



## CLIMATE-SMART AGRICULTURE INVESTMENT PLAN

# BURKINA FASO







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THE WORLD BANK GROUP • INITIATIVE FOR THE ADAPTATION OF AFRICAN AGRICULTURE •  
WEST AFRICAN SCIENCE SERVICE CENTER ON CLIMATE CHANGE AND ADAPTED LAND USE •  
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# Foreword

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The Agriculture sector including crop, animal and forest productions, fisheries and water resource management, is the main sources of livelihoods, employment and export earning in the country. Indeed, 80% of the population is employed in agriculture and agriculture contributes to 30% of GDP. However, agriculture remains extremely vulnerable to climate change and variability, threatening the ability of the agriculture sector to continue to provide economic and livelihoods benefits in the country. Burkina Faso is one of the fastest growing countries in the world by way of population, estimated to double by 2050, significant increases in productivity and employment opportunities in agriculture will be key to enabling both economic prosperity and livelihoods of farmers. Climate change will however likely intensify and impose major risks to agriculture. This will need to be anticipated and addressed so that the potential gains from agriculture aren't eroded.

This Climate Smart Agriculture Investment Plan (CSAIP), is a collaborative initiative between the World Bank and the Government of Burkina Faso with the technical assistance of the CGIAR research program (CIAT, World Agroforestry Centre, and CCAFS), WASCAL and financial support from the AAA Initiative and Agence Française de Développement (AFD). It mobilized the rural sector line ministries including the Ministry of Agriculture and Irrigation; Livestock and Fisheries; Environment, Green Growth and Climate Change; Water and Sanitation, and the support of the Ministry of Higher Education, Scientific Research and Innovation, with the participation of the National chamber of Agriculture (CNA) and the National farmers' confederation (CPF). It aims to anticipate the challenges or opportunities climate change may pose in the Agriculture sector in Burkina Faso, identify and prioritize investments in climate smart agricultural technologies and practices that are suitable to address climate change. This includes building resilience of agricultural systems, increasing productivity, raising incomes of farmers and minimizing greenhouse gas emissions and other negative impacts on the environment, while contributing significantly to the economic growth of the country.

The CSAIP identifies a set of priority investment ranging from sustainable management of water resources and irrigation, soil management and sustainable intensification of livestock production, building of CSA value chains, forestry and agro-forestry, to financial and insurance products, and capacity building. This investment portfolio if well implemented will potentially have considerable benefits for up to 1.7 million Burkinabe and their families in all regions of the country and to the economic performance of the country.

By building on multiple national policies and strategies like the National Rural Sector Program (PNSR), climate change National Adaptation Plan (NAP), National Adaptation Program of Action (NAPA), the Forest Investment Program (FIP), the National Climate Change Learning Strategy, the CSAIP reinforces Burkina Faso's commitment to climate action in the Agriculture sector. It also supports the realization of various international commitments that Burkina Faso is a signatory to such as United Nations Sustainable Development Goals (SDGs), the African Union Malabo Declaration, and the United Nations Framework Convention on Climate Change (UNFCCC) and National Determined Contributions (NDCs).

As it stands, in addition to the Government efforts, bilateral and multilateral donors have to date been major funders of climate related action in Burkina Faso. Non-profits have played a key role in program implementation. Some limited programs have been funded by private sector actors. The Government of Burkina Faso will require continued and stepped up support by these actors and other stakeholders to bring to realization the investments prioritized and detailed in this portfolio. In addition, more public investment will be mobilized to expand and strengthen the Government of Burkina Faso's ownership in this area.



# Acknowledgements

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The report, "Climate-Smart Investment Plan for Burkina Faso (CSAIP)" was prepared under the joint leadership of the World Bank, rural sector line ministries, with the support of the Ministry of Higher Education, Scientific Research and Innovation (MESRSI); Economy, Finance and Development (MINEFID) and the participation of representatives of producer organizations, through the orientation and monitoring committee that was set-up, Alliance-Bioversity-CIAT and WASCAL. The Orientation and Monitoring Committee consisted of Moussa Ouattara and François Lompo, MAAH; Anesekoum Desiré Somé and Wièmè, MRAH; Maxime Somda and Omar Komi, MEA; Joël Awouhidia Korahiré and Pamoussa Ouédraogo, MEEVCC; Amadou Sidibé and Relwendé Marc Ouédraogo, Permanent Secretariat for the Coordination of Agricultural Sectoral Policies (SP/CPSA); Pingdebamba Sawadogo, Ministry of Economy, Finance and Development (MINEFID); Mamoudou Traoré and Youssouf Ouédraogo, Ministry of Higher Education, Scientific Research and Innovation (MESRSI), Issoufou Porgo, Burkina Faso Farmers' Confederation (CPF); and Eric Zougmore, National Chamber of Agriculture (CNA). The CSAIP received support from AAA initiative and the Agence Française de Développement (AFD).

The World Bank Group core team consisted of Elisée Ouédraogo, Task Team Leader; Christine Heumesser, co-Task Team Leader; Loic Braune, Nicolas Ahouissoussi, and Ernest Ruzindaza. The Alliance-Bioversity-CIAT was led by Evan Girvetz, and consisted of Jonathan Mockshell, Stephanie Jaquet, Todd Rosenstock, Steven Pager, Sekou Traore, and Mathieu Ouédraogo. The WASCAL team was led by Oblé Neya and consisted of Loyapin Bondé, Tiga Neya and Yacouba Yira. We are particularly grateful to the CIAT and WASCAL team for their leadership on the process of stakeholder consultations, data collection, the conceptualization of the CSAIP, analyses, drafting and their participation in the report review meetings, inception and validation workshops. All teams were supported by Gwladys Kinda and Roxane Bapuuroh, program assistants, Lionel Yaro, external affairs officer all from the World Bank group.

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# Abbreviations

<b>AAA</b>	Adaption of African Agriculture
<b>AEZ</b>	Agro-Ecological zones
<b>AFOLU</b>	Agriculture, Forest and Land-Use sector
<b>AfDB</b>	African Development Bank
<b>AFR100</b>	African Forest Landscape Restoration Initiative
<b>BCR</b>	Benefit Cost Ratio
<b>CAADP</b>	Comprehensive Africa Agriculture Development Program
<b>CCAFS</b>	Climate Change, Agriculture, and Food Security (CGIAR Research programme)
<b>CGIAR</b>	Consultative Group on International Agricultural Research
<b>CIAT</b>	International Center for Tropical Agriculture
<b>CSA</b>	climate-smart agriculture
<b>CSAIP</b>	climate-smart agriculture investment plan
<b>CSI</b>	Coping Strategy Index
<b>ECOWAS</b>	Economic Community of West African States
<b>EU</b>	European Union
<b>FAO</b>	Food and Agriculture Organisation
<b>GDP</b>	Gross Domestic Product
<b>GEF</b>	Global Environment Facility
<b>GHG</b>	Greenhouse gas
<b>FIE</b>	Fond d'intervention pour l'environnement
<b>HFIAS</b>	Household Food Insecurity and Access Scale
<b>IFAD</b>	International Fund for Agricultural Development
<b>IMPACT</b>	International Model for Policy Analysis of Agricultural Commodities and Trade
<b>IUCN</b>	International Union for Conservation of Nature
<b>KPI</b>	With key performance indicators
<b>MAAH</b>	Ministry of Agriculture and Water Resources
<b>MEA</b>	Ministry of Water and Sanitation
<b>MEVCC</b>	Ministry of Environment, Green Economy and Climate Change
<b>M&amp;E</b>	Monitoring and Evaluation
<b>NAMA</b>	Nationally Appropriate Mitigation Actions
<b>NAP</b>	National Adaptation Plan
<b>NGO</b>	Non-Novernmental organization
<b>NDC</b>	Nationally determined contributions
<b>NPV</b>	Net Present Value
<b>NTFP</b>	Non-timber forest products
<b>PIF</b>	Forest Investment Program
<b>PNDES</b>	National Economic and Social Development Plan
<b>PO</b>	Policy objectives
<b>PRP</b>	Priorities Resilience Pays
<b>PSNR</b>	National Rural Sector Program
<b>RCP</b>	Representative concentration pathway
<b>REDD</b>	Reducing Emissions from Deforestation and Forest Degradation Program
<b>ROI</b>	Return on investment
<b>RIMA</b>	Resilience Index Measurement and Analysis
<b>R&amp;D</b>	Research and Development
<b>SDG</b>	Sustainable development goal
<b>SE/CSNA</b>	Executive Secretariat of the National Council for Food Security
<b>SNV</b>	Netherlands Development Organisation
<b>SP/CPSA</b>	Permanent Secretariat for the Coordination of Agricultural Sector Policies
<b>SSP</b>	Shared socioeconomic pathway
<b>TOC</b>	Theory of Change
<b>UNCCD</b>	United Nations Convention to Combat Desertification
<b>UNEP</b>	United Nations Environment Programme
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>USAID</b>	United States Agency for International Development
<b>WASCAL</b>	West African Science Service Center on Climate Change and Adapted Land Use
<b>WB</b>	The World Bank



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# Executive Summary

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**Burkina Faso's economy is growing, yet much remains to be done. Burkina Faso has made significant progress in poverty reduction in the last few decades, but it faces acute social and economic challenges. The country is one of the fastest growing in the world; the annual population growth rate of 3.1% is expected to drive the population to 42 million by 2050.<sup>1</sup> The 2018 national Gross Domestic Product (GDP) was US\$14.4 billion, or US\$731 per capita; this is below the sub-Saharan African average of US\$1,574, and far below the world average of US\$11,300.<sup>2</sup> There are 19.75 million inhabitants of Burkina Faso, and the population density is relatively high at 72 inhabitants per square kilometer, versus the global average of 60 per square kilometer.<sup>3</sup> While the poverty rate fell between 2003 and 2014 and GDP growth was 6% or higher during that period, Burkina Faso remains a severely impoverished country. While 70.6% of the total population is poor, 47.5% of the poor are rural, and poverty is linked to low agricultural productivity.<sup>4</sup>**

**Agriculture is Burkina Faso's predominant land use, and agricultural land cover has expanded 91% since 2001, when it accounted for just 116.9 million hectares.<sup>5</sup> Much of this expansion has been onto unsuitable land; just 13.3% of the national land area is suitable for cultivation.<sup>6</sup> Farming on unsuitable land, climate change, and desertification mean that 34% of the land area is already degraded.<sup>7</sup> Significant increases in productivity and intensification would enable both economic prosperity and regeneration of degraded forests. Yet the geography of Burkina Faso is challenging for agricultural production; it is an arid, land-locked country with no major rivers.**

**Agriculture is the main source of livelihoods, employment, and export goods in Burkina Faso. Agriculture employs 80% of the country's workforce and contributes nearly 28.6% of national GDP.<sup>8</sup> Smallholder producers operating on 5 hectares or fewer account for about 80% of total agricultural**

<sup>1</sup> FAO, "Africa Sustainable Livestock 2050." <http://www.fao.org/in-action/asl2050/countries/bfa/en/>

<sup>2</sup> World Bank, "Burkina Faso Overview" <https://www.worldbank.org/en/country/burkinafaso/overview>

<sup>3</sup> World Bank, "Burkina Faso." 1. <https://data.worldbank.org/country/burkina-faso>

<sup>4</sup> Nguyen and Dizon 2017.

<sup>5</sup> Knauer, K., Gessner, U., Fensholt, R., Forkuor, G., & Kuenzer, C. (2017). Monitoring agricultural expansion in Burkina Faso over 14 years with 30 m resolution time series: The role of population growth and implications for the environment. *Remote Sensing*, 9(2), 132.

<sup>6</sup> William, Country Assessment Studies on Climate Change, Agricultural Trade and Food Security in ECOWAS BURKINA FASO REPORT.

<sup>7</sup> World Bank Climate Change Country Profile, cited in Creating Markets in Burkina Faso, World Bank, 2019.

<sup>8</sup> UC Davis "Burkina Faso" <https://gfc.ucdavis.edu/profiles/rst/bfa.html>

production. Further, women account for over 50% of the agricultural workforce and produce more than 66% of the food consumed in-country. Along with gold exports, the Burkinabe economy is fueled by exports of cotton, sesame, peanuts, and soy, and cash crops such as maize, sorghum, millet, cowpeas, and sugarcane.<sup>9</sup> The country's primary staple crops, including maize, millet, sorghum, and rice, are crucial to food security.<sup>10</sup>

**Climate change is apparent and widespread in Burkina Faso. Declining rainfall and increasing temperatures are now a trend with serious consequences for agriculture and natural resources like water and forests.** Other climate-related hazards such as droughts, floods, heat waves, locusts, and dust storms are common. Climatic variations are widespread in the Sahel, especially variability in rainfall and temperature.<sup>11</sup>

**Burkina Faso's agriculture sector is very vulnerable to negative impacts from climate change.** High temperatures and reduced rainfall will catalyze desertification, ecosystem deterioration, and concomitant losses of arable land. Higher temperatures and intense rainfall could instigate outbreaks of crop and livestock pests and diseases. Postharvest losses may increase due to erratic and unpredictable weather conditions. Low agricultural diversification intensifies the risk of crop failure. Climate change will exacerbate vulnerability in the north, since the region is particularly hot and dry, has lower quality agricultural lands, and is most **susceptible to drought, soil erosion, and land degradation.**

**Climate change has already decreased yields and increased the demand for water resources.** Climate shocks and the lack of sustainability of land use threatens the food security of Burkina Faso.<sup>12</sup> Extensive droughts are likely to cause crop failure and the death of livestock especially because Burkina Faso operates under a rain-fed production system.<sup>13</sup> Burkina Faso has adequate water resources<sup>14</sup> and approximately 233,500 hectares of irrigable land, but only about 34,500 hectares were under irrigation in 2014. Water resources are affected by variability in rainfall and temperatures. Increased temperatures and reduced rainfall cause wells and other water sources to dry up. Projections indicate future water scarcity. Floods are less likely to cause damage compared to droughts; however, a successive combination of both reduces the capability of food storage, resulting in chronic food insecurity.

**Climate-smart agricultural investment plans (CSAIPs) are a way for countries to plan for the future, and Burkina Faso is developing this national CSAIP as part of the Adaptation of African Agriculture (AAA) Initiative.** AAA is a coordinated multi-country initiative that was launched at the 22<sup>nd</sup> United Nations Climate Change Conference in Marrakech, Morocco (2016). The development of this CSAIP was led by the Burkina Faso Ministry of Agriculture with generative input from a range of stakeholders. The West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) was a key technical partner under the leadership of the International Center for Tropical Agriculture (CIAT); World Agroforestry (ICRAF); and the CGIAR Research Program on Climate Change, Agriculture, and Food Security (CCAFS). Funding and technical support were provided by the World Bank. Strong government partnership and stakeholder engagement are the foundation of this CSAIP.

<sup>9</sup> UC Davis "Burkina Faso" <https://gfc.ucdavis.edu/profiles/rst/bfa.html>

<sup>10</sup> FAO (2010). Monitoring African Food and Agricultural Policies Project (MAFAP) Commodity Selection in the Five pilot countries. Document attached

<sup>11</sup> World Bank, "Vulnerability, Risk Reduction, and Adaptation to Climate Change: Climate Risk and Adaptation Country Profile Burkina Faso"

<sup>12</sup> USAID

<sup>13</sup> FAO, "Food Security and Humanitarian Implications in West Africa and the Sahel"

<sup>14</sup> William, Country Assessment Studies on Climate Change, Agricultural Trade and Food Security in ECOWAS BURKINA FASO REPORT.

**Burkina Faso's national CSAIP prioritized a set of 9 investments and actions needed to boost crop resilience and enhance yields for nearly 1.7 million beneficiaries and their families, helping them adapt to climate change and reduce climate change causing greenhouse gas (GHG) emissions as a co-benefit.** The CSA investments were identified based on a situation analysis of Burkina Faso's plans and policies, the current context of agriculture, and analysis and scenario development of climate change impacts on different crops and livestock. Burkinabe stakeholders analysed potential investments in a workshop and prioritized those presented in this CSAIP. Stakeholder experts represented a variety of organizations, including government ministries, institutions, research organizations, farmer groups, and international development organizations. An expert stakeholder workshop in Ouagadougou used an iterative, qualitative and quantitative prioritization process to rate and review 38 proposed CSA priorities. They also grouped the long list of investments by agro-ecological zones. The long list of potential investments was reduced from 38 to a shortlist of 9 priority CSA investments.

**This CSAIP also includes elements of program design and implementation. It features economic analysis, assessments of barriers and opportunities related to the success of individual priority investments, financing avenues, and policy analysis.** The plan highlights both the high-level economic benefits to Burkina Faso, as well as the financial viability of investments, related projects within the country, findings from research on similar crops, and other implementation issues to be addressed. The process used to develop this plan also supports engagement and capacity strengthening.

**Climate modeling done for this CSAIP shows that climate change could exacerbate biophysical damages for key food security and commercial crops.** Climate impacts do not affect all commodity groups uniformly, but they do affect most commodity groups. Most cereals, especially maize, exhibit high vulnerability to climate change no matter what scenario is studied, with losses of 9-12% in 2030 and 18-22% in 2050 compared to a no climate change baseline, although other cereals do better. Other crops, especially fruits, vegetables, soybeans, groundnuts, oilseeds, and sugarcane are likely to perform badly in the long term. Cotton, one of Burkina Faso's most important exports, shows declines of about 4-7% under all scenarios.

**The CSAIP climate modeling shows that some crops are climate resilient, so CSA emphasis should be on promoting practices that maintain their resilience.** Sweet potato and yams are nutritionally important and show resilience to a warmer future. Cowpeas and potatoes also demonstrate relative levels of resilience to climate change impacts under all representative concentration pathways (RCPs) for both time periods. As noted previously, other cereals and rice also appear to be relatively resilient.

**The prioritized investments include 5 national activities and 4 others that are regionally distributed throughout Burkina Faso.** The national investments are intended to provide services, infrastructure, and capacity across the country to support the outcomes of the CSAIP. The 6 regional investments focus on specific value chains and regional issues to be addressed through targeted regional investments.

**The 5 national investments that build capacity, financing, and resilience; support mitigation; and offer human health benefits are:**

- **Sustainable on-farm biogas production**, which increases access to and knowledge of sustainable domestic energy sources in order to conserve wood resources, reduce greenhouse gas (GHG)

emissions, and reduce poverty, food insecurity, and health threats to rural communities.

- **Sustainable intensification of livestock production**, which fosters climate resilience in Burkinabe livestock systems for improved food and nutritional security and economic outcomes.
- **Finance and insurance services to foster climate-smart agriculture**, which nurtures smallholder ability to invest in CSA innovations through good access to robust financial services, including credit, loan, insurance, and risk instruments and savings and payment services.
- **Forest, agroforest, and garden production for climate-smart diversification**, which fosters climate-resilient livelihoods and food sources for women and youth smallholders through home gardens, agroforestry, and non-timber forest product (NTFP) harvesting and value-addition.
- **Building capacity in climate smart agriculture**, which fully integrates national climate-smart priorities into Burkina Faso's agricultural research and extension programs, and builds robust extension mechanisms for delivering timely, practical climate-smart information to farmers and other stakeholders through highly accessible channels.

#### 4 climate-smart investments were prioritized to support adaptation of agricultural production systems by introducing a variety of climate-smart practices into the different investments:

- **Sustainable management of water resources and irrigation** fully leverages Burkina Faso's water resources in sustainable ways to improve productivity, food and nutritional security, climate resiliency, and ecological health in the North Sudan region for 100,000 farmers and their families.
- **Developing climate-smart organic value chains** develops a burgeoning niche market to create viable careers and shorten supply chains in peri-urban areas in the North Sudan and South Sudan regions for 60,000 farmers and their families.
- **Developing resilient oil-protein value chains** strengthens the quality, yield efficiency, and value chains of oil-protein crops to sustainably meet domestic demand and support international market development in the North Sahel, North Sudan, and South Sudan regions for 240,000 farmers and their families.
- **Integrated soil management for agricultural productivity and environmental restoration** provides producers and extension agents with location-tailored information on soil characteristics and best management practice recommendations, as well as the tools, products, partnerships, and policy environment to implement those recommendations for 200,000 farmers and their families in the North Sahel, North Sudan, and South Sudan regions.

To understand the CSA potential of each investment, it is important to understand how vulnerable the sector is to climate impacts, why each priority investment is important, and what the future scenario looks like for that commodity or cropping system with and without the investments. This information indicates what the investments would accomplish.

Climate Change	Project Importance	Scenario WITHOUT Investment	Scenario WITH Investment	Investment Objectives
<b>Forest, agroforest, and garden production for climate-smart diversification</b>				
Medium resiliency	Improves livelihoods and food sources for women and youth through gardens, agroforestry, and NTFPs.	Low diversification increases smallholder vulnerability to economic and food insecurity given climate change, continued deforestation and environmental degradation, and untapped international market opportunities.	Smallholder food and economic resilience increases, particularly for women and youth. Forest conservation and ecosystem services are enhanced. Diversification supports resilience. National economic growth occurs through value chain development of high-value export products.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Sustainability</li> <li>• Mitigation</li> <li>• Livelihoods</li> <li>• Inclusivity</li> </ul>

Sustainable management of water resources and irrigation				
Medium resiliency	Protects and sustainably leverages water resources to improve climate resiliency.	Agriculture remains exposed to increasingly unpredictable precipitation, crop and animal loss, food and economic insecurity, conflict over scarce resources, and watershed degradation.	Efficient water capture allows storage and management. Irrigation stabilizes crop and animal production, food supplies, and market prices. Reduced erosion and flooding and watershed protection are achieved.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Transformation</li> <li>• Sustainability</li> <li>• Environmental quality</li> </ul>
Finance and insurance services to foster Climate-Smart Agriculture				
Foundational resiliency through essential services	Enables smallholder investment in CSA through loan, insurance, and other basic services.	Smallholders have limited capacity to invest. Cost of maintaining the status quo increases with climate impacts. Food and economic security decreases. A downward poverty cycle results.	Credit and loan enable investment in system transformation. Insurance and risk distribution instruments offer protection from loss, enabling farmers to take the risk of changing to new systems. Interventions are identified to help them reduce on-farm risks and build resilience.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Trade</li> <li>• Sustainability</li> <li>• Transformation</li> <li>• Mitigation</li> </ul>
Building capacity in Climate-Smart Agriculture				
Foundational resiliency through essential services	Establishes sustainable systems for developing and disseminating CSA innovation.	Farmers make short-term decisions when facing uncertainty or high risk. This perpetuates the poverty cycle, degrades resources, and increases vulnerability.	Robust research, extension, and information services support many site-tailored solutions that drive resilience, productivity, and environmental management in a two-way dialogue that pinpoints emerging innovations (climate, pest, OneHealth).	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Sustainability</li> <li>• Transformation</li> <li>• Mitigation</li> </ul>
Developing Climate-Smart organic value chains				
Highly vulnerable	Leverages untapped domestic and international markets for diversification.	Low sectoral diversity persists along with a dearth of livelihood and income opportunities, particularly for youth and women.	Diversification improves economic resilience by creating livelihoods along several organic production value chains. Environmental impacts are reduced. Climate, pest, and other risks are reduced through local production and crop diversity.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Sustainability</li> <li>• Livelihoods</li> <li>• Economic resilience</li> </ul>
Developing resilient oil-protein value chains				
Medium resiliency	Strengthens value chains to build livelihoods, reduce import dependency, and build export markets.	The soybean yield plummets with climate change. Soil health declines. Income declines. Reliance on imports increases.	Sustainable productivity, reduced reliance on imports, improved national food security, export market development, and new livelihood opportunities are attained.	<ul style="list-style-type: none"> <li>• Resilience</li> <li>• Value chains</li> <li>• Sustainability</li> <li>• Trade</li> <li>• Food security</li> <li>• Economic resilience</li> </ul>
Integrated soil management for agricultural productivity and environmental restoration				
Foundational resiliency through essential services	Provides location-tailored soil information, recommendations, and tools and policy to support implementation.	Agriculture and extreme weather events degrade soils. Productivity decreases. The cost of production rises with increased fertilizer inputs. Increased GHG emissions exacerbate climate change. Environmental degradation results.	Soils are resilient to climate stress. Sustainable productivity, food and economic security, GHG storage, strong environmental services, and optimum fertilizer usage are achieved. Improved soils enable intensification, higher incomes, and risk reduction strategies.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Sustainability</li> <li>• Transformation</li> <li>• Mitigation</li> </ul>

Sustainable on-farm biogas production				
Resilient under climate change scenarios	Leverages farm waste to produce clean energy, support health, and reduce GHGs.	Deforestation, high GHG emissions, unreliable and costly cooking fuel and fertilizer purchases, and indoor air pollution and related diseases especially affecting women and children all continue.	Deforestation and GHG emissions are reduced. Clean cooking fuel and fertilizer is produced on-farm for free. Crop yields improve. Health outcomes improve, and demands on women and children are ameliorated.	<ul style="list-style-type: none"> <li>• Sustainability</li> <li>• Mitigation</li> <li>• Soil fertility</li> <li>• Health</li> </ul>
Sustainable intensification of livestock production				
Vulnerable to climate change	Creates climate resiliency to ensure future food security and income.	Productivity is reduced as heat stress and mortality increase. Feed sources decline. Pastoralist-smallholder conflict increases.	Health, productivity, and food and income security improve. OneHealth is adopted. Farmer-pastoralist conflict is reduced. GHG emission intensity and environmental degradation are also reduced.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Mitigation</li> <li>• Health</li> </ul>

**The financial and economic analysis shows that all 9 investments increase productivity by at least 18% on average and have positive economic benefits for beneficiaries, while the whole portfolio reduces GHG emissions.** The chances of a positive net present value (NPV) are a good way of assessing resilience to risk. Considering the priority investments without risks included, all have a better than 50% chance of a positive NPV. 4 of the 9 investments have a better than 50% chance in the face of uncertain climate and social risks. If all the priority investments were implemented in Burkina Faso, they would sequester 4.31 mega tonnes of carbon dioxide (MT CO<sub>2</sub>) overall. Only one of the investments, Livestock Intensification, will be a source of net GHG emissions, but it reduces emissions intensity from livestock (cows, goats, and sheep).

**Of the 9 priority investments analysed, some distinguish themselves for how strongly they support the 3 fundamental CSA pillars: productivity, resilience, and mitigating GHG emissions.** Forest and Garden appears in all 3 categories and is the strongest performer on resilience to risks and on reducing emissions. Based on their rank order, Integrated Soil Management is the next strongest investment across the CSA pillars, followed by Biogas, which is the 3rd strongest for yield and reducing emissions, and then Capacity Building. Oil-Protein Crops and Finance and Insurance both appear in 2 of the 3 categories.

**The 9 investments analyzed are predicted to provide significant benefits for farmers in Burkina Faso.** The cost-benefit analysis (CBA) is presented both with and without risks so the potential magnitude of foreseeable risks can be understood. Without risks included in the model, NPV (20 years) ranges from US\$16.9 million with the Biogas program to more than US\$196 million for Forests and Gardens. All investments are expected to improve the income and productivity of farmers. Investment in improved agricultural practices increases farm outputs, whether by introducing new breeds of livestock or drought tolerant seeds for crops, or by providing information for better farming decisions (for example, through knowledge, advisory, and climate services). Each investment will present positive returns relative to its costs, based on the analysis. The analysis suggests there is potential for positive returns with each of the investments—but there are also risks. Yet all the returns on investments (ROIs) are positive when risk is excluded.

**It is important to view these proposed project investments through different lenses for their potential transformative value.** The strongest performing projects for the three CSA pillars (Forest and Garden, Oil-Protein Crops, and Capacity Building) are those with the lowest mean benefit cost ratio (BCR). Some types of investors (e.g. in impact investing) may look for strong positive returns, yet these may not be appropriate metrics for this CSAIP because investments in smallholders almost

universally fall below this ROI level, and these investment plans intend to catalyze change and improve capacity and suitability so that others investors may be willing to enter. Thus, strict rules on levels of return necessary may not hold. Ultimately, this CSAIP represents a public investment in the growth of the agricultural sector, while benefits are accrued privately by farmers.

**An equivalent to a sensitivity analysis was performed for NPV, using 2 levels of carbon pricing (low and high), both with and without climate and social risks.** With high carbon prices and no risks included, all the proposed investments have a positive NPV. Yet some projects, such as Biogas, have high up-front costs but also high mitigation potential. This analysis shows that the financial and economic analyses are acutely sensitive to assumptions about carbon pricing and climate and social risks. It provides a strong rationale for cautious analysis of both future carbon pricing and risk calculations within agricultural sector investments.

**Climate modeling results show the positive effects that some of the investments can have on yield by implementing CSA practices.** The On-Farm Biogas and Integrated Soil Management investments are poised to boost key cereal crops, one through the integration of livestock and cereal systems, the other through soil recovery and conservation practices. Maize yield growth in particular stands to benefit but is otherwise projected to flatten in the near future under climate change. These practices are also projected substantially to offset Burkina Faso's steepening trade deficit in sorghum and millet. The soybean yield trajectory is projected to be one of the hardest hit by climate change. These CSA interventions could lay groundwork to offset a fledgling trade deficit in these products. These results highlight the importance of investment in Capacity Building for CSA nationally.

**This CSAIP portfolio of investments is closely aligned with national policies, strategies, and plans.** Coordination between funded CSAIP investments and Burkina Faso's Nationally Determined Contributions (NDCs) is vital, and there is a new NDC Partnership Plan under development. The CSAIP is clearly aligned with Burkina Faso's current NDCs, both with high level objectives and specific investment activities. For example, the Building Capacity investment supports 7 of 10 current NDC objectives. The CSAIP also addresses the goals of multiple national policies and strategies, including the National Rural Sector Program, the climate change National Adaptation Plan (NAP), National Adaptation Program of Action (NAPA), the Forest Investment Program (FIP), the National Climate Change Learning Strategy, and the African Adaptation Program. The CSAIP builds resilience within national institutions themselves, thus positively affecting myriad aspects of national policy. These investments thus support Burkina Faso's current national policies as well as its future developments in agriculture and food security in the face of climate change.

**It is a risk that investments in CSA program design and implementation may be constrained by the existing policy context.** There are three barriers to success identified in all investments:

- Poor land tenure regimes
- A dearth of finance services for agricultural stakeholders, particularly smallholder producers
- Weak extension services, including climate and soil services

Climate change risks may be aggravated by the policy environment, although there are climate adaptation efforts underway, from farmers changing planting times or varieties to national-scale efforts to promote adaptation within larger sectors. All programs should take into consideration the prerequisite land tenure, finance services, extension support, and climate information that all smallholders need for programs to meet the broader goals of the NDCs. Digital solutions can help lower these barriers in many cases. Furthermore, there are risks presented by internal security concerns, global financial shocks, and potential financing, related to the current 2020 COVID-19



global pandemic and the impacts within Burkina Faso from COVID-19.

**A supportive implementation context is critical for the success of these investments and should build on existing institutional capacities and on-going CSA-related projects.** Momentum from existing programs and initiatives can be used to leverage continued growth and development in Burkina Faso's agricultural sector. Many programs and initiatives funded by both the Burkinabe government and international donors have driven important agriculture sector growth. 8 of the 9 proposed investments found that a strong Burkinabe knowledge base was the greatest asset supporting implementation. This was followed by policy alignment (7 investments), another important asset working in favor of these projects. Although policy is not, in all cases, consistently implemented, the all-important first step of establishing the regulation is already done. Availability of needed inputs (6), robust climate resilience and strong demand (5 each), and aligned interests (4) will also support many of the projects proposed herein.

**Climate-smart innovation in Burkina Faso requires support from many sectors, including Burkina Faso's government, non-profits, the private sector, and international organizations.** Yet partnerships, and the number of potential collaborators, can result in both distinct benefits and increased complexity, depending on particular arrangements with specific partners. Many of the projects noted a variety of potential public sector partnerships, so clarity about institutional arrangements and about which government agencies have priority will be important during further project design phases. Many of the proposed investments also identified a large number of international and national collaborators, ranging from CGIAR international research institutions to Burkinabe non-governmental organizations (NGOs) to a variety of aid organizations.

**Burkina Faso will need to identify financial resources to implement the suite of investments proposed in this CSAIP.** All the investments in this portfolio help support Burkina Faso's objectives to improve food security and support rural livelihoods. However, interest in climate change, agriculture, and the environment may diminish as Burkina Faso deals with a humanitarian crisis and increasing insecurity. Financing costs and needs are well within the scope of reasonable projects that are financed by a range of institutions and organizations. All the projects identified at least 1 source of government funding. Blended finance from the government and the Environmental Intervention Fund (FIE) was proposed by 3 projects. There was also a strong role envisioned for the private sector, with many of the proposed investments identifying potential partners for private sector financing and collaboration.

**The investments and their objectives build on these recommendations and Burkina Faso's own policy priorities.** Specifically, through its Plan National de Développement Economique et Social (PNDES), Burkina Faso sees agriculture underpinning a major effort to drive economic growth and contribute to poverty reduction. All the investments support increasing agricultural productivity and improve sustainability. All but 3 of the investments directly support value chain creation, jobs, or agro-processing, with Organic Farming, Livestock, and Forest and Garden having the largest potential impact. All the projects could be designed to directly support women and youth. Care needs to be taken, however, to prevent commodities and crops that are now managed by women and youth from passing into men's control when investments are made and they are monetized. 4 of the proposed investments in this CSAIP have the potential to transform the agricultural sector, catalyzing new approaches and actions.



Proposed Investments	Productivity	Food Security	Supports Agriculture Sector Resilience	Agriculture Value Chains	Sustainable Land or Farming	Mitigation	Supports Women and Youth	Agriculture Sector Transformation
Capacity	✓	✓	✓	✓	✓	✓	✓	✓
Finance	✓	✓	✓	✓	✓	✓	✓	✓
Water Resources	✓	✓	✓	✓	✓	✓	✓	✓
Soils	✓	✓	✓		✓	✓	✓	✓
Organic	✓	✓	✓	✓	✓	✓	✓	
Forest And Garden	✓	✓	✓	✓	✓	✓		
Livestock	✓	✓	✓	✓	✓		✓	
Oil-Protein	✓		✓	✓	✓	✓		
Biogas	✓				✓	✓	✓	

**Taken together, these investment opportunities represent a well-balanced portfolio.** The investments span different sectors of the country, have different levels of risk, target divergent groups of beneficiaries, and introduce a wide range of well-demonstrated CSA technologies and practices. While policy interventions are not a focus of the CSAIP, having a strong portfolio of CSA investments that demonstrate which policies are supportive of success, and which are barriers to success, helps create policy coherence and furthers CSA across the policy arena. All the investments support risk reduction and resilience, and all of them support CSA pillars and contribute to meeting Burkina Faso's objectives as identified in its national plans, which are fundamental to improving its future.



# Why Climate-Smart Agriculture

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**Burkina Faso has made significant progress in poverty reduction in the last few decades, but it faces considerable social and economic challenges.** The poverty rate fell between 2003 and 2014, and GDP growth was 6% or higher during that period. Nevertheless, Burkina Faso remains a severely impoverished country. The 2019 Human Development Index ranks Burkina as 183<sup>rd</sup> of 189 countries. Poverty is especially concentrated in certain regions and is strongly linked to low agricultural productivity.<sup>15</sup> The geography of Burkina Faso is challenging for agricultural production; it is an arid, land-locked country with no major rivers.

**Climate change is adversely affecting Burkina Faso, lowering agricultural production and decreasing opportunities for future prosperity.** At the local level, climate change impacts are demonstrated by extreme and unpredictable events—including prolonged droughts, violent floods, deadly heatwaves, and erratic weather at the beginning and end of the rainy seasons. At the regional scale, distinct patterns become apparent in each agroecological region. Desertification has already claimed extensive areas, and land degradation affects nearly 34% (over 9 million hectares) of land.<sup>16</sup>

**A broad and robust suite of agricultural and rural development initiatives is needed to help Burkina Faso adapt to climate change by reducing vulnerability and increasing resilience, especially in its agricultural sector.** Food and nutritional security, smallholder livelihoods, and agricultural production must be resilient to extreme climate events and variability. Responding to this need, and taking into account Burkina's own National Adaptation Plan (NAP), an in-country team has identified and prioritized a portfolio of investments to support Burkina Faso's rural sector in addressing climate change through climate-smart agriculture (CSA). This document describes these investments and their context in detail.

<sup>15</sup> Nguyen and Dizon 2017

<sup>16</sup> CPF, 3.

**Climate-smart agriculture (CSA) addresses agricultural vulnerabilities to climate change by bolstering productivity, adaptation, and mitigation.** Increases in productivity help fill gaps in nutritional and economic security at the household level and build economic growth and resilience at the national level. Adaptation adjusts or transforms current practices into practices that are resilient in the face of climatic vagaries. Mitigation helps reduce the risk of further climate change by reducing greenhouse gas (GHG) emissions or increasing carbon storage. Taken as a whole, these 3 pillars of CSA (Figure 1) aim to identify and implement methods for increasing productivity that are resistant or resilient to extreme weather and reduce GHG intensity (the amount of GHG per unit of food produced).<sup>17</sup>

**CSA acknowledges the synergistic effects between these 3 pillars and aims to maximize co-benefits and minimize tradeoffs between them.** When tradeoffs are necessary, the well-being of the rural poor is prioritized through a focus on boosting productivity and adaptation. CSA also brings tertiary mitigation co-benefits by increasing food production at a greater rate than GHG emissions, thus reducing GHG intensity.

**CSA is not a silver-bullet approach, but rather is a process of identifying and implementing highly site-specific and time-specific solutions tailored to each community's unique needs.** Thus, the relative importance of the 3 pillars will vary from one situation and stakeholder group to the next. While CSA is inherently agriculture-oriented, it is multisectoral in its effects on household livelihoods, national food security, and the sustainable use of natural resources.

**Figure 1 CSA: The Triple Win of Sustainability, Resilience, and Lower Emissions<sup>18</sup>**



**Climate-smart agricultural investment plans (CSAIPs) are a way for countries to plan for the future, and Burkina Faso is developing this national CSAIP as part of the Adaptation of African Agriculture (AAA).** AAA is a coordinated multi-country initiative that was launched at the 22<sup>nd</sup> United Nations Climate Change Conference in Marrakech, Morocco (2016). This CSAIP was developed with generative input from a range of stakeholders, with the West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) working as a key partner. Funding and technical support were provided by the World Bank. Strong government partnership and stakeholder engagement are the foundation of this CSAIP (see Annex B).

**Burkina Faso is invested in the success of this CSAIP.** It is also a signatory to several prominent international commitments that inform this CSAIP, including the United Nations Sustainable

<sup>17</sup> Lipper et al., "Climate-Smart Agriculture for Food Security."

<sup>18</sup> Food and Agriculture Organization of the United Nations, Climate-Smart Agriculture Sourcebook.

Development Goals (SDGs), the African Union Malabo Declaration, and the United Nations Framework Convention on Climate Change (UNFCCC) National Determined Contributions (NDCs). Burkina Faso is also a member of the Global Alliance for Resilience in the Sahel and West Africa. This CSAIP supports Burkina Faso's contributions to several international agreements. This CSAIP also supports numerous national policies and initiatives, especially the NAP, the approved readiness program prepared by International Union for Conservation of Nature (IUCN), and Green Climate Fund (GCF) support for Burkina Faso for readiness in December 2019.

**Burkina Faso launched its United Nations Framework Convention on Climate Change (UNFCCC) Nationally Determined Contribution (NDC) in 2015, and agriculture is a major component of both the NDC and NAP.** The country has three strategies that are associated with increasing agricultural output and reducing poverty, revitalizing its natural resource capital, and supporting technologies and their adoption (including in agriculture). NDCs integrate climate adaptation, increased productivity, and reduced emissions intensity to guide efforts. The NDC is currently being revised, but it may offer closer alignment with this CSAIP. The NAP identifies reducing the vulnerability of specific sectors to climate change, with priorities including agriculture, livestock breeding, water, forests, and natural ecosystems.<sup>19</sup> At the 2019 United Nations Climate Change Conference in Madrid, Spain, Burkina Faso launched their partnership plan which identifies six priorities, including capacity building, mitigation, adaptation, progress reporting, financing, and communication.

**In alignment with Burkina Faso's NDC, this CSAIP has identified specific investments that help reduce GHG intensity, which is especially important given Burkina's low emissions and rapid population growth.** Each investment concept proposes actions that reduce GHG intensity by decreasing emissions or sequestering carbon in biomass and soils. Specific investments, such as using organic residue for biodigesters, improving livestock nutrition and emissions, reversing land degradation and improving soil carbon storage, and supporting agroforestry and non-timber forest expansion, all contribute to mitigation while also building resilience. These are just a few examples of the mitigation activities promoted in this CSAIP. Please see Chapter 3 for details of mitigation and Chapter 4 and Annex A for complete details of proposed investments.

**This CSAIP emphasizes the 3 pillars of CSA: productivity, adaptation and mitigation.** The global community, including Burkina Faso, is already challenged to meet food security requirements for a growing population. This challenge will increasingly be exacerbated by climate change.<sup>20</sup> In July 2019, natural disasters, food insecurity, conflict, and malnutrition resulted in 1.3 million people requiring humanitarian assistance,<sup>21</sup> with numbers increasing since then. Burkina Faso already has a vulnerable population that will feel the impacts of climate change keenly; 21% of children under age 5 are chronically malnourished, 44% live on less than US\$1.90 per person per day, and 20% are considered food insecure.<sup>22</sup> Yet Burkina Faso contributes only 0.08% of global GHG emissions. By improving and supporting Burkinabe farming systems and the production and adaptation efforts identified in Burkina Faso's NAP, this CSAIP supports mitigation.

**This CSAIP provides a tangible, vetted set of priority investments for investors and donors to consider for funding.** The proposed investments herein were identified and developed through an iterative, on-the-ground process supported by scientific literature, economic analyses, and

<sup>19</sup> Gordon, Jessica, Rohini Kohli, and Pradeep Kurukulasuriya. 2019. Principles in Practice: Integrating Adaptation into Long-Term Strategies. World Resources Institute. <https://www.wri.org/climate/expert-perspective/principles-practice-integrating-adaptation-long-term-strategies>

<sup>20</sup> Global Commission on Adaption, "Adapt Now: A Global Call for Leadership on Climate Resilience."

<sup>21</sup> <https://reliefweb.int/sites/reliefweb.int/files/resources/FFP%20Fact%20Sheet%20Burkina%20Faso%2008.14.19.pdf> USAID Food Assistance Fact Sheet, August 14, 2019 and September 30, 2019

<sup>22</sup> USAID Nutrition Profile 2018

climate impact modeling. The result is a suite of synergistic investments that can be developed and implemented as stand-alone projects or a comprehensive program for innovation in Burkina Faso. This investment portfolio has been prepared with an eye toward presentation to private sector actors, public institutions, international donors, and other key stakeholders in providing the much-needed funding for transforming Burkina Faso's agricultural sector.

**The investments in the CSAIP, and the portfolio as a whole, offer a nationally supported investment set that could be rapidly deployed to support post-COVID-19 economic recovery efforts while also reducing future risks and impacts from abrupt shocks.** The portfolio also enhances resilience in multiple sectors by supporting on farm productivity, value chain creation, and employment; reducing dependency on imported food and other commodities; and benefitting OneHealth objectives. The investments directly support 1.7 million beneficiaries in all regions of Burkina Faso and provide both short- and long-term benefits to livelihoods and food security, while also reducing risks and building resilience across multiple sectors.

## 1.1 The Climate Smart Agricultural Investment Planning Framework

**The Burkina Faso CSAIP team has developed the investment plans described herein based on the 4 components of CSA planning and implementation.** These are:

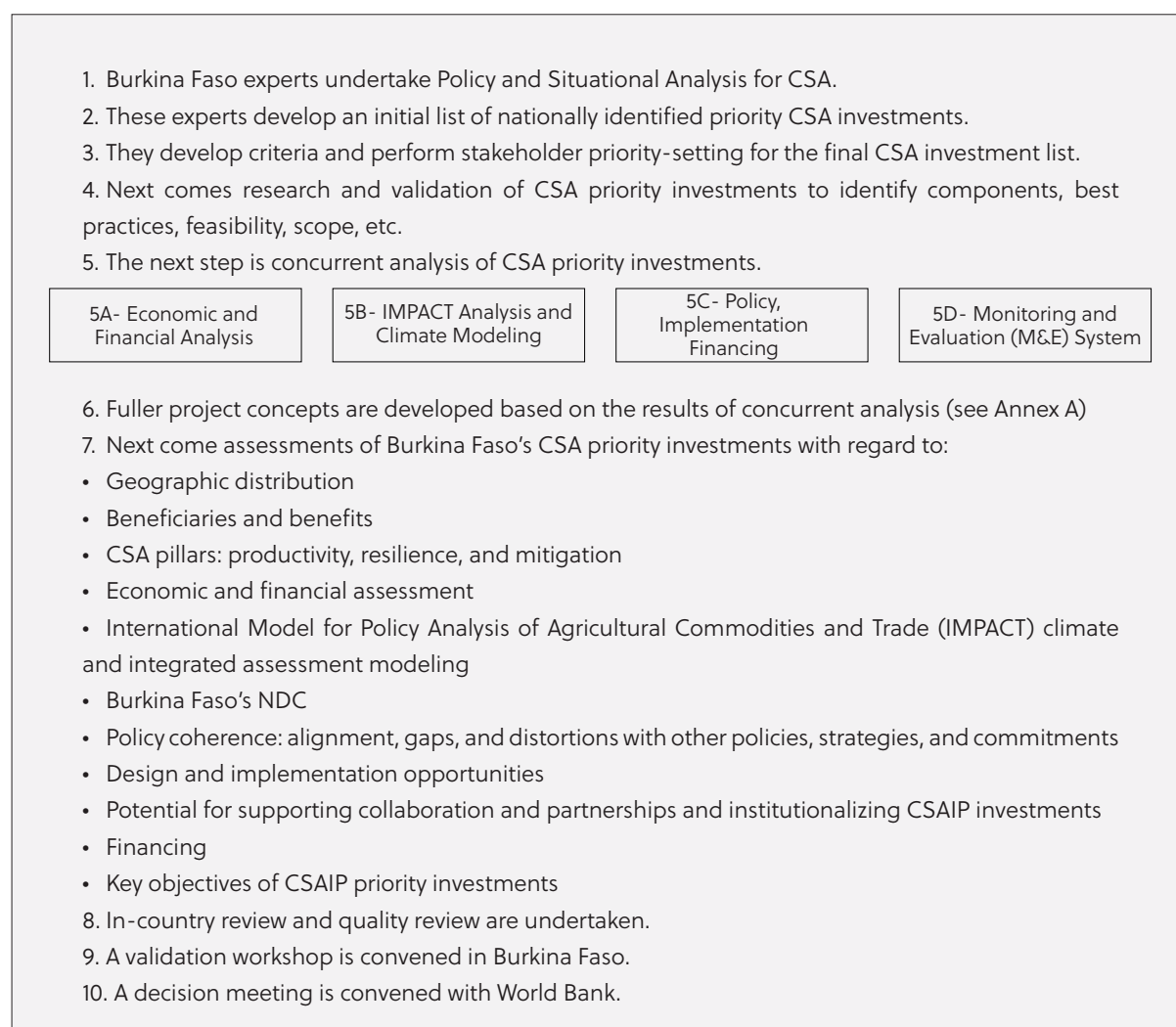
- Situation analysis
- Prioritizing interventions
- Program design
- Monitoring, evaluation, and learning

These four components of CSAIP planning (Figure 2) are based on strong stakeholder engagement, topical expert contributions, and institutional and individual capacity building. This CSAIP focuses on the first two components: situation analysis and prioritizing interventions. Additionally, elements of program design and monitoring, evaluation, and learning are discussed. In-country expertise, priorities, policies, stakeholder engagement, and capacity building were vital to the development of this CSAIP. The analysis used herein is built on both qualitative and quantitative assessments and methods. The process described below generally follows the CSA Prioritization Framework (see the CSAIP Development Guide) and Figure 2 below.

**A stakeholder workshop used detailed criteria to evaluate the initial list of 38 proposed investments.** Stakeholder experts represented a variety of organizations, including government ministries, institutions, research organizations, farmer groups, and international development organizations. The World Bank Burkina Faso Office led an expert workshop with the International Center for Tropical Agriculture (CIAT) and WASCAL counterparts providing technical support. At this workshop in Ouagadougou, participants used an iterative, qualitative and quantitative, prioritizing process to rate and review each of the 38 proposed CSA priorities (see Chapter 3 and Annex C for specifics). They also grouped the initial list of investments by agro-ecological zones to represent all regions of Burkina Faso. The initial list of potential investments was reduced from 38 to 10 priority CSA investments. A second round of consultation led to a second workshop to validate and refine the results.

