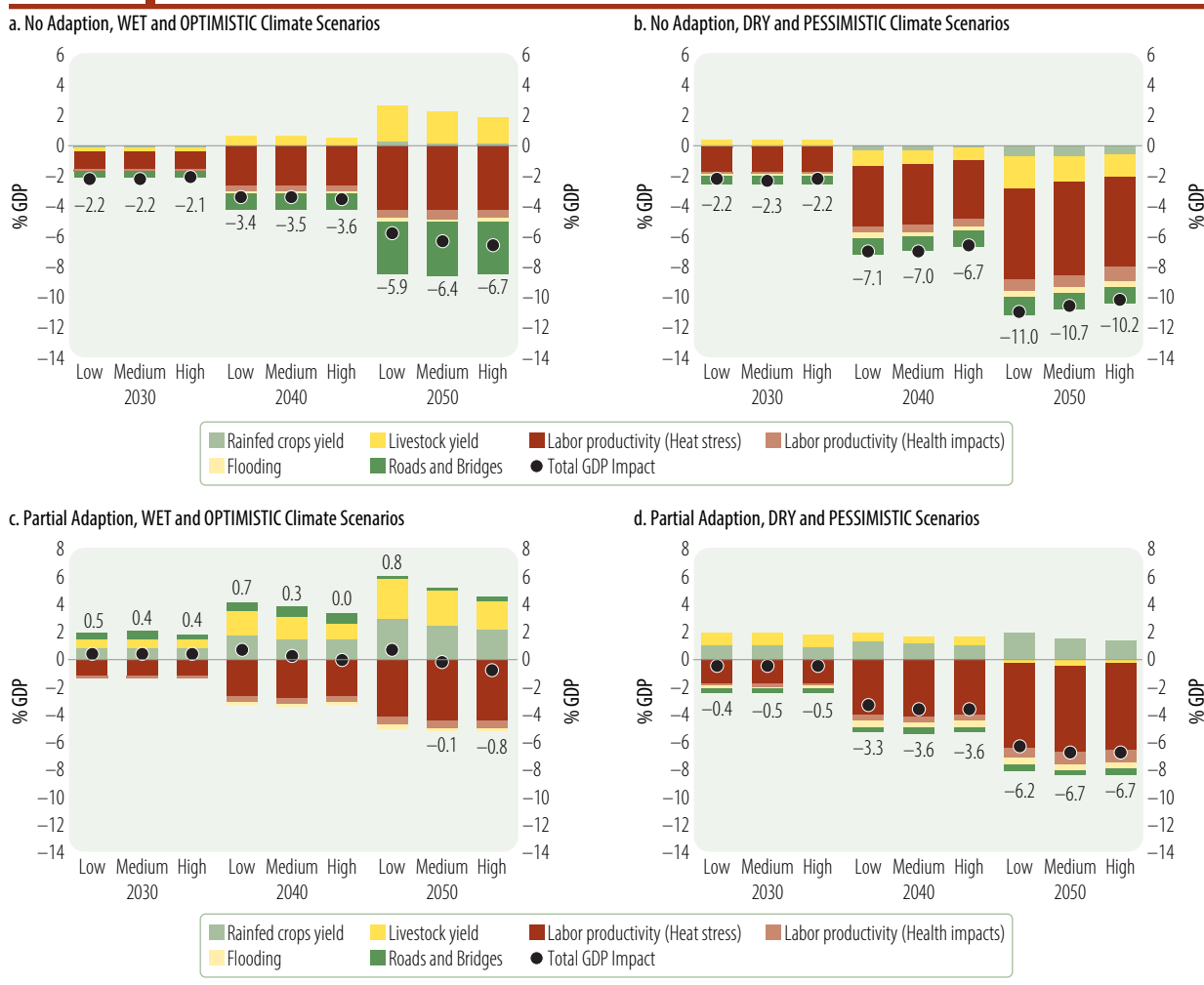
- Benefits: Roads and bridges will be less damaged by changes in temperature, precipitation, and flooding events. This will reduce the losses in capital stock and labor productivity from delays and lower future O&M costs.

- Costs: For roads, new and rehabilitated construction costs range from US$10,000 to US$818,115 per km, and annual routine maintenance range from US$750 to US$5,698 per km. For bridges, rip rap deployment is US$6,500 per pier lane and concrete strengthening is US$323 per m$^2$.

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Source: G5 Sahel CCDR Annex.
[a] Choice of Adaptation Interventions: The three interventions were selected on the basis of high potential benefits for the G5 Sahel region and feasibility to model. The analysis is not meant to be comprehensive or a prioritization of adaptation measures, as not all adaptation measures can be modeled because of the nature of the action and the lack of data on the investment costs, benefits, and co-benefits. For the heat stress and labor productivity channel, structural transformation—shifting from agriculture (predominantly outdoors work) to industry and service sectors—is a form of adaptation. The impact of structural transformation in reducing economic losses can be seen by the lower (as a percentage of baseline) GDP losses in the higher-growth scenarios.

## Mali Estimates of Economic Losses by Low, Medium and High Baseline Growth Scenario

**FIGURE 3.2** Impact on Annual GDP of Combined Effects of Climate Change Shocks from Six Impact Channels



a. No Adaption, WET and OPTIMISTIC Climate Scenarios

b. No Adaption, DRY and PESSIMISTIC Climate Scenarios

c. Partial Adaption, WET and OPTIMISTIC Climate Scenarios

d. Partial Adaption, DRY and PESSIMISTIC Scenarios

Legend: Rainfed crops yield, Livestock yield, Labor productivity (Heat stress), Labor productivity (Health impacts), Flooding, Roads and Bridges, ● Total GDP Impact

# REFERENCES

AXCO (2020). Country Information Mali. https://www.axcoinfo.com/regions/middle-east-africa/mali/.