<sup>23</sup> Girvetz et al., "'CSA-Plan': Strategies to Put Climate-Smart Agriculture (CSA) into Practice."

**Figure 2: Developing Burkina Faso's CSA Investments: Summary of Process**



**The priority setting workshop provided a strong rationale and key information on each proposed CSA investment.** The process involved reducing the initial list of priorities to a shorter list and providing detailed information on each investment. This information needs to be further refined to fully reflect the scope of each proposed investment. To do this, the CSAIP team:

- Refines the investment shortlist to ensure relevant CSA best practices are followed
- Conducts a thorough literature review on similar projects
- Identifies current and potential yields of crops and technology packages, and other project components, such as designing value chains
- Reviews related projects for best practices, implementation issues, lessons learned, barriers, and opportunities

Investment concept notes are prepared for each priority investment (see Annex A).

**Prioritized investments are analysed along five dimensions when concept notes are completed:**

- Economic and financial assessments
- IMPACT climate modelling

- Policy and financing alignment
- Implementation issues
- Monitoring and evaluation (M&E)

Each of these are described in detail in a technical annex, but the highlights of each are presented below (for more information, please see Annexes B, C, D, and E).

**Economic and financial assessments for this CSAIP are based on analysis of how the investments will perform.** Financial assessments are derived from secondary data sources. A key input for the financial analysis is Evidence for Resilient Agriculture (ERA).<sup>24</sup> This database contains information on 112 technologies used in crop, livestock, and tree production and 58 indicators of performance (e.g., yield, net economic returns, soil carbon, etc.). Each investment may include multiple technologies, so ERA provides field-based data for the Burkinabe agroecological context on outcomes for each different technology in a proposed investment. Nearly 50% of the data in ERA relates to yield benefits from use of new technologies, many of which are directly relevant to the investment plan. ERA also include data on the economic performance of technologies. These data are combined with other external data provided by national stakeholders and review of scientific literature. To ensure relevance, ERA results from similar African agroecological zones are used whenever possible. Costs were determined in a number of ways but were largely based on the number of potential beneficiaries. (See Annex E for the economics methodology.)

**The results from the economic modeling across all investments are presented in Chapter 3 and include:**

- Assessment of the Net Present Value (NPV)
- The impact of investments on the three pillars of CSA: production, resilience, and mitigation
- Return on Investment (ROI)
- Benefit to Cost Ratio (BCR)

The analyses are run in a probabilistic framework, with and without social and environmental risks, using the best available information about these risks and their potential impact. This framework allows a direct targeting of investments for the climate and pest risks threatening productivity and growth in the future. This process can be contrasted to many examples of ex ante assessment in which the analysis presents an overly optimistic picture of likely success by not integrating specific risks to the cost-benefit analysis.

**Analysis of climate models, trade, and other factors were done for the 9 investments in this CSAIP using the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT).** Climate modeling is a key component to characterize the future production environment of different commodities. Analysis involved multiple potential climate scenarios to understand the impact of climate change in Burkina Faso, how climate change affects agricultural production, and the corresponding impact of climate change on international trade in agricultural commodities. Climate change will alter which crops are suitable in different growing regions, reducing suitability across large areas (e.g., entire countries) but also creating pockets of increased suitability for a small number of crops. At a global scale, these shifts will determine which countries can grow which crops, in turn affecting international trade. Demographic and economic growth trajectories and GHG mitigation

<sup>24</sup> <http://era.ccafs.cgiar.org>



policies will thus drive changes in demand and consumption. IMPACT models the complex interplay of all these demographic, economic, mitigation, demand, and consumption factors. IMPACT modeling is therefore more thorough than climate modeling, providing integrated assessment modeling of multiple socio-economic and biophysical factors.

**IMPACT integrated assessment modeling for Burkina Faso analyzes future performance of different crops and the potential for CSA practices to improve this performance under different conditions (for instance, conditions affecting trade).** Specifically, IMPACT has three key components:

- Climate impact of all Burkina Faso's basic commodities for 30 years into the future
- Burkina Faso's future comparative advantage in these commodities versus other countries, to understand trade advantages
- CSA impact of proposed investments on future yields

Assumptions regarding demographic and economic growth are reflected by incorporating the Shared Socioeconomic Pathway (SSP) for the Middle of the Road or Business as Usual pathway, where historical patterns of development, inequality, and environmental degradation continue (see Annex D). Assumptions about the severity of increased GHG concentration are reflected in the choice of three Representative Concentration Pathways (RCPs) (4.5, 6.0, and 8.5) from least to most severe with results presented for two points in time, 2030 and 2050. IMPACT provides insights into how much comparative advantage Burkina Faso will have for different commodities in the future, given demographic, economic, demand, and trade factors. It also offers insights about the difference that investments toward new technologies can make in 10 years and in 30 years, relative to different potential climate impacts.

**Prioritized investments were reassessed for their alignment to Burkina Faso's NDC and other key policies and strategies.** The emphasis here is on reassessment because the initial list of potential investments, and then the nine prioritized investments, were selected for their alignment to Burkina Faso's national plans and policies. This reassessment was performed to indicate more fully the nuances of policy linkages for the nine priority investments. For example, policy gaps and distortions were identified for each investment. These are summarized in Chapter 3 and in Annex A, which contains full information on each investment.

**Climate change has the greatest impact on the agricultural sector since subsistence agriculture and forestry support an estimated 80% of the population.<sup>25</sup>** Extreme rainfall increases the risk of flooding, which can cause soil leaching, erosion, and run-off. Conversely, little or no rainfall leads to prolonged drought and water scarcity. Higher temperatures increase evapotranspiration, stunt crop growth and increase the prevalence of both pests and diseases (see Pests and Disease Box below). Climate change causes distortions to planting calendars, which results in loss of livestock and crops or have lower yields. Agricultural production in north and central Burkina are likely to be affected due to their exposure to drought and flood risks.<sup>26</sup> Climate change also has major impacts on agricultural pests and diseases, the spread of emerging infectious diseases such as COVID-19, and the increase of invasive species that can lead to disruptions in the agricultural sector. The "Pests and Disease in Burkina Faso" box below contains some examples of these issues, and synergistic actions to deal with them are discussed in Chapter 2.

<sup>25</sup> World Bank, "Climate knowledge portal Burkina Faso"

<sup>26</sup> Crawford et al.

### Pests & Disease in Burkina Faso<sup>27</sup>

The evidence is clear that climate change is leading to a global surge in pests and diseases, both within and outside of agricultural settings. It is also increasing the spread of other emerging infectious diseases (EIDs), such as COVID-19, and increasing movement of invasive species that can lead to disruptions in the agricultural sector. Pest populations and diseases are already spreading and extending their ranges, driven by climate change, biodiversity loss, and increased trade and travel. A recent study of found crop losses due to pests globally found that maize losses are high for Burkina Faso: 63k tons of 415k tons, and future losses will increase by an additional 9-13k tons. Fruit flies, mealybugs, and termites are some of the worst insect pests. Habitat change and biodiversity loss has generally increased the prevalence of EIDs and zoonotic diseases, which come from animals. This is unsurprising as these changes cause closer contact between wild animals, domesticated animals and livestock, and people. Livestock and poultry can not only transmit zoonotic diseases, but also bear a high disease burden with susceptibility to rift valley fever, helminths (worms), goat pox, anthrax, and avian influenza. Burkina Faso was been devastated by locust swarms in 2004; there are concerns that more swarms may move from East Africa to other countries, including Burkina Faso.

**Design and implementation considerations were also assessed.** Relevant projects, both for CSA and non-CSA projects for similar production systems within Burkina Faso, were examined. A variety of features of these projects were assessed. Some of the findings were noted by participants at the prioritizing workshop, while other findings were based on an extensive literature review of scientific papers, project documents, white papers, etc. Some of the factors briefly considered and discussed in Chapter 3 are:

- Implementation experiences to understand potential lessons
- Positive contributors or risks and barriers to project success
- Potential collaborators, in government, in non-governmental organizations (NGOs), and in the private sector

This information is all included in the individual investment concepts in Annex A and summarized in Chapter 3.

**Financing opportunities and the potential for private sector involvement were assessed in several ways.** As part of the prioritizing workshop and investment concept development process, the potential for private sector collaboration and financing, public financing opportunities, and international financing were reviewed. The World Bank's Maximizing Finance for Development Framework was used as a guide for identifying private sector financing opportunities in Burkina Faso for the prioritized investments and can be used in further assessments to leverage private finance for these investments. Results are presented in Chapter 3 and in the individual investment concepts in Annex A.

<sup>27</sup> <https://royalsocietypublishing.org/doi/10.1098/rsos.181577>; Rohr, J.R., Barrett, C.B., Civitello, D.J. et al. Emerging human infectious diseases and the links to global food production. *Nat Sustain* 2, 445–456 (2019). <https://doi.org/10.1038/s41893-019-0293-3>; Deutsch, C. D., Tewksbury, J. J., Tigchelaar, M., Battisti, D. S., Merrill, S., Huey, R. B., & Naylor, R. L. (2018) Increase in crop losses to insect pests in a warming climate. *Science*, DOI: 10.1126/science.aat3466; Nébié, K., Nacro, S., Ouédraogo, I., Dakouo, D. and Otoidobiga, L. (2016) Inventory and Distribution of Mango Mealybugs Species in Western Burkina Faso: Relative Abundance and Population Fluctuation. *Advances in Entomology*, 4, 191-199. doi: 10.4236/ae.2016.43020; Civitello, D. J. et al. Biodiversity inhibits parasites: broad evidence for the dilution effect. *Proc. Natl Acad. Sci. USA* 112, 8667–8671 (2015).; USAID. 2014. *Agricultural Adaptation to Climate Change in the Sahel: Expected Impacts on Pests and Diseases Afflicting Livestock*

**A Monitoring and Evaluation (M&E) Plan was developed for the entire portfolio (see Chapter 5) and a theory of change was developed for the entire CSAIP and each individual priority investment (see Annex A).** The M&E Plan aims to provide CSAIP implementers—particularly the government—with a manageable system to generate, collect, and analyze standardized data to assess the success of both individual investments and the portfolio of investments. The goal is to inform operational and strategic decision-making. The theory of change includes four action areas for the entire CSAIP and individual investments:

- Robust research and development (R&D)
- Uptake of climate-smart production technologies and value-added practices
- Stakeholder engagement and partnerships
- System-wide capacity to implement CSA actions



# Situation Analysis Of Livelihoods, Agriculture And Climate Change

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## 2.1 Burkina Faso's Rural and Agricultural Sector in Brief

**Burkina Faso's economy is growing, yet much remains to be done.** The 2018 national GDP was US\$14.4 billion, or US\$731 per capita; this is below the sub-Saharan African average of US\$1,574, and far below the world average of US\$11,300.<sup>28</sup> There are 19.75 million inhabitants of Burkina Faso, and the population density is relatively high at 72 inhabitants per square kilometer, versus the global average of 60 per square kilometer (see Figure 6 and Figure 7).<sup>29</sup> While 70.6% of the total population is poor, 47.5% of those in poverty live in rural areas. Just 9.5% of rural residents had electricity in 2017.<sup>30</sup>

**Burkina Faso is one of the fastest growing countries in the world; the annual population growth rate of 3.1% is expected to drive the population to 42 million by 2050.**<sup>31</sup> Population growth is already high and is unevenly distributed across the country. As of 2014, approximately 40.1% of the population lived below the national poverty line, and 43.7% lives on less than US\$1.90 per day.<sup>32</sup> This is a significant improvement from 2003, when 51.1% of the population lived below the national poverty line.<sup>33</sup> Food insecurity ranges from 23.8% to 54.2% of the population across regions.<sup>34</sup> Burkina Faso sits near the bottom of the Human Development Index; it ranked 183<sup>rd</sup> out of 189 countries in 2017 with a score of

<sup>28</sup> World Bank, "Burkina Faso Overview" <https://www.worldbank.org/en/country/burkinafaso/overview>

<sup>29</sup> World Bank, "Burkina Faso." 1. <https://data.worldbank.org/country/burkina-faso>

<sup>30</sup> World Bank, "Burkina Faso Indicators." <https://data.worldbank.org/country/burkina-faso>

<sup>31</sup> FOA, "Africa Sustainable Livestock 2050." <http://www.fao.org/in-action/asl2050/countries/bfa/en/>

<sup>32</sup> World Bank, "Burkina Faso Indicators." <https://data.worldbank.org/country/burkina-faso>

<sup>33</sup> World Bank, "Poverty and Equity Data portal." <http://povertydata.worldbank.org/poverty/country/BFA>

<sup>34</sup> William, Country Assessment Studies on Climate Change, Agricultural Trade and Food Security in ECOWAS BURKINA FASO REPORT.

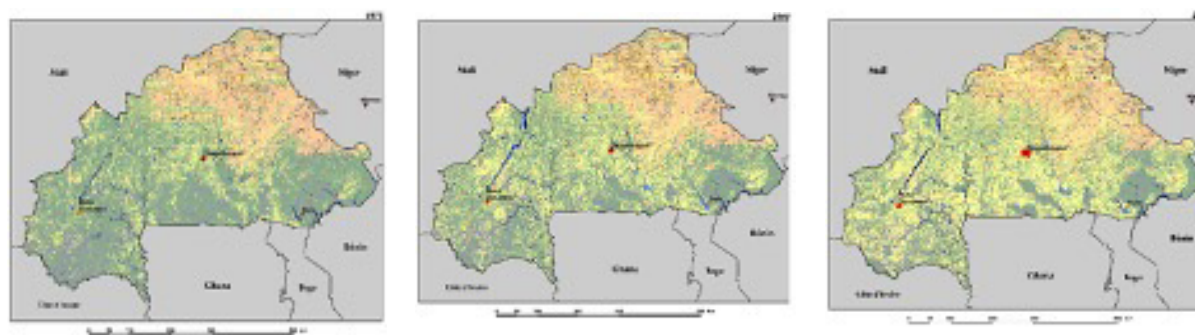
0.423, versus the Sub-Saharan African average of 0.537. This represents a notable improvement from its score of 0.286 in 2000.<sup>35</sup> The national Corruption Perceptions Index score has also declined slightly in 2018 to 41 out of 100, giving it a rank of 78th out of 180 countries.<sup>36</sup>

**Agriculture is Burkina Faso's predominant land use.** Burkina Faso's total land area is 273.6 million hectares, with 121 million hectares (44.22%) under agricultural production and 52.9 million hectares (19.33%) under forest.<sup>37, 38</sup> Of its agricultural land, about 60 million hectares (21.9%) are under arable production, 1 million hectares are under permanent crops, and 60 million hectares are under permanent meadows and pastures (see Table 1, Figure 3, and Figure 7).<sup>39</sup> The agricultural land cover has expanded 91% since 2001, when it accounted for just 116.9 million hectares.<sup>40</sup> Much of this expansion has been onto unsuitable land; just 13.3% of the national land area is suitable for cultivation.<sup>41</sup> This drastic rate of agricultural expansion onto lands with low agricultural productivity represents an attempt to feed the burgeoning population.<sup>42</sup> Yet farming on unsuitable land, climate change, and desertification mean that 34% of the land area is already degraded.<sup>43</sup> Significant increases in productivity and intensification would enable both economic prosperity and regeneration of degraded forests. Burkina Faso has significant carbon sequestration potential and could reduce emissions by up to 19,020,600 metric tons of carbon dioxide equivalent (tCO<sub>2</sub>e) annually if deforestation and land degradation were effectively mitigated (F).<sup>44</sup>

**Table 1 Land Cover Changes in Burkina Faso, 1990 to 2017**

Land Use	Area (Square Kilometers)		Percent Change (%)
	1990	2017	
Forest	68,470	52,902	-29
Arable Agriculture	95,750	121,000	21
Irrigated Agriculture	243	461	47
Permanent Agriculture	700	1,000	30

**Figure 3 Extent of Burkinabe Forest and Agriculture Cover in 1975, 2000, and 2014<sup>45</sup>**



<sup>35</sup> UNDP, "Burkina Faso Human Development Report." <http://hdr.undp.org/en/countries/profiles/BFA>

<sup>36</sup> Transparency International, "Corruption Perception Index 2018" <https://www.transparency.org/cpi2018>

<sup>37</sup> FAO Stata, "Burkina Faso"

<sup>38</sup> Index Mundi "Agricultural Land" <https://www.indexmundi.com/facts/indicators/AG.LND.AGRI.ZS>

<sup>39</sup> FAO Stata, "Burkina Faso" <http://www.fao.org/faostat/en/#country/233>

<sup>40</sup> Knauer, K., Gessner, U., Fensholt, R., Forkuor, G., & Kuenzer, C. (2017). Monitoring agricultural expansion in Burkina Faso over 14 years with 30 m resolution time series: The role of population growth and implications for the environment. *Remote Sensing*, 9(2), 132.

<sup>41</sup> William, Country Assessment Studies on Climate Change, Agricultural Trade and Food Security in ECOWAS BURKINA FASO REPORT.

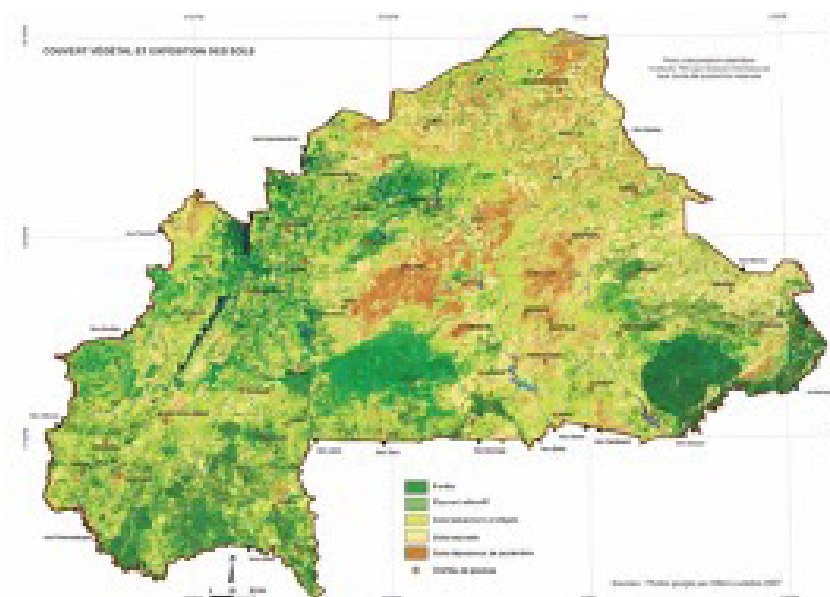
<sup>42</sup> Knauer et al., "Monitoring Agricultural Expansion in Burkina Faso over 14 Years with 30 m Resolution Time Series."

<sup>43</sup> World Bank Climate Change Country Profile, cited in *Creating Markets in Burkina Faso*, World Bank, 2019.

<sup>44</sup> Kambiré et al., *The Context of REDD+ and Adaptation to Climate Change in Burkina Faso : Drivers, Agents and Institutions*.

<sup>45</sup> United States Department of Agriculture, "Land Use, Land Cover, and Trends in Burkina Faso."

**Figure 4** Burkinabe Forest Cover and Soil Exposure, 2016<sup>46</sup>



**Burkina Faso has a warm Sahelian tropical climate with significant temporal and geographic variation**, with three climatic zones: the northern dry Sahel, the central North Sudan zone, and the humid South Sudan in the south (see Figure 5).<sup>47</sup> Average temperatures are consistently high both temporally and spatially; the national monthly mean temperature sits between 25.8oC and 29.6oC year-round. Temperatures are highest in the Sahel, ranging from 15-45oC.<sup>48</sup> National annual rainfall ranges from 400 to 900 millimeters, with 50-70 rainy days annually. There is significant spatial and temporal variation; the Sahel receives 300-600 millimeters between July and September, followed by a 7-9 month dry season. The North Sudan receives 600-900 millimeters between June and October, and the South Sudan receives 900-1200 millimeters between May and October.<sup>49, 50</sup>

**Agriculture is the main source of livelihoods, employment, and export goods in Burkina Faso. Agriculture employs 80% of the country's workforce and contributes nearly 28.6% of national GDP.**<sup>51</sup> Smallholder producers operating on 5 hectares or fewer account for about 80% of total agricultural production. Furthermore, women account for over 50% of the agricultural workforce and produce more than 66% of the food consumed in-country. However, women are given markedly lower access to crucial resources, most notably access to land and land tenure rights. Youth are leaving rural areas to seek out viable career options in urban areas. Yet despite this exodus, there has been a marked increase in the rural population density (Figure 6) and agricultural expansion (Figure 7).

<sup>46</sup> Kambiré et al., The Context of REDD+ and Adaptation to Climate Change in Burkina Faso : Drivers, Agents and Institutions.

<sup>47</sup> UC Davis "Burkina Faso" <https://gfc.ucdavis.edu/profiles/rst/bfa.html>

<sup>48</sup> USAID (2017), Climate Risk in Food For Peace Geographies Burkina Faso. USAID Washington DC. Document attached

<sup>49</sup> Knauer, K., Gessner, U., Fensholt, R., Forkuor, G., & Kuenzer, C. (2017). Monitoring agricultural expansion in Burkina Faso over 14 years with 30 m resolution time series: The role of population growth and implications for the environment. Remote Sensing, 9(2), 132.

<sup>50</sup> UC Davis "Burkina Faso" <https://gfc.ucdavis.edu/profiles/rst/bfa.html>

<sup>51</sup> UC Davis "Burkina Faso" <https://gfc.ucdavis.edu/profiles/rst/bfa.html>

Figure 5 Climactic Zones of Burkina Faso<sup>52</sup>



Figure 6 Rural Population Expansion Density, 2001-2014<sup>53</sup>

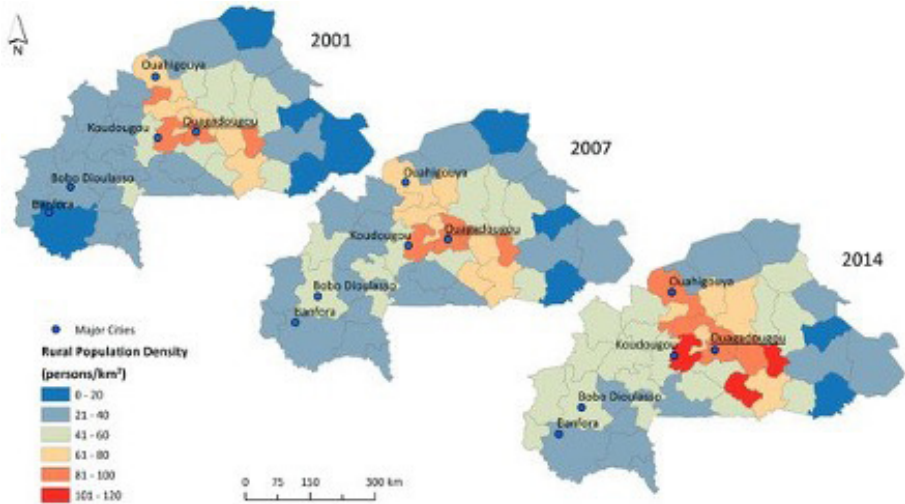
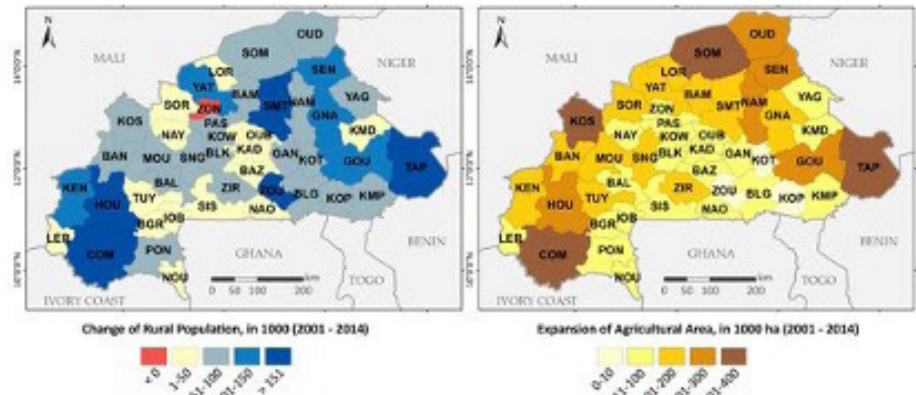


Figure 7 Changes in Rural Population and Agricultural Expansion, 2001-2014<sup>54</sup>



<sup>52</sup> Kambiré et al., The Context of REDD+ and Adaptation to Climate Change in Burkina Faso : Drivers, Agents and Institutions.

<sup>53</sup> Knauer et al., "Monitoring Agricultural Expansion in Burkina Faso over 14 Years with 30 m Resolution Time Series."

<sup>54</sup> Knauer et al.



**The agricultural economy has been growing rapidly since the 1990s and has outpaced the general economy.** Burkina Faso's agricultural sector experienced 8.4% growth in 2018 alone.<sup>55</sup> Furthermore, the national economy is closely tied to agricultural productivity and, implicitly, to weather and climate; the 2018 national economic growth of 6.8% was attributed to a rainy year and the consequent increase in cereal production.<sup>56</sup> The country's primary staple crops, including maize, millet, sorghum, and rice, are crucial to food security.<sup>57</sup> See Tables 2 and 3.

**Cereals constitute an already large and still increasing share of the Burkinabe diet and cultivated area (Figures 8 and 9).** People have increased their daily consumption of cereals (maize, sorghum, and millet), and this increased consumption in conjunction with the population increase has led to a doubling of the area planted since 1973 (Figure 9). Production of pulses, mainly cowpeas, has increased and occupies over 10% of the cultivated land, but cowpea consumption has not kept pace with increased production.

**Table 2** Key Burkinabe Food and Commodity Crops

Darker colors show higher values for each indicator. Grey color shows missing value. Data resources vary from 2014-2017.<sup>58, 59</sup>

Land Use	Percent of Cultivated Land (%)	Yield (Metric Tons per Hectare)	Production (Metric Tons, Thousands)	Food Consumption (Grams per Capita per Day)	Kcal per Capita per Day
Cotton	6.98	1.00	844,337		
Sorghum	13.78	0.80	1,365,898	158.69	438
Millet	10.04	0.68	828,234	155.83	404
Maize	7.90	1.60	1,533,431	187.70	597
Cashew Nuts	0.82	1.00	99,027	2.75	9
Beans	0.006	13.43	9,913		
Sesame	2.41	0.56	164,787	2.78	15
Sweet Potatoes	0.04	11.72	58,749	24.40	23
Sugarcane	0.04	100.54	487,643		
Rice	1.36	1.97	325,566	88.04	207
Cowpeas	10.37	0.48	603,966		
Cassava	0.03	1.26	4,842	2.35	2
Ground Nuts	4.58	0.60	334,328	28.93	159
Soybeans	0.17	0.93	18,500	3.34	11
<b>TOTAL</b>	<b>58</b>			<b>1.47</b>	<b>1815</b>

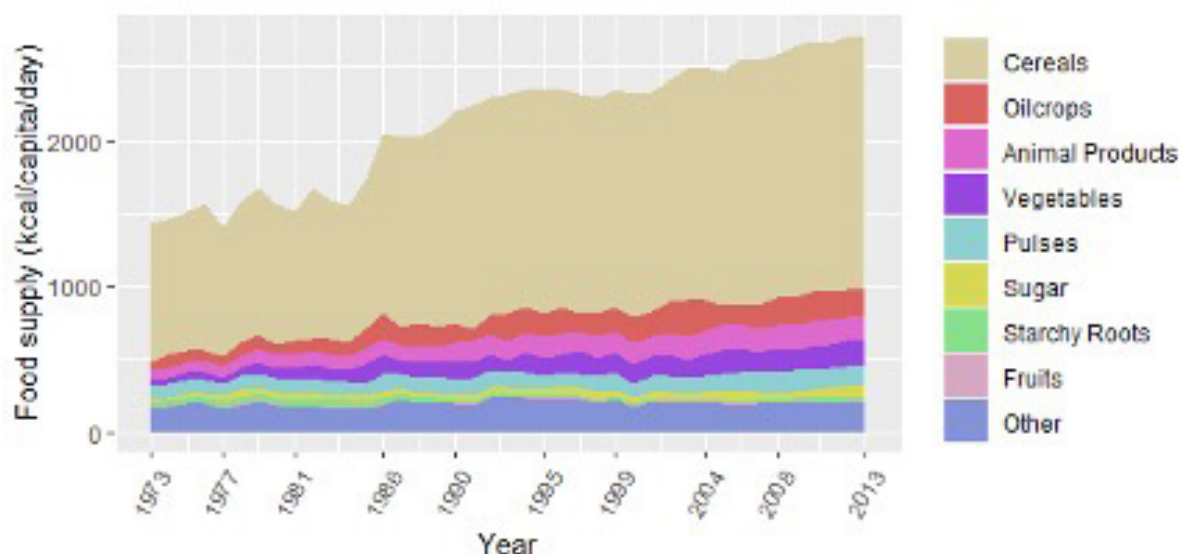
<sup>55</sup> World Bank, "Burkina Faso Indicators." <https://data.worldbank.org/country/burkina-faso>

<sup>56</sup> World Bank, "Burkina Faso Overview" <https://www.worldbank.org/en/country/burkinafaso/overview>

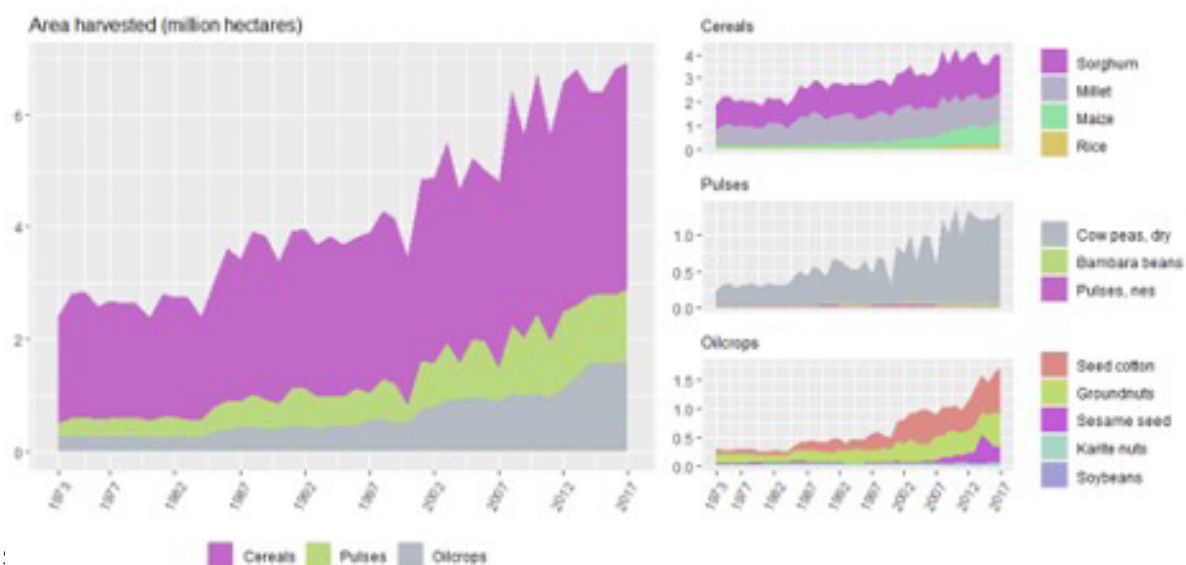
<sup>57</sup> FAO (2010). Monitoring African Food and Agricultural Policies Project (MAFAP) Commodity Selection in the Five pilot countries. Document attached

<sup>58</sup> FAO, "Crop" <http://www.fao.org/faostat/en/#data/QC>

<sup>59</sup> FAO, "Food Supply." <http://www.fao.org/faostat/en/#search/Food%20supply%20kcal%2Fcapita%2Fday>

**Figure 8: Calorie Consumption per Capita per Day in Burkina Faso, 1973-2013**

Source: Food and Agriculture Organisation (FAO)

**Figure 9: Harvested Area in Burkina Faso, 1973-2017**

**Primary agricultural commodities produced include maize, sorghum, millet, rice, cowpeas, sesame, and cotton** (Table 3). Along with gold exports, the Burkinabe economy is fueled by the export of cotton, sesame, peanuts, and soy, and of cash crops such as maize, sorghum, millet, cowpeas, and sugarcane.<sup>60</sup> See Table 3. While maize is exported, as noted above, domestic demand for it has increased. Demand for additional cereals, such as rice and wheat, is increasing and driving imports, as is demand for cattle meat.

<sup>60</sup> UC Davis "Burkina Faso" <https://gfc.ucdavis.edu/profiles/rst/bfa.html>

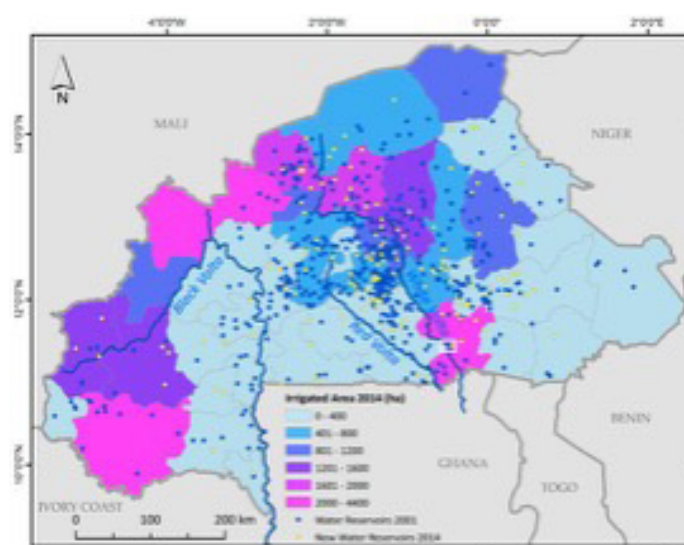
**Table 3 Import, Export, and Production of Key Commodities in Burkina Faso**

Darker colors show higher values for each indicator. Grey color shows missing value. Data resources from 2015-2017, produced for this analysis.

Land Use	Export (Tons, Thousands)	Imports (Tons, Thousands)	Production
Millet	8,700	475	828,234
Sorghum	3,020	-	1,365,898
Maize	44,902	2,036	1,533,431
Rice	2,047	431,917	325,566
Sesame	110,490	1,208	164,787
Soybean	1159	43	18,500
Cotton	250,233	2,806	844,337
Cattle Meat	2	6	-
Wheat	278	246,593	-

**Agricultural productivity is persistently low and has increased only 10% in the last decade.** Burkina Faso has regional competitive advantages in the livestock sector, but current policies substantially limit opportunities.<sup>61</sup> Some of the challenges facing the agricultural sector are low diversification, vulnerability to weather and climate impacts, and persistent discrimination. Agricultural value chains remain largely undeveloped, and policy and finance environments are non-conducive to business development. Most workers do not have the skills demanded by firms.<sup>62</sup>

**Significant opportunities exist to increase national productivity and economic growth.**<sup>63</sup> The first step is removing some of the barriers cited above. Additional opportunities can be found through intensifying smallholder production. The agricultural sector in Burkina Faso is highly reliant on a rain-fed production system. Yet expanding irrigated agriculture is an important step toward delinking climate and the economy; Burkina Faso has abundant water resources<sup>64</sup> and approximately 233,500 hectares of irrigable land, but only about 34,500 hectares were under irrigation in 2014 (Figure 10).<sup>65</sup>

**Figure 10 Irrigated Area per Province in 2014 and Locations of Artificial Water Reservoirs in 2001 and 2014**

<sup>61</sup> William, Country Assessment Studies on Climate Change, Agricultural Trade and Food Security in ECOWAS BURKINA FASO REPORT.

<sup>62</sup> Country Management Unit AFCF2, "Country Partnership Framework for Burkina Faso."

<sup>63</sup> Ksoll, C., Morgan, S., Bos, K. & Blair, R. (2018) Evaluation of the Burkina Faso Agricultural Development Project: Baseline Report. Mathematica Policy Research, NE. Document attached

<sup>64</sup> William, Country Assessment Studies on Climate Change, Agricultural Trade and Food Security in ECOWAS BURKINA FASO REPORT.

<sup>65</sup> Knauer et al., "Monitoring Agricultural Expansion in Burkina Faso over 14 Years with 30 m Resolution Time Series."

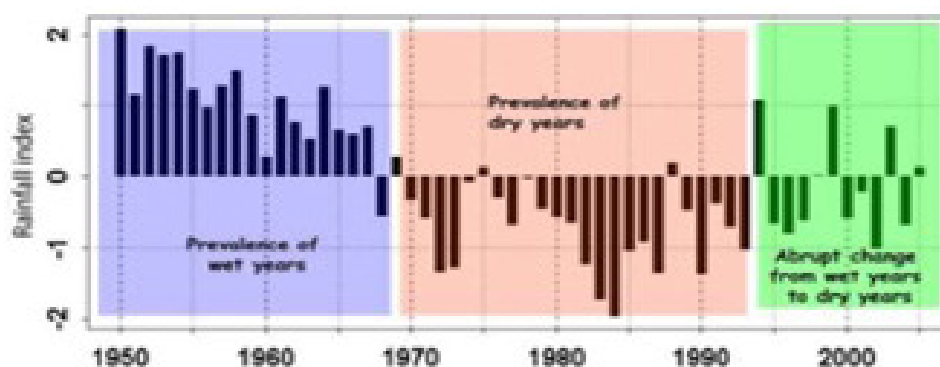
<sup>66</sup> Knauer et al

## 2.2 Climate Change Impacts on Burkina Faso's Agriculture

**Burkina Faso has experienced extreme climatic impacts.** Declining rainfall and increasing temperatures occur recurrently, substantially affecting agriculture and natural resources (water and forest). Other climate-related hazards such as droughts, floods, heat waves, locusts, and dust storms are common in the country. Climatic variations are widespread in the Sahel, especially variability in rainfall and temperature.<sup>67</sup>

**Burkina Faso's agriculture is affected by erratic precipitation patterns<sup>68</sup> related to climate change, with overall trends showing declining rainfall since 1950.** Yet when it does rain, it rains harder (more rain). The pattern of rainfall has changed, with fewer consecutive wet days and more consecutive dry days. Three main distinctive trends for different time periods have been observed: persistent wet years between 1950-1970, persistent dry years between 1970-1990, and alternating between wet and dry years from 1990 until recently (see Figure 11).<sup>69</sup>

**Figure 11 Trends in Burkina Faso's Rainfall, 1950-2005<sup>70</sup>**



**Burkina Faso is getting warmer with temperatures steadily increasing.** The average temperature range is 27-30°C, but since 1975, temperatures have increased by 0.6°C with an estimated warming rate of more than 0.15°C per decade. The period from 1975 to 2009 experienced warming in the rainy season in the months of June through September.<sup>71</sup> Similarly, high evapotranspiration is observed across the country with an average of 100 millimeters per month, and a maximum of 200 millimeters in February through March.<sup>72</sup> This phenomenon magnifies the drought scenario in the country as a whole.<sup>73</sup> (See Figure 12.)

<sup>67</sup> World Bank, "Vulnerability, Risk Reduction, and Adaptation to Climate Change: Climate Risk and Adaptation Country Profile Burkina Faso"

<sup>68</sup> Longueville et al., "Long term analysis of rainfall and temperature data in Burkina Faso"

<sup>69</sup> World Bank, "Burkina Faso climate smart agriculture profile"

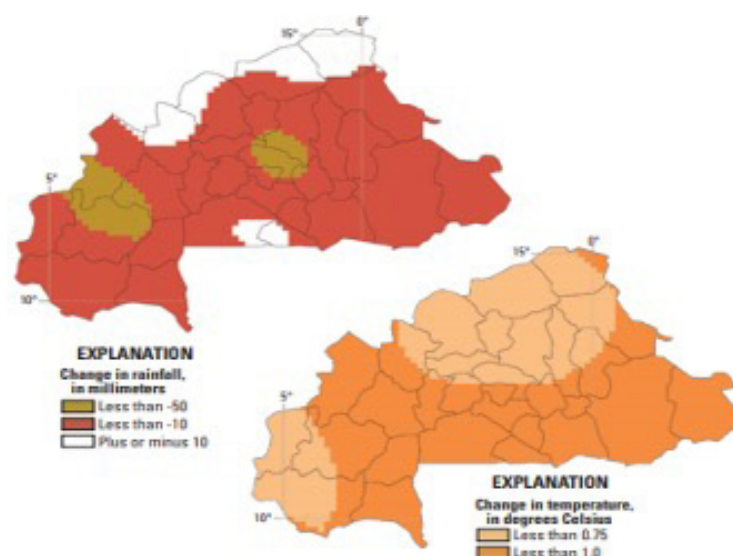
<sup>70</sup> World Bank

<sup>71</sup> USAID, "A Climate Trend Analysis of Burkina Faso"

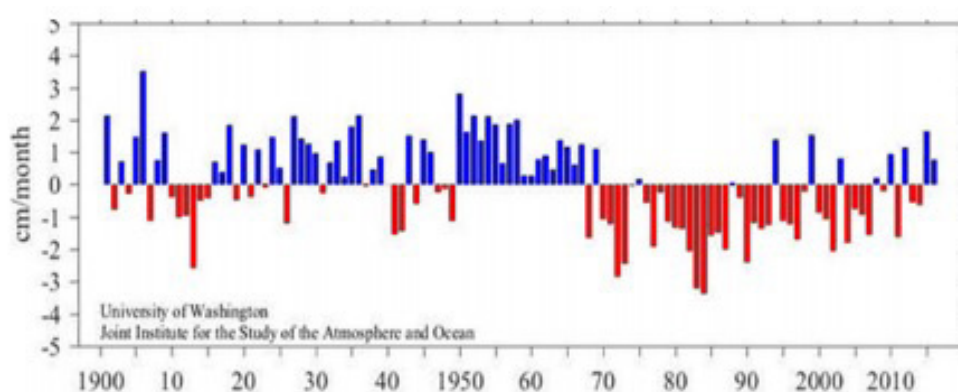
<sup>72</sup> Crawford et al., "Review of current and planned adaptation action in Burkina Faso"

<sup>73</sup> Nana, "Impact of Climate Change on Cereal Production in Burkina Faso"

**Figure 12** Changes in Rainfall and Temperature in Burkina Faso, 1960-2009<sup>74</sup>



**Figure 13** Annual Rainfall Variability Compared to Average in the Sahel, 1900-2016<sup>75</sup>



The northern region of the country has been greatly affected by the temperature and rainfall variations since 1950. Burkina Faso has had both inter-temporal and spatial variation in rainfall, which exhibits decreasing tendencies. This has had notable impacts in all climatic zones of the country. Consequently, there has been an upward trend in temperature throughout the country. However, the highest temperatures are in the northern region which lie in the desert zones,<sup>76</sup> with dry regions extending into the south during the twentieth century.<sup>77</sup> Extreme events like floods, drought, and dust winds have become recurrent in various localities of the country. Specifically, increased flash flooding occurs in the central and northern parts of Burkina Faso during the rainy season (Figure 13).<sup>78</sup>

**Climate risks, such as floods and droughts, are increasing.** Given the steady increase in temperature and decrease in rainfall, droughts are more common. Burkina Faso experienced three major droughts in 1990-91, 1995-96, and 1997-98. Although floods are less frequent than droughts, the country has experienced 11 major floods between 1991 and 2009, affecting 380,000 people and causing 93 reported deaths.<sup>79</sup>

<sup>74</sup> USAID

<sup>75</sup> USAID, "Climate risks in food for peace geographies Burkina Faso"

<sup>76</sup> Crawford et al.

<sup>77</sup> USAID, "Climate vulnerabilities and development in Burkina Faso and Niger"

<sup>78</sup> USAID

<sup>79</sup> Crawford et al.

**Climatic projections for Burkina Faso show increasing temperatures and decreasing rainfall.**

Future projections show a probable increase in temperature of 1.4-1.6°C by the year 2050.<sup>80</sup> In the north, warming is more likely during the wet season than in the dry season.<sup>81</sup> The number of both dry and wet years is expected to increase, and semi-arid areas will become more arid. There are contrasting projections for rainfall patterns, but intensity of events may increase, with less rainfall overall, although there is uncertainty about these predictions.<sup>82</sup>

**Climate change has the greatest impact on the agricultural sector since subsistence agriculture and forestry support an estimated 80% of the population.**<sup>83</sup>

With extreme rainfall, there is a risk of flooding that causes soil leaching, erosion, and runoff. Yet little or no rainfall causes prolonged drought and water scarcity. Higher temperatures increase evapotranspiration, stunt crop growth, and increase prevalence of both pests and diseases. Planting calendars are distorted, and farmers may lose livestock and crops and may have lower yields. Agricultural production in northern and central Burkina Faso is likely to be affected due to drought and flood exposure in these regions.<sup>84</sup>

**Women are the most vulnerable group in the agricultural sector.** Women are more vulnerable to climate change compared to men since they differ in asset ownership to tackle climate change impacts.<sup>85</sup> For example, during droughts, men can seek greener pastures elsewhere, while women are less able to migrate. Women also have less education and lower human capital, and men are prioritized when it comes to training and extension services. Financial access is also a challenge as men control assets needed to secure credit.

**Water resources have been adversely affected by climate change.** A larger proportion of farmers rely on rain and underground water to sustain their agricultural production.<sup>86</sup> Water resources are affected by variability in rainfall and temperature. Increased temperature and reduced rainfall mean wells and other water sources dry up. Yet excess rainfall increases flooding that destroys infrastructure, such as water pipes, and siltation and sedimentation of rivers causes water pollution. Ultimately, projections indicate that there could be water scarcity.

**Climate change is a threat to the peace and political stability of Burkina Faso.** The implications of climate change for peace and security are not only a global concern but also a local concern in West Africa in general.<sup>87</sup> Climate change extensively affects water availability, food security, population distribution, disease prevalence, and coastal boundaries. Given the variability and decline in annual precipitation, there are already disputes over water resources in Burkina Faso. With a rapidly growing population in Burkina Faso, there is a likelihood in coming years of boundary conflicts and tensions over the Volta basin, which Burkina Faso shares with Ghana. Moreover, external factors such as poor governance, economic recession, and ethnic tensions could further undermine country's economic and political stability.<sup>88</sup> Additionally, migrations of people and expansion of agricultural communities into pastoral lands could trigger conflicts.

<sup>80</sup> UNDP, "Climate change adaptation Burkina Faso"

<sup>81</sup> World Bank

<sup>82</sup> World Bank

<sup>83</sup> World Bank, "Climate knowledge portal Burkina Faso"

<sup>84</sup> Crawford et al.

<sup>85</sup> González et al., "Climate Change And Women Farmers In Burkina Faso: Impact and adaptation policies and practices"

<sup>86</sup> World Bank

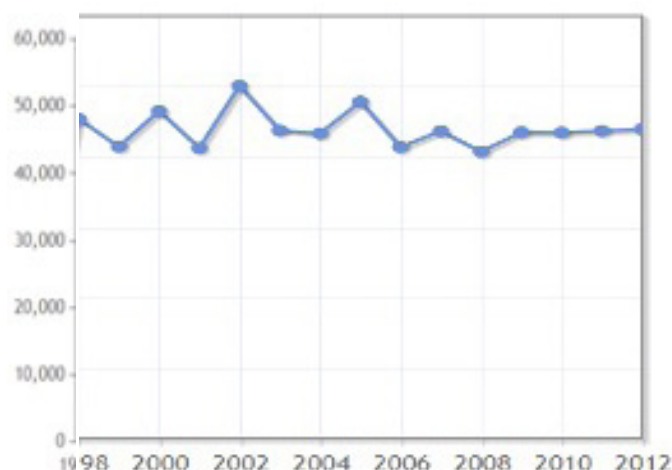
<sup>87</sup> UNDP, "Human Development report"

<sup>88</sup> Brown and Crawford, "Climate change: A new threat to stability in West Africa? Evidence from Ghana and Burkina Faso"

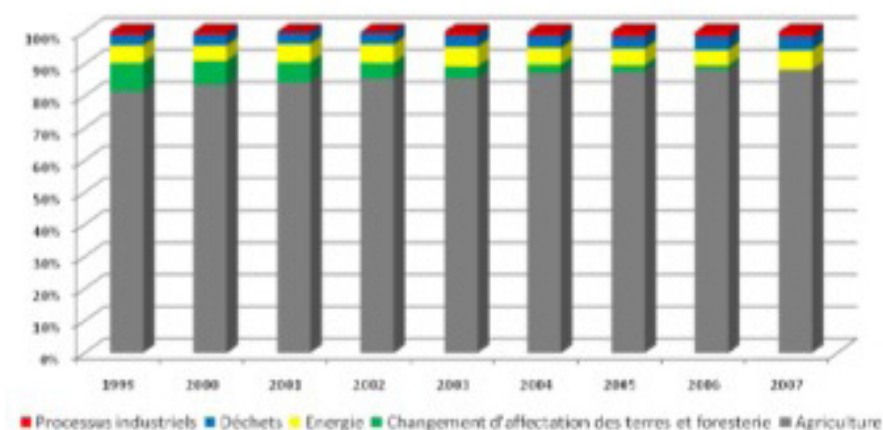


**Burkina Faso contributes only 0.07% of global greenhouse gas (GHG) emissions.** Burkina Faso produces 40,000-50,000 metric kilotons of carbon dioxide equivalent (CO<sub>2</sub>e) (Figure 14). By 2014, Burkina Faso had contributed less than a cumulative total of 32.60 mega tonnes of CO<sub>2</sub>e-1 to global GHG emissions.<sup>89</sup> The agricultural sector has been the largest source of emissions<sup>90</sup> (Figure 15).

**Figure 14 Total GHG Emissions, 1998-2012 (Metric Kilotons of Carbon Dioxide Equivalent)<sup>91</sup>**



**Figure 15 Sectoral Contribution to GHG Emissions in Burkina Faso, 1999-2007<sup>92</sup>**



## 2.3 Climate Change Impacts on Burkina Faso's Food Security and Agricultural Economy

**Burkina Faso is highly vulnerable to climate change impacts and has a low adaptive capacity.** Burkina Faso is ranked 39<sup>th</sup> in a list of countries with low readiness for climate change.<sup>93</sup> It recognizes the need for climate change adaptation in national strategies, policies, and programs. Yet low adaptive capacity and high vulnerability persist due to inadequate information and technology, lack of synergies between relevant stakeholders, and a weak education system.

<sup>89</sup> USAID, "Greenhouse Gas Emissions in the West Africa Region"

<sup>90</sup> Ministry of Environment and Sustainable Development, "Second national communication of Burkina Faso on climate change"

<sup>91</sup> <https://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE?end=2012&locations=BF&start=1998&view=chart><sup>89</sup>

<sup>92</sup> Ministry of Environment and Sustainable Development

<sup>93</sup> GAIN, "Notre Dame Global Adaptation Index Burkina Faso"

**Climate change has already negatively affected food security, causing climatic shocks and increasing demand for natural resources.** These shocks, in conjunction with a lack of sustainability in land use, threaten the food security of the country.<sup>94</sup> Extensive droughts are likely to cause crop failure and the death of livestock especially because Burkina Faso operates under a rain-fed production system.<sup>95</sup> Floods are less likely to cause damage compared to droughts; however, a successive combination of both reduces the capability for food storage, resulting in chronic food insecurity.

**Most predictions of climate change impacts on biophysical suitability hold management and technology constant at current levels.** In reality, ongoing agricultural technological improvements in breeding and management will likely help offset some of these reductions. Moreover, farmers will certainly exercise adaptive agency, intentionally switching to improved varieties or alternative crops or changing levels of inputs or farming methods. They will actively respond to shifting economic incentives induced by climate change. These techniques may bolster the resiliency to climate change of farmers, and of the agricultural sector as a whole.

**An analysis of the 9 investments in this CSAIP was performed using the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT).** IMPACT models the complex interplay of demographic, economic, mitigation, demand, and consumption factors to understand which crops are likely to be viable and competitive in the future. Not all crops and commodities are affected the same way by climate change. For example, there are distinct differences within groups of crops like cereals; maize, sorghum, rice, and other cereals respond differently to climate change. There are also distinct differences across different groups of crops, for example, in the responses of cereals versus fruits and vegetables or roots and tubers. Different crops show different levels of impact and resilience, which is reflected in different yield estimates.

**IMPACT modeling of climate change shows it will negatively affect the yield of all staple crop groups, in both the medium and long term, under a variety of socio-economic and representative carbon concentration scenarios.** Climate change affects suitability and yield across countries, and also affects the complex international interplay of socio-economic factors. Maize is expected to decline sharply, and so too will maize exports. Rice does a bit better than expected given its high water needs, as it is more resilient to climate change impacts than other cereals. While the net trade declines, it is possible that actions could be taken to improve modelled trajectories. Sorghum and white and brown beans will also decline. The steepening trade deficit in maize shows little difference under climate change.

**Climate change will impact Burkina Faso's comparative trade advantage for different crops.** Burkina Faso is dependent on imports to meet its internal cereal demand, especially for maize and sorghum, and this dependence is aggravated by climate change (Figure 16). Projected yields are shown for low, medium, and high average temperature change scenarios and for two time periods in Table 4.

**Other crops, especially fruits, vegetables, soybeans, groundnuts, oilseeds, and sugarcane are likely to perform badly in the long term.** For many of these crops, it does not matter which scenario is studied. There are similar declines in yield across all three representative carbon concentration scenarios (RCPs) at each time point. This is the case for temperate fruits, which decline around 5% in the short term and 10% by 2050; vegetables, which decline around 5% in the short term and 8% by 2050; and sugarcane, which declines 4-5% in the short term and 9-12% in the long term.

<sup>94</sup> USAID

<sup>95</sup> FAO, "Food Security and Humanitarian Implications in West Africa and the Sahel"



**Cotton, one of Burkina Faso's most important exports, shows declines of about 4-7% under all scenarios.** Given yield gaps in this sector and the potential to improve resilience, these numbers are not so dire. They suggest that with appropriate interventions, there is potential to increase the resilience of Burkina Faso's most important export crop.

**Some crops are climate resilient and offer potential for expansion.** Sweet potatoes and yams are nutritionally important and show resilience to a warmer future. Cowpeas and potatoes also show relative levels of resilience to climate change impacts under all RCPs for both time periods. As noted previously, other cereals and rice also appear to be relatively resilient.

**Cultivated area is projected to be higher for more crops under climate change than under a no-climate change reference scenario.** Many crops, however, show less than a 1% change either way. Increased area under production is not necessarily a good thing, since expansion onto land with poor agricultural suitability drives land degradation (Table 5). CSA practices that improve intensification, in turn reducing land conversion, can therefore directly contribute to mitigation. Potatoes, groundnuts, oilseeds, cowpeas, rice, millet, and sugarcane all show an increase in harvested area expansion, in both the short term and the long term. For most time periods, pulses, vegetables, temperate fruits, and other cereals show a decline in area.

**Most cereals, especially maize, exhibit high vulnerability to climate change no matter what scenario is studied.** Losses range from 9% to 12% in 2030 and from 18% to 22% in 2050, compared to a baseline that assumes no climate change. The good news is that millet and sorghum show relatively smaller declines in the short term, but both show losses of around 2-5% by 2050, while other cereals perform better. Rice also declines, but less so than other cereals, suggesting there is potential to grow resilient rice. Overall, climate change impacts on cereals are of particular relevance in Burkina Faso, where they constitute a large share of daily caloric intake and cultivated area; maize, sorghum, and millet are especially dominant.

**Table 4 Percentage Difference in Burkina Faso Rainfed Crop Yields**

Differences are calculated over a no climate change reference scenario for 2030 and 2050, under different representative carbon concentration scenarios (RCPs), with business-as-usual demographic and economic growth trajectories (SSP2).

Crops	2018 Baseline Value (TM/ha)	RCP4.5_SSP2		RCP6.0_SSP2		RCP8.5_SSP2	
		2030	2050	2030	2050	2030	2050
CER-Maize	1.9391	-9.42	-18.12	-8.53	-16.34	-11.50	-21.69
CER-Millet	1.0411	-0.47	-0.97	-1.97	-3.88	-2.56	-5.03
CER-Other Cereals	1.0409	-0.98	-1.53	-1.08	-1.63	-1.88	-3.08
CER-Rice	1.5953	-1.87	-3.77	-1.41	-2.87	-0.97	-1.99
CER-Sorghum	1.2922	-3.77	-7.46	-3.70	-7.28	-4.75	-9.32
COT-Cotton	0.4965	-2.04	-3.87	-3.66	-6.78	-3.64	-6.50
COT-Other	1.1522	-0.18	-0.29	-1.05	-1.87	-0.78	-1.17
F&V-Temperate Fruit	6.7094	-5.66	-10.99	-4.93	-9.63	-5.66	-10.85
F&V-Tropical Fruit	6.9021	-1.25	-2.18	-3.37	-6.08	-3.57	-6.13
F&V-Vegetables	9.9878	-5.02	-9.73	-4.23	-8.24	-4.64	-8.87
OLS-Groundnut	0.8500	-1.70	-3.01	-4.10	-7.34	-4.47	-7.62
OLS-Other Oilseeds	1.3220	-1.70	-3.04	-3.73	-6.80	-4.07	-6.99
OLS-Soybean	1.2798	-3.65	-6.97	-4.97	-9.16	-5.46	-9.64

<b>PUL-Cowpeas</b>	0.5919	0.16	0.41	-0.79	-1.31	-0.46	-0.57
<b>PUL-Other Pulses</b>	0.8835	-1.75	-3.40	-2.71	-5.11	-2.61	-4.59
<b>R&amp;T-Cassava</b>	4.3989	-2.28	-4.53	-1.95	3.89	-2.00	-3.92
<b>R&amp;T-Potato</b>	5.5495	0.28	-0.58	-1.91	-4.70	-0.12	-1.82
<b>R&amp;T-Sweet Potato</b>	11.7151	-0.56	-0.75	-0.91	-1.41	-0.52	-0.33
<b>R&amp;T-Yams</b>	10.1577	0.17	0.46	-0.45	-0.64	0.12	0.64
<b>SGC-Sugarcane</b>	104.8499	-4.83	-9.53	-4.34	-8.55	-6.04	-11.79

CER = cereals; COT = cotton; F&V = fruits and vegetables; OLS = oilseeds; PUL = pulses; R&T = roots and tubers; SGC = Sugarcane

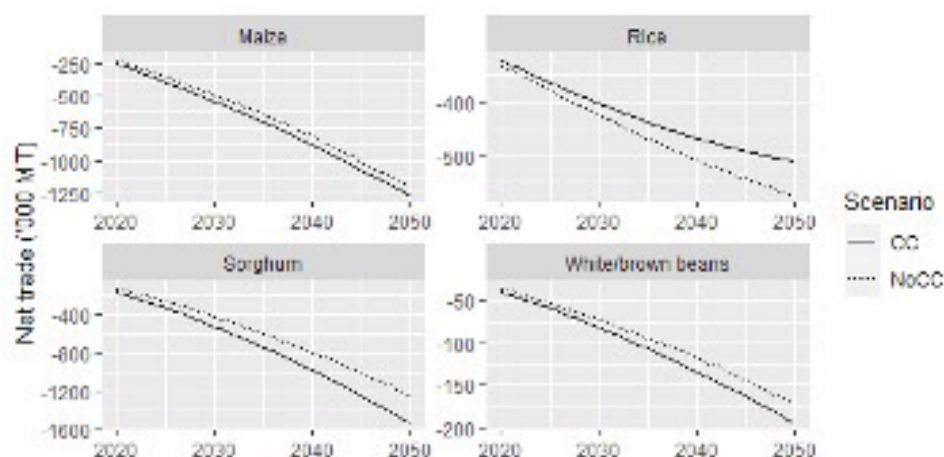
**Table 5 Percentage Difference in Burkina Faso Rainfed Crop Area**

Percentage difference is calculated over a no-climate change reference scenario for 2030 and 2050, under low, medium and high carbon emission scenarios (different representative carbon concentration scenarios [RCPs]), with business-as-usual demographic and economic growth trajectories (SSP2).

Crops	Percentage Change in Area Harvested from No Climate Change Scenario					
	RCP4.5_SSP2		RCP6.0_SSP2		RCP8.5_SSP2	
	2030	2050	2030	2050	2030	2050
CER-Maize	-0.43	-1.48	-0.34	-1.15	0.35	-0.25
CER-Millet	0.83	1.43	0.45	0.68	1.13	2.06
CER-Other Cereals	-3.27	-6.19	-3.07	-5.86	-3.59	-6.58
CER-Rice	1.19	2.41	1.54	2.97	2.16	4.40
CER-Sorghum	-0.55	-1.22	-0.46	-0.95	-0.28	-0.62
COT-Cotton	-0.07	-0.05	-0.67	-1.24	-0.67	-1.19
COT-Other	0.04	-0.12	-0.04	-0.23	-0.18	-0.54
F&V-Temperate Fruit	-2.10	-4.09	-1.75	-3.48	-2.09	-4.12
F&V-Tropical Fruit	0.51	1.10	-0.12	-0.22	-0.27	-0.40
F&V-Vegetables	-2.86	-5.29	-2.09	-3.89	-2.66	-4.85
OLS-Groundnuts	2.51	5.02	1.65	3.23	1.72	3.37
OLS-Other Oilseeds	1.31	1.96	1.87	2.51	1.79	1.86
OLS-Soybeans	-0.08	-0.21	-0.32	-0.64	-0.46	-0.94
PUL-Cowpeas	1.10	2.22	0.95	1.90	0.86	1.76
PUL-Other Pulses	-5.08	-10.04	-5.24	-10.40	-6.22	-11.81
R&T-Cassava	0.39	0.91	0.25	0.56	-0.06	0.09
R&T-Potato	3.28	4.50	1.71	1.19	4.47	5.27
R&T-Sweet Potato	-0.15	0.09	0.03	0.32	-0.17	0.12
R&T-Yams	0.61	1.35	0.52	1.12	0.51	1.18
SGC-Sugarcane	2.39	3.99	2.16	3.60	3.00	4.69

CER = cereals; COT = cotton; F&V = fruits and vegetables; OLS = oilseeds; PUL = pulses; R&T = roots and tubers; SGC = Sugarcane

**Figure 16 Net Trade Projections out to 2050. SSP2 RCP 8.5**



## 2.4 Potential for Digital Agricultural Solutions to Support Climate Resilience in Burkina Faso

**Digital agriculture presents a new portfolio of potential solutions to the current challenges in agricultural systems.** Digital agriculture is the use of new and advanced technologies, integrated into one system, to enable farmers and other stakeholders to improve their products and processes.<sup>96</sup> Digital solutions can improve agricultural efficiency and resiliency by reducing financial and labor costs, providing timely decision-support information, decreasing losses, improving quality, supporting sustainable use of resources, and increasing productivity. The emergence of digital agricultural solutions presents a unique opportunity to spur sustainable economic growth and development.

**Digital agriculture innovations may target input suppliers, producers, distributors (that is, everyone between the producer and the consumer), or consumers.** Some digital solutions serve as a broader cross-cutting framework with multiple applications across various stakeholder groups. Regardless of the target stakeholder group, the positive effects of digital solutions tend to ripple throughout the value chain.

**Robust network infrastructure and affordable services and hardware (e.g. mobile phones) are crucial prerequisites to digital solutions.** Some progress has been made in readying Burkina Faso for digital innovation, and much work remains to be done. The country ranks 162 out of 176 on the 2017 Information Communication Technology Development Index with a score of 1.90. This is an improvement on its 2016 score and rank of 1.74 and 163, respectively. Nevertheless, Burkina Faso remains far behind its neighbors, including Cote d'Ivoire at 134 and Ghana at 116.<sup>97</sup> While mobile connectivity has become more accessible, Internet costs remain high. 1 gigabyte (GB) of data costs about 7.78% of gross national income (GNI) per capita, as contrasted with Sudan, where 1GB costs just 0.75% of GNI.<sup>98</sup> Burkina Faso is not included in the Network Readiness Index.<sup>99</sup>

**As of 2017, there were 126 mobile subscriptions per 100 inhabitants.** This fact indicates that approximately 26% of individuals hold multiple subscriptions, and this is typically an effort on the

<sup>96</sup> United Nations, "Digital Agriculture."

<sup>97</sup> International Telecommunication Union, "Global ICT Development Index," ITU, 2017, <https://www.itu.int/net4/ITU-D/idi/2017/index.html>.

<sup>98</sup> Alliance for Affordable Internet, "Affordability Index," 2019, <https://a4ai.org/affordability-report/data/>.

<sup>99</sup> World Economic Forum, "Networked Readiness Index," Global Information Technology Report 2016, 2016, <http://wef.ch/29cCKbU>.

part of the individual to augment their coverage area or take advantage of improved rates when communicating with contacts across various service providers. Mobile subscription over-saturation tends to decline as coverage improves and costs decline. Of these mobile subscriptions, just over a third (48 out of 126) are Internet-enabled mobile-broadband subscriptions. About 27% of Burkinabes use the Internet.<sup>100</sup>

**The most promising cross-cutting foundational technologies for Burkina Faso's agricultural sector include big data, remote sensing, GPS, barcoding, and blockchain.** Digital solutions for individual stakeholder groups will integrate with and rely on these foundational technologies to various extents.

**For individual stakeholder groups, promising near-term solutions include short message service (SMS) and interactive voice response (IVR) technologies for delivering basic mobile money and information services, including weather and extension services.**<sup>101</sup> Close collaboration with mobile service providers to ensure ease of use and transparency of costs is crucial to the success of such initiatives. The development of smartphone-adapted financial and information services, as well as peer network platforms (e.g. for knowledge sharing and marketing), can also begin in this timeframe.

**In the medium term, smartphone-enabled mobile solutions should be fully developed.** As foundational technologies improve, advanced solutions for larger farms can begin to come online, including precision farming, digitized farm records, secure certification systems, barcode product tracking, and GPS-equipped transportation.

**In the long term, advanced services mentioned above should become widely accessible to smallholders, particularly digitized farm records, which improve access to finance services by creating a credit history.** Blockchain-enabled "trustless" smart contracts and Internet-of-things capability will become feasible as the aforementioned foundational technology systems become more robust.

**In addition to network and hardware access, digital solutions face barriers in terms of human capacity and resources.** At the user interface, low literacy and digital literacy rates prevent full use of services; an outsized percentage of vulnerable populations—generally female and minority producers—are impacted by literacy barriers. Low digital literacy also negatively impacts the system-level; decision-makers who have low understanding of how digital innovations might work are very unlikely to consider them as potential solutions. At the provider interface, there is a dearth of qualified individuals to design, launch, and maintain service platforms, as well as to produce content for release via the platform. This challenge is further aggravated where many languages are spoken.

**In the short term, these challenges can be addressed by integrating literacy and digital literacy components into programming, with an emphasis on gender-responsiveness and meeting stakeholders at their current level of capacity.** These efforts should target producers as well as local and national decision-makers who have the power to bring digital innovations into solution development. In the medium term, training and deployment of national-level teams for design, launch, and maintenance of service platforms will be crucial. Simultaneously, building digital literacy into all levels of education will help minimize current digital literacy gaps and build long-term national capacity for innovating digital solutions.

<sup>100</sup> International Telecommunication Union, "Global ICT Development Index," ITU, 2017, <https://www.itu.int/net4/ITU-D/idi/2017/index.html>.

<sup>101</sup> The World Bank Group, "Agriculture Observatory."

## 2.5 Climate Change Impacts and Burkina Faso's Overall Risk and Resilience

**A fundamental transformation of Burkina Faso's agricultural sector is needed to address the risks and challenges that climate change poses to food security and the overall agricultural sector.**

While this CSAIP focuses directly on the 3 CSA pillars, there are strong co-benefits offered by the proposed investments to help mitigate other risks and build resilience across multiple sectors. Many of the challenges posed by climate change affect multiple sectors, and there are strong inter-linkages across sectors and scales to mitigate risks and build resilience. A comprehensive analysis of all the ways this CSAIP supports risk and resilience would be extensive, but it is worth presenting a framework for considering how to view the proposed investments and their potential linkages with other sectors in order to build broader resilience.

**Evidence shows that risks from climate change are increasing, as presented earlier in this chapter.**

More significant for poor rural farmers and countries is the frequent prevalence of shocks, which in a fleeting moment seem to reduce all progress that has been made. Actions to adapt to climate change, the very actions supported by CSA, also provide positive ripple effects across the agricultural investment landscape to deal with some of these other shocks and risks. It is also important to differentiate between on one hand, an early intervention to prevent a potential risk from having an impact, and on the other, a response to the risk once it has been realized. The CSA portfolio of actions is an ex ante intervention; it takes account of what the problems are but identifies solutions before potential problems turn into larger risks or shocks. By increasing stability for farmers and markets, even as climate change increases volatility, CSA supports resilience. Table 6 below provides a few examples of how to intentionally build on these synergies and co-benefits to increase resilience. These are not intended to be complete but to provide a few examples of overlaps between CSA investments and of how they provide resilience co-benefits to other categories of risks.

**Table 6 Agricultural Risks and Potential CSA Actions and Synergies with Other Sectors**

### AGRICULTURAL RISKS<sup>102</sup> AND EXAMPLES OF POTENTIAL CSA ACTIONS AND SYNERGIES WITH OTHER SECTORS

**Production Risks:** Climate and weather risks (including drought, floods, extreme or erratic rainfall, and changed timing of rain; temperature and heat extremes; and wind and sandstorms); natural disasters; crops losses to wildlife; forest fires and bush fires.

**CSA Actions:** While CSA cannot stop climate change (although it does help mitigate it), the on-farm context for investments and relevant trends can be clearly analyzed in a site-specific way for each targeted investment, using state-of-the-art trend data and information. This information about localized climate, changes in rainfall, and the likelihood of temperature increases is a basis for minimizing management and operational risks.

**Resilience Co-Benefits:** In many local areas, access to sound information for disaster management planning is not available. Access to information about climate extremes used for CSA can help with disaster mitigation planning for infrastructure, flood escape routes, windbreaks, firebreaks, and other actions. It can also help identify how patterns have changed so that other sectors like schools could decide if calendars should be shifted to reduce children's exposure to extreme events, e.g. rain.

<sup>102</sup> Adapted from Adam M. Komarek, Alessandro De Pinto, Vincent H. Smith, 2020 A review of types of risks in agriculture: What we know and what we need to know, Agricultural Systems, Volume 178, and Steven Jaffee, Paul Siegel, And Colin Andrews. 2008. Rapid Agricultural Supply Chain Risk Assessment Conceptual Framework And Guidelines For Application Commodity Risk Management Group Agriculture And Rural Development Department World Bank

**Management and Operational Risks:** Poor information for decision-making leading to forecast and planning errors; inadequate seeds; low awareness of optimal inputs; agricultural pests and diseases; unpreparedness to deal with changes affecting production.

**CSA Actions:** Farmers rarely have adequate access to seeds or animal stocks that are identified to be climate resilient. They often use what is available or their best guess. Farmers also lack real-time information, such as is provided by the World Bank's Ag Observatory, to know the right time to plant. CSA introduces the appropriate seeds and inputs and the set of actions needed to maximize gains in productivity, adaptation, and mitigation.

**Resilience Co-Benefits:** Studies have shown that even farmers who are not project beneficiaries often adopt some or all new approaches. Also, broad use of new crops, aligned with integrated pest management (IPM), can reduce overall use of and exposure to pesticides. Better farm management and productivity lead to better overall household income and nutritional status, reducing childhood malnutrition and stunting, and increasing disease resistance.

**Personal Risks:** Undernourishment; human health impacts caused by agriculture (e.g. pesticide exposure and human disease, especially zoonotic, directly harming people or causing labor loss); security risks; displacement (e.g. due to rising sea levels); political or social instability.

**CSA Actions:** All projects increase productivity, supporting food security and improving human health. They all support poor farmers and help support resilience for COVID-19 or other emerging infectious diseases (EIDs) by supporting nutrition, jobs, and health largely in rural areas. Some project interventions will reduce conflicts between pastoralists and farmers with livestock by improving forage supplies. Others support efforts for women and children to have greater safety and fewer hours spent collecting water or fuelwood (also increasing their personal safety).

**Resilience Co-Benefits:** Both OneHealth and EcoHealth approaches can easily be blended into capacity building, extension, and digital agriculture activities. Monitoring the health of livestock, poultry, and people can become part of the information flow to pinpoint any spread of EIDs, zoonotic spread, or weather conditions, such as drought. These can be linked to develop an early warning and response capacity.

**Financial Risks:** Farm financing and obligations, loans, credit repayment, and insurance.

**CSA Actions:** Many CSA interventions would not be possible without supported funding; in some, the on-farm costs of equipment are too high for individuals, credit would be impossible to obtain, and even innovative farmers cannot adopt new practices or try new crops because they lack support. For reasons detailed below, the 1.7 million beneficiaries with enhanced capacity to undertake on-farm activities will likely have broader private-sector support through their households and communities.

**Resilience Co-Benefits:** Private sector involvement with small farmers is often low because no one deals with the up-front costs. In this scenario, it is hard to achieve the volume of products to create a vibrant value chain for a crop, so all the multiplier effects of strong production do not happen. CSA investments act as an incubator or start-up by creating sufficient capacity and supply for private sector involvement. Financial mechanisms such as farm insurance are essential to helping farmers build resilience.<sup>103</sup>

**Market Risks:** Price, cost, and market uncertainty related to international trade, major crises, or protectionism; price shocks from energy input or energy price fluctuations; changes in inputs or outputs.

**CSA Actions:** All investment priorities in these portfolios have been assessed by the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT), which considers a number of market risks and provides decision support based on how the competitiveness of the investments.

**Resilience Co-Benefits:** All the products produced for export could be consumed in-country if trade shocks occurred (e.g. economic problems or closed borders due to an EID or conflict). The CSA investments improve what already exists. Building on strong in-country knowledge of existing crops, commodities, and demand helps counter future market uncertainty and risk. Also, stronger in-country production and diversification support rural producers and urban consumers in the case of potential shortages because exports are stopped, civil unrest occurs, or other such risks are realized.

<sup>103</sup> William Adzawla, Solace Kudadze, Aminu Rashad Mohammed, Ismail Issaka Ibrahim, Climate perceptions, farmers' willingness-to-insure farms and resilience to climate change in Northern region, Ghana, Environmental Development, Volume 32, 2019,

**Processing, Logistics, and Operational Risks:** Sanitation and processing problems, human illness, contamination, food safety issues, contaminated processing facilities; changing transport, energy, infrastructure, or service flows.

**CSA Actions:** A key action is to improve the phytosanitary conditions for food processing, with special attention to investments that deal with livestock, fisheries and aquaculture, or protein. These improvements support local confidence in food safety and potentially reduce the spread of diseases, while creating new jobs, especially as food is moved from rural to urban areas.

**Resilience Co-Benefits:** Bushmeat frequently moves from rural to urban centers and may be processed in the same places as livestock. EcoHealth approaches can reduce the human disease burden (e.g. from worms) as well as reducing possibilities of serious zoonotic infections (e.g. monkeypox). Monitoring on-site can also identify the source of origin, detecting, for example, an outbreak of bovine tuberculosis.

**Institutional Risks:** Policies or institutional changes from the government or informal institutions (e.g. producer cooperatives); enabling environment; civil unrest or conflict; implementation risks; uncertainty over fiscal and tax policies.

**CSA Actions:** CSA priorities are defined by in-country expert stakeholders and have undergone multiple reviews both within and outside of the country. They are demand-driven by countries to transform their agricultural sectors, and they are produced with input from government officials representing different ministries and agencies. This CSAIP identifies policy gaps and barriers to implementation as well as coordination issues to be addressed. In endorsing these proposals, governments help define ways forward by giving endorsements to improve the institutional and policy context for CSAIP investment.

**Resilience Co-Benefits:** The World Bank assess how easy it is to engage in agriculture in different countries. This synthesis of a variety of factors, from seed supplies, sustaining livestock, protecting plant health, finance, and other such considerations, is found in *Enabling the Business of Agriculture*.<sup>104</sup> This document presents indicator scores that benchmark countries against regulatory good practices affecting farmers. CSAIP actions will engage with policy discussions and implementation, and it is likely that they will provide leverage that supports doing business in the agricultural sector.

**By enhancing production, adaptation, and mitigation to climate change, CSA supports a wide range of co-benefits to reduce risks and build overall resilience within the agricultural sector.** During the design phase, a strategic assessment of co-benefits identifies which co-benefits are most valued by different stakeholders, which are the easiest to implement, and which have the most impact. The current global challenge presented by COVID-19, while terrible, opens the door to push for strategic investments that will support recovery efforts and minimize future risks to Burkina Faso.

<sup>104</sup> World Bank. 2019. *Enabling the Business of Agriculture* 2019. Washington, DC: World Bank. doi: 978-1-4648-1387-0. License: Creative Commons Attribution CC BY 3.0 IGO





# Assessing Prioritized Investments For This Climate-Smart Agriculture Portfolio

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The initial list of 38 potential investments was reduced to 9 priority investments for Burkina Faso at a priority-setting workshop. Participants used an iterative, qualitative and quantitative prioritizing process to review each of the 38 proposed Climate-Smart Agriculture (CSA) investments. Specifically, 8 clusters of criteria were used to reduce the 38 identified investments to the 9 final investment priorities (see Annex C). The criteria used to evaluate and select the 9 final priorities are:

**1. On-farm value:**

- Economic
- Nutritional
- Food security

**2. CSA smartness**

- Productivity
- Adaptation or resilience
- Mitigation

**3. Investment objectives:**

- Growth in a new sector
- Resilience in a crop or sector that is already important

**4. Boosting agriculture:**

- Agriculture value diversification
- Infrastructure and connectivity.

**5. Climate risks, climate mitigation, and productivity:**

- Addresses key climate risks
- Increases agricultural productivity
- Provides adaptation and builds resilience to climate risks

- Reduces greenhouse gas (GHG) emissions (absolute emissions or emissions intensity)

#### 6. Finance and private sector engagement:

- Improves access and affordability of financing for CSA
- Improves competitiveness of the agriculture sector through infrastructure, incentives, and other means
- Provides private sector investment and business opportunities, including Public-Private Partnerships (PPPs)
- Long-term sustainability of investment and adoption of interventions

#### 7. Policies and institutions:

- Aligns with national policies for CSA
- Improves institutional capacities (economic, financial, natural resource management, and local government)
- Engages and strengthens farmer networks or organizations
- Improves extension (public or private)
- Improves research and development to support CSA

#### 8. Social benefits and safety nets:

- Provides job creation opportunities
- Enhances gender equity and engages the youth
- Protects the poor and vulnerable through social safety nets
- Improves access to clean water and sanitation

**Names used in this report, especially in tables, have been shortened from the names identified at the prioritizing workshop.** Investment titles were simply too long to easily fit in a table, so for the purposes of this CSAIP, names are often shortened (as shown in Table 6), so that “Sustainable on-farm biogas production” appears as simply “On-farm biogas” or “Biogas.” The proposed investment called “Forest, Agroforest, and Garden Production for Climate-Smart Diversification,” which has multiple components spanning forests and agroforests to improve their health and create value chains (among other aims), is shortened to “Forest, Agroforest, and Garden” or more simply, “Forest and Garden.” Use of these shorter names does not detract from the fact that they represent the full names or practices to support CSA; the shorter names are needed for the tables and for simplicity.

**Table 6 Complete and Shortened Names of Proposed Project Investments**

Full Name	Medium Length	Short
Sustainable On-Farm Biogas Production	On-Farm Biogas	BIOGAS
Sustainable Intensification of Livestock Production	Sustainable Livestock Intensification	LIVESTOCK
Finance and Insurance Services to Foster Climate-Smart Agriculture	Finance and Insurance	FINANCE
Forest, Agroforest, and Garden Production for Climate-Smart Diversification	Forest, Agroforest, and Garden	FOREST AND GARDEN
Building Capacity in Climate-Smart Agriculture	Capacity Building	CAPACITY
Sustainable Management of Water Resources and Irrigation	Water Resources and Irrigation	WATER RESOURCES
Developing Climate-Smart Organic Value Chains	Organic Farming	ORGANIC
Developing Resilient Oil-Protein Value Chains	Oil-Protein Crops	OIL-PROTEIN
Integrated Soil Management for Agricultural Productivity and Environmental Restoration	Integrated Soil Management	SOILS

**All the prioritized investments include cutting edge and proven technologies and practices for CSA (Table 7).** Each of the 9 priority investments was selected based on the criteria given above and

based on their importance either to Burkina Faso or to the region where they would be implemented. Each project's main objective is shown in Table 7.

**Table 7 Proposed Project Investments, Regions, Beneficiaries, and Objectives**

NATIONAL SCALE INVESTMENTS
<p><b>SUSTAINABLE ON-FARM BIOGAS PRODUCTION</b>  <b>BENEFICIARIES:</b> 65,000 farmers and their families  <b>OBJECTIVE:</b> Increase access to and knowledge of sustainable domestic energy sources in order to conserve wood resources, reduce GHG emissions, and reduce poverty, food insecurity, and health threats to rural communities.</p>
<p><b>SUSTAINABLE INTENSIFICATION OF LIVESTOCK PRODUCTION</b>  <b>BENEFICIARIES:</b> 150,000 farmers and their families  <b>OBJECTIVE:</b> Foster climate resilience in Burkinabe livestock systems for improved food and nutritional security and economic outcomes</p>
<p><b>FINANCIAL AND INSURANCE PRODUCTS</b>  <b>BENEFICIARIES:</b> 200,000 farmers and their families  <b>OBJECTIVE:</b> Foster smallholder ability to invest in CSA innovations through good access to robust financial services, including credit, loan, insurance, and risk instruments and savings and payment services.</p>
<p><b>FOREST, AGROFOREST, AND GARDEN PRODUCTION FOR CLIMATE-SMART DIVERSIFICATION</b>  <b>BENEFICIARIES:</b> 180,000 farmers and their families  <b>OBJECTIVE:</b> Foster climate-resilient livelihoods and food sources for women and youth smallholders through home gardens, agroforestry, and non-timber forest product (NTFP) harvesting and value-addition.</p>
<p><b>BUILDING CAPACITY IN CLIMATE SMART AGRICULTURE</b>  <b>BENEFICIARIES:</b> 500,000 farmers and their families  <b>OBJECTIVE:</b> Fully integrate national climate-smart priorities into Burkina Faso's agricultural research and extension programs and build robust extension mechanisms for delivering timely, practical climate-smart information to farmers and other stakeholders through highly accessible channels.</p>
REGIONAL SCALE INVESTMENTS
<p><b>SUSTAINABLE MANAGEMENT OF WATER RESOURCES AND IRRIGATION</b>  <b>ZONES:</b> North Sudan  <b>BENEFICIARIES:</b> 100,000 farmers and their families  <b>OBJECTIVE:</b> Fully leverage Burkina Faso's water resources in sustainable ways to improve productivity, food and nutritional security, climate resiliency, and ecological health.</p>
<p><b>DEVELOPING CLIMATE-SMART ORGANIC VALUE CHAINS</b>  <b>ZONES:</b> North Sudan and South Sudan  <b>BENEFICIARIES:</b> 60,000 farmers and their families  <b>OBJECTIVE:</b> Improve organic production and develop markets to create viable careers and shorten supply chains in peri-urban areas.</p>
<p><b>DEVELOPING RESILIENT OIL-PROTEIN VALUE CHAINS</b>  <b>ZONES:</b> North Sahel, North Sudan, and South Sudan  <b>BENEFICIARIES:</b> 240,000 farmers and their families  <b>OBJECTIVE:</b> Strengthen the quality, yield efficiency, and value chains of oil-protein crops to sustainably meet domestic demands and support international market development.</p>
<p><b>INTEGRATED SOIL MANAGEMENT FOR AGRICULTURAL PRODUCTIVITY AND ENVIRONMENTAL RESTORATION</b>  <b>ZONES:</b> North Sahel, North Sudan, and South Sudan  <b>BENEFICIARIES:</b> 200,000 farmers and their families.  <b>OBJECTIVE:</b> Provide producers and extension agents with location-tailored information about soil characteristics and best management practice recommendations, as well as with the tools, products, partnerships, and policy environment to implement those recommendations.</p>

### 3.1 Assessing Geographic Distribution of Burkina Faso's Priority Investments

The prioritized investments include 5 national plans, and 4 others that are distributed throughout Burkina Faso (Table 8). 5 investments are national in scope, providing a set of investments that build capacity, strengthen resilience, support mitigation, and offer human health benefits. The Capacity Building project in particular benefits from economies of scale. Additionally, 4 projects address the

North Sudan zone, including the Organic Farming project, which is focused on urban and peri-urban areas. 3 additional projects also address the South Sudan zone. The North Sahel features in two additional projects that will also be conducted in the Sundanian zones. No investments were focused on the South Sahel zone, with the exception of national investments, which could be targeted there. Stakeholders identified these agroecological zones, but they may also be called regions within this document, acknowledging that administrative areas that correlate need to be defined in future project stages.

**Table 8 Prioritized CSA Investments by Agroecological Zone in Burkina Faso**

North Sahel	South Sahel	North Sudan	South Sudan
		WATER RESOURCES	
		ORGANIC	
OIL-PROTEIN		OIL-PROTEIN	
SOILS		SOILS	
BIOGAS			
LIVESTOCK			
FINANCE			
FOREST AND GARDEN			
CAPACITY			

### 3.2 Assessing Beneficiaries and Costs of Burkina Faso's Priority Investments

If all the recommended investments for Burkina Faso were implemented, they would reach nearly 1.7 million people (Table 9). Taken together, the 4 national-scale projects would reach 895,000 small farmers across Burkina Faso. The On-Farm Biogas project is projected to reach a relatively low number of beneficiaries, while the investment in Capacity Building would reach the greatest number of beneficiaries (500,000), but at a lower intensity. In contrast, the Oil-Protein Crop investment is a large project that would reach 240,000 farmers, intended to build resilience and exports of an important crop that is largely managed by women. Integrated Soil Management would transform farming for 200,000 smallholders, and the Finance and Insurance investment would reach the same number. The smallest project is Organic Farming, reaching 60,000 small farmers (see Annex E for further methodology).

To reach these beneficiaries, the total cost of all investments is US\$472.5 million (Table 9). The individual project average is US\$52.5 million, ranging in size from US\$37.5 million (Forest, Agroforest, and Garden) to US\$65 million (Sustainable Livestock Intensification). The cost per beneficiary averages US\$252 ranging from US\$110 (Capacity Building) to US\$1000 (Organic Farming).

**Table 9 Beneficiaries and Costs in Each Project**

(N) denotes national-scale projects.

Proposed Investments	Beneficiaries	Costs	Percent Change (%)
Organic Farming	60,000	60.0	1000
On-Farm Biogas (N)	65,000	50.0	769
Water Resources and Irrigation	100,000	55.0	550
Sustainable Livestock Intensification (N)	150,000	65.0	433
Forest, Agroforest, and Garden (N)	180,000	37.5	208
Finance and Insurance	200,000	40.0	200

Integrated Soil Management	200,000	55.0	275
Oil-Protein Crops	240,000	55.0	229
Capacity Building (N)	500,000	55.0	110
<b>Total</b>	<b>1,695,000</b>	<b>472.5</b>	<b>252</b>

While all the projects are likely primarily to reach poor Burkinabe farmers, some of the projects are more likely primarily to benefit women and youth. Two of the smaller projects, Organic Farming and Biogas, will have especially strong benefits for women and youth. Fruits and gardens are mainly tended by women. The Water investment and the Biogas investment reduce burdens that disproportionately affect women and children, such as the time and risks associated with collecting and hauling water and fuel, and the poor health outcomes due to indoor air pollution from burning unclean fuel. Livestock, Forest and Garden, and Oil-Protein Crops also impact agricultural production that is primarily the responsibility of women in Burkina Faso.

### 3.3 Burkina Faso's Priority Investments and the CSA Pillars (Productivity, Resilience, Mitigation)

Climate smartness involves improving productivity, resilience, and mitigation. Results from assessing these core components of CSA for the 9 priority investments are presented below.

#### Productivity

All the CSA priority investments increase productivity by at least 18%, looking at the change in yield for beneficiaries with and without the project (Table 10). Water Resources and Irrigation is the priority investment that shows the highest yield increase per beneficiary at 56%. Organic Farming is close behind with a 54% yield increase. Two other projects also perform over 40%: Biogas and Forest and Garden. Three projects, Oil-Protein Crops, Livestock, and Soils, have strong yield increases between 29% and 39%. The two projects that provide less direct benefits, Finance and Insurance and Capacity Building, have lower relative yield improvements, but still come in at 18% to 19%. Looking at the standard deviations (SD) of the projects, three of them have relatively narrow deviations: Capacity Building, Finance and Insurance, and Oil-Protein Crops.

**Table 10** Change in Yield

	Change in Yield (% , SD)
Water Resources and Irrigation	56 (41)
Organic Farming	54 (45)
On-Farm Biogas	45 (28)
Forest, Agroforest, and Garden	40 (21)
Oil-Protein Crops	39 (9)
Sustainable Livestock Intensification	38 (28)
Integrated Soil Management	29 (34)
Finance and Insurance	19 (10)
Capacity Building	18 (8)

Note: Change in Yield (% , SD) is defined as average percentage change between beneficiaries with versus without project

#### Resilience and Risk

One way of showing the resilience of projects is by understanding the risks, and then using the probability of a positive Net Present Value (NPV) as an indicator of resilience. This investment plan and economic analysis enable direct targeting of investments for the climate and pest risks threatening productivity and growth in the future. This analysis guards against excessive optimism

when risks are excluded from economic analysis. As shown in Table 11, 4 of the 9 investments have a better than 50% chance in the face of uncertain climate and social risks. This suggests that these investments are robust for tomorrow's environmental conditions. 2 additional investments have a better than 40% chance of a positive NPV with risks. The three riskiest projects are Biogas, Organic Farming, and Water Resources and Irrigation. Notably, those three projects also provide the greatest benefits (see the Production section above) to the smallest numbers of people (see the Beneficiary section above).

**If risks are ignored, the chances of a positive NPV increase in all investments.** Looking at the priority investments without risks included, all have a better than 50% chance of a positive NPV. Excluding risks, Forest and Garden and Oil-Protein Crops show a better than 90% change of a positive NPV. For the projects with a higher chance of a positive NPV, there is only a small difference in results with and without risk. Some of the projects also show a higher sensitivity to risk. Water Resources and Irrigation, Oil-Protein Crops, and Organic Farming show a higher sensitivity and lower resilience to potential risks (e.g. over 25% difference).

**Overall, the chances of a positive NPV are good for most of the investments.** The modelling, using 100 runs for each, suggests high probability of a positive return. However, the reality is that risks make the likelihood of success for any given individual investment uncertain. Where the probability is lower, it is important to consider the downside risk of the investments. There is the possibility that investments may not perform as planned or hoped and may not produce positive results when implemented. Uncertainty in performance is inherent to investments in agricultural development. An evaluation of 86 projects by the World Bank found that 41% had non positive outcomes.<sup>105</sup> Climate change will only add to this uncertainty. Methodologically, variation in predicted results is produced from consideration of joint effects of multiple uncertain parameters. While these models are based on the best available information at the time of development, information about costs, benefits, and performance is scarce and uncertain. The modeling approach used here attempts to account for that reality and make it explicit, and in so doing, strives to provide all the information necessary to arrive at a sound decision.

**Table 11 Land Cover Changes in Burkina Faso, 1990 to 2017**

	WITH RISKS	WITHOUT RISKS
	Chance Positive NPV (%) <sup>2</sup>	
Forest, Agroforest, and Garden	89%	92%
Integrated Soil Management	71%	83%
Capacity Building	62%	80%
Oil-Protein Crops	60%	90%
Finance and Insurance	45%	63%
Sustainable Livestock Intensification	43%	65%
On-Farm Biogas	32%	51%
Organic Farming	29%	54%
Water Resources and Irrigation	21%	54%

<sup>2</sup> Average of 100 model runs

<sup>105</sup> [https://ieg.worldbankgroup.org/sites/default/files/Data/reports/ie\\_for\\_ag.pdf](https://ieg.worldbankgroup.org/sites/default/files/Data/reports/ie_for_ag.pdf)

## Emissions

The entire portfolio reduces Burkina Faso's overall emissions and would sequester 4.31 mega tonnes of carbon dioxide (MT CO<sub>2</sub>) if all the priority investments were implemented. Only one of the investments, Sustainable Livestock Intensification, will be a source of net GHG emissions (Table 12).

Overall, this investment reduces emissions intensity from livestock (cows, goats, and sheep), and can be justified because it supports increased consumption of animal source foods, a critical nutrition intervention to combat childhood stunting and wasting. The investments with the greatest emissions reduction potential are Integrated Soil Management and Forest, Agroforest, and Garden. Both investments increase soil carbon storage and reduce practices that generate emissions. It is vital to Burkina Faso's agricultural sector development to create and support appropriate structures to nurture sustainable intensification that supports both productivity and mitigation (e.g. through the Capacity Building and Finance and Insurance investments).

**Table 12 Emissions from Priority Investments (MT CO<sub>2</sub>)**

Sustainable Livestock Intensification	-0.69
Water Resources and Irrigation	0.03
Organic Farming	0.04
Oil-Protein Crops	0.11
Capacity Building	0.21
Finance and Insurance	0.25
On-Farm Biogas	0.53
Integrated Soil Management	1.25
Forest, Agroforest, and Garden	2.58
<b>TOTAL CARBON SEQUESTERED</b>	<b>4.31</b>

Of the 9 priority investments, some distinguish themselves for how robustly they support the fundamental CSA pillars. A summary of the top 5 investments for each of the 3 CSA pillars is shown in Table 13. Of the 9 investments, only Forest and Garden appears in all 3 categories. It is the strongest performer on resilience to risks and on reducing emissions. Based on their rank order, Integrated Soil Management, with the 2nd highest rank in two categories, performs 2nd best across the CSA pillars. This is followed by Biogas, which is the 3rd strongest for yield and reducing emissions, and then Capacity Building. Oil-Protein Crops and Finance and Insurance rank the lowest, but both appear in 2 categories.

**Table 13 CSA Pillars: Ranking the Top 5 Investments in Each CSA Smartness Category**

PRODUCTIVITY	RESILIENCE WITH RISKS	REDUCING EMISSIONS
Water Resources and Irrigation	Forest, Agroforest, and Garden	Forest, Agroforest, and Garden
Organic Farming	Integrated Soil Management	Integrated Soil Management
On-Farm Biogas	Capacity Building	On-Farm Biogas
Forests, Agroforests, and Gardens	Oil-Protein Crops	Finance and Insurance
Oil-Protein Crops	Finance and Insurance	Capacity Building

### 3.4 Economic and Financial Assessment of Burkina Faso's Priority Investments

**These 9 investments are predicted to provide significant benefits for farmers in Burkina Faso.**

As shown in Table 14, the cost-benefit analysis (CBA) is presented both with and without risks so the potential magnitude of foreseeable risks can be understood. Without risks included in the model, NPV (20-years) ranges from \$16.9 million with the Biogas investment to more than \$196 million for Forest and Garden.

**The projects with a lower NPV generally have high up-front investment costs per beneficiary, but they are have the highest yield per beneficiary.**<sup>106</sup>

Costs per beneficiary also support the entire project and are pro-rated to beneficiaries. Some projects may have more complex and higher overall costs. Others may have lower administrative costs, but high start-up costs. The relatively low NPV of the Biogas investment can likely be attributed to the high initial investment cost for equipment. Biodigesters often cost more than \$500 per household and this fact, combined with the program implementation costs, creates poor conditions for very productive investments. It may be, however, that NPV is the wrong indicator to judge a green energy product. There are many reasons, such as reducing GHG emissions, improving indoor health and sanitation, and freeing women from the time-intensive collection of fuelwood, to promote on-farm biogas. These values are not captured in the project's NPV. Another project with a lower NPV is Organic Farming, which features solar irrigation systems and improved storage for vegetables and fruits (which is usually cool storage). The cost for solar irrigation systems is about \$1000 per system, and cool storage units are similar in terms of costs. Water Resources and Irrigation costs about \$1000 per smallholder system, and rehabilitation of ponds or water bodies costs about the same. In contrast, the Forest and Garden valuation represents the opposite condition: low investment requirements, large numbers of relevant beneficiaries, and high prices for carbon. The parkland agroforestry systems of Burkina Faso create a ripe opportunity for sustainable development. These wild harvesting systems often promote gender inclusion in the marketplace, with knock-on effects for the health and nutrition of households.