Centre for Research on the Epidemiology of Disasters (2022). EM-DAT: The International Disaster Database. www.emdat.be.

Clarke, D. and R.V. Hill (2013). Cost-Benefit Analysis of the African Risk Capacity Facility. Vol. 1292. International Food Policy Research Institute. http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/127813.

Cotillon, S. E., and G.G. Tappan (2016). Landscapes of West Africa: A Window on a Changing World. https://eros.usgs.gov/westafrica/.

Demirgüç-Kunt, A., L. Klapper, D. Singer, and S. Ansar (2022). The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19. Washington, D.C.: World Bank. https://openknowledge.worldbank.org/handle/10986/37578.

Fava, F., N. Jensen, J. Sina, A. Mude, and B. Maher (2021). Building financial resilience in pastoral communities in Africa: Lessons Learned from Implementing the Kenya Livestock Insurance Program (KLIP). Washington, D.C.: World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/888931613729186587/building-financial-resilience-in-pastoral-communities-in-africa-lessons-learned-from-implementing-the-kenya-livestock-insurance-program-klip.

Fava, F., R. Banerjee, N. Kahiu, A. Maiga, F. Lung, N. Jensen, T.F. Dicko, and J. Plevin (2023). Strengthening Financial Resilience to Drought: A Feasibility Study for an Index-Based Drought Risk Financing Solution for Pastoralists in Mali. Washington, D.C.: World Bank Group.

Food and Agriculture Organization (FAO) (2021). FAOSTAT Data. http://www.fao.org/faostat/en/.

GSMA (2017). The Potential of Mobile for Rural Energy Access in Mali. https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2017/04/Mobile-for-Development-Utilities-The-potential-of-mobile-for-rural-energy-access-in-Mali.pdf.

Hallegatte, S., A. Vogt-Schilb, M. Bangalore, and J. Rozenberg (2017). Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters. Climate Change and Development. Washington, D.C.: World Bank. https://openknowledge.worldbank.org/handle/10986/25335.

Hansen, J., A. Rose, and D. Dinh (2017). World Met Day: Partnering with National Meteorological Services to Support Farmers in Africa. https://iri.columbia.edu/news/world-met-day-partnering-with-national-meteorological-services-to-support-farmers-in-africa/.

International Livestock Research Institute (2022). Index-Based Livestock Insurance. https://ibli.ilri.org/.

Museru, M., F. Toerien, and S. Gossel (2014). The Impact of Aid and Public Investment Volatility on Economic Growth in Sub-Saharan Africa. World Development (Vol. 57, pp. 138–147). https://www.sciencedirect.com/science/article/abs/pii/S0305750X13002854.

Comité inter-États de lutte contre la sécheresse au Sahel (CILSS) (2022). Cadre Harmonisé d'identification des zones à risque et des populations en insécurité alimentaire et nutritionnelle. https://www.ipcinfo.org/fileadmin/user_upload/ipcinfo/docs/ch/Fiche_comunicaion_R%C3%A9gion_SAO_MARS2022_VF_.pdf

Schaefer, L., and E. Waters (2016). Climate Risk Insurance for the Poor and Vulnerable: How to Effectively Implement the Pro-Poor Focus of Insuresilience. Munich Climate Insurance Initiative. https://collections.unu.edu/eserv/UNU:5956/MCII_CRI_for_the_Poor_and_Vulnerable_meta.pdf.

Venton, C.C. (2018). The Economics of Resilience to Drought. Washington, D.C.: USAID. https://2017-2020.usaid.gov/sites/default/files/documents/1867/Somalia_Economics_of_Resilience_Final_Jan_4_2018_BRANDED.pdf.

World Bank Group (2018). Kenya's Pastoralists Protect Assets from Drought Risk with Financial Protection. Feature Story. https://www.worldbank.org/en/news/feature/2018/11/05/kenyas-pastoralists-protect-assets-from-drought-risk-with-financial-protection.

World Bank Group (2022a). G5 Sahel Region Country Climate and Development Report. CCDR Series. Washington, D.C.: World Bank. https://openknowledge.worldbank.org/handle/10986/37620.

World Bank Group (2022b). Climate Change Knowledge Portal. Country Profile Mali. https://climateknowledgeportal.worldbank.org/country/mali/climate-data-projections.

World Bank (2023a). Africa's Pulse, No. 27, April 2023: Leveraging Resource Wealth During the Low Carbon Transition. http://hdl.handle.net/10986/39615.

World Bank Group (2023b). Commodity Markets Outlook, April 2023: Lower Prices, Little Relief. http://hdl.handle.net/10986/39633.

World Bank (2023c). Global Economic Prospects, January 2023. Global Economic Prospects. http://hdl.handle.net/10986/38030.

World Food Programme (2019). Ethiopia, Satellite Index Insurance for Pastoralists (2017–2019): Impact Evaluation. https://www.wfp.org/publications/ethiopia-satellite-index-insurance-pastoralists-2017–2019-impact-evaluation.

Zambian Business Times (2020). Index-based Livestock Insurance Launched. https://zambianbusinesstimes.com/index-based-livestock-insurance-launched/.

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