**All investments are expected to improve the income and productivity of farmers.** Evidence shows that investments in improved agricultural practices increase the outputs of farms. Key types of investments for which Burkina Faso's CSAIP advocates include organic waste management (e.g., biogas, organic agriculture, soil management), which provides nutrient-rich composts to the soil, preserving and building soil fertility; improved breeds and feeds in Sustainable Livestock Intensification; and improved water distribution and management in Water Resources and Irrigation. Importantly, the Finance and Insurance investment plan suggests interventions that are also geared to help farmers perform under uncertain and harsh conditions, for example by providing improved access to finance and insurance products (e.g., credit and index-based insurance).

<sup>106</sup> The midpoint of the distribution used for the discount rate was 13%, had a low of 4%, and was unbounded on the high side, with 90% of values less than 19.5%. See Annex E.



**Table 14 Assessing the Performance of the 9 Priority Investments**

Performance assessed with and without climate and social risks.

CSA Investment	Estimated Project Budget (US\$, Millions)	Mean NPV (US\$, Millions)		Mean ROI		Mean BCR (SD)	
		With	Without	With	Without	With	Without
Integrated Soil Management	60.00	72.0	128.9	1.35	2.46	5.30 (7.85)	5.64 (8.00)
Organic Farming	50.00	-5.1	21.8	-0.15	0.48	2.99 (14.31)	4.99 (17.12)
On-Farm Biogas	55.00	-1.5	16.9	-0.09	0.30	2.72 (3.96)	3.33 (4.33)
Water Resources and Irrigation	65.00	-15.8	22.9	-0.35	0.35	2.63 (5.54)	5.04 (6.96)
Sustainable Livestock	37.50	16.4	76.1	0.67	2.57	1.97 (4.90)	2.88 (5.70)
Finance and Insurance	40.00	15.9	52.2	0.43	1.51	1.54 (2.36)	1.84 (2.47)
Forest, Agroforest, and Garden	55.00	168.2	196.1	3.47	4.06	0.77 (7.26)	1.78 (7.74)
Oil-Protein Crops	55.00	32.5	106.1	0.62	2.19	0.36 (2.39)	1.15 (2.76)
Capacity Building	55.00	52.5	140.4	1.06	2.95	0.21 (0.92)	0.62 (1.24)

NPV = net present value, ROI = return on investment, BCR = benefit cost ratio with standard deviations (SD).

NPV and ROI are averages of 100 model runs. ROI is here expressed as a ratio between discounted net benefit and discounted costs.

**Overall, differences in the estimated productivity are due to inherent variation in the costs of interventions, the number of beneficiaries impacted, and the relative speed at which interventions reach scale.** When considering the realities of inter-annual weather fluctuations, pest outbreaks, and social and political drivers of adoption, the estimated NPV of the investments drops. This is perhaps most noticeable for Organic Farming. This tendency reflects the extent of the negative impacts that climate change is expected to have on crop and livestock production in Burkina Faso. It thus provides further justification of the need for CSA.

**How well these on-farm improvements translate to overall investment productivity varies because of the variable costs of interventions and the pace of adoption.** A few investments distinguished themselves as high performing, such as Capacity Building. This investment had a relatively low level of individual change, but when aggregated across the large domain of applicability, it has potential to transform the landscape. With its combination of face-to-face training and smart use of information and communication technologies, the investment will be able to reach many beneficiaries quickly and thus has potential to create substantial change despite its lower per beneficiary result. Also, increased information flows help build resilience across systems by enabling timely advice about and monitoring of conditions that increase risk. Common types of interventions that are the result of receiving information, such as on-time planting, have a relatively low impact on average yields (i.e., 4-8%) compared to planting at a suboptimal time. Of course, when poor planting decisions occur, they create crop failures in households not participating in the program, so relative changes in production can be more substantial and are captured in the tails of distributions used in the models. Or, soil management improves soil fertility, but typically this happens over longer time horizons and depends on specific management interventions. So, an important improvement in the long term may not show dramatic results, but such investments can be critical when considering the health of agricultural systems.

**The analysis suggests there is potential for positive returns with each of the investments—but there are risks.** In some cases, the ROI is expected to reach as high as 400% (e.g., Forest, Agroforest,

and Gardens), indicating that this investment has potential to create impact at scale over the 20-year period. Even accounting for risks, ROIs and benefit-cost ratios (BCRs) remain positive.

**Benefit-cost ratios (BCRs) for practically all the CSAIP portfolio investments are within the range of the investments identified by the Global Commission on Adaptation,<sup>107</sup> suggesting these programs are consistent with those identified in other initiatives.** Ironically, some of the strongest performing projects for the CSA pillars (Table 14) (Forest and Garden, Oil-Protein Crops, and Capacity Building) are those with the lowest mean BCR. This suggests that it is important to view these proposed project investments through different lenses, such as for the variety of ways that they reduce risk from climate change or other shocks, for the ways they build resilience in the agricultural sector and for poor households, and for their potential transformative value across rural Burkina Faso. Ultimately, they represent a public investment in the growth of the agricultural sector, while benefits are accrued privately by farmers. Thus, strict rules about necessary levels of return may not hold.

**An equivalent to a sensitivity analysis was performed for NPV, using 2 levels of carbon pricing (low and high), both with and without climate and social risks** (Table 15 and Figure 17). With high carbon prices and no risks included, all the proposed investments have a positive NPV. The mean NPV shows an especially acute sensitivity to high carbon prices for the 3 investments that strongly support mitigation (Forest and Garden, Soils, and Biogas). Yet for some projects (e.g. Biogas), even high carbon prices are insufficient to offset potential climate and social risks, although they make these investments more attractive financially and significantly offset the high cost per person. The sensitivity analysis also highlights potential tradeoffs; the Biogas project has high up-front costs, but also strong mitigation potential. This analysis shows that the financial and economic analyses are highly sensitive to some of the model assumptions and provides a strong rationale for cautious analysis of both future carbon pricing and risk calculations within agricultural sector investments.

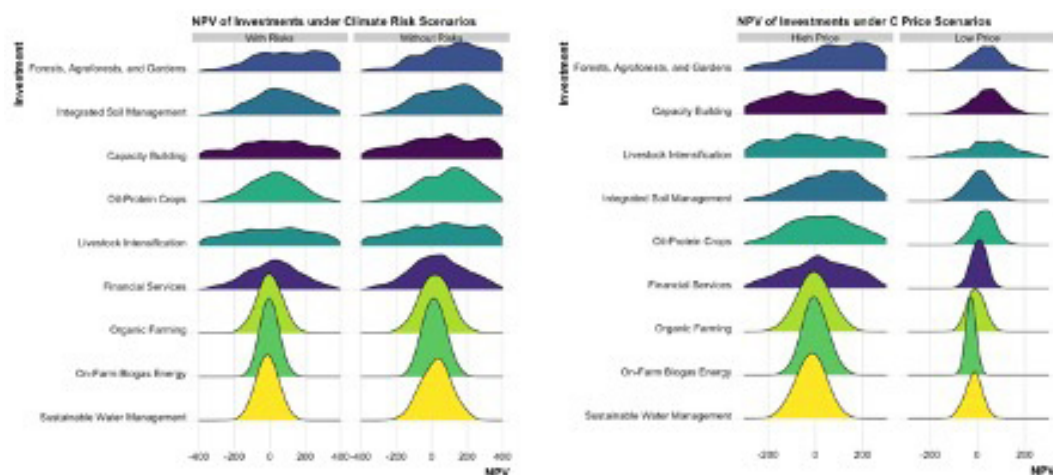
**Table 15 Comparison of Mean Investment NPV under Carbon Price and Risk Scenarios (US\$, Millions)**

Investment	No Risk - Low C Price	No Risk - High C Price	With Risks - Low C Price	With Risks - High C Price
Capacity Building	129.9	140.4	42	52.5
Sustainable Livestock Intensification	110.3	76.1	50.7	16.4
Oil-Protein Crops	100.8	106.1	27.2	32.5
Forest, Agroforest, and Garden	66.9	196.1	39	168.2
Integrated Soil Management	66.3	128.9	9.4	72
Finance and Insurance	39.6	52.2	3.2	15.9
Water Resources and Irrigation	21.5	22.9	-17.2	-15.8
Organic Farming	19.8	21.8	-7.2	-5.1
On-Farm Biogas	-9.6	16.9	-28	-1.5

<sup>107</sup> Global Commission on Adaptation, WRI, 2019

**Figure 17 NPV of Prioritized Investments**

With and without risks, for low and high carbon prices



### 3.5. Climate Modeling Assessment of CSAIP Priority Investments

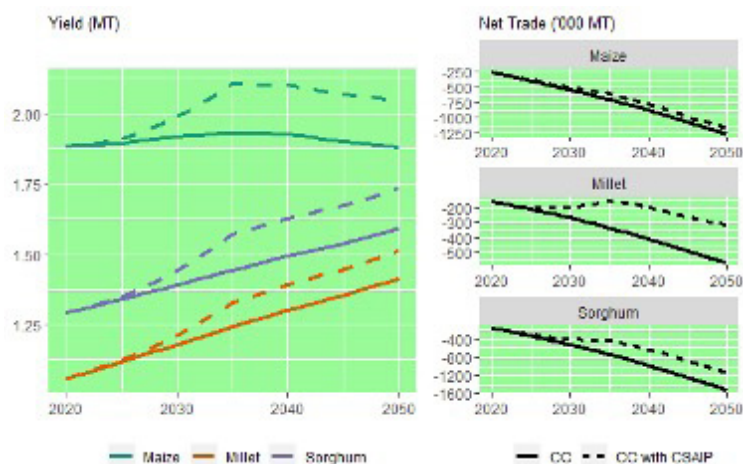
The CSA investment plans are built on the strengths of commodities exhibiting resilience under climate change, while simultaneously offsetting potential damages to commodities exhibiting vulnerability. We assessed the potential impact of this CSAIP on yield, food security, and trade trajectories in Burkina Faso out to 2050 under climate change, given different assumptions regarding demographic, economic, and emissions over this period. This analysis identified the crops that exhibit resilience or vulnerability under climate change and focused on how the CSAIP can leverage or offset their resilience or vulnerability. For this analysis, the team considered yield shocks, expected time horizons, and adoption rates associated with each of the CSAIP investments. This input came from experts familiar with these technologies and practices. The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) scenarios below show “with CSAIP” and “without CSAIP” future climate change scenarios out to 2050, for the Business as Usual Shared Socioeconomic Pathways (SSP 2), as well as different assumptions about future GHG concentration scenarios (Representative Concentration Pathways [RCP]).

**The On-Farm Biogas and Integrated Soil Management CSA interventions are poised to give a boost to key cereal crops,** one through the integration of livestock and cereal systems, the other through soil recovery and conservation practices. Maize yield growth in particular stands to benefit, but is otherwise projected to flatten in the near future under climate change. These practices are also projected substantially to offset Burkina Faso’s steepening trade deficit in sorghum and millet.

**The Oil-Protein Crop CSA investment is projected to offset declining soybean yields and to enhance white and brown bean yields.** The soybean yield trajectory is projected to be one of the hardest hit by climate change. These CSA interventions could lay groundwork to offset a fledgling trade deficit in these products (Figure 19).

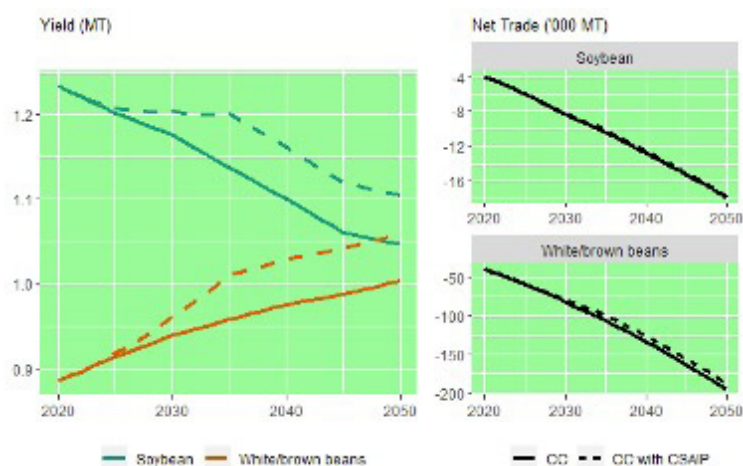
**Figure 18 Potential Impact of the On-Farm Biogas and Integrated Soil Management Investments**

Investments show potential to improve maize, millet, and sorghum yields and the balance of trade. Trajectories modeled using IMPACT under a Business-as-Usual Shared Socioeconomic Pathway (SSP 2) and a pessimistic Representative Carbon Concentration Scenario (RCP 8.5).

**Figure 19 Potential Impact of the Oil-Protein Crop Investment**

The investment shows potential to impact soybean and white and brown bean yields and the balance of trade.

Trajectories modeled using IMPACT under a business-as-usual shared socioeconomic pathway (SSP 2) and a pessimistic representative carbon concentration scenario (RCP 8.5).



### 3.6 Assessing CSAIP Investment Alignment with Burkina Faso's Nationally Determined Contribution (NDCs)

The Burkinabe government has emphasized mitigation and adaptation actions given the high dependency on the Agriculture, Forestry, and Other Land Use (AFOLU) sector and its vulnerability to climate change. The Burkinabe government has submitted NDCs to the Paris Climate Agreement.

Burkinabe commitment to a climate-smart future is also visible in the goals of the Fond d'Intervention pour l'Environnement (FIE)<sup>108</sup> whose mission is to contribute to the environmental objectives of Burkina Faso. Those initiatives are supported by the international community, including the United Nations (UN), the Economic Community of West African States (ECOWAS), and donors such as the West African Development Bank (BOAD), the African Development Bank (AfDB), the World Bank (WB), and the European Union (EU).<sup>109</sup>

**This CSAIP is clearly aligned with Burkina Faso's NDCs both for high level objectives and specific investment activities, and the NDCs integrate all three CSA pillars.** The World Bank is supporting Burkina Faso's development of this CSAIP in alignment with and under the auspices of the NDCs. A new NDC Partnership Plan is under development, and coordination between funded CSAIP investments and the NDCs is vital. It will be crucial to ensure that this alignment and support continues. The NDCs include two types of objectives: mitigation and adaptation. The adaptation objective is more ambitious than the mitigation objective because it aims to use a Project/Activity/Action approach. AFOLU is the sector producing the most GHG emissions; however, with more than 80% of the population working in that sector, it is also the sector contributing the most to the Burkinabe economy and the sector most vulnerable to climate change. The adaptation objective stresses first improving environmental services through actions supporting food security, soil and water conservation, sustainable agriculture, etc. These actions then lead to a long-term reduction in GHG intensity through projects. These projects fall in 4 sectors: AFOLU, Habitat and Urbanism, Health, and Extreme Climatic Events Management. This CSAIP contributes to supporting all 4 of these sectors.

**The proposed investments make robust contributions to the adaptation objective in the AFOLU sector at the national scale.** Given unavoidable, continuing, erratic, and variable climate change impacts, greater additional focus on adaptation is warranted to ensure continued productivity. Investments across the CSAIP portfolio reduce risks from climate change or other abrupt shocks, thereby contributing to adaptation. Table 16 shows the links between specific national-scale NDC AFOLU sector objectives and these investments. For example, of 10 components in the NDCs, the Building Capacity investment supports 7 objectives. Developing the capacity for CSA implementation is key to better disseminating technologies and innovations on the farm level. Introducing CSA into the national extension system supports reduced emissions, climate resiliency, and equitable development via sustainable intensification and natural resource management. The Finance and Insurance investment supports 5 objectives and helps attain adaptation objectives by developing climate insurance, helping farmers adapt to new crops and technologies, and improving long-term productivity and resilience.

<sup>108</sup> FIE, "Fonds d'Intervention pour l'Environnement."

<sup>109</sup> Government of Burkina Faso, "Contribution prévue déterminée au niveau national (CPDN) au Burkina Faso."

**Table 16 Alignment of CSAIP with NDC Partnership Investments**

Only the investment plans with at least 1 area of strong alignment or 2 areas of partial alignment are shown here. See Annex C for additional information.

BURKINA FASO CSA PRIORITY INVESTMENTS										
NDC Components	Building Capacity	Finance	On-farm Biogas	Livestock	Forests Gardens	Organic Farms	Oil-protein	Soils	Water Mngmt	Dams
Improved farming technologies/ CA										
Conserve water & irrigation mgmt										
Soils: manage, conserve fertility										
Governance reform										
Post-harvest handle & process										
Renewable energy support										
Livestock & aquaculture										
Info mgmt/ advisory services										
Restoring forests/ agroforestry										
Financial services support										

The adaptation strategies supported by the CSAIP also support broader resilience to abrupt shocks across the agricultural sector and even build resilience in institutions. The global spread of COVID-19 and its potential impacts on Burkina Faso's human health and economy show the high importance of building resilience not just to climate change, but also to other potential shocks. This point is made in Chapter 2, with reference to climate-vulnerable landscapes and the most vulnerable populations. Many of the investments are targeted to support rural farmers who could potentially become food insecure. They reduce the impacts of future shocks by increasing production, introducing more resilient crops and breeds, increasing income, replacing food imports with domestic products, and improving knowledge transfer and communication to provide early warnings and advice about potential shocks.

### 3.7 Policy Coherence: Alignment, Gaps and Distortions with Other Policies, Strategies, and Commitments

**The CSAIP addresses and supports the goals of multiple national policies and strategies.** These policies and strategies include the National Rural Sector Program, climate change National Adaptation Plan (NAP), National Adaptation Program of Action (NAPA), the Forest Investment Program (FIP), the National Climate Change Learning Strategy, the African Adaptation Program (Annex C). The CSAIP also strongly supports several main components of national forest policy, national action on integrated water management, the national plan for capacity building on risk reduction and response to emergencies in Burkina Faso, and other policies key to maintaining the agricultural sector's growth and contribution to the national economy. Furthermore, by promoting and expanding the adaptation approaches previously discussed, the CSAIP builds resilience within national institutions themselves, thus positively impacting myriad aspects of national policy. These investments thus support Burkina Faso's current national policies as well as its future developments in agriculture and food security in the face of climate change.

**Implementation of the CSAIP will make significant strides toward meeting several of Burkina Faso's international commitments.** While Burkina Faso's contribution to GHG emissions is very low, the country has committed to international initiatives such as the Reducing Emissions from Deforestation and Forest Degradation Program (REDD+), the Forest Investment Program (FIP), and

Nationally Appropriate Mitigation Actions (NAMA). In addition to its NDCs, Burkina Faso is signatory to other international commitments, including:

- Sustainable Development Goals (SDGs)
- Comprehensive Africa Agriculture Development Program (CAADP)
- Malabo Declaration on the Transformation of Agriculture
- African Union 2063 Agenda
- African Forest Landscape Restoration Initiative (AFR100)
- Land Degradation Neutrality (LDN) Target Setting Program of the United Nations Convention to Combat Desertification (UNCCD)

**The CSAIP will move Burkina Faso closer to meeting all these international commitments.** Every one of the proposed investments addresses the poverty reduction and environmental conservation aims of the 2030 Sustainable Development Goals (SDGs) and the African Union 2063 agenda for inclusive and sustainable development.<sup>110</sup> Burkina Faso is on track with the re-commitment to CAADP Process (score 5.63 out of 10, minimum 3.33).<sup>111</sup> Nevertheless, the country only has 7.7% of agricultural land under sustainable land management practices. Implementing the investments in this CSAIP will help Burkina Faso get back on track to meeting its Malabo Declaration commitment to enhancing investment finance in agriculture, specifically its commitments with regard to access to finance and ending hunger by 2025 by doubling agricultural productivity and reduction of post-harvest losses.<sup>112</sup> Finally, these investments will significantly augment Burkina Faso's contribution to AFR100's goal of restoring 100 million hectares of deforested and degraded landscapes across Africa by 2030 with 5 million hectares in Burkina Faso.

## Policy Gaps and Distortions

**Investments in CSA program design and implementation may be constrained by the existing policy context.** As shown in Table 17, there are some barriers that are more common (top of the table), and some investments that are more likely to be threatened by multiple policy gaps or barriers (more affected investments appear on the left side). There are three barriers present in all projects:

- Poor land tenure regimes
- A dearth of finance services for agricultural stakeholders, particularly smallholder producers
- Weak extension services, including climate and soil services

Additional important barriers include:

- Institutional capacity
- Market distortions
- Low political will and a lack of inter-institutional coordination

Distortions or gaps in digital policy, conservation, standards and certifications, funding, and research and development may also affect the implementation of some investment programs.

**Investments in CSA are disincentivized by current tenure regimes, input costs, and land-use planning practices.** Tenure insecurity and poor marketing systems are major limiting factors to national agricultural development. The cost of inputs to improve productivity on existing lands often exceeds the cost of agricultural expansion, leading to forest clearing. Minimal resources and low capacity make rural land use planning and forestry conservation laws difficult to enforce.

<sup>110</sup> African Union, "Agenda 2063: The Africa We Want."

<sup>111</sup> AUDA-NEPAD, "Tracking Progress: Burkina Faso."

<sup>112</sup> AUDA-NEPAD.



**Table 17 Policy Gaps and Distortions**

Shaded regions denote that a particular policy gap or distortion affects a particular investment

Policy Gaps	Proposed Investments									
	Finance	Capacity	Organic	Oil-Protein	Soils	Livestock	Forest Garden	Biogas	Water	Dams
Land Tenure										
Finance Services										
Extension										
Institutional Capacity										
Markets										
Political Will/Coordination										
R&D										
Digital										
Program										
Standards										
Conservation Management										

**Climate change risks, and other risks and shocks, may be aggravated by the policy environment and vice versa, although CSAIP investments will counter these.** Climate and pest risks are incorporated into the economic models (see Annex E). While climate stresses cannot be ignored, there are climate adaptation efforts underway, from farmers changing planting times or varieties, to national-scale efforts to promote adaptation within larger sectors. Urban and rural impacts and risks will be quite different and will have different pathways in terms of who is affected, how, and to what extent. This CSAIP portfolio helps reduce both risks and shocks to the agricultural sector, especially national-scale investments for finance and capacity. These begin to address some of the policy gaps that are fundamental to building resilience across the sector. The IMPACT modeling reflects the differences in urban and rural impacts and risks, including with regard to global trade competitiveness given changing advantages in the agricultural sectors of different countries.

**Several pro-CSA policies are not fully implemented due to weak collaboration between sectors and governmental ministries.** Multiple Burkinabe policies outline CSA goals without specifying precisely how they will be achieved or by whom. As a result, there is poor coherence between sectoral policy documents and approaches. Competition and disagreement exist between sectors and ministries rather than alliances and collaboration toward common goals. This has been recognized as a major limiting factor to development by the Ministry of Food and Agriculture, among other key stakeholders. Defining roles, synergies, compromises, and trade-offs between stakeholders and state institutions will be a vital step toward implementing and improving the effectiveness of existing pro-CSA policies, particularly given limited resources and budgets. Better coordination across government entities or a single unit to coordinate between the government and private sectors could increase the very limited private sector engagement in Burkinabe CSA programs at the present time.

**Most national policies give attention to climate change issues, and there is an opportunity to better align these policies with national objectives.** Legislation going as far back as the 1995 National Forest Policy acknowledges climate change. However, many policies stop short of offering concrete steps toward adaptation, mitigation, or CSA. For example, the Strategy for Accelerated Growth and Sustainable Development (2011-2015) and National Economic and Social Development Plan (2016-2020) mention climate change only in passing and do not address any specific adaptation or mitigation



measures. The National Climate Change Learning Strategy (2016), the African Adaptation Program (2012), and the Reducing Emissions from Deforestation and Forest Degradation Strategy (2010) do not address CSA. Addressing impacts from COVID-19 on Burkina Faso and building responses, including CSA, offer an entry point to reducing a variety of risks and building resilience across the agriculture sector and other sectors. Doing so can help policymakers devise coordinated approaches to holistic climate-smart development goals that also support OneHealth and risk reduction objectives.

**Distortions of some pro-CSA policies and subsidies are creating potential further barriers to CSA implementation.** For example, the Burkinabe government has prioritized the soybean industry to help fill domestic demand gaps and reduce reliance on imports. However, the monetization of this and other oil-protein crops is causing farmers to abandon CSA practices such as intercropping and fallowing and is pushing women out of production of oil-protein crops. Both these shifts increase smallholder and national vulnerability to climate impacts. Careful design and implementation of policies, and a legislative understanding that revisions are expected as policies come into force, can resolve these unintended consequences. Maximizing policy coherence is crucial to achieving all agreed-on national objectives.

**Institutional capacity increases will be foundational to meeting Burkina Faso's national climate-smart goals.** Stakeholders, including the Ministry of Agriculture, have repeatedly highlighted the need for investments in the capacity necessary to move toward integrated implementation of national planning priorities. Enhanced institutional capacity would prepare ministries for the necessary realignment of existing policy frameworks to achieve coherence across policies and establish coordinated efforts across departments, ministries, and sectors.

**Burkinabe farmers have little or no access to the essential services necessary for successful agricultural production.** These include land climate, soil, market, and technical extension information, finance and insurance services, and land tenure. Information services support farmers' capacity to implement new CSA practices and inform their decision making regarding the same. Finance and insurance services give farmers access to the capital and risk protection needed to implement new practices. Land tenure ensures they will be able to benefit from these investments in the future.

**Without climate information services, most Burkinabe smallholders rely on traditional techniques and indigenous knowledge to forecast near-term weather and season climate.** Traditional knowledge such as when birds migrate, when plants germinate, and changes in cloud cover and wind patterns have historically guided farmers' decision-making. However, the erratic weather conditions caused by climate change have made such knowledge and practices increasingly unreliable. The current national extension model is costly to implement and has not scaled to reach the majority of farmers.

**Farmers are not receiving agricultural extension services based on state-of-the-art research, technology, or science innovations.** Farmers respond to this lack of information by delaying farming decisions, hoping they will receive some useful information later. Delayed decision-making, combined with erratic weather patterns, often results in farmers missing crucial windows for field management activities. Climate and knowledge services fix this gap by providing timely, reliable agricultural forecasting if all stakeholders are involved in both producing and disseminating climate information.

**Climate and knowledge must be available and designed to reach to smallholders via a variety of channels and formats.** For example, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) has been a leader in participatory production of climate services that

integrate farmer knowledge and experiences with meteorology.<sup>113</sup> Furthermore, the World Bank Ag Observatory uses existing global data to provide near-real time information to offer farmers relevant to their current situations, allowing extension agents and farmers to implement tailored and fast solutions to emerging risks. Introducing such systems within extension and financial services would also be transformative. They would allow for pivotal reporting that supports risk mitigation measures, such as early warning systems and advice for pest outbreaks. They would also allow for identifying livestock disease outbreaks and early action. Such services coupled with financial services would enable farmers to invest in innovation and vastly improve farmers' capacity to make informed farm management decisions.<sup>114</sup>

### 3.8 Assessing Design and Implementation Opportunities in CSAIP Priority Investments

#### Opportunities: Building on Existing CSA Activities

**Momentum from existing programs and initiatives can be used to leverage continued growth and development in Burkina Faso's agricultural sector.** Many programs and initiatives (Table 18), funded by both the Burkinabe government and international donors, have driven important agriculture sector growth. Most projects have focused on enhancing productivity, sustainability, and rural livelihoods; some projects also include capacity development. Several initiatives focus on fostering an enabling environment for private sector actors in various commodity value chains. Smallholders' adaptive capacity remains low, particularly in northern Burkina Faso. All programs should take into consideration the prerequisite land tenure, finance services, extension support, climate information, and other risk reduction strategies that all smallholders need for programs to meet the broader goals of the NDCs.

**Continued climate-smart innovation in Burkina Faso requires support from many sectors, including Burkina Faso's government, non-profits, the private sector, and international organizations.** Governmental policy is already closely aligned with several programs in this portfolio, in particular Biogas, Oil-Protein Crops, and Water Resources. The government of Burkina Faso has also been the sole funder of several programs. Bilateral and multilateral donors have to date been major funders of programs, and have recently committed to generous continued support particularly of climate adaptation efforts. Non-profits have played a key role in program implementation. A limited number of programs have been funded by private sector actors.

**International alliances strongly support various projects in this portfolio.** In addition to the NDCs, this investment plan closely aligns with multiple international accords to which Burkina Faso is party, including the Dakar Declaration on Irrigation, the CAADP, the Sahel Irrigation Initiative, ECOWAS, Organics International, and the African Biogas Partnership Program. The international coalitions around water issues are particularly robust. Given the current and predicted future water scarcity in Burkina Faso, water management in the context of climate change is key to continuing agricultural sector growth. Careful coordination at the national level will help engage these multinational actors behind a climate-resilient Burkinabe agenda.

<sup>113</sup> Naab, Abubakari, and Ahmed, "The Role of Climate Services in Agricultural Productivity in Ghana."

<sup>114</sup> Partey et al., "Developing Climate-Smart Agriculture to Face Climate Variability in West Africa."

**Table 18 Select Current CSA Projects in Burkina Faso**

See Annex B, Section C for past projects.

Fund	Project	CSA Relevance	(USD\$M)	Term
World Bank	Burkina Faso Agriculture Resilience and Competitiveness Project	Irrigation, land-tenure, input supply, advisory services, producer group services, institutional capacity, emergency response, market connections, finance services, natural resource management.	261	2019-2025
	Local Forest Communities Support Project	Strengthening capacity of local communities to participate in REDD. Restoring 2,000 hectares of forest. Increasing benefits to 8,000 households from forest products and non-timber products. Ensuring 3,500 households have adopted sustainable land management practices.	4.5	2015-2020
	First Fiscal Management, Sustainable Growth, and Health Service Delivery Development Policy Operation	Increasing livestock production and productivity through vaccination.	50	2019-2020
	Livestock Sector Development Support Project	Improving livestock producers' access to animal health services and quality inputs to strengthen efficiency and competitiveness.	78.9	2017-2022
	Strengthening Climate Resilience in Burkina Faso	Institutional capacity building, infrastructure, and ICT development to deliver hydro-meteorological and climate information and early warning and emergency response systems.	33	2018-2024
	Financial Inclusion Support Project in Burkina Faso	Strengthening credit supply for farmers and small- to medium-sized enterprises.	100	2019-2025
Netherlands Development Organization, with World Bank, and Burkinabe National Government	National Biodigester Program	Clean energy course leveraging on-farm materials to reduce deforestation.	6.6	2017-2022
United States Agency for International Development	2010-2024	Institutional capacity building, infrastructure, and ICT development to deliver hydro-meteorological and climate information and early warning and emergency response systems.	33	2018-2024
African Development Bank	Support Project for Establishing an Agribusiness Bank	Enhancing agricultural financing and insurance and supporting value chain development.	10.86	2019-2021
United States Department of Agriculture	Sesame Marketing and Exports	Enhancing the production, marketing, and export of sesame.	24	2016-2021
International Fund for Agricultural Development	Projet d'Appui à la Promotion des Filières Agricoles	Developing the value chains of rice, vegetables, sesame, and cowpeas and improving productivity for 57,000 households.	71.7	2017-2024
International Fund for Agricultural Development	Land Technology Solutions Project	Improving land and resources governance and strengthening property rights through Mobile Applications to Secure Tenure technology.	3.99	2017-2020
Food and Agriculture Organization	Action Contre la Désertification	Improved productivity and land restoration.	nd	2016-present

Fund	Project	CSA Relevance	(USD\$M)	Term
African Development Bank	Bagre Growth Pole Support Project	Extending canal, surge tanks, and irrigation infrastructure.	71.7	2017-2024
International Fund for Agricultural Development	Agricultural Value Chains Support Project in the Southwest, Hauts-Bassins, Cascades and Boucle du Mouhoun Regions	Improving access to certified seed and fertilizer, strengthening value chains of rice, horticulture, sesame, cowpeas, non-wood forest products, and fish.	123.93	2019-2025
Global Partnership on Results-Based Approaches, with International Finance Corporation and World Bank	Burkina Faso Smallholder Irrigation Project	Small-scale irrigation.	5.85	2018-present

## Design and Implementation Opportunities

There are favorable circumstances around each project that could support their success. These may, in some cases, help offset the challenges outlined above. 8 of the 9 proposed investments are linked the strong knowledge base that exists in Burkina Faso as the greatest asset supporting implementation (Table 19). This was followed by policy alignment (7 investments), another important asset working in favor of these projects. Although policy is not, in all cases, consistently implemented, the all-important first step of establishing the regulation is already done. Availability of needed inputs (6), robust climate resilience and strong demand (5 each), and aligned interests (4) will also support many of the projects proposed herein (Table 19). Existing assets for project success are described in greater detail in Annex A.

**Table 19 Opportunities Supporting CSAIP Investment Design and Implementation**

Opportunities	Biogas	Finance	Organic	Water Resources	Oil-Protein	Soil	Forest And Garden	Capacity	Livestock
Knowledge Base	✓	✓	✓	✓		✓	✓	✓	✓
Policy Alignment	✓	✓		✓	✓	✓		✓	✓
Inputs Available	✓	✓		✓		✓	✓	✓	
Highly Climate Resilient	✓	✓		✓	✓	✓	✓		
Aligned Interests	✓	✓	✓	✓	✓				
Strong Demand	✓	✓	✓		✓		✓		
Existing Technology	✓	✓	✓	✓					
Program Alignment	✓		✓		✓			✓	
Private Sector Support	✓		✓		✓				
Low Cost			✓				✓		
Funding Available	✓								

## 3.9 Assessing the Potential for Supporting Collaboration and Partnerships and Institutionalizing CSAIP Investments

Partnerships, and the number of potential collaborators, can bring both strong benefits, as well as complexity, depending arrangements with specific partners. Clarifying obligations up front is vital to create strong partnerships and understand how fully partners can support project design and implementation (i.e. what partners bring to the table) versus the obligations inherent in partnerships

(i.e. what partners expect). There are also huge differences in partners' levels of involvement, whether they provide support and expertise or funding and whether legal requirements are involved. Projects with many partners need to prioritize and clarify roles and responsibilities of all partners at the outset of projects.

**Clarity on institutional arrangements will be important during further project design phases,** given that many of the proposed investments would, potentially, be involved with a high number of ministries (Table 20). Table 20 only identifies potential ministries and is not comprehensive of the myriad of other national-level Secretariats, Directorates, Federations, National Councils, and related agencies; another 12 of these were identified in the prioritizing process. The Livestock investment recorded 11 different Ministries with which to engage, while Finance and Insurance identified 7, and Biogas identified 5. For public sector partners, this can bring considerable challenges, with a need to identify lead agencies, funding flows and responsibilities, which ministries or agencies have authority, and how to resolve any policy conflicts. Virtually all projects envisioned coordination with the Ministry of Environment, Green Economy, and Climate Change, and with the Ministry of Agriculture and Food Security.

**Table 20 Ministry Level Coordination and Proposed Investments**

Key Public Institutional Collaborators	Biogas	Live-stock	Forest and Garden	Capacity	Water	Finance	Organic	Oil-Protein	Soils
<b>MINISTRIES - Total</b>	5	11	2	3	3	7	4	1	2
Environment, G. Econ and CC	✓	✓	✓	✓	✓	✓	✓		✓
l'Agriculture and Aménagements Hydro-agricoles	✓	✓		✓	✓	✓	✓	✓	✓
Water Resources	✓	✓		✓	✓				
Animal Resources	✓	✓				✓			
Higher Education, Scientific Research, and Innovation		✓				✓	✓		
l'Industrie, du Commerce et de l'Artisanat		✓	✓						
Health		✓				✓			
Economy and Finance		✓				✓			
l'Action Sociale et de la Solidarité Nationale		✓				✓			
l'Administration Territorial et de la Décentralisation		✓							
Energy	✓								
l'Urbanisme et de l'Habitat							✓		
Hydraulic Facilities and Sanitation		✓							

Many of the proposed investments identified a large number of international and national collaborators, ranging from CGIAR international research institutions to Bukinabe NGOs to a variety of aid organizations. The collaborators are identified in Annex A with each investment and serve as a preliminary list, since others will be identified during the design and implementation process. Some of the investments, such as the Capacity Building investment, identified large numbers (12) of different NGOs or research organizations for collaboration. Again, this level of engagement

has both benefits and costs, and the higher the number of collaborators, the more important it is to have a clear plan for what the collaboration entails. Yet overall, engaging both public and NGO collaborators offers robust potential mechanisms for institutionalizing CSAIP objectives, both for specific investments and for the overall CSAIP. Yet this will not happen spontaneously but must be purposefully planned.

### 3.10 Assessing Financing in CSAIP Priority Investments

**The Government of Burkina Faso will ultimately need to fully endorse and support this plan and be active in identifying financial resources to implement the suite of investments proposed in this CSAIP.** Additional funding streams are needed to take changes to scale and meet Burkina Faso's NDC commitments. At the 25<sup>th</sup> United Nations Climate Change Conference in Spain in 2019, Burkina Faso's Minister announced that 10 different partners expressed interest to support implementation of Burkina Faso's NDCs.<sup>115</sup>

**All the investments in this portfolio help support Burkina Faso's objectives to improve food security and support rural livelihoods.** However, the interest in climate change, agriculture, and the environment may diminish as Burkina Faso deals with a humanitarian crisis and declining security. One estimate suggests that nearly one-third of the population is affected by insecurity, and that in 2020, 2.2 million people will require humanitarian assistance. The UN is providing emergency food aid, and a 2020 Humanitarian Response Plan for Burkina Faso is requesting \$295 million to assist 1.8 million people.<sup>116</sup> This highlights the trade-offs between on one hand, long-term investments that can improve food security and rural lives in the context of climate change and other shocks, and on the other hand, the potential need to prioritize food aid in the short term over long-term agricultural development. However, all these investments reduce risks from future climate or other shocks and support the long-term health and resilience of Burkina Faso's most vulnerable people.

**Financing costs and needs are well within the scope of reasonable projects that are financed by a range of institutions and organizations.** There are a range of different approaches to funding for the 9 investments, from multilateral and bilateral organizations, foundations, and donors (e.g. the Bill and Melinda Gates Foundation); national budgets; NGO support; and private sector financing (see Table 21 and potential funding sources for each investment in Annex A). All the projects identified at least one source of government funding. Blended finance from the government and the Environmental Intervention Fund (FIE) was proposed by 3 projects. In contrast, 8 of the 9 projects believed that financing could be obtained from the World Bank, with 7 of the 9 looking toward the African Development Bank and 6 projects looking at financing from the Global Environment Fund (GEF) or the Green Climate Fund (GCF) or both. In all, the 9 proposed investments identified more than 40 different potential sources of funding, including international foundations (e.g. the Bill and Melinda Gates Foundation), bilateral assistance (e.g. from the Swiss, the Netherlands, or U.S. Department of Agriculture), regional African support (e.g. ECOWAS), and a range of other initiatives shown in Table 21.

**There was also a strong role envisioned for the private sector, with many of the proposed investments identifying potential partners for private sector financing and collaboration (Table 21).** The Agricultural Bank of Burkina Faso is the most likely source of private sector funding for Forest and Garden, Water Resource, Finance and Insurance, Biogas, and Soils investments. The Oil-Protein

<sup>115</sup> <https://sdg.iisd.org/news/six-countries-launch-ndc-partnership-plans-at-unfccc-cop-25/>

<sup>116</sup> December 11, 2019 - <https://www.un.org/press/en/2019/db191211.doc.htm>

and Organic investments identified other potential private funding sources, including Sinergi Burkina, a new fund for small businesses that might well be a partner, although the lending size is too small for the overall investment needed for the entire project. The Livestock investment identified several potential funding streams from within that sector.

**Table 21 Financing Needed and Key Potential Sources**

Proposed Investments	Estimated Project budget (US\$, millions)	Total Beneficiaries	Cost per Beneficiary (US\$)	Results of Maximizing Finance for Development Analysis (Preliminary)
Capacity Building	\$55.0	500,000	\$110	Multi and bilateral donor organizations
Finance and Insurance	\$40.0	200,000	\$200	Multi and bilateral donor organizations, ABB
Oil-Protein Crops	\$55.0	240,000	\$228	Multi and bilateral donor organizations
Livestock	\$37.5	150,000	\$250	Multi and bilateral donor organizations, private sector commercial producers or processors
Integrated Soil Management	\$60.0	200,000	\$300	Multi and bilateral donor organizations, ABB
Forest, Agroforest, and Garden	\$55.0	180,000	\$306	Multi and bilateral donor organizations, ABB, over 10 in private sector
Water Resources and Irrigation	\$65.0	100,000	\$650	Multi and bilateral and donor organizations, ABB
Organic Farming	\$50.0	60,000	\$833	Multi and bilateral donor organizations, many private sector possibilities
On-Farm Biogas	\$55.0	65,000	\$846	Multi and bilateral donor organizations, ABB
<b>Total</b>	<b>\$472.5</b>	<b>1,695,000</b>		

ABB = Agricultural Bank of Burkina, a private bank

**Opportunities exist to greatly expand private sector investment, in ways that are consistent with Burkina Faso's private sector development plans and the World Bank's Country Partnership Framework (CPF).**<sup>117</sup> The World Bank and IFC recommend diversifying agricultural value chains, with key private sector entry points in agriculture and food processing. Many of the investments identified in this proposal support recommendations for private sector expansion and resilience. For example, cold-storage units, irrigation systems, value-chain creation, and expansion of oilseed crops and livestock in this CSAIP are components of bringing strength to the private sector in Burkina Faso.<sup>118</sup> These also provide needed employment for Burkina Faso's growing population and create stronger links between rural and urban sectors.

**An operational framework to guide CSAIP programming into practice will help ensure that funding is focused on priorities crucial to project success.** Effective frameworks support planning and implementation by producing concrete information. There are many potential private, public, and international funders and financing instruments, as shown in Annex B. Developing financing strategies specifically for priority investments, or packages tailored to specific donors for financing, can help secure funding. Specific targeting and proposed partnerships with the private sector, where appropriate, are also vital and recommended in recent analyses of improving private sector performance in Burkina Faso. Once funding is obtained, strong operational mechanisms will be

<sup>117</sup> World Bank and International Finance Corporation, 2019. "Creating Markets in Burkina Faso," World Bank Other Operational Studies 32401, The World Bank.

<sup>118</sup> World Bank and International Finance Corporation, 2019. "Creating Markets in Burkina Faso," World Bank Other Operational Studies 32401, The World Bank.

needed to assure that this CSAIP brings together necessary partners and stakeholders to plan for implementation.

### 3.11 Key Objectives of CSAIP Priority Investments

**The Global Commission on Adaptation<sup>119</sup> identifies 4 key high priority recommendations to help countries adapt to climate change, with emphasis on supporting small-scale farmers:**

- Improve smallholder productivity
- Help small producers manage risks from increased variability and climate shocks
- Address the challenges of the most climate-affected and vulnerable
- Achieve policy coherence by making agriculture interventions climate-smart

**These investments and their objectives build on these recommendations and Burkina Faso's own policy priorities.** Specifically, through its Plan National de Développement Economique et Social (PNDES), Burkina Faso sees agriculture underpinning a major effort to drive economic growth and contribute to poverty reduction. The plan also supports a broad transformation within the agricultural sector. Other key Burkinabe policies include the National Policy on Food Security and Nutrition and Burkina Faso's NDCs and NAP. We assert that another way to assess any investment hinges on whether it has the potential, as a demonstration project, to leverage change and begin to transform a sector. This is done by examining whether the investment strongly supports any of the following national priorities:

- Supporting productivity and food and nutritional security
- Building agricultural sector resilience
- Creating agricultural value chains
- Improving sustainable management of lands and resources
- Supporting mitigation
- Supporting agricultural sector transformation
- Supporting women and youth

**All the investments support increasing agricultural productivity and improve sustainability** (Table 22). 8 investments improve food security, and all support resilience to climate change directly, except On-Farm Biogas, which does so indirectly. All but 3 of the investments directly support value chain creation, jobs, or agro-processing, with Organic Farming, Livestock, and Forest and Garden having the largest potential impact. Mitigation is addressed in all of them, although in the Livestock project, there is a reduction in GHG intensity but not in overall emissions. 4 of the proposed investments in this CSAIP have the potential to help transform the agricultural sector, catalyzing new approaches and actions.

The Capacity Building and Finance and Insurance investments are intended as transformational activities to promote investment and catalyze knowledge and awareness of CSA across the country. Such information is critical for the government and private sectors to appropriately support investments that are less "risky" given Burkina Faso's vulnerability to climate change. It is vital to encourage investments in more resilient crops or areas. 7 of the investments directly support women and youth. Livestock production could be greatly increased, and there is a potential to increase value chains and jobs by improving production and processing of livestock products. The Forest, Agro-Forest, and Garden investment protects forests from destruction or degradation and promotes

<sup>119</sup> Global Commission on Adaptation, WRI, 2019



expansion of existing and new value chains. All the investments could be designed in ways that more directly support policy objectives, although individually and as a portfolio, this CSAIP emphatically supports Burkina Faso's agricultural objectives. Scenarios with and without the investment and key investment outcomes are shown in Table 23.

**Table 22 Objectives of Investments**

Proposed Investments	Burkina Faso Agriculture and Rural Sector Objectives							
	Productivity	Food Security	Support Agriculture Sector Resilience	Ag. Value Chains	Sustainable Land or Farming	Mitigation	Support Women and Youth	Ag. Sector Trans-formation
CAPACITY	✓	✓	✓	✓	✓	✓	✓	✓
FINANCE	✓	✓	✓	✓	✓	✓	✓	✓
WATER RESOURCES	✓	✓	✓	✓	✓	✓	✓	✓
SOILS	✓	✓	✓		✓	✓	✓	✓
ORGANIC	✓	✓	✓	✓	✓	✓	✓	
FOREST AND GARDEN	✓	✓	✓	✓	✓	✓		
LIVESTOCK	✓	✓	✓	✓	✓		✓	
OIL-PROTEIN	✓		✓	✓	✓	✓		
BIOGAS	✓				✓	✓	✓	

**Table 23 Investments, Scenarios with and without the Investment, and Objectives**

Shown from most objectives to least.

Climate Change	Project Importance	Scenario WITHOUT Investment	Scenario WITH Investment	Investment Objectives
Forest, agroforest, and garden production for climate-smart diversification				
Medium resiliency	Improves livelihoods and food sources for women and youth through gardens, agroforestry, and NTFPs	Low diversification increases smallholder vulnerability to economic and food insecurity given climate change, continued deforestation and environmental degradation, and untapped international market opportunities.	Smallholder food and economic resilience increases, particularly for women and youth. Forest conservation and ecosystem services are enhanced. Diversification supports resilience. National economic growth occurs through value chain development of high-value export products.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Sustainability</li> <li>• Mitigation</li> <li>• Livelihoods</li> <li>• Inclusivity</li> </ul>
Sustainable management of water resources and irrigation				
Medium resiliency	Protects and sustainably leverages water resources to improve climate resiliency.	Agriculture remains exposed to increasingly unpredictable precipitation, crop and animal loss, food and economic insecurity, conflict over scarce resources, and watershed degradation.	Efficient water capture allows storage and management. Irrigation stabilizes crop and animal production, food supplies, and market prices. Reduced erosion and flooding and watershed protection are achieved.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Transformation</li> <li>• Sustainability</li> <li>• Environmental quality</li> </ul>

**Finance and insurance services to foster Climate-Smart Agriculture**

Foundational resilience through essential services	Enables smallholder investment in CSA through loan, insurance, and other basic services.	Smallholders have limited capacity to invest. Cost of maintaining the status quo increases with climate impacts. Food and economic security decreases. A downward poverty cycle results.	Credit and loan enable investment in system transformation. Insurance and risk distribution instruments offer protection from loss, enabling farmers to take the risk of changing to new systems. Interventions are identified to help them reduce on-farm risks and build resilience.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Trade</li> <li>• Sustainability</li> <li>• Transformation</li> <li>• Mitigation</li> </ul>
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**Finance and insurance services to foster climate-smart agriculture**

Foundational resilience through essential services	Enables smallholder investment in CSA through loan, insurance, and other basic services.	Smallholders have limited capacity to invest. Cost of maintaining the status quo increases with climate impacts. Food and economic security decreases. A downward poverty cycle results.	Credit and loan enable investment in system transformation. Insurance and risk distribution instruments offer protection from loss, enabling farmers to take the risk of changing to new systems. Interventions are identified to help them reduce on-farm risks and build resilience.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Trade</li> <li>• Sustainability</li> <li>• Transformation</li> <li>• Mitigation</li> </ul>
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**Building capacity in Climate-Smart Agriculture**

Foundational resilience through essential services	Establishes sustainable systems for developing and disseminating CSA innovation.	Farmers make short-term decisions when facing uncertainty or high risk. This perpetuates the poverty cycle, degrades resources, and increases vulnerability.	Robust research, extension, and information services support many site-tailored solutions that drive resilience, productivity, and environmental management in a two-way dialogue that pinpoints emerging innovations (climate, pest, OneHealth).	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Sustainability</li> <li>• Transformation</li> <li>• Mitigation</li> </ul>
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**Developing resilient oil-protein value chains**

Highly vulnerable	Leverages untapped domestic and international markets for diversification.	Low sectoral diversity persists along with a dearth of livelihood and income opportunities, particularly for youth and women.	Diversification improves economic resilience by creating livelihoods along several organic production value chains. Environmental impacts are reduced. Climate, pest, and other risks are reduced through local production and crop diversity.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Value chains</li> <li>• Sustainability</li> <li>• Livelihoods</li> <li>• Economic resilience</li> </ul>
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**Developing resilient oil-protein value chains**

Medium resiliency	Strengthens value chains to build livelihoods, reduce import dependency, and build export markets.	The soybean yield plummets with climate change. Soil health declines. Income declines. Reliance on imports increases.	Sustainable productivity, reduced reliance on imports, improved national food security, export market development, and new livelihood opportunities are attained.	<ul style="list-style-type: none"> <li>• Resilience</li> <li>• Value chains</li> <li>• Sustainability</li> <li>• Trade</li> <li>• Food security</li> <li>• Economic resilience</li> </ul>
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**Integrated soil management for agricultural productivity and environmental restoration**

Foundational resilience through essential services	Provides location-tailored soil information, recommendations, and tools and policy to support implementation.	Agriculture and extreme weather events degrade soils. Productivity decreases. The cost of production rises with increased fertilizer inputs. Increased GHG emissions exacerbate climate change. Environmental degradation results.	Soils are resilient to climate stress. Sustainable productivity, food and economic security, GHG storage, strong environmental services, and optimum fertilizer usage are achieved. Improved soils enable intensification, higher incomes, and risk reduction strategies.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Sustainability</li> <li>• Transformation</li> <li>• Mitigation</li> </ul>
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Sustainable on-farm biogas production				
Resilient under climate change scenarios	Leverages farm waste to produce clean energy, support health, and reduce GHGs.	Deforestation, high GHG emissions, unreliable and costly cooking fuel and fertilizer purchases, and indoor air pollution and related diseases especially affecting women and children all continue.	Deforestation and GHG emissions are reduced. Clean cooking fuel and fertilizer is produced on-farm for free. Crop yields improve. Health outcomes improve, and demands on women and children are ameliorated.	<ul style="list-style-type: none"> <li>• Sustainability</li> <li>• Mitigation</li> <li>• Soil fertility</li> <li>• Health</li> </ul>
Sustainable intensification of livestock production				
Vulnerable to climate change	Creates climate resiliency to ensure future food security and income.	Productivity is reduced as heat stress and mortality increase. Feed sources decline. Pastoralist-smallholder conflict increases.	Health, productivity, and food and income security improve. OneHealth is adopted. Farmer-pastoralist conflict is reduced. GHG emission intensity and environmental degradation are also reduced.	<ul style="list-style-type: none"> <li>• Food security</li> <li>• Resilience</li> <li>• Mitigation</li> <li>• Health</li> </ul>

**All these projects could be designed to directly support women and youth.** Care needs to be taken to prevent commodities and crops that are now managed by women and youth from passing into men's control when investments are made and they are monetized. For this reason, 3 of the projects are projected potentially to have mixed results. The projects where value chains are most likely to be taken over by men are the Forest and Garden, Organic Farming, and Oil-Protein Crops investments. In contrast, Building Capacity, Finance and Insurance, and Integrated Soil Management are potentially transformational for the impact that they could have on women.

**Taken together, these investments opportunities represent a well-balanced portfolio.** The investments span different sectors of the country, have different levels of risk, target divergent groups of beneficiaries, and introduce a wide range of well-demonstrated CSA technologies and practices. While policy interventions are not a focus of the CSAIP, having a strong portfolio of CSA investments that demonstrate which policies are supportive of success, and which are barriers to success, helps create policy coherence and furthers CSA across the policy arena. All the investments support risk reduction and resilience, and all of them support CSA pillars and contribute to meeting Burkina Faso's objectives as identified in its national plans, which are fundamental to improving its future.



# Summaries Of The Nine Prioritized CSAIP Investments For Burkina Faso

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This CSAIP includes 5 national-scale investments and 5 regional climate-smart crop and animal investments. All of these are described in short summary form in this section, while more detailed information on each of the investments is provided in Annex A. The five national investments that build capacity, financing, and resilience; support mitigation; and offer human health benefits are:

- **Sustainable on-farm biogas production**, which increases access to and knowledge of sustainable domestic energy sources in order to conserve wood resources, reduce greenhouse gas (GHG) emissions, and reduce poverty, food insecurity, and health threats to rural communities.
- **Sustainable intensification of livestock production**, which fosters climate resilience in Burkinabe livestock systems for improved food and nutritional security and economic outcomes.
- **Finance and insurance services to foster climate-smart agriculture**, which nurtures smallholder ability to invest in CSA innovations through good access to robust financial services, including credit, loan, insurance, and risk instruments and savings and payment services.
- **Forest, agroforest, and garden production for climate-smart diversification**, which fosters climate-resilient livelihoods and food sources for women and youth smallholders through home gardens, agroforestry, and non-timber forest product (NTFP) harvesting and value-addition.
- **Building capacity in climate smart agriculture**, which fully integrates national climate-smart priorities into Burkina Faso's agricultural research and extension programs, and builds robust extension mechanisms for delivering timely, practical climate-smart information to farmers and other stakeholders through highly accessible channels.

4 climate-smart investments were prioritized to support adaptation of agricultural production systems by introducing a variety of climate-smart practices into the different investments:

- **Sustainable management of water resources and irrigation** fully leverages Burkina Faso's water resources in sustainable ways to improve productivity, food and nutritional security, climate resiliency, and ecological health in the North Sudan region for 100,000 farmers and their families.
- **Developing climate-smart organic value chains** develops a burgeoning niche market to create viable careers and shorten supply chains in peri-urban areas in the North Sudan and South Sudan regions for 60,000 farmers and their families.
- **Developing resilient oil-protein value chains** strengthens the quality, yield efficiency, and value chains of oil-protein crops to sustainably meet domestic demand and support international market development in the North Sahel, North Sudan, and South Sudan regions for 240,000 farmers and their families.
- **Integrated soil management for agricultural productivity and environmental restoration** provides producers and extension agents with location-tailored information on soil characteristics and best management practice recommendations, as well as the tools, products, partnerships, and policy environment to implement those recommendations for 200,000 farmers and their families in the North Sahel, North Sudan, and South Sudan regions.

**While undertaking the technical analysis, points were raised for further consideration and analysis.**

The prioritized investments and their locations are decisions made in-country and by stakeholders. Yet findings emerged during the different analyses that could furnish reasons to modify components of the proposed investments. These are:

- **Infrastructure components within a CSAIP:** All agree that infrastructure (dams, irrigation, roads, processing and storage, and energy systems) are vital to supporting agriculture, including climate-smart agriculture (CSA). Yet infrastructure requires special knowledge, analytical methods, and safeguards, which are not included within the scope of this CSAIP.
- **Climate change impact and crops:** Several stark results emerged from the climate change analysis that potentially sway the selection of crops. Maize performs terribly and sorghum badly in all scenarios. While these are key cereals in Burkina Faso, it is important to consider alternatives like other cereals and rice, and to emphatically support their adoption. Similarly, the Oil-Protein investment may greatly improve the resilience of oilseeds, but as a group, groundnuts, soybeans, and other oilseeds are not resilient. In contrast, yams and sweet potatoes perform well, as do cowpeas, and these should be included for their nutritional value and resilience.
- **Consider Changing Investment Scope and Scale:**
  - The Sahel regions are the poorest and driest, yet the Sudan regions have more potential investments planned for them. The trade-offs between productivity and poverty resulting from the location of projects should be assessed more specifically in future scoping activities, since this becomes a fundamental policy-related decision.
  - The Soils project is currently limited to being regional in scope but is greatly needed at a national scale and could potentially be transformational to the agricultural sector. It would likely enjoy economies of scale if implemented more broadly and help Burkina Faso reduce vulnerability to climate change.
  - The Oil-Protein project is proposed in 3 of 4 regions. While this CSA investment greatly increases yield, oil-crops are not generally climate resilient, so there may be achievable economies of scale with specific targeting as a national program to ensure that anyone growing these crops benefits from CSA practices.

**It is crucial to understand the meaning of CSA and the potential climate impacts on agriculture at different scales, from within government policy-making circles, at the Chamber of Commerce, in private banks, and among different international donor organizations.** During our analysis, we found many proposals or studies by donors and other groups recommending that Burkina Faso expand crops such as maize, vegetables, or mangos. Because these crops fare poorly given climate warming (although CSA improves their performance), it is vital that Burkina Faso has the capacity to understand the short- and long-term trade-offs associated with crops that are not climate resilient. More bluntly, Burkina Faso is getting policy and project advice that may be good in the short term but fails to understand long-term climate impacts and risks. Capacity Building is one of the proposed investments intended to understand these impacts and risks.

**If Burkina chooses to support investments in crops with low resilience, all efforts must be made to ensure that these investments are climate smart.** It is vital that all parties, including the government, donors, investors, and farmers, understand that these are high-risk crops, so that they can make an informed choice about whether to proceed or substitute more resilient crops. Given Burkina Faso's high levels of poverty, the acute vulnerability of its crops and people to climate change, and its scarce financial resources, all donors, projects, and policies related to the agricultural sector or value chain must take climate resilience into account. Rather than short-term higher risk investments, it is better to build resilient crops, commodities, and value chains that bridge Burkina Faso to a resilient future.

## 4.1 Sustainable On-Farm Biogas Production

### PROJECT SUMMARY

**REGION:** National

**BENEFICIARIES:** 65,000 farmers and their families

**OBJECTIVE:** Increase access to and knowledge of sustainable domestic energy sources in order to conserve wood resources, reduce greenhouse gas (GHG) emissions, and reduce poverty, food insecurity, and health threats to rural communities.

**HIGHLIGHT:**

- Fertilizer and clean cooking fuel from on-farm resources, protecting forests and reducing costs and labor

### JUSTIFICATION AND KEY INVESTMENTS

**Burkina Faso's energy supply is characterized by dependence on fossil fuels and low and inequitable access to electricity.** As of 2017, about 20% of the national population had some degree of access to electricity services, and only about 15% had reliable electricity access. There is a notable disparity between urban areas, where over 66.5% of the population has some degree of electricity access, and rural areas, where just 3.2% of people have at least limited access. Energy access may worsen. Demand for electricity services has been growing as the economy diversifies, but supply has not kept pace with demand, and prices are consequently rising, further excluding most households by pricing them out of the market.

**Biomass remains the primary energy source for over 80% of Burkinabe households.** The particulate matter released from open biomass fires can be extremely detrimental to human health, particularly when indoors. This is an especially great threat to women and children, who tend to spend the most time collecting fuel, tending fires, and preparing meals. Burkina Faso is one of the top 21 countries most heavily impacted by this issue.

**Biodigesters are an alternative method of energy production that require minimal infrastructure, inputs, and maintenance.** Biodigesters are highly complementary to farm production; they leverage on-farm resources, and they help reduce household fuel and fertilizer costs in terms of both time and money. Biodigesters also have tangible environmental benefits. Biogas does not produce particulate matter air pollution and does not involve felling trees or clearing vegetation. As such, biogas does not carry the human health implications or high GHG emissions associated with biomass and fossil fuel use.

**Some of the necessary enabling factors are already in place to support the success of biodigester projects.** The Burkinabe national government is heavily invested in equitable energy access. There is also significant international support for biodigester programs in Burkina Faso. Synergy with other energy programs will help maximize the impacts of biodigester solutions. Remaining to be addressed are land tenure, robust extension, and finance services; these are essential to the success of sustainable energy production solutions.

**Biodigester systems have limitations. Although biodigesters** relieve the burden of purchasing or collecting fossil or biomass fuel, they exacerbate the burden of collecting fresh manure from primarily extensive livestock systems or converting to intensive livestock management. Producers must also have consistent access to a large amount of manure—the yield of at least 3 cows—in order to employ a biodigester effectively. This requisite excludes the poorest and most vulnerable members of the community. Finally, biodigesters do not power in-home lighting, electro-domestics, water pumps, technology solutions, and other basic services made possible by electricity.



### KEY PROJECT INVESTMENTS:

A site-tailored focus on promoting the Pillars of Climate-Smart Agriculture (CSA) with emphasis on:

- Creating a sustainable source of on-farm energy and fertilizer production using readily available residues
- Bolstering research and development capacity for sustainable on-farm energy production technologies
- Raising public awareness of the benefits of sustainable energy production and use

### POTENTIAL PROJECT IMPACTS

<b>Production</b>	This project will increase production even as input costs decrease via on-farm production of high-quality compost.
<b>Resilience</b>	This project increases resilience through decreased dependence on unreliable inputs, decreased cost of crop production and fuel usage, improved health outcomes, and stable sources of cooking fuel.
<b>Mitigation</b>	Mitigation will result from reduced GHG emissions from manure, felling trees, and burning biomass.
<b>Cost</b>	The cost is US\$846 per beneficiary, or a total cost of about US\$54.99 million.
<b>Yield</b>	Yield will increase by 45% for 65,000 small farming families.

### ECONOMIC AND FINANCIAL ANALYSIS

#### Cost Benefit Analysis with and without Climate Risks

With Climate and Pest Risks					
Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
65,000	45	-1.5	32	-0.09	-0.02 (0.66)
With Climate and Pest Risks					
65,000	45	16.9	51	0.3	0.23 (0.83)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

### ENABLING ENVIRONMENT

#### EXISTING ASSETS FOR PROJECT SUCCESS:

- Strong demand for energy services
- Inputs (crop residues and manure) already available
- Short- and long-term cost and labor savings
- Complementarity with forestation and soil fertility programming
- Many sources of funding, foundational knowledge, and lessons learned
- Established carbon credits program for biodigesters
- Excellent alignment with national and international policy environment

#### EXISTING BARRIERS TO SUCCESS:

- Labor burden of collecting manure from extensive livestock systems
- Livestock ownership requirement excludes poorest households
- Insufficient manure availability could exacerbate land clearing
- Potential lack of buy-in if electricity services become available by other means, e.g. dam hydroelectricity

#### KEY DIGITAL AGRICULTURE TECHNOLOGIES:

- Remote sensing, drones, GPS, and GIS for informing optimum regions for programming
- Mobile finance services, along with digitized farm records, to identify high-potential candidates
- Smart contracting for transparent and equitable land tenure processes
- Mobile extension services, enabled by big data, machine learning, and mobile technology

## FINANCING

### **PUBLIC FINANCING OPPORTUNITIES:**

- Environmental Intervention Fund
- National Biogas Program

### **PRIVATE FINANCING OPPORTUNITIES:**

- Banque Agricole du Burkina Faso (Agricultural Bank of Burkina Faso)
- Institut International d'Ingénierie de l'Eau et de l'Environnement (2iE)

### **INTERNATIONAL FINANCING OPPORTUNITIES:**

- Global Environment Fund (GEF)
  - Green Climate Fund (GCF)
  - The World Bank Carbon Initiative for Development (Ci-Dev)
  - The United Nations Clean Development Mechanism (CDM)
  - African Development Bank (AfDB)
-

## 4.2 Sustainable Intensification Of Livestock Production

### PROJECT SUMMARY

**REGION:** National

**BENEFICIARIES:** 150,000 farmers and their families

**OBJECTIVE:** Foster climate resilience in livestock systems for improved nutritional security and economic outcomes

**HIGHLIGHT:**

- 38% improvement in livestock productivity for 150,000 farm households
- Increased income and nutritional security and diversification
- Reduced conflict between pastoralists and sedentary producers
- Reduced GHG intensity and mitigation of agricultural expansion

### JUSTIFICATION AND KEY INVESTMENTS

**Burkina Faso is an agropastoral country.** The livestock sector contributes about 18% of GNP, accounts for 26% of exports, and constitutes a source of income for nearly 80% of the population. Livestock typically range freely in the dry season and are kept tethered, sometimes with feed supplementation, in the wet season.

**The Burkina be livestock sector has consistently low productivity.** This situation results from extensive farming practices exacerbated by a burgeoning population, suboptimal livestock feeding, recurrent animal diseases, unimproved breeds, and poor market access. The government has responded to these issues with strong policy support for livestock intensification, and smallholders have also adopted crop-livestock integration to some extent. However, rapid intensification, inconsistent system integration, and climate change impacts have taken their toll, resulting in increasing soil and environmental degradation.

**Livestock producers are acutely exposed to unpredictable climate extremes and variability because of climate change.** Precipitation variability makes the availability of forage and water unpredictable, affecting livestock productivity and pushing pastoralists to travel longer distances and exploit more land in order to sustain their herds. Droughts, floods, and extreme heat increase livestock mortality and destabilize markets. Poor market access to inputs and financing, widespread animal disease despite the efforts of veterinary service providers, and weak infrastructure further compromise the livelihoods of livestock farmers. These issues exacerbate existing tensions between pastoralists and sedentary producers for natural resources.

**CSA reduces the environmental impacts of livestock systems and makes livestock systems more resilient in the face of climate change.** For example, improved varieties of ruminants offer resource use efficiency and tolerance to adverse conditions. Water reservoirs help maintain livestock in dry areas. Livestock corridors support pastoralists in search of resources and protect smallholders. Fodder production supports improved feed quality, health outcomes, and productivity. Agroforestry-based forage production offers multiple production, adaptation, and mitigation benefits. Integrated crop-livestock production systems are synergistically more productive and resilient than either system alone. Small ruminant are particularly advantageous for their short gestation periods, high prolificacy, rapid growth rate, high feed conversion efficiency, high disease resistance capacity, easy marketability, and the chemical similarity of their manure to synthetic fertilizer.

**The opportunities for improvement in livestock production may have both positive and negative impacts on women farmers.** Increases in livestock productivity and a shift toward small ruminants can increase women's workload per traditional gender roles. Careful community-based planning and prioritization is necessary to ensure that the responsibilities and benefits of such programs are equitably distributed across stakeholders.

**KEY PROJECT INVESTMENTS:**

A site-tailored focus on promoting CSA Pillars with emphasis on:

- Conservation and selection of local cattle breeds
- Control of emerging and re-emerging animal diseases related to climate change
- Establishment of agroforestry-based fodder stands
- Full crop-livestock system integration
- Pastoral infrastructure and equipment to establish water reservoirs and livestock corridors
- Capacity building in livestock intensification

**POTENTIAL PROJECT IMPACTS**

<b>Production</b>	The project will increase production through improved feed, health care, and management to augment income and nutritional security.
<b>Resilience</b>	Resilience will be strengthened through improved breeds, crop-livestock integration, and infrastructure development.
<b>Mitigation</b>	Mitigation is a co-benefit of more efficient production, integration of livestock into crop systems, and reduced agricultural expansion.
<b>Cost</b>	The cost is US\$250 per beneficiary for a total of US\$37.5 million.
<b>Yield</b>	This project will increase livestock yield by 38%.

**ECONOMIC AND FINANCIAL ANALYSIS****Cost Benefit Analysis with and without Climate Risks**

With Climate and Pest Risks					
Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
150,000	38	16.4	43	0.67	0.32 (6.35)
Without Climate and Pest Risks					
150,000	38	76.1	65	2.57	1.49 (6.70)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

**ENABLING ENVIRONMENT****KEY ENABLING FACTORS:**

- Most smallholders already own livestock and practice some degree of crop-livestock integration.
- Most smallholders already practice some agroforestry.
- Governmental policy supports livestock intensification.
- This project aligns closely with nationally determined contributions (NDCs) and many other national policies.

**KEY RISKS:**

- Competing interests of pastoralists and farmers
- Labor intensiveness of using manure as a fertilizer alternative under extensive grazing system
- Land tenure insecurity, which dissuades farmers from investing in trees and soil

**KEY DIGITAL AGRICULTURE TECHNOLOGIES:**

- Remote sensing, drones, GPS, internet of things, and GIS for management of corridors and reservoirs
- Climate information services, mobile extension services, and pest and disease early warning systems, enabled by weather stations, big data, machine learning, and mobile technology

### **PUBLIC FINANCING OPPORTUNITY:**

- Action Plan and Investment Programme for the Livestock Sector

### **INTERNATIONAL FINANCING OPPORTUNITIES:**

- The Economic Community of West African States (ECOWAS)
- Global Environment Fund (GEF)
- Green Climate Fund (GCF)
- World Bank
- African Development Bank (AfDB)
- West African Development Bank (BOAD)

### **PRIVATE FINANCING OPPORTUNITIES:**

- Commercial producers of by-products commonly used as supplemental feed
  - Providers of animal health services and artificial insemination
  - Animal product processors
-

## 4.3 Financial And Insurance Services To Foster Climate-Smart Agriculture

### PROJECT SUMMARY

**REGION:** National

**BENEFICIARIES:** 200,000 farmers and their families

**OBJECTIVE:** Promote smallholder ability to invest in CSA innovations through good access to robust financial services, including credit and loan services, insurance and risk instruments, and savings and payment services.

**PROJECT HIGHLIGHT:**

- This cost-efficient program will increase household yields by 19% across both crop and livestock systems, with concomitant increases in national GDP.
- The program will significantly increase the ability of farmers to implement advisory recommendations and take innovation risks to improve their productivity.
- It will also strengthen producer and sectoral resilience in the face of major events such as extreme weather.

### JUSTIFICATION AND KEY INVESTMENTS

**Financial services are prerequisites to agricultural development.** Even the most robust advisory services only improve farmers' outcomes if they have the financial security to take the recommended risks in changing established practices. Financial services enable producers and agribusinesses to leverage collateral, decrease transaction costs, and reduce risk. Secure land tenure, robust information services, reliable market access, and safe harvest and capital storage options further **foster financial** stability and enable investments. Financial services include:

- **Credit and financing**, including input loans and credit, crop loans, value chain finance, equity investments, equipment loans or leases, warehouse receipts, and group loans to enable farmers to invest in crucial inputs, system transformations, equipment, and other technologies that increase productivity and resilience.
- **Insurance and risk instruments** such as index-based insurance and disaster relief funds to sustain producers' ability to invest in the face of costly unforeseen events. Farmers who are protected from major losses are much more likely to invest in higher-value crops, thus increasing their future income and climate resiliency.
- **Savings services** to ensure savings security, and **low-risk investments** to prevent loss of value due to inflation. In-home cash savings, on the other hand, expose producers to loss from theft, misplacement, and currency devaluation.
- **Payment services** such as mobile money and utility bill pay that enable producers to make and receive payments without investing time and money in travel, and without the risk of loss or theft. The resulting secure digital records lend transparency to local informal economies and can serve as a line of credit for loan applications.

**Financial services in Burkina Faso disproportionately underserve smallholder farmers.** Rural residents, women, and low-income individuals—that is to say, smallholder farmers—represent an outsized portion of those with constrained financial service access. Microfinance institutions, cooperatives, and rural banks offer a good foundation to reach rural populations with diverse financial services.

### KEY PROJECT INVESTMENTS:

A site-tailored focus on promoting CSA Pillars with emphasis on:

- Addressing issues preventing penetration of financial institutions / services in rural areas:
  - Low economies of scale
  - Poor financial performance indicators and norms compliance
  - Low profitability and portfolio quality ratios
  - Barriers to digitalization
  - Lack of institutional capacity for consistent monitoring
- Expanding digital services in rural areas:
  - Establishing policy to ensure consumer protection and good practices
  - Optimizing network coverage
  - Digitizing producer records to support the establishment of creditability
  - Digitizing government records to support transparency and efficiency
- Ensuring broad access to financial services by Burkinabe smallholders, including:
  - Crop and livestock insurance and risk instruments
  - Credit and financing
  - Savings services
  - Payment services
- Building financial literacy of smallholders

### POTENTIAL PROJECT IMPACTS

<b>Production</b>	This project supports production through risk redistribution and up-front capital for innovation investments.
<b>Resilience</b>	Resilience is achieved by enabling implementation of recommended CSA practices and reducing their risk.
<b>Mitigation</b>	Mitigation is a co-benefit of sustainable increases in production and resilience.
<b>Cost</b>	The cost is US\$200 per beneficiary, in total US\$40 million.
<b>Yield</b>	The project will increase income benefits to farm households by 19%.

### ECONOMIC AND FINANCIAL ANALYSIS

#### Cost Benefit Analysis with and without Climate Risks

With Climate and Pest Risks					
Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
200,000	19	15.9	45	0.43	0.30 (2.88)
Without Climate and Pest Risks					
200,000	19	52.2	63	1.51	0.98 (3.03)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

## ENABLING ENVIRONMENT

### KEY ASSETS FOR PROJECT SUCCESS:

- Broad microfinance and mobile money networks
- Grassroots buy-in to mobile financial services and the microfinance sector
- Established policy to regulate the financial industry
- Robust, profitable, stable banking sector
- Strong government support and investment in improved smallholder financial services access

### KEY RISKS AND BARRIERS TO PROJECT SUCCESS:

- Relatively undeveloped information-communication technology networks
- Weaknesses in business operations of microfinance organizations
- Poor economies of scale of existing microfinance organizations
- Low financial literacy among smallholders

### KEY DIGITAL AGRICULTURE TECHNOLOGIES:

- Mobile finance services, along with digitized farm records to support credit line establishment
- Smart contracting for transparent and equitable land tenure processes
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support management decisions
- Insurance services, powered by big data, machine learning, mobile technology, and integration with climate information services
- Mobile peer-to-peer platforms, enabled by big data, machine learning, and mobile technology, to support knowledge exchange, input supply, middleman reduction, economies of scale, and product sales at fair market rates

## FINANCING

### PUBLIC FINANCING OPPORTUNITIES:

- Burkina Social and Economic Development Fund
- Women's Entrepreneurial Activities Support Fund

### INTERNATIONAL FINANCING OPPORTUNITIES:

- FinMark Trust
- World Bank
- International Monetary Fund (IMF)
- International Finance Corporation (IFC)
- United Nation Environment Program (UNEP)
- Fonds International de Développement Agricole (FIDA)
- World Food Program (WFP)
- Organisation Meteorologique Mondiale (WMO)

### PRIVATE FINANCING OPPORTUNITIES:

- Réseau des Caisses Populaires du Burkina (RCPB)
- Première Agence de Microfinance Burkina Faso
- Creditinfo VoLo
- Banque Agricole du Burkina Faso (BADF)



## 4.4 Forest, Agroforest, And Garden Production For Climate-Smart Diversification

### PROJECT SUMMARY

**REGION:** National

**BENEFICIARIES:** 200,000 farmers and their families

**OBJECTIVE:** : Foster climate-resilient livelihoods and food sources for women and youth smallholders through home gardens, agroforestry, and non-timber forest product harvesting and value-addition.

**HIGHLIGHT:**

- A 40% income increase for farm families through low-input, low-impact farming
- Income and nutritional diversification and security through high-value product chain development
- GHG mitigation through soil and biomass sequestration

### JUSTIFICATION AND KEY INVESTMENTS

**Garden, forest, and agroforest systems are often more resilient than arable crops.** Trees in particular play a key role in Burkina agricultural landscapes, and account for a significant portion of household incomes, particularly for poor and women-led households.

**Non-timber forest products (NTFPs), gardening, and agroforestry practices are common in Burkina Faso, and there is significant demand for these products in domestic and international markets.** Examples include shea, gum arabic, honey, baobab, medicinal products, and fruits.

**However, many farmers are unable fully to leverage these practices due to lack of training.** For example, farmers trained in shea pruning, assisted natural regeneration, and grafting techniques have 44% higher revenues than those that are not trained. These techniques are low-cost and use tools that most farmers already have on hand.

**Household returns are not currently sufficient to catalyze protection against environmental degradation.** Value chains for NTFPs remain largely undeveloped, resulting in a low return on investment (ROI) for harvested products, low forest resource valuation, and consequent overexploitation.

**There are four synergistic opportunities to increase the value of agroforestry and NTFPs to this crucial threshold:**

- Training in improved planting material, gardening, and NTFP and agroforestry management practices
- Technological innovation to reduce processing drudgery and augment income potential
- Enabling land tenure, particularly for women, who are the primary owners of garden, agroforestry, and NTFP processes
- Enforcement of conservation laws and sustainable practice guidelines

Projects activities addressing these four key opportunities must consider the context of gender inequality as well as geographic and ethnic variation in traditional uses and practices of forest and garden products.

**KEY PROJECT INVESTMENTS:**

A site-tailored focus on promoting CSA Pillars with emphasis on:

- NTFPs for nutritional diversity and security
- NTFP processing enterprises, including shea, gum arabic, and baobab
- Gardens for nutritional diversity
- Soil fertility management
- Forest and agroforest management to support NTFP productivity

**POTENTIAL PROJECT IMPACTS**

<b>Production</b>	The project results in production of high-value, low-impact, low-investment products and highly nutritional foods for increased income and food security.
<b>Resilience</b>	The project strengthens resilience through diversification of income sources and nutritional sources as well as environmental sustainability.
<b>Mitigation</b>	Mitigation will result through profitable protection and management of forests and soils.
<b>Cost</b>	The cost is US\$306 per beneficiary for a total of US\$ 55.08 million
<b>Yield</b>	This project will yield a 40% increase in income to 180,000 farmers and their families

**ECONOMIC AND FINANCIAL ANALYSIS****Cost Benefit Analysis with and without Climate Risks**

With Climate and Pest Risks					
Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
180,000	40	168.2	89	3.47	2.28 (3.20)
With Climate and Pest Risks					
180,000	40	196.1	92	4.06	2.66 (3.36)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

**ENABLING ENVIRONMENT****KEY ENABLING FACTORS:**

- Agroforestry and NTFPs are already widely practiced.
- They require very few inputs, training, investments, or technologies to get started.
- They align closely with NDCs and many other national policies.

**• KEY RISKS:**

- Lack of training and capacity to optimize ROI
- Little or no access to improved planting materials
- Overexploitation of forest resources
- Land tenure insecurity, particularly for women

**KEY DIGITAL AGRICULTURE TECHNOLOGIES:**

- Mobile finance services, digitized farm records, and smart contracting
- Mobile extension, peer-to-peer platforms, and climate information services, enabled by weather stations, big data, machine learning, and mobile technology

**FINANCING****PUBLIC FINANCING OPPORTUNITY:** Environmental Intervention Fund**INTERNATIONAL FINANCING OPPORTUNITIES:**

- Global Environment Fund (GEF)
- Green Climate Fund (GCF)
- World Bank
- African Development Bank (AfDB)
- Swiss government
- Organisation for Economic Co-operation and Development Scheme for the Certification of Forest Reproductive Material

**PRIVATE FINANCING OPPORTUNITIES:**

- Banque Agricole du Burkina Faso (BADF)
  - Ecobank
  - Bank of Africa
  - Coris Bank International
  - United Bank for Africa (UBA)
  - La Banque pour le Commerce, l'Industrie et l'Agriculture du Burkina Faso (BICIAB)
  - Orabank
  - Credit unions (caisses populaires)
  - La Société Financière de Garantie Interbancaire du Burkina (SOFIGIB)
  - PlaNet Finance
  - Terrafin
-

## 4.5 Building Capacity In Climate-Smart Agriculture

### PROJECT SUMMARY

**REGION:** National

**BENEFICIARIES:** 500,000 farmers and their families

**OBJECTIVE:** Fully integrate national climate-smart priorities into Burkina Faso's agricultural research and extension programs and build robust extension mechanisms for delivering timely, practical climate-smart information to farmers and other stakeholders through highly accessible channels.

**HIGHLIGHT:**

- This cost-efficient, high-impact project cuts across sectors and boosts the national economy.
- The project establishes robust research and extension services to augment farmer productivity, adaptivity, and mitigation in the face of climate change.
- The project also empowers individuals to continue advancing Burkinabe climate adaptivity and innovation.

### JUSTIFICATION AND KEY INVESTMENTS

**Strong agricultural research and extension networks are the primary predictor of agricultural productivity growth in Sub-Saharan Africa.** Development and dissemination of new technologies accounts for 51% of productivity gains; improved trade and marketing policies account for 20%, and reductions in conflict for 18%. Climate information services are especially helpful to farmers facing erratic weather patterns. Timing of advisory services and the integration of top-down, value-chain, business approaches with bottom-up, smallholder, traditional approaches are also crucial to effectiveness.

**CSA and research are both well-supported by the Burkinabe government, but they remain disjointed in practice.** Burkina Faso has notable research and development capacities, and significant efforts have been made to support the dissemination of new research findings to farmers. This work is not yet fully aligned with national climate-smart policies, particularly in terms of climate and weather advisories.

**Additionally, the country's waning extension workforce has created a gap that prevents new technologies and information from reaching farmers.** The number of national extension agents on staff has been in decline since the 1990s, and now stands at approximately 1 agent per every 1000 farmers. In contrast, the World Bank's standard ratio is 1 agent per 800 farmers. This degree of understaffing prevents the timely and effective dissemination of information and capacity-building services to farmers.

**Mobile phone network access is improving rapidly in Burkina Faso.** Mobile-based solutions have been successful in providing services to rural Burkinabe populations and hold promise in terms of providing actionable climate-smart information to farmers and other stakeholders. However, existing digital agricultural information services are limited, and they are not well adapted to rural smallholders.

**Significant access inequalities in the current advisory system perpetuate poverty and poor productivity.** Just 19% of national agricultural researchers were women in 2014 (up from 13% in 2008). Gender norms, patriarchal values, time poverty, and illiteracy also reduce farmer access to extension services, particularly for women farmers. Seniority, religion, class, and position within the household further reconfigure advisory services access.

**Even farmers who have access to extension services often remain constrained from receiving and implementing advisory recommendation by external circumstances.** Restrictive land tenure, unprofitable markets, poor storage, a dearth of finance services, and low household incomes prevent farmers from taking risks to invest in changing established practices. For these farmers, advisory services increase their knowledge but do not improve their outcomes. In contrast, farmers with extensive social networks, many years of experience, large farm sizes, securer land tenure, good access to financial services, group memberships, and greater general knowledge are much more able and likely to adopt new practices.

### KEY PROJECT INVESTMENTS:

A site-tailored focus on promoting CSA Pillars with emphasis on: NTFPs for nutritional diversity and security

- Training at national and regional levels for:
  - Transparency
  - CSA technical capacity
  - Production and management of information, particularly about water resources
  - Development of agricultural services and climate information services
- Establishment of evidence-based climate-smart research programs
- Timely, practical, and tailored extension services oriented toward climate-smart actions
- Timely, practical climate information services

### POTENTIAL PROJECT IMPACTS

<b>Production</b>	Production across sectors is increased by demand-driven research and timely dissemination of climate-smart innovations.
<b>Resilience</b>	Resilience is increased through adaptive, sustainable, site-tailored practices such that productivity is stable even under extreme and variable climate scenarios.
<b>Mitigation</b>	Mitigation is a co-benefit of climate-smart production and resilience practices.
<b>Cost</b>	The cost is US\$110 per beneficiary for a total of US\$55 million.
<b>Yield</b>	The project will increase yield by 18% for 500,000 farmers and their families.

### ECONOMIC AND FINANCIAL ANALYSIS

#### Cost Benefit Analysis with and without Climate Risks

With Climate and Pest Risks					
Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
500,000	18	52.5	62	1.06	0.71 (4.80)
Without Climate and Pest Risks					
500,000	18	140.4	80	2.95	1.91 (5.05)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

### ENABLING ENVIRONMENT

#### KEY ASSETS FOR SUCCESS:

- University degree programs in agricultural studies to train qualified agricultural extensionists (at the University of Ouagadougou [UO] among others)
- Well-established agricultural research institute networks, including:
  - Institut National de l'Environnement et de Recherches Agricoles (INERA)
  - Research Institute for Applied Sciences and Technologies (IRSAT)
  - National Forest Seed Center (CNSF)
  - University of Ouagadougou
- Strong governmental commitment to research and extension systems
- Strong farmer cooperative unions and Regional Chambers of Agriculture
- Strong alignment between NDCs and many national policies

#### KEY BARRIERS TO SUCCESS:

- Lack of inter-sectoral coherence and coordination in regard to cross-cutting CSA topics
- Lack of high-level commitment to CSA

- Dearth of funding for National Adaptation Program of Action (NAPA)
- Very low electricity penetration, which inhibits use of computer technologies and mobile devices to deliver services
- Persistent segregation and discrimination, particularly in terms of gender
- External circumstances that dissuade or prevent farmers from implementing recommendations, including:
  - Restrictive land tenure
  - Unreliable access to profitable markets
  - Lack of safe harvest storage
  - Dearth of financial services such as loans and credit
- Strong social and cultural norms that influence adoption of innovative practices

#### **KEY DIGITAL AGRICULTURE TECHNOLOGIES:**

- Mobile extension services, enabled by big data, machine learning, and mobile technology, to support best practices and disseminate research and development outputs
- Mobile finance services, along with digitized farm records to support credit line establishment
- Smart contracting for transparent and equitable land tenure processes
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support management decisions
- Mobile platforms, enabled by big data, machine learning, and mobile technology, to support peer knowledge exchange, input supply, and product sales at fair market rates

## **FINANCING**

**PUBLIC FINANCING OPPORTUNITY:** National Adaptation Program of Action (NAPA)

#### **INTERNATIONAL FINANCING OPPORTUNITIES:**

- Netherlands Space Office
- ECOWAS Bank for Investment and Development (EBID)
- Regional Agency for Agriculture and Food (RAAF)
- UK Department for International Development (DFID)
- Netherlands Development Organization (SNV)
- Permanent Interstate Committee for Drought Control in the Sahel (CILSS)
- Agriculture et Gestion des Risques Climatiques: Outils et Recherches en Afrique (AGRICORA), supported by French Ministry of Foreign Affairs and International Development
- West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL)
- World Bank

#### **PRIVATE FINANCING OPPORTUNITIES:**

- Banque Agricole du Burkina Faso (BADF)
- Ecobank
- Bank of Africa
- Coris Bank International
- United Bank for Africa (UBA)
- La Banque pour le Commerce, l'Industrie et l'Agriculture du Burkina Faso (BICIAB)
- Orabank
- Credit unions (caisses populaires)
- La Société Financière de Garantie Interbancaire du Burkina (SOFIGIB)
- PlaNet Finance
- Terrafin

## 4.6 Sustainable Management Of Water Resources And Irrigation

### PROJECT SUMMARY

**REGION:** North Sudan

**BENEFICIARIES:** 100,000 farmers and their families

**OBJECTIVE:** : Fully leverage Burkina Faso's water resources in sustainable ways to improve productivity, food and nutritional security, climate resiliency, and ecological health.

**HIGHLIGHT:**

- This project will increase benefits to farm households by 56%
- Taking risks into account, the project has a positive net present value (NPV) of 21%, but over 50% if risks are not realized.
- This project will increase yields and decrease flooding and erosion through water management infrastructure.

### JUSTIFICATION AND KEY INVESTMENTS

**Water harvesting and irrigation improve yields and efficiency by partially unlinking production from the vagaries of rainfall.** Worldwide, irrigated agriculture takes up about 20% of agricultural land and contributes about 40% of crop production.

**The vast majority of Burkina Faso's agriculture depends on rainfall.** Pollution, population growth, high evapotranspiration, and environmental degradation have also reduced water availability. In response to this, the Burkinabe government has committed to sustainable water management for agricultural production and receives significant international commitment and support.

**There is a remarkable untapped opportunity to leverage water harvesting and irrigation to increase productivity in Burkina Faso.** Nearly 4.4 million hectares of Burkinabe agriculture are rainfed, and just 25,000 hectares are irrigated. The country currently uses a tiny fraction of its 18.5 billion cubic meters of renewable surface and groundwater water resources. The economy is strongly oriented toward agriculture, resulting in a low industrial demand for water. As such, nearly all the untapped water resources could be used to irrigate agricultural land.

**Burkina Faso's diverse renewable water resources enable highly site-tailored water management solutions.** This affords Burkina Faso significant flexibility in terms of resource options and necessitates careful situational analysis to ensure project solutions are sustainable. Where dams and reservoirs are appropriate, multiple uses can be considered to ensure environmental and economic sustainability; for example, reservoirs and canals may be used for aquaculture, and hydroelectricity may be generated. In areas of low rainfall, high evapotranspiration, and rich groundwater resources, wells would be much more appropriate. About half of Burkina Faso's renewable water resources are groundwater.

**Any given water management solution is not appropriate across all scenarios.** The feasibility and potential impacts of water projects vary widely depending on geography; time, especially given growing climate change impacts; the population served through economies of scale; and the type of system used. In some cases, improvements in existing infrastructure or in use efficiency of existing water sources removes the need for new technologies.

**Surface reservoirs alone do not result in significant social benefits or a large return on investment (ROI).** Integrating some combination of energy production, agricultural irrigation infrastructure, livestock watering, and aquaculture is essential to the impact and profitability of reservoir projects. These accompanying projects also offer diversified nutritional sources and generate new economic sectors, job opportunities, and opportunities for rural services such as affordable electricity.

**Even after the appropriate site-tailored water management solution is identified, significant challenges remain.** Land tenure, finance services, and robust extension are prerequisites to successful water management solutions.

**KEY PROJECT INVESTMENTS:**

A site-tailored focus on promoting CSA Pillars with emphasis on:

- Improvement or rehabilitation of existing infrastructure
- Protection of water bodies and associated ecosystems
- Establishment of irrigation and water infrastructure
- Capacity building for water use efficiency

**POTENTIAL PROJECT IMPACTS**

<b>Production</b>	This project increases production across crop and livestock systems.
<b>Resilience</b>	This project strengthens resilience by sustainably unlinking production from precipitation.
<b>Mitigation</b>	Mitigation is a co-benefit through intensification and reduced need for agricultural expansion into natural areas.
<b>Cost</b>	The cost is US \$650 per beneficiary, or a total cost of about US\$65 million.
<b>Yield</b>	This project increases yield by 56 % for 100,000 small farming families.

**ECONOMIC AND FINANCIAL ANALYSIS****Cost Benefit Analysis with and without Climate Risks**

With Climate and Pest Risks					
Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
100,000	56	-15.8	21	-0.35	-0.18 (0.67)
With Climate and Pest Risks					
100,000	56	22.9	54	0.35	0.26 (0.98)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

**ENABLING ENVIRONMENT****KEY ASSETS FOR SUCCESS:**

- Vast untapped water resources
- Minimal inter-sectoral competing interests for water resources
- Roughly equal division of water resources between ground and surface, enabling flexibility in solution design
- Aligned international agreements and national policies
- Good existing knowledge base through previous projects

**KEY BARRIERS TO SUCCESS:**

- Low financial capacity
- Scant mechanisms for capacity building and extension
- Highly site-specific solutions requiring significant upfront investment in diagnostics
- Lack of land tenure
- Divergence between government yield objectives and rural farmers' food security objectives
- Insufficient land access for farmers to leverage water resources in breaking the poverty cycle

**KEY DIGITAL AGRICULTURE TECHNOLOGIES:**

- Remote sensing, drones, GPS, and GIS for informing tailored water management approaches
- Internet of things and remote sensing for regulating water canals, reservoirs, and precision irrigation



- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support decisions regarding surface water management in the face of extreme weather events
- Mobile finance services, smart contracting for land tenure, and digitized farm records to support credit line establishment

## FINANCING

**PUBLIC FINANCING OPPORTUNITIES:** Blended financing opportunities via the government and the Environmental Intervention Fund

**PRIVATE FINANCING OPPORTUNITIES:**

- Banque Agricole du Burkina Faso (BADF) (Agricultural Bank of Burkina)
- Millennium Challenge Corporation
- Société Burkinabé des Fibres Textiles (Sofitex)

**INTERNATIONAL FINANCING OPPORTUNITIES:**

- International Commission on Irrigation and Drainage (ICID)
  - Comprehensive Africa Agriculture Development Programme (CAADP)
  - Agricultural Water for Africa (AgWA)
  - Economic Community of West African States (ECOWAS) Water Resources Coordination Centre
  - Permanent Interstate Committee for Drought Control in the Sahel (CILSS)
  - Global Environment Fund (GEF)
  - Green Climate Fund (GCF)
  - World Bank
  - African Development Bank (AfDB)
  - West African Development Bank (BOAD)
  - Global Partnership for Results Based Approaches (GPRBA)
-

## 4.7 Developing Climate-Smart Organic Value Chains

### PROJECT SUMMARY

**REGION:** North Sudan and South Sudan

**BENEFICIARIES:** 60,000 farmers and their families

**OBJECTIVE:** Develop a burgeoning niche market to create viable careers and shorten supply chains in peri-urban areas.

**HIGHLIGHT:**

- Economic benefits to farm households will increase by 54%.
- Resilience to climate and pest risks is low, with chance of a positive NPV of 29%.
- Improved varieties, integrated soil management, post-harvest technology, improved access inputs, and capacity building will create resiliency in a growing market subsector.

### JUSTIFICATION AND KEY INVESTMENTS

**The risks of agricultural chemical exposure have catalyzed an interest in organic food products in Burkina Faso.** The benefits of organic agriculture in terms of both environmental impact and human health impact have been widely appreciated in Burkina Faso since the 1990s.

**Organic labelling has also recently emerged in Burkina Faso.** Smallholder producers of fresh fruits and vegetables have been prominent among those farms already certified by the label.

**Producers are attempting to respond to the domestic and international demand for organic products.** However, producers remain severely limited by poor market linkages and a lack of capacity building. Organic certification demands significantly higher quality standards. It is incredibly challenging for producers to become familiar with and meet these quality standards without capacity building. Poor access to organic inputs and the higher costs of these inputs dissuade producers from investing in organic systems. Transportation challenges force producers to work with traders who hold purchase prices artificially low. Consequently, despite strong consumer and producer interest, just 0.5% of Burkinabe land has been converted to organic agricultural production as of 2017.

**Burkina Faso is becoming increasingly urbanized.** The country has one of the highest birth rates in the world, and the burgeoning population is increasingly moving to urban areas in search of viable careers. Urban populations are heavily reliant on urban and peri-urban farmers for food. These farmers provide up to 36% of the city's total food demand and up to 90% of its fresh vegetables.

**Climate change may put urban populations at significantly increased risk of food insecurity.** Increasing frequent and severe droughts, downpours, and floods threaten the stability of regional food supplies, putting the entire urban population's food security at risk.

**Irrigation systems are key to unlinking farm productivity from the vagaries of climate change.** In rural areas, feasible irrigation solution options are limited by low access to services like electricity, as well as by the tools and equipment necessary for system maintenance, operation, and repair. In urban and peri-urban areas, these access barriers are significantly lower, and concomitantly, the options for irrigation innovation are broader. Solar-powered irrigation is an excellent example of a solution that may be infeasible in most rural areas but has strong potential in many urban and peri-urban areas.

**Land tenure and finance services enable innovative irrigation solutions.** Finance services, and in particular those tailored to the unique characteristics of agricultural production, are scant. Even farmers trained in a variety of irrigation solutions are unable to implement new knowledge without access to financing and land security.

### KEY PROJECT INVESTMENTS:

A site-tailored focus on promoting CSA Pillars with emphasis on:

- Organic cotton, mango, and vegetable production
- Development of heat, drought, and disease resistant varieties
- Integrated soil fertility management
- Post-harvest technology and infrastructure development
- Improved access to bio fertilizer and bio pesticide inputs
- Increased capacity for and awareness of organic production and marketing
- Solar powered garden irrigation

### POTENTIAL PROJECT IMPACTS

<b>Production</b>	This project increases production for organic farmers in peri-urban and urban areas.
<b>Resilience</b>	The resilience of organic farming to climate and pest risks is moderate; economic resilience is increased through sectoral diversification.
<b>Mitigation</b>	Mitigation is a co-benefit of improved soil quality.
<b>Cost</b>	The cost is US \$833 per beneficiary, or a total cost of about US\$49.98 million.
<b>Yield</b>	Yield will increase by 54% for 60,000 small farming families.

### ECONOMIC AND FINANCIAL ANALYSIS

#### Cost Benefit Analysis with and without Climate Risks

With Climate and Pest Risks					
Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
60,000	54	-5.1	29	-0.15	-0.08 (1.03)
Without Climate and Pest Risks					
60,000	54	21.8	54	0.48	0.33 (1.27)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

### ENABLING ENVIRONMENT

#### KEY ASSETS FOR SUCCESS:

- Strong domestic interest in organic products
- Robust international market demand for organic products
- Rapidly growing year-round urban demand for garden products
- Established, innovative organic certification process
- Organic farming already practiced by some farmers
- Relatively little investment in training and infrastructure required
- Useful existing technologies

#### KEY BARRIERS TO SUCCESS:

- Lack of access to and availability of organic inputs
- Significant market control by powerful conventional companies
- Policy that supports market control by powerful conventional companies
- High dependency on external support mechanisms and poor access to the same
- Current gap in extension service supply relative to demand

#### KEY DIGITAL AGRICULTURE TECHNOLOGIES:

- Smart contracting for transparent and equitable sustainability certification
- Barcoding and blockchain for certification labeling and product tracing

- Mobile finance services, along with digitized farm records to support credit line establishment
- Smart contracting for transparent and equitable land tenure processes
- Mobile extension services, enabled by big data, machine learning, and mobile technology, to support best practices and disseminate research and development outputs
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support management decisions
- Mobile platforms, enabled by big data, machine learning, and mobile technology, to support peer knowledge exchange, input supply, and product sales at fair market rates

## FINANCING

### PUBLIC FINANCING OPPORTUNITIES:

- Blended finance opportunities via the government and the Environmental Intervention Fund
- National Council for Biological Agriculture

### PRIVATE FINANCING OPPORTUNITIES:

- SINERGI BURKINA
- Textile Exchange
- Union of Vegetable and Fruit Producers (UFMB)
- Association des Professionnels de la Mangue au Burkina (APROMAB)
- Plateforme Nationale de Commerce Équitable Burkina
- Burkinabe Interprofessional Cotton Association (AICB)
- Union Nationale des Producteurs de Coton du Burkina (UNPCB)
- Organic and Fairtrade Cotton Coalition West Africa
- Europe-Africa-Caribbean-Pacific Liaison Committee (COLEACP) for assistance in compliance with European import standards
- These three regional cotton groups provide inputs, value chain support, and advisory services:
  - Société Burkinabé des Fibres Textiles (SOFITEX), western region, owned by GEOCOTON, the Union Nationale des Producteurs de Coton du Burkina (UNPCB), and the government
  - SOCOMA, eastern region, owned by GEOCOTON and UNPCB
  - Faso Coton, central region, part of the Industrial Promotion Services (West Africa) S.A.
- The Association Professionnelle des Sociétés Cotonnières du Burkina (APROCOB) jointly represents these three groups.

### INTERNATIONAL FINANCING OPPORTUNITIES:

- United States Department of Agriculture (USDA)
  - World Bank
  - African Development Bank (AfDB)
  - United Nations (UN)
  - Ecocert Burkina Faso
  - Organics International
-

## 4.8 Developing Resilient Oil-Protein Value Chains

### PROJECT SUMMARY

**REGION:** North Sahel, North Sudan, South Sudan

**BENEFICIARIES:** 240,000 farmers and their families

**OBJECTIVE:** Strengthen the quality, yield efficiency, and value chains of oil-protein crops to sustainably meet domestic demands and support international market development

**HIGHLIGHT:**

- The project will raise income for 240,000 poor farming families by 39%.
- With an NPV of 60%, the project is likely to be successful even if risks are realized.
- The project will result in access to improved quality seeds and improved soil quality, soil fertility, and yields.

### JUSTIFICATION AND KEY INVESTMENTS

**Oil-protein crops are well suited to Burkina Faso's climate and hold significant nutritional and economic potential in Burkina Faso.** However, the growth of the oil-protein crop markets has caused some producers to abandon their climate-smart production practices, increasing their already-high vulnerability to climate change impacts.

**COWPEA is a main source of both protein and income for most Burkinabe households.** Burkina Faso now exceeds cowpea self-sufficiency and is beginning to export. There are important opportunities to increase cowpea productivity in Burkina Faso using existing technologies. For example, the shift from food crop to cash crop has implied a move away from traditional intercropping toward monocropped systems. In addition, there is currently very little processing of cowpea crops, and prices are highly volatile.

**SESAME offers significant opportunities for increased yield in Burkina Faso.** In one study, farmer managed trials showed that 75 kilograms of NPK fertilizer per hectare increased yields by 75% and provided a 320% return on investment (ROI). Improved seed varieties returned 1,900% on investment as compared to recycled seed. However, strong international demand has driven 1,500% growth in sesame production over the last decade, and to some extent has deterred improvements in production systems and value chains. Price and demand for crude sesame have been so high that local storage and processing facilities have not been commercially viable, and conventional sesame prices have been peaking above those of organic sesame.

**SOYBEAN sector development is a national priority.** There is currently a 74% gap in animal feed demand that could be met by domestic supplies, and especially by soybeans. Soy is also becoming part of local diets, and regional export demand is growing. As a nitrogen-fixing legume, soybeans require relatively little fertilizer and can be grown in rotation with other crops to help maintain soil quality. Soy also requires less pesticide than cotton and is an excellent nutritional source.

**Developing oil-protein value chains could reduce Burkinabe dependency on imports.** The nation has an 85,000 MT annual demand gap in edible oil that must be imported. Meanwhile, the amount of sesame and soybean oil produced remains small to negligible, although the country has a competitive advantage in producing these crops.

**Women farmers are being pushed out of oil-protein crop production.** Cowpea and sesame are traditionally women's crops from production through processing. As these crops have gained economic value, they have become men's crops. Female-led households are now less likely to adopt sesame and cowpea production than male-led households, potentially as a result of women's more limited access to resources that would enable them to diversify into non-staple crops.

**KEY PROJECT INVESTMENTS:**

- Improved seed varieties that:
  - Combine drought and pest resistance
  - Address standards and certification processes
- Value chains improved through:
  - Development
  - Integration
  - Infrastructure, particularly storage and oil processing
  - Organizing for economies of scale
- Optimized field management to maximize yield efficiency through:
  - Strengthening producer organizations
  - Building technical skills
  - Supporting robust basic farmer services (e.g. extension, climate, and finance services)

**POTENTIAL PROJECT IMPACTS**

<b>Production</b>	This project increases the production of nutritionally and economically strategic crops.
<b>Resilience</b>	This project strengthens resilience as reliance on imports, synthetic fertilizer, and animal-based proteins decreases, and as the agricultural economy diversifies to meet demand.
<b>Mitigation</b>	Mitigation is achieved through intercropping, leguminous nitrogen fixing, a shift from animal to plant -based proteins, and reduction in GHG intensity.
<b>Cost</b>	The cost is US\$228 per beneficiary, or a total cost of about US\$54.72 million.
<b>Yield</b>	This project increases yield by 39% for 240,000 small farming families.

**ECONOMIC AND FINANCIAL ANALYSIS**

With Climate and Pest Risks					
Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
240,000	39	32.5	60	0.62	0.44 (2.02)
With Climate and Pest Risks					
240,000	39	106.1	90	2.19	1.44 (2.32)
60,000	54	21.8	54	0.48	0.33 (1.27)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

**ENABLING ENVIRONMENT****KEY ASSETS FOR SUCCESS:**

- Burkina Faso's competitive advantage on the international sesame market
- High nutritional value of oil-protein crops
- Rising domestic and international demand for oil-protein crops
- Nitrogen-fixing properties of cowpea and soybean
- Natural drought resistance and resiliency

**KEY BARRIERS TO SUCCESS:**

- Low accessibility to basic services, such as finance, extension, and climate services, particularly for women
- Poor land tenure, particularly for women
- Removal of women from value chains as they become profitable

- Volatile pricing
- International demand and pricing for raw product that may disincentivize domestic value chain development
- Difficult seed certification processes

#### **KEY DIGITAL AGRICULTURE TECHNOLOGIES:**

- Mobile extension services, enabled by big data, machine learning, and mobile technology, to support best practices and disseminate research and development outputs
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support management decisions
- Mobile platforms, enabled by big data, machine learning, and mobile technology, to support peer knowledge exchange, input supply, and product sales at fair market rates

### **FINANCING**

**PUBLIC FINANCING OPPORTUNITIES:** Société Nationale de Gestion des Stocks de Sécurité Alimentaire du Burkina Faso

#### **PRIVATE FINANCING OPPORTUNITIES:**

- SINERGI BURKINA
- Seeds suppliers
- Entreprises de Services et Organisations de Producteurs (ESOPs), such as:
  - Helvetas
  - Siatol

#### **INTERNATIONAL FINANCING OPPORTUNITIES:**

- United States Department of Agriculture (USDA)
  - Bill and Melinda Gates Foundation
  - Organization of the Petroleum Exporting Countries (OPEC) Fund for International Development
  - International Fund for Agricultural Development (IFAD)
-

## 4.9 Integrated Soil Management For Agricultural Productivity And Environmental Restoration

### PROJECT SUMMARY

**REGION:** North Sahel, North Sudan, South Sudan

**BENEFICIARIES:** 200,000 farmers and their families

**OBJECTIVE:** Provide producers and extension agents with location-tailored information about soil characteristics and with best management practice recommendations, as well as the tools, products, partnerships, and policy environment to implement those recommendations.

**HIGHLIGHT:**

- Improved agricultural soil fertility
- Concomitant increases in productivity, food and nutritional security, and economic growth that foster climate resilience
- Restoration of degraded lands, slowing of agricultural expansion, and GHG mitigation

### JUSTIFICATION AND KEY INVESTMENTS

**Soil health is essential to CSA, yet agriculture generally has negative effects on soils.**

**Burkina Faso's economy is threatened by soil degradation. Growing food demand because of rapid population growth has driven significant agricultural expansion.** Between 1971 and 2016, agriculture production expanded from 30% to 44% of total land area, and natural spaces fell from 83% to 57%. Today, 9 million hectares of productive land, or 33% of the total national territory, is degraded. Agricultural expansion is expected to accelerate, and degradation will be further exacerbated by extreme weather events such as drought, flooding, and high winds. The result is loss of productivity.

**Integrated soil fertility management (ISFM) is an effective way to regenerate soils with limited inputs.** Burkinabe soils can be very agriculturally productive under ISFM.

**Burkinabe smallholders' degree of access to fertilizers creates demand for ISFM efforts.** While current fertilizer application rates are insufficient for improving yields alone, they are sufficient for ISFM-based targeted dosing of inorganic fertilizers as informed by a national Soil Information System (SIS). Given current fertilizer access, such optimization of crop productivity via ISFM is crucial to achieving soil fertility and crop productivity.

**Soil information systems enable ISFM on a large scale.** The World Agroforestry Center (ICRAF) has developed spectral diagnostics using infrared and x-ray technology. These systems enable rapid, low-cost analysis of soil properties and plant nutrients that can be applied at scale for digital mapping. The level of detail, accuracy, and geographic scale that this technology offers at low cost promises to transform the soil management paradigm.

**Burkina Faso has committed to stop land degradation by 2030 and is a signatory to several international initiatives to address degraded lands.** Burkinabe stakeholders already practice some techniques to help maintain land and soil quality. However, a lack of equipment and materials and an insufficient labor force for soil restoration technologies are hindering the implementation of restoration and conservation management.

**KEY PROJECT INVESTMENTS:**

A site-tailored focus on promoting CSA Pillars with emphasis on:

- ISFM capacity building
- SIS development and implementation



## POTENTIAL PROJECT IMPACTS

<b>Production</b>	This project increases production across all crops because of optimized soil fertility, resulting in improved incomes and food and nutritional security as well as less drive for agricultural expansion.
<b>Resilience</b>	This project improves resilience through leveraging readily available technologies and materials and reducing reliance on scant or inconsistently available inputs.
<b>Mitigation</b>	Mitigation is achieved through slowed agricultural expansion, augmented soil, and biomass sequestration.
<b>Cost</b>	The cost is US\$300 per beneficiary, totaling US\$60 million.
<b>Yield</b>	This project increases yield by 29% for 200,000 farmers and their families.

## ECONOMIC AND FINANCIAL ANALYSIS

### Cost Benefit Analysis with and without Climate Risks

With Climate and Pest Risks					
Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
200,000	29	72.0	71	1.35	0.9 (2.05)
Without Climate and Pest Risks					
200,000	29	128.9	83	2.46	1.61 (2.43)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

## ENABLING ENVIRONMENT

### KEY ASSETS FOR SUCCESS:

- Close alignment with NDCs and many other national policies.
- Grassroots buy-in: producers and extension agents already familiar with soil conservation practices
- Robust governmental commitments and international support
- National fertilizer supply sufficient for ISFM practices

### KEY BARRIERS TO SUCCESS:

- Fertilizer distribution may not reach all smallholders.
- Organic matter soil inputs available are limited.
- Drought and flood events are increasing in frequency.
- Land tenure insecurity curbs smallholder investments.
- Availability of quality planting material is low.

### KEY DIGITAL AGRICULTURE TECHNOLOGIES:

- Soil information, climate information, and mobile extension services, enabled by big data, weather stations, machine learning, and mobile technology, to support decision-making
- Mobile finance services, digitized farm records, and smart contracting

## FINANCING

**PUBLIC FINANCING OPPORTUNITIES:** Environmental Intervention Fund (FIE)

**INTERNATIONAL FINANCING OPPORTUNITIES:**

- Global Environment Fund (GEF)
- Green Climate Fund (GCF)
- World Bank
- African Development Bank (AfDB)
- West African Development Bank (BOAD)
- International Fund for Agriculture Development (IFAD)
- Global Soil Partnership
- Great Green Wall Initiative
- Land Degradation Neutrality (LDN) program

**PRIVATE FINANCING OPPORTUNITIES:**

- Banque Agricole du Burkina Faso (BADF) (Agricultural Bank of Burkina)
  - Irrigation companies
  - Timber and forest product processors
-

# Monitoring And Evaluation: Assessing Outcomes And Impacts

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## 5.1 Context

A robust and practical Monitoring and Evaluation (M&E) Plan is an integral component of the **Climate Smart Agriculture Investment Plan (CSAIP) for Burkina Faso**. These M&E guidelines aim to provide CSAIP implementors—particularly the government—with a manageable system to facilitate generating, collecting, and analyzing standardized data to assess the success of portfolio investments and inform operational and strategic decision-making. This M&E guide establishes and illustrates links between the plan’s objectives (expected outcomes and impacts) and its inputs and activities (projects). It also identifies key requirements for implementing the Plan (Box 5-1).

**M&E activities provide information on how project activities influence change and how investments are performing.** They create a mechanism for tracking progress against targets, learning lessons, increasing accountability, raising flags when adaptive action may be necessary, and telling data-driven stories of success by government agencies, financial institutions, subnational agencies, communities and other decision-makers. M&E plans and activities need to be dynamic and can be revised and adjusted as lessons emerge from their implementation.

**Box 5.1 Defining Key M&E Terms**

- **EVALUATION:** occasional and in-depth data collection for assessing outcomes, impact, and intervention strategy (e.g., its effectiveness).
- **IMPACT:** high-level objectives identified by stakeholders during the development of the investment plan (e.g. the project development objective).
- **INDICATORS:** information documenting the current state and any changes in activities, outputs, outcomes, or impact.
- **MONITORING:** continuous data collection tracking implementation of budgets and activities (planned vs. achieved).
- **OUTPUTS:** tangible products of project activities including trainings, publications, partnerships, new technologies, government policies, and infrastructure (e.g. weather stations).
- **OUTCOMES:** changes in behavior including knowledge, attitudes, and skills of stakeholder groups that result from project activities and outputs.
- **RESULTS FRAMEWORK:** a graphic summary and management tool detailing expected results from particular interventions, such as investments, development plans, or policies.
- **THEORY OF CHANGE:** a description or diagram of why and how the desired change and objectives will occur.

**5.2 Theory of Change**

**The CSAIP emphasizes improving the food and nutritional security of the population in Burkina Faso by sustainably increasing agricultural productivity and the resilience of food systems.** This includes agricultural and natural landscapes, infrastructure such as irrigation systems and cold chain, and stakeholders such as producers and value chain actors. The CSAIP emphasizes productivity and resilience because, firstly, the country's agriculture, forest, and land-use sector (AFOLU) has been a low contributor to global carbon emissions, and, secondly, the program is designed to address national food security and resilience priorities.

**This CSAIP also contributes to climate change mitigation, the third pillar of Climate-Smart Agriculture (CSA).** In Burkina Faso's original Intended Nationally Determined Contribution (INDC), the country committed to a 10% decrease in emissions associated with agriculture, land use, and forestry by 2030 primarily through sustainable land management and reforestation.<sup>120</sup> Later, in the Burkinabe Nationally Determined Contributions (NDCs), the country expressed commitments to voluntary national mitigation via co-benefits. This CSAIP acknowledges and works toward those national mitigation efforts. Many projects reflected in this CSAIP—particularly the ones focused on sustainable livestock intensification—will contribute to decreases in greenhouse gas (GHG) emissions per unit of product (known as GHG intensity). Investments in tree crops systems also sequester carbon and reduce emissions from farms and landscapes.

**These long-term benefits are embedded within the broader framework of the 2030 Agenda on Sustainable Development Goals (SDGs).** Improving productivity and food and nutrition security and increasing farmers' incomes and resilience will put Burkina Faso on target to achieve at least

<sup>120</sup> Government of Burkina Faso, 2015 (<https://www4.unfccc.int>)

six of the seventeen SDGs, which are also reflected in the National Plan for Economic and Social Development (PNDES) and its 14 sectoral policies.<sup>121</sup> This CSAIP increases impact in the six above-mentioned development areas, while the M&E Plan will support the government in harmonizing reporting systems related to global voluntary commitments (SDGs, NDCs) and national goals.

**Four key action areas can foster change in the short, medium, and long term:**

- Robust research and development (R&D)
- Stakeholder engagement and partnerships
- System-wide capacity to implement CSA
- Uptake of value chain-level practices and technologies

Robust R&D is needed to facilitate the introduction of improved varieties and breeds adapted to new climate conditions (especially to droughts and floods), while reliable, timely knowledge and information is critical for risk management. Stakeholder engagement and partnerships are required to foster concerted action, particularly in the areas of information exchange and learning and natural resource planning, management, and use. System-wide capacity (human, technical, institutional, and financial) is essential for implementing CSA actions (technologies, services, and policies) across the agricultural decision-making spectrum. On-farm actions that target production as well as value-addition and marketing technologies and strategies are crucial instruments for improving the resilience of the food system. These four key actions build on each other and form the core of this CSAIP's theory of change.

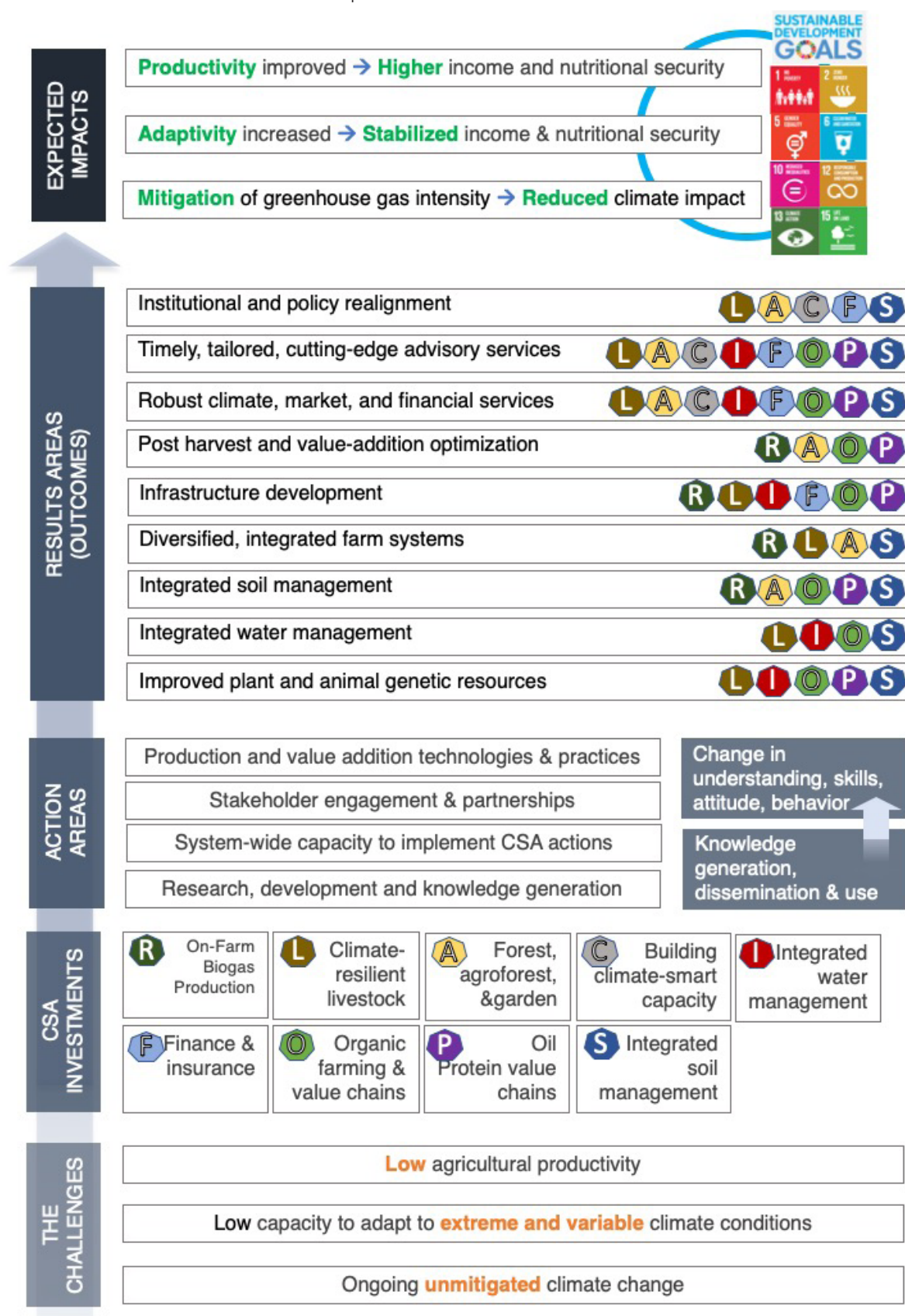
**The theory of change (TOC) assumes that increased use of CSA will be facilitated by knowledge development and dissemination and also by its accessibility and usability for end users (e.g. farmers, extension staff, private sector actors, and decision makers).** According to the TOC, use of relevant knowledge and timely information will lead in the short term to changes in attitudes, awareness levels, skills, opinions, and ultimately to changes in behavior, in the medium term to increases in productivity and incomes, and in the long term to improved food security, nutrition, and resilience.

**To strengthen the resilience of the agricultural system, change needs to happen at multiple scales, across sectors and landscapes, to meet development goals (Figure 20).** Transformation needs to occur at the level of farms, institutional policy, economic markets, and within the private sector. The CSAIP aims to work with diverse beneficiaries across the food system, located in different agroecological zones (AEZ) of the country (see Chapter 3). Investments are directed to crop farmers and livestock keepers, but also to smallholders engaged in aquaculture and to fisheries. The CSAIP also plans activities that affect the functioning of markets and value chains in the private sector, and it supports government institutions to establish the needed framework for CSA, through e.g., policy setting and implementation, research, knowledge development, and capacity building. This broad support ensures that all the major actors in the food system will benefit from the CSAIP, catalyzing transformative change.

<sup>121</sup> SDG 1 (No poverty), SDG 2 (Zero hunger), SDG 6 (Clean water and sanitation), SDG 12 (Responsible consumption and production), SDG 13 (Climate action), and SDG 15 (Life on land)

**Figure 20: CSAIP Investments Lead to Benefits at Multiple Levels**

The key action areas apply to all nine investments, enabling different types of outcomes. Outcomes are investment-specific. Medium-term and long-term changes (outcomes and impacts, respectively) contribute to the attainment of multiple SDGs.



## 5.3 Results Framework and Core Indicators

**The results framework forms a core component of the CSAIP M&E Plan and is built from fundamental data about farm, household, and value-chain activities.** It tracks productivity, resilience, and adaptive capacity and quantifies adaptation and mitigation benefits from program investments. This approach allows it to be extended to agricultural interventions outside the CSAIP. It includes core indicators agreed upon by investment stakeholders that need to be collected and monitored at national and regional (investment zone) levels and reported on a regular basis. Each project will be monitored separately using guidelines established at its inception, along with key performance indicators (KPIs) and targets. Various types of indicators will be reflected in the Results Framework, to suggest the different objectives of M&E activities—tracking implementation progress, adaptive project management, and evaluation of outcomes and impacts. There are three types of indicators that track different scales:

- *Output indicators:* linked directly with portfolio investment activities and more easily tracked
- *Outcome indicators:* closely—but not exclusively—related to project activities
- *Impact indicators:* measuring change in the broader goals and providing insights toward the end of a five-year (or longer) project lifespan

**A consultation process informed the development of this M&E guide.** Consultations in the form of semi-structured interviews and focus groups were carried out with staff at four CSAIP implementing ministries: the Ministry of Agriculture and Water Resources (MAAH), the Ministry of Animal and Fishery Resources (MRAH), the Ministry of Water and Sanitation (MEA), and the Ministry of Environment, Green Economy and Climate Change. Consultations were also undertaken with the World Bank and the West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), a key partner in the CSAIP design process. These stakeholders provided critical input and support in three main areas:

- Establishing the scope of the M&E guidelines
- Determining investment-level elements to be monitored and evaluated
- Providing general direction on how CSAIP M&E will be carried out, based on current M&E system(s) available

Table 24 and Table 26 provide examples of output-level, outcome, and impact indicators relevant for the nine portfolio investments.

**Output indicators are directly tied to project activities.** Different investments may involve similar project activities, so the indicators, and how they are measured, would be similar. A complete list is prepared when the investments are being developed and as part of the M&E system design. Data for output indicators is typically collected through the Project Management Information System (PMIS), which can be coordinated with existing information systems under the Ministry of Agriculture.

**Table 24** Sample Output-Level Indicators

Project	Sample Indicators
<b>Sustainable management of water resources and irrigation</b>	<ul style="list-style-type: none"> <li>• Management committee(s) established for dams to coordinate and supervise planning and use of water and land resources in the area (number)</li> <li>• Actions undertaken to protect water bodies and water banks (e.g., tree planting, agroforestry, livestock corridors, etc.) (number, type)</li> <li>• Production infrastructure established for aquaculture and fisheries production (e.g., basins, cages, etc.) (number, type)</li> <li>• Improved crop varieties released number, type)</li> <li>• Farmers provided with technical assistance on adequate use of inputs for aquaculture and crop production (fingerlings, improved feed, organic fertilizers, etc.) (number, type)</li> <li>• Farmers provided with technical assistance on improved CSA production practices and technologies (e.g., systems of rice intensification, using water pumps and sprinklers, crop diversification, etc.) (number)</li> </ul>
<b>Sustainable on-farm biogas production</b>	<ul style="list-style-type: none"> <li>• Domestic biodigesters installed (number)</li> <li>• Farmers provided with technical assistance on management and use of organic residues for biogas and fertilizer production, including biodigesters (number)</li> </ul>
<b>Sustainable intensification of livestock production</b>	<ul style="list-style-type: none"> <li>• Farmers provided with technical assistance on sustainable livestock intensification (number)</li> <li>• Equipment and facilities for sustainable livestock intensification installed (irrigation for fodder production, water ponds, fattening units) (number, type)</li> <li>• Livestock markets (physical infrastructure) established and/or improved (number)</li> <li>• Animal vaccine production units created (number)</li> <li>• Extension agents trained in adequate use of animal vaccines (number)</li> </ul>
<b>Forest, agroforest, and garden production for climate-smart diversification</b>	<ul style="list-style-type: none"> <li>• Community-based park management committee established (y/n)</li> <li>• Reforestation activities carried out (number, type)</li> <li>• Nutritional or productive trees planted (shea tree, baobab, gum arabic, moringa) (number, type)</li> <li>• Non-timber forest product (NTFP) transformation units established (number)</li> <li>• Communal nutritional gardens established (number)</li> <li>• Communal harvest storage facilities established (number)</li> </ul>
<b>Building capacity in CSA</b>	<ul style="list-style-type: none"> <li>• Staff trained in agricultural impact evaluation (vegetation inventories, use of satellite images, early-warning systems using climate information) (number)</li> <li>• Equipment for measurement of water levels purchased (type, value)</li> <li>• Open-source platform that integrates climate and agricultural information established</li> <li>• Communication channels established to make information about weather, climate, and agriculture accessible to users (number and type of channels and users)</li> <li>• Training module on CSA elaborated and integrated into school curricula (universities and other specialized institutions)</li> <li>• CSA experimental areas established (number)</li> <li>• International scholarships for regional knowledge exchange on CSA set up (number, value)</li> </ul>
<b>Financial and insurance services to foster CSA</b>	<ul style="list-style-type: none"> <li>• Weather stations established (number)</li> <li>• Financial products developed for smallholder farmers (number, type)</li> <li>• Insurance products developed for smallholder farmers (number, type)</li> </ul>
<b>Developing climate-smart organic value chains</b>	<ul style="list-style-type: none"> <li>• Farmers receiving technical assistance on organic production of cotton, mangoes, or vegetables (number, type)</li> <li>• Product processing units established (number, type)</li> </ul>
<b>Developing resilient oil-protein value chains</b>	<ul style="list-style-type: none"> <li>• Farmers provided with technical assistance on CSA practices and technologies for oil-protein crops (sesame or leguminous), (number of farmers, crop type, practice type)</li> <li>• Product processing units established (number, type)</li> </ul>
<b>Integrated soil management for agricultural productivity and environmental restoration</b>	<ul style="list-style-type: none"> <li>• Farmers receiving technical assistance on CSA practices for soil conservation or restoration (stone bounds, zai pits, farmer assisted natural regeneration, agroforestry, etc.) (number, type)</li> <li>• Infrastructure and equipment (tractors) for soil restoration, recovery, or conservation (number)</li> </ul>



**Outcome-level indicators require M&E systems to be in place and special studies as they are not reported on a routine basis.** Special studies can include baseline studies and follow-up longitudinal studies, national surveys, case studies introduced to routine M&E activities, and participatory beneficiary assessments (see Table 25). It is particularly important to evaluate farmers' opinions, changes in knowledge and behavior, and related factors.

**Table 25 Sample Outcome-Level Indicators**

Investment	CSA Pillar	Indicator and Measurement
<b>Outcome: Improved and/or Conserved Breeds</b>		
3	Productivity, Resilience	<ul style="list-style-type: none"> <li>Improved or conserved breed stock (percentage change by type of breed)</li> <li>Farmers using improved or local breeds (number or percent by type of breed)</li> <li>Public or public and private funding allocated to R&amp;D for breed improvement or conservation (percent change in funding allocated by type of breed)</li> </ul>
<b>Outcome: Improved Production Practices, Technologies, and Infrastructure</b>		
1, 2, 3, 4, 7, 8, 9, 10	Productivity, Resilience	<ul style="list-style-type: none"> <li>Community-based park management committee established (y/n)</li> <li>Reforestation activities carried out (number, type)</li> <li>Nutritional or productive trees planted (shea tree, baobab, gum arabic, moringa) (number, type)</li> <li>Non-timber forest product (NTFP) transformation units established (number)</li> <li>Communal nutritional gardens established (number)</li> <li>Communal harvest storage facilities established (number)</li> </ul>
<b>Outcome: Improved Post-Harvest Activities and Facilities, Enhanced Marketing Conditions</b>		
3, 4, 7, 8	Productivity, Resilience	<ul style="list-style-type: none"> <li>Farmers engaged in value addition activities (number or percent by activity type and value chain)</li> <li>Unit cost for transportation of agricultural products (US\$)</li> <li>Distance to markets (kilometers)</li> </ul>
<b>Outcome: Improved Access to Water for Agriculture</b>		
1, 10	Productivity, Resilience	<ul style="list-style-type: none"> <li>Farmers using water-harvesting technologies for crops, livestock, or fish (number or percent, by technology and purpose)</li> <li>Increased crop area under irrigation (percentage change)</li> <li>Increased area under sustainable aquaculture (percentage change)</li> </ul>
<b>Outcome: Improved Access to Clean, Affordable Energy Sources</b>		
2	Productivity, Mitigation	<ul style="list-style-type: none"> <li>Farmers using domestic biogas for biogas and/or fertilizer production (number or percent)</li> <li>Decreased consumption of fossil fuels for farm and household energy demands (percent change)</li> <li>Money spent on farm and household energy consumption (US\$ per year)</li> </ul>
<b>Outcome: Improved Ecosystem Service Delivery</b>		
3, 4	Productivity, Resilience, Mitigation	<ul style="list-style-type: none"> <li>Decreased soil erosion rates (percentage change)</li> <li>Improved soils: changes in soil physical indicators (texture, aggregation, moisture, porosity), chemical makeup (C, N, mineral nutrients, organic matter), and biological indicators (microbial biomass C and N, biodiversity, soil enzymes, soil respiration, etc.) (percent)</li> <li>Area under sustainable communal grazing system (hectares)</li> <li>Farmers with access to sustainable communal grazing systems (number or percent)</li> <li>Farmers with access to improved fodder or legume seeds (number or percent)</li> <li>Farmers with access to communal, nutritional gardens (number or percent)</li> </ul>

**Outcome: Sustainably Intensified, Diversified, Integrated Farming Systems**

<b>1, 3, 4, 8</b>	Productivity, Resilience	<ul style="list-style-type: none"> <li>• Area under sustainable livestock intensification (hectares)</li> <li>• Area under agricultural diversification (hectares, by diversification type and products included)</li> <li>• Farmers using diversification practices on their farms (number or percent)</li> <li>• Farmers using integrated farm systems (crop-livestock, crop-trees, crop-livestock-trees, fish-poultry, etc.) (number or percent, by type of system)</li> </ul>
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**Outcome: Strengthened Institutions and Policies to Enable CSA Actions**

<b>1, 3, 4, 10</b>	Productivity, Resilience	<ul style="list-style-type: none"> <li>• Improved planning, supervision, and coordination of water and land resources in dam areas (number of meetings per year, number of decisions taken per year, number of cases solved per year)</li> <li>• Improved management of NTFP parks (number of committee meetings per year, number of decisions taken per year, number of cases solved per year)</li> <li>• National action plan for managing climate-related risks to animal health developed and implemented</li> </ul>
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**Outcome: Strengthened Capacity to Implement CSA Actions and Manage Climate Risks**

<b>1, 2, 3, 5, 6, 7, 8, 9</b>	Productivity, Resilience	<ul style="list-style-type: none"> <li>• Number of qualified extension staff</li> <li>• Ratio of extension agents to farmers or farmer groups (by farmer type, crop/livestock type)</li> <li>• Value chain activity /production (units)</li> <li>• Post-harvest efficiency (units)</li> <li>• Number of client contacts per extension agent</li> <li>• Beneficiaries of digital-based extension services (number, by beneficiary type and digital tool)</li> <li>• Quality rating of service or technical capacity by beneficiary (qualitative assessment)</li> <li>• Increase in funding for extension services (US\$)</li> <li>• Quality rating of CSA training modules by beneficiary (qualitative assessment)</li> <li>• Number of students with access to CSA experimental sites</li> <li>• Farmers using financial instruments and insurance services to fund their farm activities (number or percent)</li> </ul>
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**Investments Key:**

<b>1</b>	Water management	<b>2</b>	Organic residues
<b>3</b>	Sustainable livestock intensification	<b>4</b>	Non-timber forest products and nutritious gardens
<b>5</b>	Capacity building for CSA	<b>6</b>	Financial and insurance products
<b>7</b>	Organic farming (cotton, mango, vegetables)	<b>8</b>	Oil protein crops (sesame, leguminous)
<b>9</b>	Restoration of degraded lands and soil conservation	<b>10</b>	Surface water mobilization

**Impact indicators are broader in scope and refer to larger societal changes.** Various actors in Burkina Faso already collect relevant data for measuring and analyzing the impact of agricultural interventions. Much necessary data for the sample impact indicators below can be found in agricultural censuses such as the Recensement Général de l'Agriculture, the National Nutritional Survey or Enquête Nutritionnelle Nationale, the Standardized Monitoring and Assessment of Relief and Transition Survey, and donor reports such as Nutrition Profiles of the United States Agency for International Development [USAID] and the Food and Agriculture Organization of the United Nations [FAO], etc.). See Table 26.

**Table 26** Sample Impact Indicators

Impact Indicator	Suggested Measurement(s)
<b>Impact: Improved Productivity and Food and Nutrition Security</b>	
<b>Productivity</b>	<ul style="list-style-type: none"> <li>• Harvested crop yield per hectare (per CSAIP agricultural commodity)</li> <li>• Gap between actual and potential yields, calculated as: <math>(1 - \text{actual} / \text{potential}) \times 100</math> (percent)</li> <li>• Yield variability under varying conditions (yield time series, kilogram per hectare)</li> </ul>
<b>Nutrition of the population</b>	<ul style="list-style-type: none"> <li>• Population suffering from stunting (number or percent by age group, sex)</li> <li>• Population underweight (number or percent, by age group, sex)</li> <li>• Population suffering from wasting (number or percent, by age group, sex)</li> <li>• Population suffering from anemia (number or percent, by age group, sex)</li> </ul>
<b>Food security of the population (availability, accessibility, utilization, stability)</b>	<ul style="list-style-type: none"> <li>• Prevalence of food insecurity (percent, by type)</li> <li>• Crop losses during storage, calculated as: loss rate per time period x amount stored (percent)</li> <li>• Dietary diversity and food frequency (Food Consumption Score [FCS], Household Dietary Diversity Scale [HDDS], spending on food, US\$ per year)</li> <li>• Consumption behavior (Coping Strategy Index [CSI], Household Food Insecurity and Access Scale [HFIAS])</li> </ul>
<b>Impact: Increased Farmers' Incomes and Climate Resilience</b>	
<b>Income</b>	<ul style="list-style-type: none"> <li>• Average farm income (US\$ per year)</li> <li>• Value of crop, livestock, or fish on local market (US\$)</li> </ul>
<b>Farm resilience to food insecurity</b>	<ul style="list-style-type: none"> <li>• Resilience capacity index (Food and Agriculture Organization of the United Nations Resilience Index Measurement and Analysis – II [FAO-RIMA II])</li> <li>• Increased representation of women in food and nutrition activities at community level (USAID resilience goal for Burkina Faso)</li> </ul>

**Box 5.2** Aspects of a Comprehensive M&E Plan for the CSAIP

**WHY:** Determine the scope of the M&E Plan. Describe how data will be used and by whom and how it will impact policymaking and decision-making in general (including international reporting processes). Setting the scope is an essential first step, as it helps define the breadth of indicators required and the information systems that will need to be put in place or adapted.

**WHO:** Clearly delineate roles and responsibilities. This refers to defining which institutions will be responsible for different M&E activities, how responsibilities are divided, and staff and qualifications required to carry out M&E activities (from data collection to cleaning, analysis, reporting, dissemination, coordination, etc.). Establishing clear procedures for regular flow of information between decentralized implementation units and a central M&E unit will be essential for a smooth execution of the Plan.

**WHAT:** Determine information and data that need to be collected. This section of the CSAIP provides guidance on the initial design of the M&E, furnishing a first appraisal of potential opportunities for Burkina Faso. Next, the list of indicators should be refined and aligned to the needs of information users and the objectives outlined in each project. To define these objectives, additional consultations with investment stakeholders and M&E staff from existing governmental departments are required to ensure participation, alignment, and coordination.

**HOW:** Establish procedures and methodologies for M&E. Determine what methods and sources will be used to gather, analyze, and report data; how the PMIS will manage data flow across levels and institutions; and when data needs to be collected and reported in terms of frequency. Baseline data should ideally be available at project appraisal, but, if not, arrangements for collection of baseline data in the first year of the project should be spelled out in the M&E Plan. Tools for established procedures and guidelines may include an annual work plan and budget for M&E, planning and tracking tools, an M&E calendar, and standard progress reports and quarterly reports, among others.

**RESOURCES:** Carry out an initial capacity assessment with CSAIP stakeholders. Understand existing capacities at all levels (local, regional, national) in terms of established M&E systems, staffing, strengths, and weaknesses. Lay out additional training, technical assistance, and other inputs needed to strengthen M&E capacity for the CSAIP. This ensures a results-based reporting approach throughout the CSAIP implementation period.

## 5.4 Next Steps

**Several steps are needed to develop a comprehensive, nationally integrated information system for measuring and reporting progress in implementing CSA,** based on a recent multi-country analysis.<sup>122</sup> Additional information is needed to outline the components of the M&E Plan, including: establishing the scope of the M&E activities, outlining roles and responsibilities of participating institutions, defining tools for implementation, establishing data management protocols, and refining logistics. These actions, adapted to Burkina Faso's context, are summarized in Box 5-2. They pertain to assessment of resources required for M&E setup and implementation, defining the space for the M&E system, and ensuring long-term sustainability.

**Refining indicators is a necessary step.** To make it actionable, the CSAIP M&E system should strike a balance between what is ideal and practical in terms of costs and time. The total number of indicators included needs to be reasonable and reflect the project's theory of change and also the resources available to track them periodically. Applying SMART criteria (Specific, Measurable, Attainable, Relevant and Timely) when selecting the indicators will help shorten the list, ensuring the relevance and usability of the system. Ideally, the final list of prioritized impact, outcome, and output indicators should be developed by project component and contain clear targets (defined in terms of time, quantity, and quality). The list should be gender-disaggregated where possible.

**Data from various sources can be combined and used.** The CSAIP M&E system will need to draw on data from various sources, including project management information systems (PMIS), national data sets, and other studies. PMIS are typically based on regular project implementation reports and provide data on inputs (e.g. number of extension staff), outputs (e.g. farmers trained) and initial outcomes (e.g. adoption rates of CSA technologies). National statistics are typically used for assessing long-term outcomes (5-10 years or more), while special studies and participatory evaluations are good sources for qualitative information (changes in attitudes, knowledge, behavior, wellbeing levels, etc.). Rapid rural appraisals and case studies are designed to provide targeted information in a cost- and time-effective way and can be an additional source of M&E data for CSAIP projects.

**Leveraging existing information systems can quickly start the process.** M&E systems embedded in different ministries and agencies working on agriculture and climate change in the country already contain a wealth of information relevant to CSA investments. All major policies lay down objectives and targets concerning aspects of productivity, food security and nutrition, and sustainable natural resource management. Examples of such policies include the Sectoral Policy for Agro-silvo-pastoral Production, the Rural Development Strategy, the National Policy for Food and Nutrition Security, the National Policy for Sustainable Development, and the National Environmental Policy, among others. Information systems are embedded within sectoral ministries but also within larger coordination bodies, such as the information system for food security under the Executive Secretariat of the National Council for Food Security (SE/CSNA) or the M&E framework under the Permanent Secretariat for the Coordination of Agricultural Sector Policies (SP/CPSA).<sup>123</sup> Table 5-2 illustrates how CSAIP M&E is relevant and aligned to key national strategies, plans, and programs and their results frameworks. Exploring synergies between the CSAIP and existing information systems will be a key step not only for improved coordination and alignment and for effective resource allocation, but also for harmonizing reporting processes (national, regional, and international).

<sup>122</sup> Nowak et al., 2019.

<sup>123</sup> SP/CPSA is a key actor for M&E of the rural sector. It is an inter-ministerial structure mandated to ensure coordination, coherence, implementation, and M&E of agriculture sector policies and strategies. It also promotes multi-stakeholder dialogue on rural development, among other functions. It is formed of representatives in the ministries whose work falls within the scope of rural development, including the Ministries of Agriculture, Livestock and Fisheries, Water Resources, and Environment and Climate Change.

**Existing policies and institutions provide opportunities for basing CSAIP M&E on established, legitimate structures, rather than creating new ones.** The National Programme for Rural Development (PNSR) is the country's reference framework for agricultural and food policies and the main vehicle for operationalizing Comprehensive Africa Agriculture Development Programme (CAADP) commitments. It also establishes a governmental mechanism for M&E of food and agricultural investments under PNSR, lays out key performance indicators, designates M&E roles and responsibilities for the main institutions that produce the bulk of agricultural and food data in the country, and recommends M&E methods and tools to use for data collection, analysis, reporting, and dissemination.<sup>124</sup> Embedding CSAIP M&E into existing infrastructure like this will avoid multiplication of structures and mechanisms, guarantee continuity and sustainability of efforts, and utilize available human, material, and financial resources for greater efficiency.

**Clearly defining roles and responsibilities is integral to CSAIP M&E.** Even when using already established institutional structures and information flow mechanisms, roles and responsibilities need to be spelled out. Ideally, the CSAIP M&E system would be embedded within the SP/CPSA, with relevant directorates in line ministries and field offices carrying out routine monitoring. An M&E coordinating team would operate through the decentralized framework of the CSAIP, support and coordinate M&E staff at the project and district levels, and assist with their training. The coordinating team would also provide the necessary technical support and would be responsible for regular reporting to stakeholders, for tracking and documenting implementation progress, and for performance and outcome evaluation. Regular data collection would mostly fall under extension officers' mandates, while district-level cleaning, analysis, and reporting to the M&E coordination team would be undertaken by district-level M&E officers.

**Strengthening permanent M&E capacity.** A robust, functioning M&E system will require adequate investment in staffing, including human resources and skills training. A study assessing capacities and gaps in investment planning, implementation, and M&E of PNSR programs revealed that the low quantity of human resources and quality of their skills, as well as inadequate funding at all levels (local, regional, and on the level of national coordination), prevents the smooth functioning of the current system (Table 27). Moreover, more than 50% of PNSR institutions do not have a formal M&E system, even if they produce periodic M&E reports, while efforts to disseminate their data and information especially to non-state actors were insufficient due to inadequate funding for such activities.<sup>125</sup> The CSAIP M&E system needs to take stock of lessons learned from similar processes and build on them in order to ensure its operability and sustainability.

<sup>124</sup> For instance, there is an established multi-level information flow among: PNSR beneficiaries (population); M&E systems of PNSR sub-programs and line ministries that organize data collection and analysis and prepare initial reports; General Directorates of Studies and Statistics (DGESs) of line ministries which ensure production and dissemination of all internal M&E documents within the ministry; the coordination body that summarizes all reports (SP/CPSA); and higher decision-making bodies (the National Committee for Guidance and Piloting, the Chief of Party, and the Inter-ministerial Technical Committee, CTI).

<sup>125</sup> Yameogo and Bako, 2014 (<https://www.ifpri.org/node/15569>)

**Table 27 National CSA Strategies and Programs and Expected Outcomes**

Selected Policy Objectives (PO) Relevant to Major CSAIP Outcomes and Investments	Existence of M&E Plan with Indicators
<b>National Programme for the Rural Sector II, 2016-2020 (PNSR)</b>	
<p>Focus Area 1: Food and nutrition security and resilience of vulnerable populations</p> <p>1.1: Sustainable development of agricultural production</p> <p>1.2: Food and nutritional crisis risk management and mitigation</p> <p>1.3: Irrigation systems</p> <p>1.4: Animal health and public safety</p> <p>1.5: Development of aquaculture and fishery systems</p> <p>Focus Area 2: Access to markets and competitiveness of agro-silvo-pastoral and aquaculture products</p> <p>2.1: Agricultural economy</p> <p>2.2: Productivity and competitiveness of livestock products</p> <p>Focus Area 3: Environmental governance, promotion of sustainable development, and management of natural resources</p> <p>3.1: Environmental governance and sustainable development</p> <p>3.2: Sustainable management of forest resources and fauna</p> <p>3.3: Green economy and climate change</p> <p>3.4 Sustainable management of pastures</p> <p>Focus Area 4: Water, sanitation, and living environment</p> <p>4.1: Water resource mobilization</p> <p>4.2: Integrated water resource management</p> <p>Focus Area 5: Land security and strengthened human capital in the rural sector</p> <p>5.1: Land security, agricultural vocational training, and rural organization</p> <p>5.2: Scientific and technological research</p>	<p>Yes, including output, outcome, and impact indicators and baseline values. PNSR I (2011-2015) lays out an implementation guide with defined roles and responsibilities for M&amp;E across the concerned ministries, with SP/CPSA spearheading M&amp;E activities at the national level.</p>
<b>National Climate Change Adaptation Plan, 2015 (NAP)</b>	
<p>Agriculture sector:</p> <p>Overall objective: Increase the resilience of family farms through climate change adaptations.</p> <p>O1: Restore the fertility of degraded soils.</p> <p>O2: Improve access for farmers to high-quality agricultural production factors (equipment, inputs, land, agricultural research outcomes, etc.).</p> <p>O3: Increase stakeholder resilience to climate change.</p> <p>O4: Develop early warning systems to ensure efficient management of variability and climate change.</p> <p>Livestock farming sector:</p> <p>O1: Improve the security of pastoralism through better dissemination and promotion of information about pastoral resources and relevant access conditions.</p> <p>O2: Improve protection of animal capital to provide sustainable support for the pastoralist economy and improve stakeholder resilience with a view to sustainable food security.</p> <p>O3: Reduce the climate vulnerability of pastoralist farmers and promote local economic development.</p> <p>Environment and natural resources sector:</p> <p>O1: Increase ecosystem productivity and resilience.</p> <p>O2: Improve biodiversity conservation.</p> <p>O3: Improve ecological research and monitoring.</p> <p>O4: Mitigate greenhouse gas emissions.</p> <p>Energy sector:</p> <p>O1: Reduce the use of wood energy by promoting alternative energies such as butane and biogas and by promoting the use of agricultural residue biomass.</p>	<p>Yes, a results-framework for the agriculture and livestock sectors. Responsibilities rest with the Permanent Secretariat of the National Council for the Environment and Sustainable Development (SP/CONEDD), which is tasked to review overall implementation progress and to run a database with performance indicators. M&amp;E focal points in the ministries covered by the Action Plan are expected to work closely with SP/CONEDD in updating the database periodically.</p>

## National Plan for Economic and Social Development, 2016-2020 (PNDES)

EA 2.1.2: The nutritional status of the population, especially women and children, is improving.  
 EA 3.1.2: The resilience of at-risk agropastoral, wildlife, and fishery households is strengthened.  
 EA 3.5.1: The environment and natural resources are managed sustainably.  
 EA 3.5.2: Mitigation and adaptation to the adverse effects of climate change are reinforced with a view to transitioning to the green economy.

Yes, including baseline values for indicators. The M&E framework provides reporting formats at various levels: global, national, regional, and sectoral.

## National Priorities for Resilience, 2016-2020 (Priorities Resilience Pays, PRP)

General objective: By 2035, poverty rates will be reduced significantly, livelihoods will be securer, and food and nutrition security will be sustainably improved.

Pillar 1: Improve social protection and secure livelihoods of communities and vulnerable households.

Pillar 2: Improve nutrition for vulnerable households.

Pillar 3: Sustainably improve agricultural productivity, raise the income of the most vulnerable populations, and increase their access to food.

- 3.1. Intensify agro-silvo-pastoral and aquaculture production.
- 3.2. Sustainably develop agricultural and pastoral water management systems.
- 3.3. Strengthen links between producers and markets.
- 3.4. Improve the income of vulnerable populations.
- 3.5. Improve land security in rural areas.
- 3.6 Combat desertification and adapt to the effects of climate change.

Pillar 4: Strengthen governance of food and nutrition security.

Yes, with clear targets and baseline values for suggested indicators. Technical and administrative supervision of the PRP is led by ministries linked to the rural sector (agriculture, water and sanitation, livestock and fishery resources, and environment and climate change), and the ministries linked to health, education, and infrastructure.

# Annex A: Prioritized Investment Opportunities

## A.1 Sustainable On-Farm Biogas Production

### PROJECT SUMMARY

**PROJECT HIGHLIGHT:** Generates fertilizer and clean cooking fuel from on-farm resources, protecting forests and reducing costs and labor.

**OBJECTIVE:** Increase access to and knowledge of sustainable domestic energy sources to conserve wood resources, reduce greenhouse gas (GHG) emissions, and reduce poverty, food insecurity, and health threats to rural communities.

**PROJECTED BENEFICIARIES:** 65,000

**REGIONS:** National

**CLIMATE-SMART AGRICULTURE (CSA) PILLARS ADDRESSED:** Adaptation, Production

**KEY CSA INVESTMENT ACTIVITIES:**

- Create a sustainable source of on-farm energy and fertilizer production using readily available residues.
- Bolster research and development capacity for sustainable on-farm energy production technologies.
- Raise public awareness of the benefits of sustainable energy production and use.

### JUSTIFICATION

**Burkina Faso's energy supply is characterized by dependence on fossil fuels, very low use of renewable energies, and low and inequitable access to electricity.**<sup>126</sup> As of 2017, about 20% of the national population had some degree of access to electricity services, and only about 15% had reliable electricity access. There is a notable disparity between urban areas, where over 66.5% of the population has some degree of electricity access, and rural areas, where just 3.2% of people have at least limited access.<sup>127</sup>

**Biodigesters are an alternative method of energy production that require minimal infrastructure, inputs, and maintenance.** Biodigesters are enclosed, normally stone or brick structures, that anaerobically decompose manure, plant residues, and food waste into methane gas. This biogas can then be piped to a cooking stove.

**Biodigesters are highly complementary to farm production.**<sup>128</sup> Biodigesters leverage on-farm resources to help reduce household fuel and fertilizer costs in terms of both time and money. Biodigester inputs include crop residues and livestock manure. Unlike fossil and biomass fuels (e.g. wood, charcoal, dry dung), these inputs are readily available on-farm as a by-product of crop and livestock production. Importantly, using crop residues and manures for biogas production does not preclude their utility as fertilizers. To the contrary, the biodigestion process converts raw plant residues and manure into nutrient-rich compost that can be applied directly to gardens and fields to improve soil structure, fertility, and water hold capacity. This process, in turn, supports improved crop

<sup>126</sup> Ministère des Mines et de l'Energie, "Politique Sectorielle de l'Energie 2014-2025."

<sup>127</sup> Direction générale des études et des statistiques sectorielles, "Annuaire Statistique 2016 Du Ministère de l'Energie."

<sup>128</sup> World Bank, "The Power of Dung."



productivity and reduces the need to purchase fertilizer. A 6 cubic meter biodigester can produce 20 tons of compost annually.<sup>129</sup> In some cases, producers value this compost even more than the biogas.<sup>130</sup>

**Biodigesters also have tangible environmental benefits.** Unlike biomass and fossil fuels, biogas does not produce particulate matter air pollution. And unlike wood fuel, it does not involve felling trees or clearing vegetation. As such, biogas does not carry the human health implications or high GHG emissions associated with biomass and fossil fuel use. Improved public health is strongly associated with improved work productivity, quality of life, and positive economic outcomes. When used in place of biomass or fossil fuels, each biodigester reduces CO<sub>2</sub>e emissions by 3.62 tons annually.<sup>131</sup>

**Land tenure, robust extension, and finance services are essential to the success of sustainable energy production solutions.** It is unreasonable for farmers who do not have tenure on their land to make long-term investments in infrastructure such as a biodigester.<sup>132</sup> Strong extension services help prepare farmers with best practices for using on-farm energy production systems. Training and certifying specialists in the construction and maintenance of energy production systems supports job creation and sustainability.<sup>133</sup> High quality finance services for smallholders are also crucial.<sup>134</sup> Training without financing often results in increases in knowledge without changes in behavior.<sup>135</sup> One high-potential option is the existing micro-finance environmental credit line, which could be expanded to cover biodigesters relatively easily. Burkinabe banks are also considering partial risk guarantees that would allow them to offer favorable terms on micro-credit services.<sup>136</sup>

**The Burkinabe national government is invested in equitable energy access.** To rectify ongoing energy access issues, the national government began undertaking energy sector reforms in 2000.<sup>137</sup> Most recently, the government has established the National Biogas Program in coordination with the Dutch national government for large-scale installment of biodigesters.<sup>138</sup> The Burkinabe government is subsidizing the technology to improve accessibility for poor households. Estimates on the number of Burkinabe households that could benefit from a biodigester (that is, which have sufficient manure access and are still primarily reliant on biomass or fossil fuel energy sources) vary from 220,000 to 800,000.<sup>139</sup>

**There is also significant international support for biodigester programs in Burkina Faso.** For example, the United Nations Clean Development Mechanism has issued the first carbon credits in Burkina Faso, which have been purchased by the World Bank's Carbon Initiative for Development (Ci-Dev). Ci-Dev will purchase 540,000 certified emission reductions through 2024; this revenue stream will lower the price of biodigesters and extend their warranties.<sup>140</sup>

**Synergy with other energy programs will help maximize the impacts of biodigester solutions.** Large dam projects also hold considerable promise in terms of increasing the energy supply in rural

<sup>129</sup> Borgen Project, "Biodigesters Reduce Indoor Air Pollution in Burkina Faso."

<sup>130</sup> World Bank, "The Power of Dung."

<sup>131</sup> Borgen Project, "Biodigesters Reduce Indoor Air Pollution in Burkina Faso."

<sup>132</sup> World Bank, "Burkina Faso Access to Irrigation for Cotton Farming."

<sup>133</sup> Borgen Project, "Biodigesters Reduce Indoor Air Pollution in Burkina Faso."

<sup>134</sup> Anang and Awuni, "Effect of Training on Small Scale Rice Production in Northern Ghana."

<sup>135</sup> Balana et al., "Economic and Food Security Effects of Small-Scale Irrigation Technologies in Northern Ghana."

<sup>136</sup> World Bank, "Support to the National Biodigester Program."

<sup>137</sup> Ministère des Mines et de l'Énergie, "Politique Sectorielle de l'Énergie 2014-2025."

<sup>138</sup> Borgen Project, "Biodigesters Reduce Indoor Air Pollution in Burkina Faso."

<sup>139</sup> World Bank, "Support to the National Biodigester Program."

<sup>140</sup> Borgen Project, "Biodigesters Reduce Indoor Air Pollution in Burkina Faso."

areas. Coordination between dam and biodigester programs could help maximize reach by targeting regions outside of hydropower infrastructure for biodigester installation.

## PROBLEM STATEMENT

**Energy access in rural areas is extremely limited and may worsen.**<sup>141</sup> Demand for electricity services has been growing as the economy diversifies. But supply has not kept pace with demand, and prices are consequently rising, further excluding most households by pricing them out of the market.<sup>142</sup>

**Biomass remains the primary energy source for over 80% of Burkinabe households.**<sup>143</sup> Wood comprises 86% of household energy consumption,<sup>144</sup> as well as the bulk of the national energy balance.<sup>145</sup> Approximately 105,000 hectares are deforested annually in Burkina Faso to meet the demand for wood fuel; about 46% of the national territory now suffers from soil degradation as a result. This makes domestic energy consumption a major source of deforestation, air pollution, and GHG emissions on the national level. Where wood is scarce, dried cattle dung—which emits even higher rates of pollution and GHGs—is often the next best alternative.<sup>146</sup>

**Indoor pollution due to open biomass fires is one of the top 10 most significant threats to public health worldwide.** The particulate matter released from open biomass fires can be extremely detrimental to human health, particularly when indoors. Ongoing exposure to open biomass fires poses significant health risks. This is an especially severe threat to women and children, who tend to spend the most time collecting fuel, tending fires, and preparing meals. Burkina Faso is one of the top 21 countries most heavily impacted by this issue. Nationwide, there are about 16,500 deaths annually due to indoor air pollution.<sup>147</sup>

**Biodigester systems pose some challenges.** Although biodigesters relieve the burden of purchasing or collecting fossil or biomass fuel, they exacerbate the burden of either collecting fresh manure from primarily extensive livestock systems or converting to intensive livestock management. Producers must also have consistent access to a large amount of manure—the yield of at least 3 cows—in order to employ a biodigester effectively. This requisite excludes the poorest and most vulnerable members of the community. Wild harvesting of vegetation to compensate for a lack of manure and crop residues for biogas production could exacerbate environmental degradation. Finally, biodigesters are very beneficial in terms of cooking, heating, and composting. However, they do not power in-home lighting, electro-domestics, water pumps, technology solutions, and other basic services made possible by electricity. As such, while on-farm biogas production is an important step in terms of health, economic improvement, and sustainability, it should not ultimately be considered a substitute for affordable, reliable electricity services.

## ECONOMIC AND FINANCIAL ANALYSIS

### ESTIMATED IMPACTS

- **Improved:** rural energy access, on-farm compost resources for improved soil quality and production

<sup>141</sup> World Bank, "The Power of Dung."

<sup>142</sup> Ministère des Mines et de l'Energie, "Politique Sectorielle de l'Energie 2014-2025"; Direction générale des études et des statistiques sectorielles, "Annuaire Statistique 2016 Du Ministère de l'Energie."

<sup>143</sup> Kampmann and Thiombiano, Atlas de La Biodiversité de l'Afrique de l'Ouest, Tome II.

<sup>144</sup> Borgen Project, "Biodigesters Reduce Indoor Air Pollution in Burkina Faso."

<sup>145</sup> Ministère de L'Environnement, de l'Economie Verte et du Changement Climatique, "Plan Décennal d'action En Matière d'environnement et de Cadre de Vie (PDA/ECV)."

<sup>146</sup> Kampmann and Thiombiano, Atlas de La Biodiversité de l'Afrique de l'Ouest, Tome II.

<sup>147</sup> Borgen Project, "Biodigesters Reduce Indoor Air Pollution in Burkina Faso."

- **Reduced:** GHG emissions, deforestation and land degradation, household expenses, family health risk exposures, household reliance on external inputs

## ESTIMATES OF IMPACTS: PRODUCTION, RESILIENCE, EMISSIONS

For the tables below, values are the percentage change with and without project.

**Table A-1.1: Financial Analysis**

Values derived from the Compendium and other secondary sources

Mean No. Beneficiaries	Change in Yield (%)	Mean NPV (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
<b>With Climate and Pest Risks</b>					
65000	45	-1.5	32	-0.09	-0.02 (0.66)
<b>Without Climate and Pest Risks</b>					
65000	45	16.9	51	0.3	0.23 (0.83)

**Table A-1.2 Financial Analysis**

Values derived from Evidence for Resilient Agriculture (ERA) and other secondary sources

Change with On-Farm Energy Production			
Technology	Yield	Gross Returns	Costs
<b>On-Farm Energy Production</b>			
<b>Rice</b>			
Organic Fertilizer	71.3 (8.5)	16.9	51
Improved Varieties	11.6 (27.9)		
<b>Maize</b>			
Organic Fertilizer	80.6 (5.1)	56.4 (12.3)	38.4 (4.3)
Improved Varieties	29.8 (9.6)	8.8 (15.8)	6.9 (2.8)
<b>Sorghum</b>			
Organic Fertilizer	79.9 (5.8)		
Improved Varieties	31.1 (7.8)		
Household	10.0		
<b>Mean of All Technologies</b>	<b>45.4 (28.4)</b>	<b>51.3 (61.4)</b>	<b>47.2 (31.4)</b>

**Table A-1.3 Values for Estimating the Number of Beneficiaries**

Investment	Budget (US\$, billions)	Cost per Beneficiary (US\$)
On-Farm Energy	55.00	846

**ESTIMATED PROJECT COSTS:** Project costs were based on average cost per beneficiary following a typology of investments' cost effectiveness derived from expert opinion. Investments typically range between US\$200-900 per beneficiary (see Annex E). Outside this range, the project is either unrealistic (if on the low end) or not cost efficient (if above the high end).

## CLIMATE MODELING

The crops that were modeled as part of the biogas climate change scenario were millet, sorghum, and rice. Production of all these crops except rice is assumed to do worse under climate change. CSA actions will make all three crops more resilient, with higher yields.

Crops	Baseline Values	Low Emissions		Medium Emissions		High Emissions	
	2018	2030	2050	2030	2050	2030	2050
	YIELD: Percent Change from No Climate Change Scenario						
	Yield (TM)						
CER-Millet	1545.3	0.35	0.45	-1.55	-3.26	-1.46	-3.09
CER-Rice	89.2	-0.71	-1.45	0.11	0.03	1.15	2.27
CER-Sorghum	2141.3	-4.3	-8.6	-4.14	-8.17	-5.01	-9.88
	AREA: Percent Change from No Climate Change Scenario						
	Area (Ha)						
CER-Millet	1484.28	0.83	1.43	0.45	0.68	1.13	2.06
CER-Sorghum	1657.07	-0.55	-1.22	-0.46	-0.95	-0.28	-0.62
CER-Rice	55.90	1.19	2.41	1.54	2.97	2.16	4.40

## ENABLING ENVIRONMENT

**NDC Alignment:** This project aligns with the Nationally Determined Contribution (NDC) Land Management goals of sustainable solar, wind, and biogas energy production, and with the Agriculture and Water goals of manure as fertilizer and forest management. NDC components are presented in the table below.

Strong Alignment		Partial Alignment				
Renewable Energy		Improved Farming Technologies, Conservation Agriculture			Managing and Conserving Soils and Fertility	
Little or No Alignment						
Water Conservation, Irrigation Management	Governance Reform	Post-Harvest Handling and Processing	Livestock and Aquaculture Productivity	Information Management, Advisory Services	Restoring Forests, Agroforestry	Financial Services

EXISTING ASSETS FOR PROJECT SUCCESS

### EXISTING ASSETS FOR PROJECT SUCCESS:

- Strong demand for energy services
- Inputs (crop residues and manure) already available
- Short- and long-term cost and labor savings
- Complementary to forestation and soil fertility programming
- Opportunity to coordinate with dams project and other energy programming
- Many sources of funding, foundational knowledge, and lessons learned
- Established carbon credits program for biodigesters
- Excellent alignment with national and international policy environment

### EXISTING BARRIERS TO SUCCESS:

- Labor burden of collecting manure from extensive livestock systems
- Poorest households excluded by livestock ownership requirement
- Insufficient manure availability, which might exacerbate land clearing
- Potential lack of buy-in if electricity becomes available by other means (e.g. dam hydroelectricity)

### RELEVANT POLICIES:

- Politique Sectorielle de l'Energie 2014-2025<sup>148</sup>
- Plan décennal d'action en matière d'environnement et de cadre de vie (PDA/ECV)<sup>149</sup>
- Plan National de Développement Economique et Social
- Environmental Code

<sup>148</sup> Ministère des Mines et de l'Energie, "Politique Sectorielle de l'Energie 2014-2025."

<sup>149</sup> Ministère de L'Environnement, de l'Economie Verte et du Changement Climatique, "Plan Décennal d'action En Matière d'environnement et de Cadre de Vie (PDA/ECV)."

- Programme National du Secteur Rural Phase 2
- Stratégie de Croissance Accélérée et de Développement Durable (SCADD)<sup>150</sup>

**KEY POLICY GAPS:** Regulation to ensure reliable provision and accessible pricing of domestic electricity services

**KEY POLICY DISTORTIONS:** There is good national policy alignment with biodigester programming.

**KEY DIGITAL AGRICULTURE TECHNOLOGIES:**

- Remote sensing, drones, GPS, and GIS to indicate optimum regions for targeted biodigester programming
- Mobile finance services, along with digitized farm records, to identify high-potential biodigester candidates and support credit line establishment
- Smart contracting for transparent and equitable land tenure processes
- Mobile extension services, enabled by big data, machine learning, and mobile technology, to support optimum biodigester use and output use

## SYNTHESIS OF IMPLEMENTATION EXPERIENCE AND BEST PRACTICE

**Relevant projects provide a strong knowledge base and lessons learned. Current projects include:**

- **National Biodigester Program**<sup>151</sup> to increase the use of biodigesters in rural households, through the Netherlands Development Organisation (SNV) with support from the World Bank and Burkina National Government, from 2010-2024. World Bank support began in 2016 with US\$6.60 million. 8000 biodigesters were installed, 4700 with support of World Bank, and 300 masons were trained in biodigester construction. Phase II aims to construct an additional 18,200 biodigesters, at least 30% of these with microcredit. The goal of this project is to install 40,000 biodigesters by 2024.
- **Energizing Development (EnDev)**<sup>152</sup> to enhance access to more sustainable, energy-efficient, and reliable power supplies, and to increase usage of modern cooking stoves among 1.6 million people. This project is funded by GiZ from 2005-2021 (amount undisclosed).
- **Projet de Développement et de Vulgarisation de Technologies de Biodigesteurs Domestiques pour les Ménages Urbains et Ruraux**
- **Programme National de Biodigester du Burkina Faso (PNB-BF)**

## KEY INSTITUTIONAL ARRANGEMENTS AND POTENTIAL COLLABORATORS

- **Public Institutional Framework:** Ministries of: Energy; Animal Resources; Agriculture; Higher Education, Scientific Research, and Innovation; Environment, Green Economy, and Climate Change
- **Potential NGO Collaborators:** Africa Biogas Partnership Program (ABPP), German Development Organization (GiZ)

## FINANCING

- **Public Financing Opportunities:** Environmental Intervention Fund, National Biogas Program
- **Private Financing Opportunities:** Banque Agricole du Burkina Faso (Agricultural Bank of Burkina)

<sup>150</sup> UNESCO, "Stratégie de Croissance Accélérée et de Développement Durable (SCADD)."

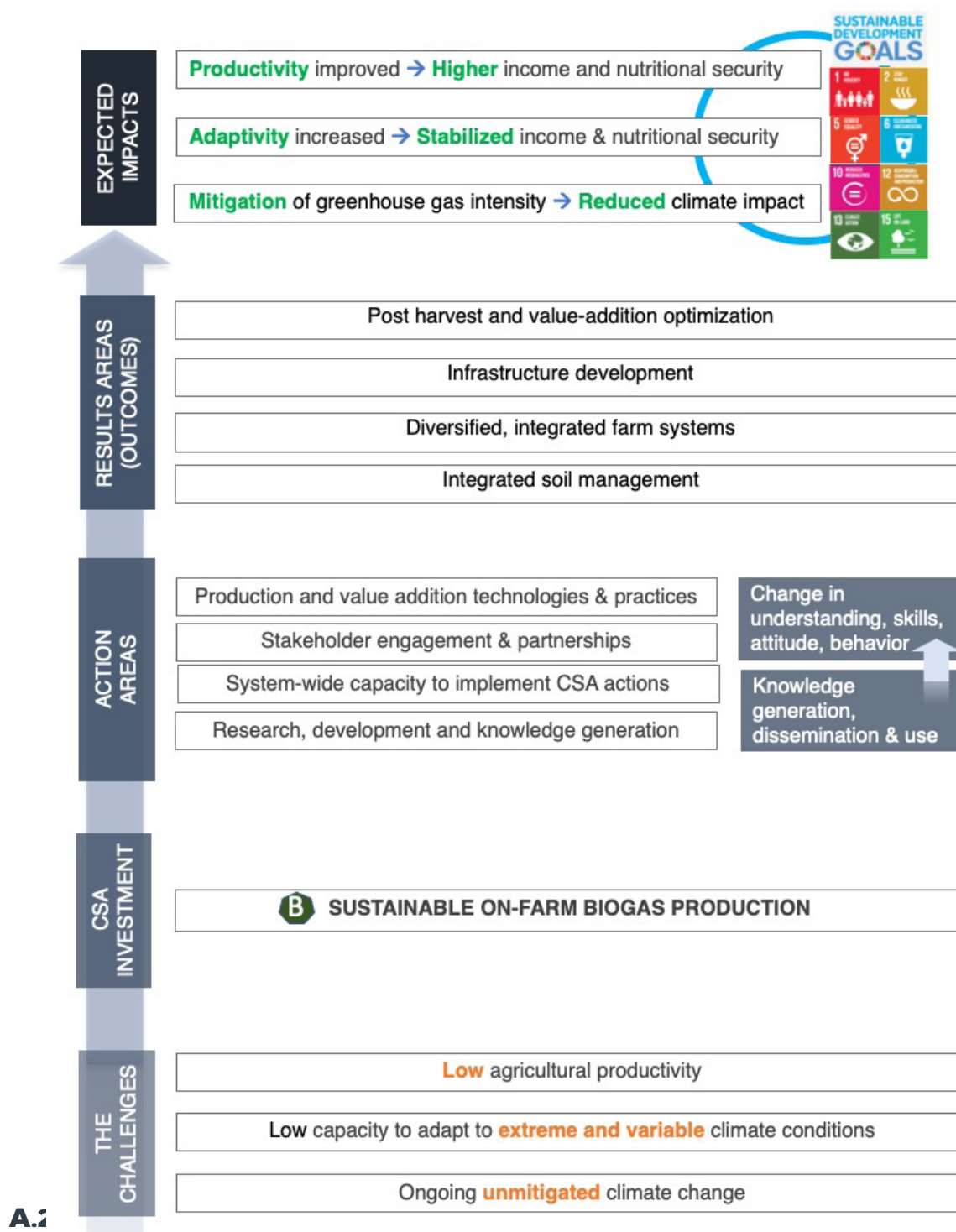
<sup>151</sup> World Bank, "Support to the National Biodigester Program"; SNV, "Africa Biogas Partnership Programme (ABPP)."

<sup>152</sup> giz, "Energising Development (EnDev) – Programme for Energy Access."

Faso)

- **Potential Private Sector Collaborators:** Institut International d'Ingénierie de l'Eau et de l'Environnement (2iE)
- **International Financing Opportunities:** Global Environment Fund, Green Climate Fund, World Bank's Carbon Initiative for Development, United Nations Clean Development Mechanism, African Development Bank (AfDB)

## THEORY OF CHANGE



## PROJECT SUMMARY

### PROJECT HIGHLIGHT:

- Increase income and nutritional security and diversification.
- Promote a 38% improvement in livestock productivity for 150,000 farm households.
- Reduce conflict between pastoralists and sedentary producers.
- Reduce greenhouse gas (GHG) intensity and mitigate agricultural expansion.

**OBJECTIVE:** Foster climate resilience in Burkinabe livestock systems for improved nutritional security and economic outcomes.

**CLIMATE-SMART AGRICULTURE (CSA) PILLARS:** Adaptation, Production, Mitigation

**PROJECTED BENEFICIARIES:** 150,000

**REGIONS:** National

### KEY CSA INVESTMENT ACTIVITIES:

- Conservation and selection of local cattle breeds
- Control of emerging and re-emerging animal diseases related to climate change
- Establishment of agroforestry-based fodder stands
- Full crop-livestock system integration
- Establishment of pastoral infrastructure and equipment, such as water reservoirs and livestock corridors
- Capacity building in livestock intensification

## JUSTIFICATION

**Smallholder livestock production in sub-Saharan Africa is closely intertwined with climate change.** The livestock sector is a significant contributor of global GHG emissions, primarily through ruminant digestive emissions and expansion of grazing lands. Developing economies account for about ⅓ of livestock emissions, or 12% of total global emissions.<sup>153</sup> Sub-Saharan Africa is a hotspot of emissions intensity due to low animal productivity and lower animal health.

**Burkina Faso is an agropastoral country.** The livestock sector contributes about 18% of GNP, accounts for 26% of exports, and constitutes a source of income for nearly 80% of the population.<sup>154</sup> (See Figures SL-1 and SL-2.) Livestock typically range freely in the dry season and are kept tethered, sometimes with feed supplementation, in the wet season. Very few households have stands of browse plants like *Leucaena leucocephala*, mucuna, pigeon pea, acacia, or *Gliricidia sepium*.

**CSA reduces the environmental impacts of livestock systems and makes livestock systems more resilient in the face of climate change.** Climate-smart livestock systems improve productivity with better breeds, disease prevention, integrated crop-livestock systems, and improved water and shade resources.<sup>155</sup> Animal manure is used to produce biogas and to improve soil fertility.<sup>156</sup> Crop residues can be used as fodder. Fodder stands of highly nutritious legumes, such as pigeon pea and mucuna, further supplement livestock diets.<sup>157</sup> Improved livestock nutrition increases survival rates, as well as improving the quality and quantity of animal products such as milk, meat, and hides.<sup>158</sup>

### Figure A-2.1 Livestock Head in Burkina Faso<sup>159</sup>

<sup>153</sup> Amole and Ayantunde, "Climate-Smart Livestock Interventions in West Africa: A Review."

<sup>154</sup> Ministère des Ressources Animales, "Politique Nationale de Développement Durable de l'Élevage (PNDEL) Au Burkina Faso."

<sup>155</sup> Williams et al., "Agriculture Climate Smart Facing the African Context."

<sup>156</sup> FAO, "Climate-Smart Livestock Production."

<sup>157</sup> Best Practices Note, "Selecting Legumes as Green Manure/Cover Crops."

<sup>158</sup> IFAD, "Overview."



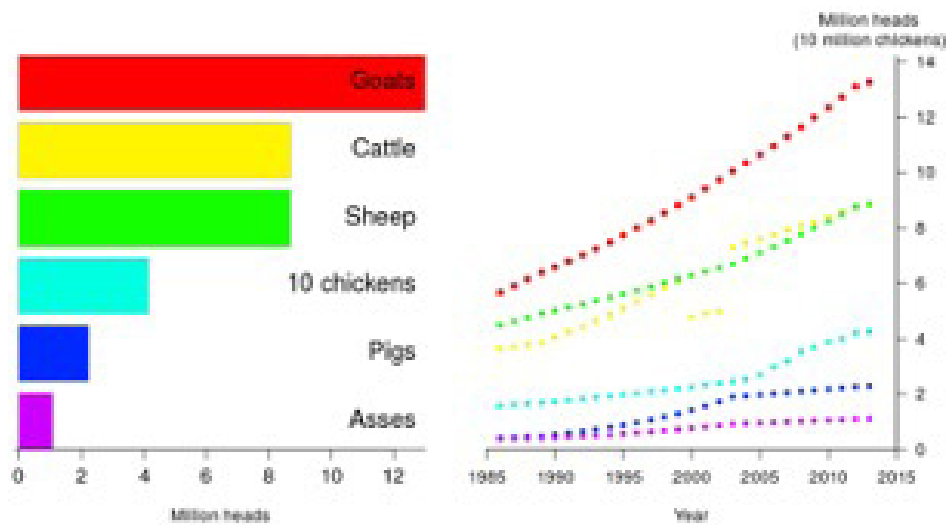
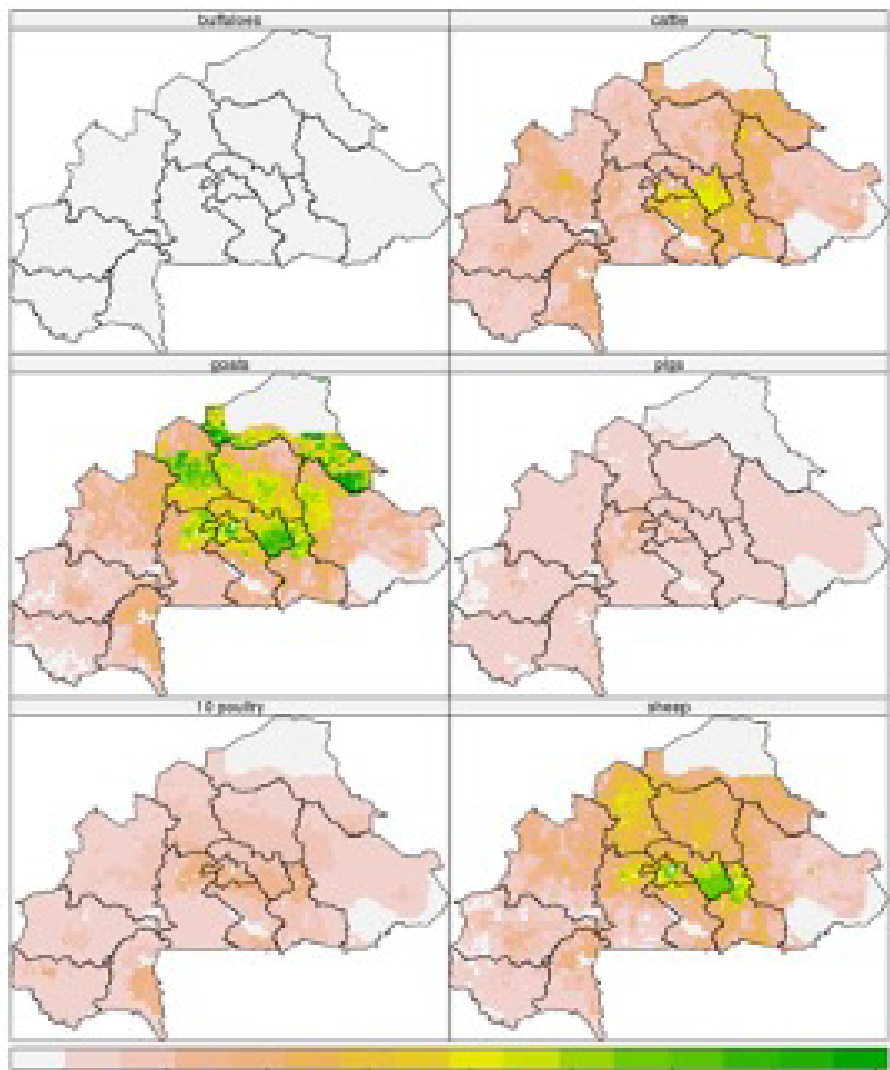


Figure A-2.2 Livestock head per square kilometer in Burkina Faso<sup>159</sup>



The diversity of integrated crop-livestock production systems makes them synergistically more

<sup>159</sup> Beal et al., "Country Profiles."  
<sup>160</sup> Beal et al.



**productive and resilient than either system alone.**<sup>161</sup> Sustainable intensification of crop and small ruminant systems offers significant benefits to Burkinabe smallholders.<sup>162</sup> Small ruminants have short gestation periods, high prolificacy, rapid growth rates, high feed conversion efficiency, high disease-resistance capacity, and easy marketability.<sup>163</sup> Small ruminant manure is also an important alternative source of fertilizer with similar chemical characteristics to synthetic fertilizer.<sup>164</sup>

**Improved varieties of ruminants offer significant potential in terms of resource use efficiency and climate resiliency.**<sup>165</sup> Existing technologies in livestock management, breeding, and health could sustainably develop the livestock industry to close the animal protein gap.<sup>166</sup> Heat stress is the most detrimental factor for the economy of small ruminant production. HSF1, HSP70, HSP90, THR, and NOS can act as biomarkers to identify indigenous breeds of sheep and goats with high heat resilience for gene therapy.<sup>167</sup>

**Water reservoirs are crucial to maintaining livestock in dry areas.** Small reservoirs are constructed to capture and store run-off from upstream. This storage of water resources is essential to building water security in the driest regions of Burkina Faso. While reservoirs are primarily used for livestock, they can also help irrigate fodder banks and vegetable gardens. During dry periods, purposeful management of water resource access is necessary to avoid conflict.<sup>168</sup>

**Livestock corridors can help build resiliency for pastoralists in search of pasture and water resources.** Cross-border mobility may be particularly important as pastoralists avoid areas affected by livestock disease or engage in trade. Conflicts between farmers and pastoralists have become recurrent as natural resources grow increasingly scarce.<sup>169</sup> The Economic Community of West African States, including Burkina Faso, has passed legislation for international livestock corridors, but these have yet to be put into operation.<sup>170</sup>

**Establishing corridors can be very helpful to smallholder producers.** When establishing corridors, it is crucial to weigh benefits and costs, consider the effect of corridor establishment on competing land uses (particularly farming), understand the need for and means of protecting the corridors, and identify the appropriate authority to establish and protect the corridors. There is a noteworthy distinction between groups that view the primary function of the corridors as protecting local farms, and those that view them as enabling pastoralist movement.<sup>171</sup>

**Fodder production can support improved feed quality, health outcomes, and productivity.** Agroforestry-based forage production offers multiple production, adaptation, and mitigation benefits. Forage trees offer nutrition crucial to livestock health and productivity, particularly during the long dry season. Organic matter inputs from tree leaves and livestock manure improve soil quality, which in turn supports crop and tree productivity. Trees provide habitats for beneficial insects that control pests. Trees also protect crops and livestock from direct sun, strong winds, high evaporation rates,

<sup>161</sup> Villano, Asante, and Bravo-Ureta, "Farming Systems and Productivity Gaps"; Asante et al., "Determinants of Farm Diversification in Integrated Crop-Livestock Farming Systems in Ghana."

<sup>162</sup> van Wijk, Yameogo, and Ayantunde, "Assessment of the Potential Food Security Benefits of Increased Income from Crops, Livestock and off-Farm Employment in Burkina Faso."

<sup>163</sup> Sejian et al., "Genes for Resilience to Heat Stress in Small Ruminants."

<sup>164</sup> Ansah et al., "Manure Characteristics of Small Ruminants Fed Agro By-Products in the Guinea Savannah Agro-Ecological Zone of Ghana."

<sup>165</sup> Crookston et al., "How Do You Know 'Resilience' When You See It?"

<sup>166</sup> Ibeagha-Awemu et al., "Leveraging Available Resources and Stakeholder Involvement for Improved Productivity of African Livestock in the Era of Genomic Breeding."

<sup>167</sup> Sejian et al., "Genes for Resilience to Heat Stress in Small Ruminants."

<sup>168</sup> Ayantunde, Cofie, and Barron, "Multiple Uses of Small Reservoirs in Crop-Livestock Agro-Ecosystems of Volta Basin."

<sup>169</sup> Okhimamhe et al., "Climate Variability Adaptation Strategies."

<sup>170</sup> Alidou, "Cross-Border Transhumance Corridors in West Africa."

<sup>171</sup> Kitchell, Turner, and McPeak, "Mapping of Pastoral Corridors."

and extreme temperatures. Agroforestry additionally provides fuelwood, nutritional diversification, and income diversification through non-timber forest products.<sup>172</sup> Tree growth also mitigates climate change by sequestering carbon. Most agroforestry practices, including farmer-managed natural regeneration, require minimal labor, input costs, and training.<sup>173</sup>

## PROBLEM STATEMENT

**The Burkinabe livestock sector has consistently low productivity.** This comes as a result of extensive farming practices<sup>174</sup> exacerbated by a burgeoning population,<sup>175</sup> suboptimal livestock feeding, recurrent animal diseases, unimproved breeds, and poor market access.<sup>176</sup> The government has responded to these issues with strong policy support for livestock intensification, and smallholders have also adopted crop-livestock integration to some extent. However, rapid intensification, inconsistent system integration, and climate change impacts have taken their toll, resulting in rapid soil and environmental degradation.<sup>177</sup>

**Livestock producers are highly exposed to unpredictable climate extremes and variability as a result of climate change.**<sup>178</sup> Precipitation variability makes the availability of forage and water unpredictable, affecting livestock productivity and pushing pastoralists to travel longer distances and exploit more land in order to sustain their herds.<sup>179</sup> Droughts, floods, and extreme heat increase livestock mortality and destabilize markets.<sup>180</sup> Poor market access to inputs and financing, widespread animal disease despite the efforts of veterinary service providers,<sup>181</sup> and weak infrastructure further compromise the livelihoods of livestock farmers.<sup>182</sup> These issues intensify existing tensions between pastoralists and sedentary producers for natural resources.<sup>183</sup> These are grave threats to the nutritional security and economic viability of smallholders.<sup>184</sup> Burkina Faso is challenged to establish productive livestock systems that are climate-resilient to fight poverty and nutritional insecurity while also sustainably managing natural resources.<sup>185</sup>

**Opportunities for improvement in livestock production may have both positive and negative impacts on women farmers.** Women are traditionally in charge of fetching water, and higher producing animals typically consume more water. They are also responsible for milk production and sales; again, higher producing animals such as improved breeds generally produce greater quantities of milk. In addition, small ruminants, such as sheep and goats, and fowl, such as chickens and ducks, are typically owned and managed by women.<sup>186</sup> Careful community-based planning and prioritization is necessary to ensure that the responsibilities and benefits of such programs are equitably distributed

<sup>172</sup> Zougmore, CCAFS ICRISAT Africa Program Leader; Bamako, Mali.

<sup>173</sup> Ministère des Ressources Animales et Halieutique, "Plan National d'Adaptation (PNA) Aux Changements Climatiques Du Secteur de l'Élevage Burkina Faso."

<sup>174</sup> Vall et al., "Co-Design of Innovative Mixed Crop-livestock Farming Systems in the Cotton Zone of Burkina Faso."

<sup>175</sup> Food and Agriculture Organization of the United Nations, "Burkina Faso."

<sup>176</sup> Ministère des Ressources Animales, "Politique Nationale de Développement Durable de l'Élevage (PNDEL) Au Burkina Faso"; Okhimamhe et al., "Climate Variability Adaptation Strategies."

<sup>177</sup> Vall et al., "Co-Design of Innovative Mixed Crop-livestock Farming Systems in the Cotton Zone of Burkina Faso."

<sup>178</sup> Government of Burkina Faso, "Burkina Faso National Climate Change Adaption Plan."

<sup>179</sup> GiZ, "National Investment Plan for the Implementation of the Determined Contributions."

<sup>180</sup> Doumbia, "Changements Climatiques et Agriculture Intelligente En Côte d'Ivoire: Diagnostic Du Contexte National et Recueil Des Résultats de La Recherche Sur Les Facteurs Socio-Économiques Favorisant l'adaptation et Les Technologies Appropriées de l'AIC Chez Les Petits Agriculteurs."

<sup>181</sup> Ministère des Ressources Animales, "Politique Nationale de Développement Durable de l'Élevage (PNDEL) Au Burkina Faso"; Okhimamhe et al., "Climate Variability Adaptation Strategies."

<sup>182</sup> Williams et al., "Agriculture Climate Smart Facing the African Context."

<sup>183</sup> Ministère des Ressources Animales et Halieutique, "Plan National d'Adaptation (PNA) Aux Changements Climatiques Du Secteur de l'Élevage Burkina Faso."

<sup>184</sup> Enahoro et al., "Contributions of Livestock-Derived Foods to Nutrient Supply under Changing Demand in Low- and Middle-Income Countries."

<sup>185</sup> van Wijk, Yameogo, and Ayantunde, "Assessment of the Potential Food Security Benefits of Increased Income from Crops, Livestock and off-Farm Employment in Burkina Faso."

<sup>186</sup> Expert Panel Workshop, Crop-Livestock Integration Project Components.

across stakeholders.<sup>187</sup>

## ECONOMIC AND FINANCIAL ANALYSIS

### ESTIMATED IMPACTS

#### Production:

- Improved animal health
- Reduced risk of zoonotic diseases
- Improved crop and livestock productivity

#### Adaptation:

- Increased nutritional security and diversification
- Increased income and income diversification
- Reduced conflict between pastoralists and sedentary producers

#### Mitigation:

- Reduced GHG intensity
- Reduced agricultural expansion and environmental degradation

### ESTIMATES OF IMPACTS: PRODUCTION, RESILIENCE, EMISSIONS

**Table A-2.3** Livestock Cost Benefit Analysis with and without Climate Risks

Mean No. Beneficiaries	Change in Yield (%)	Mean NPV (million USD)	Chance Pos NPV (%)	ROI	BCR (SD)
<b>With Climate and Pest Risks</b>					
150,000	38	16.4	43	0.67	0.32 (6.35)
<b>Without Climate and Pest Risks</b>					
150,000	38	76.1	65	2.57	1.49 (6.70)

**Table A-2.4** Financial Analysis

Values are the percentage change with and without project. Values are derived from Evidence for Resilient Agriculture (ERA) and other secondary sources.

Change with On-Farm Energy Production			
Technology	Yield	Gross Returns	Costs
<b>Sustainable Livestock Intensification</b>			
<b>Cattle (Meat)</b>			
Improved Breeds	33.6 (6.4)		
Feed Supplementation	37.2 (5.8)	21.2 (1.1)	27.4 (12.6)
Feed Substitutions	6.0 (8.9)	12.4 (14.4)	-14.4 (8.4)
Improved Pasture	31.3 (2.6)		
Animal Health Improvement	50		
<b>Goats (Meat)</b>			
Improved Breeds	16.4 (6.0)		
Feed Supplementation	32.8 (9.1)	68.2 (5.1)	16.1 (48.6)
Feed Substitutions	9.6 (7.6)		1.0 (8.0)
<b>Sheep (Meat)</b>			
Improved Breeds	49.5 (3.8)		
Feed Supplementation	61.3 (19.1)	42.8 (12.5)	
Feed Substitutions	7.1 (5.3)		-9.1 (1.4)
Improved Pasture	9.7 (11.4)		

<sup>187</sup> Bayala et al., "Methodological Guide."

Cattle (Milk)			
Feed Supplementation	271 (7.3)		
Agroforestry Fodder Supplementation	32 (15)		
Improved Breeds	118.6 (44.5)		
Goats (Milk)			
Feed Supplementation	65.5 (36.7)		
Improved Breeds	<b>63.6 (12.3)</b>		
<b>Mean of All Technologies</b>	<b>38.3 (28.5)</b>	<b>36.2 (8.3)</b>	<b>4.2 (20.9)</b>

**Table A-2.5** Values for Estimating the Number of Beneficiaries

Investment	Budget (US\$, billions)	Cost per Beneficiary (US\$)
Sustainable Livestock Intensification	37.5	250

**ESTIMATED PROJECT COSTS:** Referring to the estimates of the NAPA, the overall amount of the project amounts to 24 billion 314 million CFAF (48 million US\$) for the realization of three Animal Production Intensification Zones (ZIPA) or about 8 billion 105 million CFAF per ZIPA.<sup>188</sup> Project costs were based on average costs per beneficiary following a typology of investments' cost effectiveness derived from expert opinion. Investments typically range between 200-900 US\$ per beneficiary (see Annex E).

## CLIMATE MODELING

**Table A-2.1** Projected Impact of Climate Change on Livestock Yields

Percentage difference in livestock yields over a no-climate change reference scenario for 2030 and 2050, under different GHG concentration scenarios (RCPs), with business-as-usual demographic and economic growth trajectories (SSP2).

Livestock	2018 Baseline Value (TM)	RCP4.5_SSP2		RCP6.0_SSP2		RCP8.5_SSP2	
		2030	2050	2030	2050	2030	2050
Beef	149.6	0.04	0.09	-0.02	-0.02	0.18	0.38
Lamb	89.4	0.08	0.14	0.05	0.09	0.15	0.28

**Table A-2.2** Net Trade Scenario Models in Livestock

Livestock	Net Trade Negative						Net Trade Positive					
	RCP4.5_SSP2		RCP6.0_SSP2		RCP8.5_SSP2		RCP4.5_SSP2		RCP6.0_SSP2		RCP8.5_SSP2	
	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050
Beef	-0.14	-0.19	0.02	-0.02	-0.54	-0.68						
Lamb							0.48	2.23	0.21	0.47	1.22	7.37

## ENABLING ENVIRONMENT : SITUATION ANALYSIS

**Alignment** of Livestock with Nationally Determined Contributions (NDC) Partnership Investments

<sup>188</sup> Ministère des Ressources Animales et Halieutique, "Plan National d'Adaptation (PNA) Aux Changements Climatiques Du Secteur de l'Élevage Burkina Faso."

Strong Alignment	Partial Alignment			
Livestock and Aquaculture Productivity	Improved Farming Technologies, CA	Governance Reform	Information Management, Advisory Services	Renewable Energy
Little or No Alignment				
Water Conservation and Irrigation Management	Management and Conservation of Soils and Fertility	Post-Harvest Handling and Processing	Restoring Forests, Agroforestry	Financial Services

#### RELEVANT POLICIES:<sup>189</sup>

- 2010-2015 National Sustainable Development Policy for Livestock
- Action Plan and Investment Programme for the Livestock Sector
- 2016-2020 National Plan for Economic and Social Development

#### KEY POLICY GAPS:

- Poor preservation of cattle genetic diversity
- Little or no access to crucial inputs (e.g. forage crop planting materials and improved breeds)
- Lack of financial and risk mitigation services, which might deter farmers from innovating

#### KEY POLICY DISTORTIONS:

- Land tenure
- Customary land rules in terms of pastoral area designation
- Inconsistent animal production and health services support systems available

#### KEY ASSETS FOR SUCCESS:

- Most smallholders already own livestock.
- Most also practice some degree of crop-livestock integration and agroforestry.
- Governmental policy supports livestock intensification.

#### KEY BARRIERS TO SUCCESS:<sup>190</sup>

- Pastoralists and farmers have competing interests.
- Using manure as fertilizer is labor intensive in extensive grazing systems.
- Land tenure insecurity dissuades farmers from investing in trees and soil.

**PUBLIC INSTITUTIONAL FRAMEWORK:** Ministries of Animal Resources; Directorate General of Animal Production; Directorate General of Veterinary Services; Institute of Environment and Agricultural Research; Ministry of Agriculture and Food Security; Ministry of Water, Hydraulic Facilities, and Sanitation; Ministry of Environment and Sustainable Development; Ministry of Scientific Research and Innovation; Ministry of Industry, Trade, and Handicrafts; Ministry of Territorial Administration and Security; Ministry of Health; Ministry of Economy and Finance

**POTENTIAL NGO COLLABORATORS:** L'Association Nodde Nooto (A2N), International Livestock Research Institute

#### KEY DIGITAL AGRICULTURE TECHNOLOGIES:

- Remote sensing, drones, GPS, and GIS for informing the establishment and management of corridors and water reservoirs

<sup>189</sup> Food and Agriculture Organization of the United Nations, "Burkina Faso"; Government of Burkina Faso, "Burkina Faso National Climate Change Adaption Plan"; Ministère des Ressources Animales, "Politique Nationale de Développement Durable de l'Élevage (PNDEL) Au Burkina Faso"; Ministère des Ressources Animales et Halieutique, "Plan National d'Adaptation (PNA) Aux Changements Climatiques Du Secteur de l'Élevage Burkina Faso."

<sup>190</sup> Vall et al., "Co-Design of Innovative Mixed Crop-livestock Farming Systems in the Cotton Zone of Burkina Faso."

- Internet of things and remote sensing for monitoring water resources
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support decision-making in the face of extreme weather events<sup>191</sup>
- Pest and disease early warning systems, enabled by weather stations, big data, machine learning, and mobile technology
- Mobile extension services, enabled by big data, machine learning, and mobile technology, to support best livestock practices and disseminate research and development innovations

## DELIVERY: SYNTHESIS OF IMPLEMENTATION EXPERIENCE AND BEST PRACTICE

**Related projects provide a strong knowledge base and lessons learned. Current projects include:**

- **First Fiscal Management, Sustainable Growth and Health Service Delivery Development Policy Operation**,<sup>192</sup> supported by the World Bank, 2019-2020, US\$50 million to increase livestock production and productivity through vaccination
- **Livestock Sector Development Support Project**,<sup>193</sup> supported by the World Bank, 2017-2022, US\$78.9 million for improving livestock producers' access to animal health services and high quality inputs to strengthen the efficiency and competitiveness of value chains for beef, small ruminants, milk, poultry, pigs, honey, and aquaculture products

**Past projects include:**

- **The Sahel Pastoralism Support Project (PRAPS-BF)**, to improve access to essential means and services of production and markets for pastoralists, as well as national response capacity for pastoral crises
- **Burkina Faso Livestock Sector Development Support Project (PADEL-BF)**, to enhance productivity and commercialization of non-pastoral animal products in selected value chains and strengthen national capacity to provide immediate and effective response in the event of a crisis
- **Le Projet de Développement de l'Élevage Dans la Région du Liptako-Gourma (PDEL-LG)**
- **Projet d'Amélioration de l'Élevage du Zébu Azawak et Gestion Durable des Ressources Naturelles (PARP)**
- **Emergency Livestock Feed Access Project**,<sup>194</sup> a World Bank project from 2013-2015, US\$2.85 million, to provide vaccines and veterinary products, rehabilitation of water points, procurement and distribution of quality feed supplements, feed shredder provision, and capacity building in food production using crop residues and other methods for improving animal production and health
- **Projet d'Appui à la Formulation d'un Programme de Sécurisation et de Valorisation des Espaces et Aménagements Pastoraux**
- **Projet d'Études d'Aménagement des Zones Pastorales**

## FINANCING DEVELOPMENT

**PUBLIC FINANCING OPPORTUNITIES:** Action Plan and Investment Programme for the Livestock Sector

**POTENTIAL PRIVATE SECTOR COLLABORATORS AND FINANCING OPPORTUNITIES:**

- Commercial producers of by-products commonly used as supplemental feed

<sup>191</sup> The World Bank Group, "Agriculture Observatory."

<sup>192</sup> The World Bank, "First Fiscal Management, Sustainable Growth, and Health Service Delivery Development Policy Operation."

<sup>193</sup> World Bank, "Livestock Sector Development Support Project."

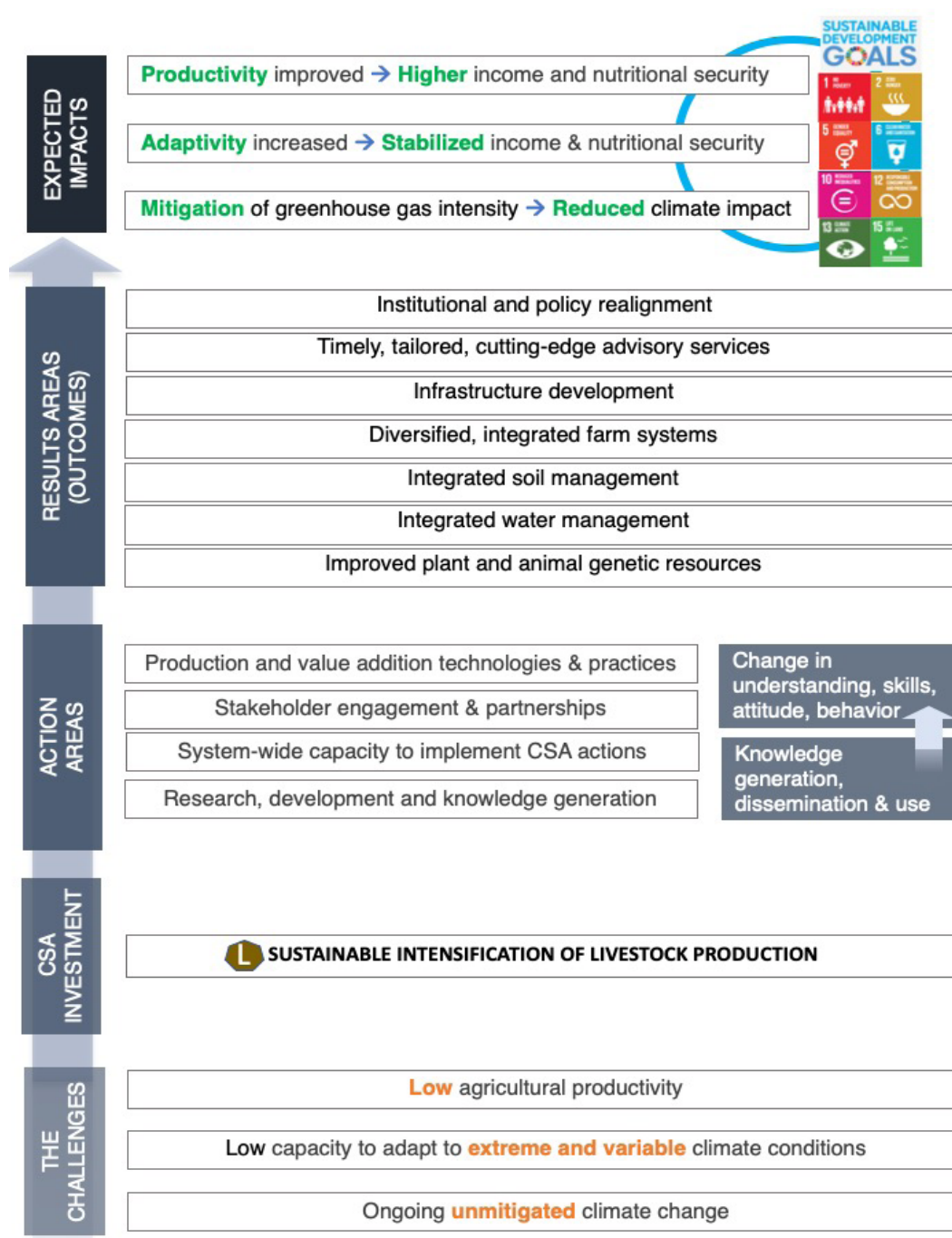
<sup>194</sup> The World Bank, "First Fiscal Management, Sustainable Growth, and Health Service Delivery Development Policy Operation."

- Providers of animal health services and artificial insemination
- Animal product processors

#### INTERNATIONAL FINANCING OPPORTUNITIES:

- The Economic Community of the West African States
- Global Environment Fund
- Green Climate Fund
- World Bank
- African Development Bank
- West African Development Bank.

#### THEORY OF CHANGE



## A.3 Financial And Insurance Services To Foster Climate-Smart Agriculture

### PROJECT SUMMARY

#### PROJECT HIGHLIGHT:

- Create a cost-efficient program to increase household yields by 19% across both crop and livestock systems, also increasing national GDP.
- Significantly increase farmers' ability to implement advisory recommendations and take innovation risks to improve productivity.
- Increase producer and sectoral resilience in the face of major events such as extreme weather.

**OBJECTIVE:** Foster smallholder ability to invest in climate-smart agriculture (CSA) innovations through good access to robust financial services, including credit and loan, insurance, and risk instruments, and savings and payment services.

**CSA PILLARS:** Adaptation, Production

**PROJECTED BENEFICIARIES:** 200,000

**REGIONS:** National

#### KEY CSA INVESTMENT ACTIVITIES:

##### Address issues hindering financial institution services in rural areas:

- Low economies of scale
- Poor financial performance indicators and norms compliance
- Low profitability and portfolio quality ratios
- Barriers to digitalization
- Lack of institutional capacity for consistent monitoring

##### Expand digital services in rural areas:

- Establish policy to ensure consumer protection and good practices.
- Optimize network coverage.
- Digitize producer records to support establishment of creditability.
- Digitize government records to support transparency and efficiency.

##### Broaden access to financial services by Burkinabe smallholders, including:

- Crop and livestock insurance and risk instruments
- Credit and financing
- Savings services
- Payment services

##### Build financial literacy of smallholders.

### JUSTIFICATION

**Financial services that enable entrepreneurship, risk-taking, and innovation are prerequisites to agricultural development.** In developing economies that are heavily reliant on agriculture, the risk and high volatility of the sector often translates into underperformance at the macro-economic level.<sup>195</sup> Widely accessible financial products and services enable agricultural producers and agribusinesses to transform the sector by leveraging collateral, decreasing transaction costs, and reducing risk.<sup>196</sup> Producers and other value chain actors are consequently abler and more willing to invest in inputs and other technologies that increase productivity and resilience. These may include improved seeds, soil amendments, diversification, agroforestry, digital technologies, advisory services, and other CSA

<sup>195</sup> WSBI-ESBG, "Africa Post Offices Give Migrants New Financial Network Access."

<sup>196</sup> Palmer, "Making Climate Finance Work in Agriculture"; Ruben, Wattel, and van Asseldonk, "Rural Finance to Support Climate Change Adaptation: Experiences, Lessons and Policy Perspectives"; Wattel and van Asseldonk, "Financial Service Supply with Potential for Supporting Climatesmart Agriculture Quick Scan around the CCAFS Climate-Smart Village AR4D Sites of the CGIAR-CCAFS Research Program in 20 Countries"; World Bank, "Atelier de Restitution, Diagnostic de Finance Agricole et Plan d'Action."



approaches. Such financial services include credit and financing, insurance and risk instruments, savings services, and payment services.

**Credit and financing services are crucial to implement advisory recommendations in order to improve resilience and productivity.** These services include input loans and credit, crop loans, value chain finance, equity investments, equipment loans<sup>197</sup> or leases, warehouse receipts, and group loans. Strong agricultural research and extension networks are the primary predictor of agricultural productivity growth in Sub-Saharan Africa,<sup>198</sup> accounting for 51% of productivity gains across the continent.<sup>199</sup> However, advisory services only improve farmers' outcomes<sup>200</sup> if they have the financial security to take the recommended risks in changing established practices.<sup>201</sup>

**Financial security is derived from access to robust credit and loan services, disposable income, collateral through safe harvest and capital storage, secure land tenure, and reliable market access.** Indeed, farmers with extensive social networks, many years of experience, large farm sizes, secure land tenure, good access to financial services, group memberships, and greater general knowledge are much more likely to participate in extension programs and to adopt new practices.<sup>202</sup> Digital producer profiling and record keeping demonstrates the credibility of producers for loan eligibility.

**Risk instruments sustain producers' ability to invest in the face of costly unforeseen events.** Farmers exposed to high risks, such as unpredictable weather, tend to hedge risk by planting low-value crops; this is an effective strategy for reducing potential losses, but also severely limits potential gains. On the other hand, farmers who are protected from major losses by risk instruments are much more likely to invest in higher-value crops, thus increasing their future income and climate resiliency.<sup>203</sup> Agriculture-specific risk instruments such as index-based insurance and disaster relief funds protect producers against major losses from, for example, extreme weather and disease outbreaks. Partial guarantee funds, warehouse receipts, and value chain finance enable producers to leverage their collateral and decrease creditor risk in lending to producers without a credit history.<sup>204</sup>

**General risk instruments, including social security services, funeral societies, health insurance, and life insurance protect producers against other costly, unexpected life events that can compromise their ability to continue investing time and money in their agricultural livelihood.**<sup>205</sup> Indirectly acquired risk instruments can also be effective; 22% of urban Burkinabe residents accepted the opportunity to purchase weather insurance for their rural relatives, and this percentage was nearly doubled when the option for direct payout to the beneficiary was made available.<sup>206</sup> Automatic payouts and mobile money result in significantly lower barriers to scalability of risk instruments.

**Savings services sustain and improve producers' ability to invest in CSA.** Planned savings and savings accounts result in savings security, and low-risk investments prevent loss of value due to

<sup>197</sup> Palmer, "Making Climate Finance Work in Agriculture"; Ruben, Wattel, and van Asseldonk, "Rural Finance to Support Climate Change Adaptation: Experiences, Lessons and Policy Perspectives"; Wattel and van Asseldonk, "Financial Service Supply with Potential for Supporting Climatesmart Agriculture Quick Scan around the CCAFS Climate-Smart Village AR4D Sites of the CGIAR-CCAFS Research Program in 20 Countries"; World Bank, "Atelier de Restitution, Diagnostic de Finance Agricole et Plan d'Action."

<sup>198</sup> International Food Policy Research Institute (IFPRI), "Public Agricultural Spending and Growth in Ghana."

<sup>199</sup> World Bank, "Transforming Agriculture for Economic Growth, Job Creation and Food Security."

<sup>200</sup> Innovations for Poverty Action, "Evidence for Agriculture in Ghana."

<sup>202</sup> Andres et al., "Social Network to Inform and Prevent the Spread of Cocoa Swollen Shoot Virus Disease in Ghana"; Danso-Abbeam, Ehiakpor, and Aidoo, "Agricultural Extension and Its Effects on Farm Productivity and Income."

<sup>203</sup> Stoeffler et al., "Policy Brief."

<sup>204</sup> Palmer, "Making Climate Finance Work in Agriculture"; World Bank, "Atelier de Restitution, Diagnostic de Finance Agricole et Plan d'Action."

<sup>205</sup> Wattel and van Asseldonk, "Financial Service Supply with Potential for Supporting Climatesmart Agriculture Quick Scan around the CCAFS Climate-Smart Village AR4D Sites of the CGIAR-CCAFS Research Program in 20 Countries."

<sup>206</sup> Kazianga and Wahhaj, "Will Urban Migrants Formally Insure Their Rural Relatives?"

inflation.<sup>207</sup> In-home cash savings, on the other hand, expose producers to loss from theft and misplacement. In addition, unlike low-risk investments, cash does not accrue interest, and thus loses value over time due to inflation.

**Payment services improve producers' ability to invest in CSA by eliminating the risks of cash and the costs of traveling.** Mobile money, utility bill pay, and transfer services enable producers to make and receive payments without investing time and money in traveling, and without the risk of cash loss or theft.<sup>208</sup> These services also facilitate secure and documented person-to-person capital flow, fostering local informal economies and financial exchange between distant family members.<sup>209</sup> Such digital records can also support the establishment of a line of credit for producers to enable loan eligibility.<sup>210</sup>

**Banks dominate the Burkinabe financial sector, with 13 banks accounting for 82% of assets.** Nonbank financial institutions remain small and underdeveloped; these include 2 leasing companies, 16 insurance companies, 2 pension funds, 1 guarantee fund, and 133 microfinance institutions in the country. The Burkinabe banking system is well-established, profitable, and growing faster than those of most other West African countries.

**Microfinance institutions, cooperatives, and rural banks constitute a good foundation to reach rural populations with diverse financial services.** The microfinance sector serves about 1.9 million people and accounts for 6% of the country's financial sector and 7% of total savings.<sup>211</sup> These organizations have established infrastructure, networks, and lessons learned with which to expand rural financial service availability. There are opportunities to increase efficiency and performance, expand coverage to leverage economies of scale, and utilize digital agriculture innovations to improve service.<sup>212</sup>

## PROBLEM STATEMENT

**Financial services in Burkina Faso disproportionately underserve smallholder farmers.** Less than 25% of Burkinabe residents have a bank account, less than 15% have a savings account, and less than 10% have been able to obtain a loan. Rural residents, women, and low-income individuals—that is to say, smallholder farmers—represent an outsized portion of those with constrained financial services access. About 20% of Burkinabe women have bank accounts, versus 27% of men, and only about 10% of the poorest 40% of the population has a bank account, versus 32% of the remaining 60% of the population. This also implies a generally low level of financial literacy among smallholders, and the need for financial literacy training alongside financial services access.<sup>213</sup>

**The agricultural sector is extremely underrepresented among financial service clientele.** Agriculture employs 80% of the Burkinabe population and accounts for about 25% of the national GDP. However, the agriculture sector receives only about 5% of credit. In contrast, commerce constitutes 12% of GDP and receives 29% of credit, and construction comprises 7% of GDP and receives 16% of credit.<sup>214</sup> Such

<sup>207</sup> Ruben, Wattel, and van Asseldonk, "Rural Finance to Support Climate Change Adaptation: Experiences, Lessons and Policy Perspectives"; Wattel and van Asseldonk, "Financial Service Supply with Potential for Supporting Climatesmart Agriculture Quick Scan around the CCAFS Climate-Smart Village AR4D Sites of the CGIAR-CCAFS Research Program in 20 Countries."

<sup>208</sup> CCAFS, "10 Best Bet Innovations for Adaptation in Agriculture: A Supplement to the UNFCCC NAP Technical Guidelines"; Wattel and van Asseldonk, "Financial Service Supply with Potential for Supporting Climatesmart Agriculture Quick Scan around the CCAFS Climate-Smart Village AR4D Sites of the CGIAR-CCAFS Research Program in 20 Countries."

<sup>209</sup> Palmer, "Making Climate Finance Work in Agriculture."

<sup>210</sup> International Monetary Fund, "Burkina Faso."

<sup>211</sup> World Bank, "Financial Inclusion Support Project."

<sup>212</sup> International Monetary Fund, "Burkina Faso."

<sup>213</sup> International Monetary Fund.

<sup>214</sup> International Monetary Fund.

chronic under-investing in the largest national employer and economic sector has grave implications for national economic growth and resilience. The Burkinabe Government has attempted to address this gross asymmetry with several government-established funds and a local guarantee company to supply finance to individuals and small- to medium-sized enterprises. To date, these organizations have struggled with mismanagement, inadequate reporting, long processing delays, and other issues.<sup>215</sup>

**Microfinance organizations' services have been well received in rural areas but remain limited in scale.** Microfinance organizations make up the vast majority of financial institutions. There are 6.95 microfinance branches per 100,000 adults in the country (versus 2.89 bank branches), and it takes an average of 30 minutes to reach the nearest microfinance branch.<sup>216</sup> Nevertheless, the microfinance sector remains underdeveloped due to low efficiency, unverified business practices, limited opportunities for economies of scale, and major barriers to leveraging digital solutions.<sup>217</sup> Despite serving nearly 2 million people and accounting for 7% of total national savings, microfinance's total assets stood at just 4.6% of total national assets in 2016. The sector regularly fails to comply with key profitability and portfolio quality ratios, suggesting weaknesses in operations and limiting its potential to make additional investments. Only about 20% of microfinance institutions are compliant with all norms and financial performance indicators. Microfinance institutions have consequently been withdrawing to urban areas in an effort to achieve improved business efficiency.<sup>218</sup>

**Mobile financial services offer a cost-efficient way for microfinance and other financial organizations to reach large numbers of rural clients.** At US\$6.7 million in 2017, Burkina Faso has the second-largest mobile money market in the West Africa Economic and Monetary Union.<sup>219</sup> Among the approximately 70% of the population with mobile phone service in 2017,<sup>220</sup> about half used mobile money services.<sup>221</sup> This indicates a strong demand for financial services among Burkinabe inhabitants. However, network coverage is inconsistent in rural areas, and this fact limits potential economies of scale from leveraging such services. Additionally, the government still primarily operates in cash, requiring citizens to travel to make or receive payments.<sup>222</sup>

**Promising supporting digital agriculture technologies include:**

- Mobile finance services, along with digitized farm records to support credit line establishment
- Smart contracting for transparent and equitable land tenure processes
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support management decisions<sup>223</sup>
- Insurance services, powered by big data, machine learning, mobile technology, and integration with climate information services
- Mobile peer-to-peer platforms, enabled by big data, machine learning, and mobile technology, to support knowledge exchange, input supply, middleman reduction, economies of scale, and product sales at fair market rates

<sup>215</sup> World Bank, "Financial Inclusion Support Project."

<sup>216</sup> World Bank.

<sup>217</sup> International Monetary Fund, "Burkina Faso."

<sup>218</sup> World Bank, "Financial Inclusion Support Project."

<sup>219</sup> World Bank.

<sup>220</sup> ITU, "Global ICT Development Index."

<sup>221</sup> International Monetary Fund, "Burkina Faso."

<sup>222</sup> World Bank, "Financial Inclusion Support Project."

<sup>223</sup> The World Bank Group, "Agriculture Observatory."

## ECONOMIC AND FINANCIAL ANALYSIS

### ESTIMATED IMPACTS:

- Significantly improve farmers' ability to implement advisory recommendations and take innovation risks to improve productivity
- Increase household incomes and expand national GDP
- Increase producer and sectoral resilience in the face of major events such as extreme weather
- Improve financial literacy

### ESTIMATED IMPACTS: PRODUCTION, RESILIENCE, EMISSIONS

**Table A-3.1: Cost-Benefit Analysis with and without Climate Risks**

Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI*	BCR (SD)*
<b>With Climate and Pest Risks</b>					
200,000	19	15.9	45	0.43	0.30 (2.88)
<b>Without Climate and Pest Risks</b>					
200,000	19	52.2	63	1.51	0.98 (3.03)

**Table A-3.2 Financial Analysis**

Values are the percentage change with and without project. Values are derived from Evidence for Resilient Agriculture (ERA) and other secondary sources.

Change with Financial Services for CSA			
Technology	Yield	Gross Returns	Costs
<b>Financial Services for CSA</b>			
<b>Maize</b>			
Implement CSA due to Crop Insurance	27.3 (8.7)	56.1 (30.9)	25.7 (23.3)
<b>Cotton</b>			
Implement CSA due to Crop Insurance	12.5 (12.3)		
<b>Cattle</b>			
Implement CSA due to Livestock Insurance	19.6 (4.1)		
<b>Goats</b>			
Implement CSA due to Livestock Insurance	16.5 (1.8)		
<b>Mean of All Technologies</b>	<b>19.0 (10.0)</b>	<b>56.1 (30.9)</b>	<b>25.7 (23.3)</b>

**Table A-3.3 Values for Estimating the Number of Beneficiaries**

Investment	Budget (US\$, thousands)	Cost per Beneficiary (US\$)
Financial Services for CSA	40.0	200

**ESTIMATED PROJECT COSTS** were based on average costs per beneficiary following a typology of investments' cost effectiveness derived from expert opinion. Investments typically range between US\$200-900 per beneficiary (see Annex E).

## CLIMATE MODELING

These are the projections for the crops in the water project without assuming that investments are made.

		YIELD: Percentage Change from No Climate Change Scenario					
Product	Baseline Value (TM)	Low Emissions		Medium Emissions		High Emissions	
	2018	2030	2050	2030	2050	2030	2050
Maize	861.9	-9.79	-19.24	-8.80	-17.15	-11.10	-21.58
Cotton	290.1	-2.05	-3.69	-4.16	-7.37	-4.14	-7.05
Beef	149.6	0.04	0.09	-0.02	-0.02	0.18	0.38
Product							
Product	Baseline Value (Ha)	AREA: Percentage Change from No Climate Change Scenario					
	2018						
Maize	861.9	-9.79	-19.24	-8.80	-17.15	-11.10	-21.58
Cotton	584.26	-0.07	-0.05	-0.67	-1.24	-0.67	-1.19
Beef	No Data	No Data	No Data	No Data	No Data	No Data	No Data

Financial services investments are projected to increase yields of maize, cotton, beef, and goats (not modeled) over the time periods shown above.

## ENABLING ENVIRONMENT: SITUATION ANALYSIS

This project aligns to the following Nationally Determined Contribution (NDC) aims:<sup>224</sup>

- Integrate hydrometeorological, meteorological, and climatic data into development plans and early warning systems
- Conduct participatory research and development on sustainable land management technologies and adaptive techniques in the water, agriculture, livestock, and forest sectors

Strong Alignment	Partial Alignment			
Financial Services	Information Management, Advisory Services	Governance Reform	Improved Farming Technologies, CA	Water Conservation and Irrigation Management
Little or No Alignment				
Restoring Forests, Agroforestry	Livestock and Aquaculture Productivity	Post-Harvest Handling and Processing	Renewable Energy	Management and Conservation of Soils and Fertility

### RELEVANT POLICIES:

- Crédit d'Intensification de la Production Agricole
- National Adaptation Plan of Action (NAPA)
- Joint Ministerial Decision N0 2012
- Plan National de Développement Economique et Social (PNDES)
- Programme National du Secteur Rural Phase 2 (PNSR 2)

### KEY POLICY GAPS:

- Extremely high bank collateral requirements have not yet been adequately addressed by policy
- Lack of digital policy, including terms of access to Unstructured Supplementary Service Data

<sup>224</sup> WASCAL, "Finance in Burkina Faso," 2019

- (USSD) codes, cybercrime regulation, and consumer protection regulation
- Low-transparency regulation for funding management

**KEY POLICY DISTORTIONS:<sup>225</sup>**

- Limited capacity for the Directorate for the Supervision and Control of Decentralized Financial Institutions to complete on-site inspections to improve supervision of microfinance industry
- Paper-based systems at the Directorate for the Supervision and Control of Decentralized Financial Institutions and other institutions that are vulnerable to error, loss, and manipulation

**KEY CONTRIBUTORS TO PROJECT SUCCESS:**

- Broad microfinance and mobile money networks
- Grassroots buy-in to mobile financial services and the microfinance sector
- Established policy to regulate the financial industry
- Robust, profitable, stable banking sector
- Strong government support and investment in improved smallholder financial services access

**KEY RISKS AND BARRIERS TO SUCCESS:<sup>226</sup>**

- Relatively undeveloped information-communication technology networks
- Weaknesses in business operations of microfinance organizations
- Poor economies of scale of existing microfinance organizations
- Low financial literacy among smallholders

**PUBLIC INSTITUTIONAL FRAMEWORK :**

- Ministère de l'Agriculture et de l'Hydraulique
- Ministère des Ressources Animales
- Ministère de l'Environnement et du Développement Durable
- Ministère de l'Economie et des Finance
- Development Directorate for the Supervision and Control of Decentralized Financial Institutions
- Ministère de l'Industrie du Commerce et de l'Artisanat
- Ministère de l'Action Sociale et de la Solidarité Nationale
- Ministère de l'Administration Territoriale et de la Décentralisation

**POTENTIAL NGO COLLABORATORS:**

- Aga Khan Agency for Microfinance<sup>227</sup>
- The Hunger Project's Microfinance Program
- Fondation pour les Etudes et Recherche sur le Développement International (FEDI)

**DELIVERY: SYNTHESIS OF IMPLEMENTATION EXPERIENCE AND BEST PRACTICE**

**Related past and current projects provide foundational knowledge and lessons learned. Relevant projects include:**

- **Financial Inclusion Support Project** in Burkina Faso supported by the World Bank, 2019-2025, US\$100 million for strengthening the credit supply for farmers and small- to medium-sized enterprises

<sup>224</sup> WASCAL, "Finance in Burkina Faso," 2019

<sup>225</sup> World Bank, "Financial Inclusion Support Project."

<sup>226</sup> International Monetary Fund, "Burkina Faso."

<sup>227</sup> Aga Khan Development Network, "Microfinance in Burkina Faso."

- **Support Project for Establishing an Agribusiness Bank (PACBA),**<sup>228</sup> African Development Bank (AfDB), 2019-2021, USD \$10.86 million to enhance agricultural financing and insurance and support value chain development to increase resilience of rural smallholder households
- **PlaNet Guarantee 2011**<sup>229</sup>

## FINANCING DEVELOPMENT

### PUBLIC FINANCING OPPORTUNITIES:

- Burkina Social and Economic Development Fund
- Women's Entrepreneurial Activities Support Fund

### INTERNATIONAL FUNDING OPPORTUNITIES:

- FinMark Trust
- World Bank
- International Finance Corporation
- United Nation Environment Program (UNEP)
- Fonds International de Développement Agricole (FIDA)
- World Food Program (WFP)
- Organisation Météorologique Mondiale (WMO)

### POTENTIAL PRIVATE SECTOR COLLABORATORS:

- Réseau des Caisses Populaires du Burkina
- Première Agence de Microfinance Burkina Faso
- CreditInfo VoLo

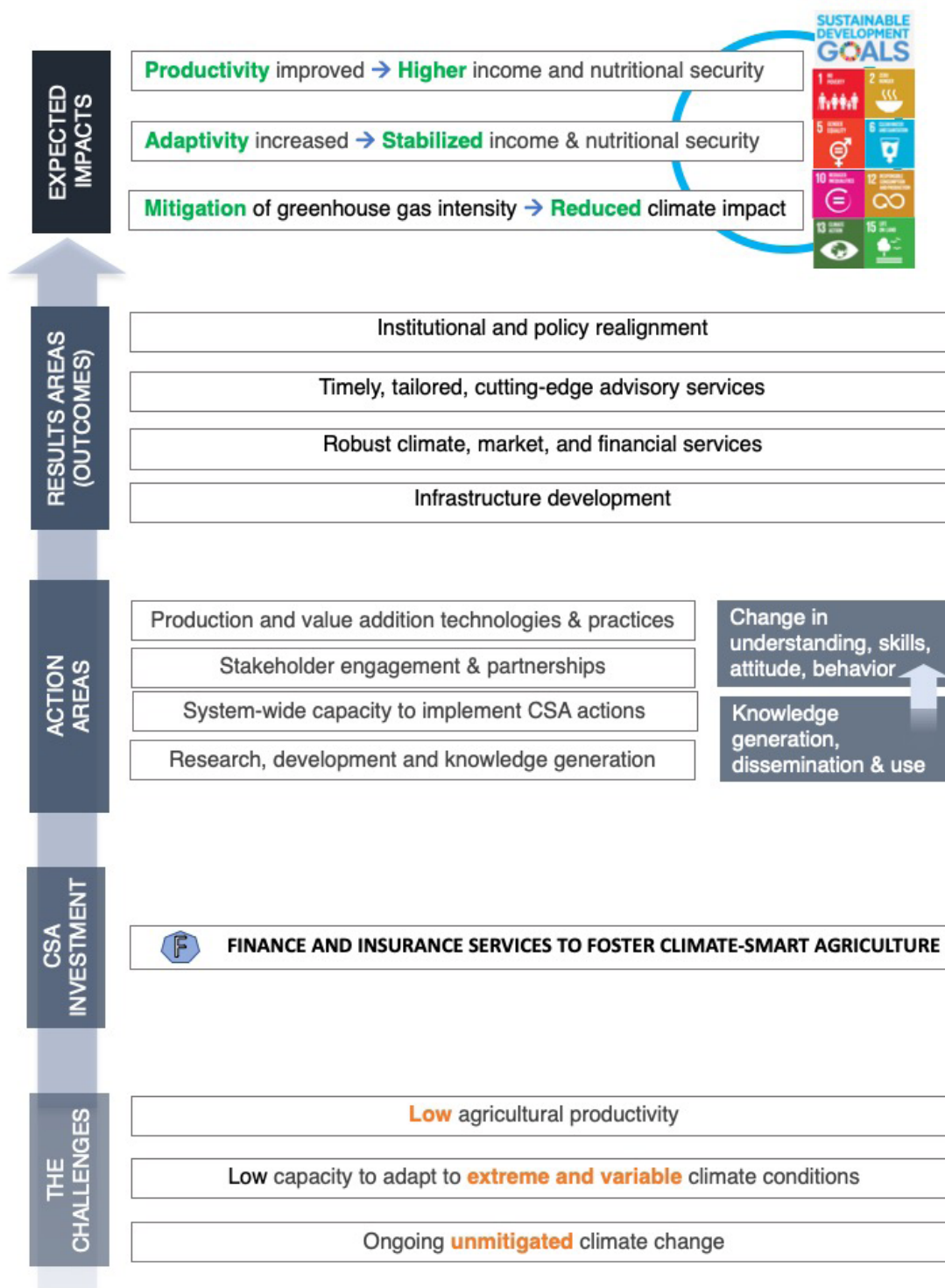
### PRIVATE FINANCING OPPORTUNITIES:

- Banque Agricole du Burkina
- Réseau des Caisses Populaires du Burkina Première
- Agence de Microfinance Burkina Faso

<sup>228</sup> African Development Bank, "Burkina Faso - Support Project for Establishing an Agribusiness Bank (PACBA)."

<sup>229</sup> Fonta et al., "Estimating Farmers' Willingness to Pay for Weather Index-Based Crop Insurance Uptake in West Africa."

## THEORY OF CHANGE





## A.4 Forest, Agroforest, And Garden Production For Climate-Smart Diversification

### PROJECT SUMMARY

#### PROJECT HIGHLIGHT:

- A 40% income increase for farm families through low-input, low-impact farming
- Income and nutritional diversification and security through high-value product chain development
- Greenhouse gas mitigation through soil and biomass sequestration

**OBJECTIVE:** Foster climate-resilient livelihoods and food sources for women and youth smallholders through home gardens, agroforestry, and non-timber forest product harvesting and value-addition.

**CSA PILLARS:** Adaptation, Production

**PROJECTED BENEFICIARIES:** 180,000

**REGIONS:** National

#### KEY CLIMATE-SMART AGRICULTURE (CSA) INVESTMENT ACTIVITIES:

- Non-timber forest products (NTFPs) for nutritional diversity and security
- NTFP processing enterprises, including shea, gum arabic, and baobab
- Gardens for nutritional diversity
- Soil fertility management
- Forest and agroforest management to support NTFP productivity

### JUSTIFICATION

**Trees play a key role in Burkinabe agricultural landscapes.** Burkina Faso is in the heart of the Great Green Wall in Western Africa that holds back desert expansion.<sup>230</sup> About 20% of the Sudanian and South-Sahelian Burkinabe ecozones are covered in shea trees; the remaining 80% are composed of over 40 other species.<sup>231</sup> Forest and agroforestry parklands mitigate climate change effects through dune and soil stabilization, improving soil quality, and reducing wind speeds. These trees are multifunctional; they are frequently combined with millet, sorghum, sesame, and groundnuts in agroforestry systems to increase crop yields and improve soil quality.<sup>232</sup> The trees themselves provide various products, including fruits, fats, nuts, oils, and leaves. This improves smallholder resiliency by creating an additional source of forage for livestock, firewood for the home, and regulated microclimates for crops and livestock.<sup>234</sup> Forage trees are especially important toward the end of the dry season and during droughts; their deep roots can access water and continue to feed livestock when grazelands have dried.<sup>235</sup>

**Forest and agroforestry systems tend to be more climate-resilient than arable crops.** Perennials are generally more resistant to climate extremes, such as drought, flood, and heat, than annual crops are. Trees create microclimates by regulating soil moisture and air temperature. This fact makes agroforestry and managed forest systems excellent supplemental sources of nutrition and income for smallholder farmers vulnerable to the impacts of climate change.

**NTFPs are useful products obtained from forests that do not require the harvesting of trees.** They may include fruits, nuts, gums, leaves, bark, mosses, honey, and flowers, among others. The

<sup>230</sup> Sacande and Parfondry, "Non-Timber Forest Products."

<sup>231</sup> Simelton et al., Multifunctional Land Uses in Africa Sustainable Food Security Solutions.

<sup>232</sup> Simelton et al.

<sup>233</sup> Tiebre et al., "Diversité Floristique et Disponibilité Des Plantes Utilitaires En Zone Soudanienne de La Côte d'Ivoire"; Angoni et al., "Composition Floristique, Structure et Menaces de La Végétation de La Ligne Côtière de La Réserve de Faune de Douala-Edéa."

<sup>234</sup> Iiyama et al., "Tree-Based Ecosystem Approaches (TBEAs) as Multi-Functional Land Management Strategies—Evidence from Rwanda."

<sup>235</sup> Kandji, Verchot, and Mackensen, "Climate Change and Variability in the Sahel Region:"

forests of African drylands offer a wealth of NTFP products for both improved nutritional diversity and diversified income. There is significant economic demand for NTFPs native to Burkina Faso, including shea, gum arabic, honey, and baobab. Many medicinal products, supplemental livestock feed, and fruits are also NTFPs.<sup>236</sup> NTFPs may be harvested from unmanaged forests, agroforestry systems, or semi-domesticated plantations.<sup>237</sup>

**NTFPs account for an average of 45% of household income in Burkina Faso.** Poorer households receive a larger percentage of their total income from NTFPs, and wealthier households earn more from NTFPs in absolute terms. NTFPs have an equalizing effect on income inequality. NTFP management and preference patterns vary across both sites and ethnic groups in Burkina Faso.<sup>238</sup>

**Shea is particularly important and contributes up to 12% of poor households' incomes.** In Burkina Faso, shea collection and processing are traditionally done by women, and shea is sometimes called "women's gold."<sup>239</sup> These are particularly important income generating activities since the emergence of international shea markets in the 1980s. However, shea butter production is labor-intensive; it takes one woman nearly nine hours to process 10 kilograms of shea nuts to yield 2 kilograms of shea butter.<sup>240</sup>

**Agroforestry and NTFP development are not without challenges.** Bush fires can quickly damage or destroy large swaths of parkland. High winds are common and particularly risky during flowering.<sup>241</sup> Overexploitation for firewood, charcoal, fodder, and large-scale land development has reduced existing stands of trees considerably. This deforestation has instigated significant soil degradation. Persistent drought has shifted the shea suitable growing region southward.<sup>242</sup> Access to improved planting material is very limited. Agroforestry product processing is labor-intensive and often requires a sustained heat source; this fuelwood demand can instigate deforestation.<sup>243</sup>

**Gardens are often more climate-resilient than arable crops.** This makes gardens an excellent supplemental income and nutritional source for smallholders.<sup>244</sup> Unlike crop fields, home gardens are generally near the home and easily monitored. The relatively small area of gardens means they can be irrigated by hand during dry periods and covered with semi-shade during heat waves and heavy precipitation. Gardens and livestock offer synergetic co-benefits. Garden residues can be used as animal feed or soil organic matter input. Manure from one or a few livestock is enough to fertilize the garden. Poultry grazing in the garden after harvest controls pests, aerates the soil, and provides nitrogenous fertilizer inputs.

**Although NTFP, gardening, and agroforestry practices are common in Burkina Faso, many farmers are unable fully to leverage these practices due to lack of training.** For example, millet yields are highest under baobab canopy and lowest near the trunks of *néré* trees. In contrast, taro production is highest under the heavily shaded canopy of the *néré* and near the trunks of baobab trees.<sup>245</sup> Such scientific findings can significantly improve agroforestry system productivity. Similarly, nearly all

<sup>236</sup> Altieri, Funes-Monzote, and Petersen, "Agroecologically Efficient Agricultural Systems for Smallholder Farmers."

<sup>237</sup> Choudhury and Jansen, "Terminology for Integrated Resources Planning and Management."

<sup>238</sup> Leßmeister et al., "The Contribution of Non-Timber Forest Products (NTFPs) to Rural Household Revenues in Two Villages in South-Eastern Burkina Faso."

<sup>239</sup> Kiptot, "Gender Roles, Responsibilities, and Spaces: Implications for Agroforestry Research and Development in Africa."

<sup>240</sup> Simelton et al., Multifunctional Land Uses in Africa Sustainable Food Security Solutions.

<sup>241</sup> Expert Panel Workshop, Non-Timber Forest Product Value Chains Project Components.

<sup>242</sup> Venturini et al., "Cultivating Climate Resilience: The Shea Value Chain."

<sup>243</sup> Boffa, "Opportunities and Challenges in the Improvement of the Shea (*Vitellaria Paradoxa*) Resource and Its Management"; Rousseau, Gautier, and Wardell, "Coping with the Upheavals of Globalization in the Shea Value Chain."

<sup>244</sup> World Vegetable Center, "School Vegetable Gardens: Linking Nutrition, Health, and Communities."

<sup>245</sup> Jules and Sanou, "Replication Data For."

farmers who engage in shea production report good earnings. However, farmers trained in pruning, assisted natural regeneration, and grafting techniques have 44% higher revenues than those that are not trained. These techniques are low-cost and use tools that most farmers already have on hand, such as axes and machetes. Similar training techniques have increased income from wood production by over 400%.<sup>246</sup> Training in good gardening practices significantly increases knowledge of both sustainable agriculture and food and nutrition.<sup>247</sup> Baobab management strategies improve leaf production, the distinguishing of palatable leaves, and seasonality.<sup>248</sup>

**Garden, agroforestry, and NTFP production and processing represent excellent opportunities to foster economic inclusivity of women and youth in the Burkinabe agricultural sector.** West African women play a key role in garden, agroforestry, and NTFP production and processing, as well as the harvesting and processing of subsistence products such as fodder, firewood, and fruits. Women process the fruit, leaves, flowers, bark, seeds, branches, and roots of the baobab that are harvested to create a variety of products, including dye, juice, jam, rope, gum, seed oil, dishes, and water storage containers.<sup>249</sup> The fruit and leaves of zaban shrubs are prized for juice and jam production.<sup>250</sup> In addition to its valuable gum, the leaves and pods of the gum arabic tree are excellent fodder.<sup>251</sup>

**The availability of improved planting materials is crucial to the scalability of productive garden, NTFP, and agroforestry systems.** The capacity of national forest seed centers to meet this need is low. However, Burkina Faso is registered under the Organization for Economic Cooperation and Development Scheme for the Certification of Forest Reproductive Material, which can help ensure product control, seed traceability, and adequate material quality. This represents an important opportunity to build capacity among female farmers and youth to propagate and sell economically viable, locally adapted, and biodiverse plant materials.<sup>252</sup>

## PROBLEM STATEMENT

**Nearly all Burkinabe agriculture is rainfed; as such, smallholders' economic and food security relies heavily on predictable weather patterns.** The variability and extremes inherent to climate change thus leave Burkinabe smallholders extremely vulnerable to livelihood and nutritional insecurity.<sup>253</sup> Diversification of food sources and income opportunities is essential to mitigating this issue.

**Land degradation is occurring at alarming rates in Burkina Faso.** Approximately 19% of total national land area, or 51,6000 square kilometers, is impacted, and land degradation continues at a rate of about 470,000 hectares annually. The price of this environmental loss is estimated to be about 26% of the country's GDP.<sup>254</sup> As a core country in the Great Green Wall, it is crucial that Burkina Faso's forests be restored and managed sustainably.

**NTFPs are essential to sustainable forestry.** Environmental degradation cannot be tackled without leveraging the land's economic potential; rural communities must obtain economic benefits in order to buy into restoration work.<sup>255</sup>

<sup>246</sup> Simelton et al., Multifunctional Land Uses in Africa Sustainable Food Security Solutions.

<sup>247</sup> Schreinemachers et al., "Impact of School Gardens and Complementary Nutrition Education in Burkina Faso."

<sup>248</sup> Rashford, "The Use of Baobab Leaves (*Adansonia Digitata* L.) for Food in Africa."

<sup>249</sup> Gebauer et al., "Africa's Wooden Elephant."

<sup>250</sup> Daily Mail, "The Juice Startup Putting Mali in a Bottle."

<sup>251</sup> Daily Nation, "The Gold in Acacia Trees."

<sup>252</sup> Sacande and Parfondry, "Non-Timber Forest Products."

<sup>253</sup> van Vliet, Reenberg, and Rasmussen, "Scientific Documentation of Crop Land Changes in the Sahel"; Neya, Neya, and Abunyewa, "Agroforestry Parkland Profiles in Three Climatic Zones of Burkina Faso."

<sup>254</sup> Zida and M., "Reshaping the Terrain."

<sup>255</sup> Sacande and Parfondry, "Non-Timber Forest Products."

**Household returns from agroforestry and NTFPs are not currently sufficient to catalyze protection against environmental degradation.** Value chains for NTFPs remain largely undeveloped, resulting in a low return on investment for harvested products, low forest resource valuation, and consequent overexploitation.<sup>256</sup> There are four synergistic opportunities to increase the value of agroforestry and NTFPs:

- Training in improved planting material, gardening, and NTFP and agroforestry management practices
- Technological innovation to reduce processing drudgery and augment income potential
- Enabling land tenure, particularly for women, who are the primary owners of garden, agroforestry, and NTFP processes<sup>257</sup>
- Enforcement of conservation laws and sustainable practice guidelines

Projects activities addressing these four key opportunities must consider the context of gender inequality<sup>258</sup> as well as geographic and ethnic variation in traditional uses and practices of forest and garden products.<sup>259</sup>

**Table A-4.1 Cost Benefit Analysis with and without Climate Risks**

Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI*	BCR (SD)*
<b>With Climate and Pest Risks</b>					
180,000	40	168.2	89	3.47	2.28 (3.20)
<b>Without Climate and Pest Risks</b>					
180,000	40	196.2	92	4.06	2.66 (3.36)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

**Table A-4.2 Financial Analysis**

Values are the percentage change with and without project. Values derived from Evidence for Resistant Agriculture (ERA) and other secondary sources.

<b>Gross Returns from Forests, Agroforests and Gardens</b>	
<b>Technology</b>	<b>Gross Returns</b>
<b>Forests, Agroforests, and Gardens</b>	
<b>Shea</b>	
Engagement in Shea Value Chain	63.0
Improved Shea Cultivation	44.0
<b>Gum Arabic</b>	
Engagement in Gum Arabic Agroforestry	52.8
<b>Baobab</b>	
Collection of Baobab Fruits for Use or Selling	31.9
<b>Nutrition Garden</b>	
Addition of Nutrition Garden	9.0
<b>Mean of All Technologies</b>	<b>40.0</b>

**Table A-4.3 Values for Estimating the Number of Beneficiaries**

<b>Investment</b>	<b>Budget (US\$, billions)</b>	<b>Cost per Beneficiary (US\$)</b>
<b>Forests, Agroforests, and Gardens</b>	55.08	306

<sup>256</sup> Shackleton and Shackleton, "The Importance of Non-Timber Forest Products in Rural Livelihood Security and as Safety Nets"; Ticktin, "The Ecological Implications of Harvesting Non-timber Forest Products."

<sup>257</sup> Simelton et al., Multifunctional Land Uses in Africa Sustainable Food Security Solutions.

<sup>258</sup> Westholm, "Fruits from the Forest and the Fields."

<sup>259</sup> Leßmeister et al., "The Contribution of Non-Timber Forest Products (NTFPs) to Rural Household Revenues in Two Villages in South-Eastern Burkina Faso."

**ESTIMATED PROJECT COSTS** were based on average costs per beneficiary following a typology of investments' cost effectiveness derived from expert opinion. Investments typically range between US\$200-900 per beneficiary (see Annex E).

## CLIMATE MODELING

These are the projections for vegetables only. Climate projections are not available for the agroforestry approaches described above. The CSA investments described herein will make all agricultural systems and species more climate-resilient.

Crops	Baseline Value (TM)	YIELD: Percentage Change from No Climate Change Scenario					
		Low Emissions		Medium Emissions		High Emissions	
	2018	2030	2050	2030	2050	2030	2050
Vegetables	665.8	-7.73	-14.51	-6.22	-11.76	-7.13	-13.16
	Baseline Value (Ha)	AREA: Percentage Change from No Climate Change Scenario					
	2018						
Vegetables	665.8	-7.73	-14.51	-6.22	-11.76	-7.13	-13.16

## ENABLING ENVIRONMENT: SITUATION ANALYSIS

### Alignment to Nationally Determined Contribution (NDC)

This project aligns with the NDC's stated goal to implement agroforestry practices for sustainable management of natural resources. Of the ten NDC categories, this project aligns as follows:

Strong Alignment	Partial Alignment				
Restoring Forests, Agroforestry	Improved Farming Technologies, Conservation Agriculture		Governance Reform	Post-Harvest Handling and Processing	
Little or No Alignment					
Water Conservation, Irrigation Management	Management and Conservation of Soils and Fertility	Renewable Energy	Livestock and Aquaculture Productivity	Information Management, Advisory Services	Financial Services

### RELEVANT POLICIES:

- Plan National de Développement Economique et Social (PNDES)
- Code Forestier
- Code de l'Environnement
- Programme National Secteur Rural Phase 2 (PNSR2)
- Plan National d'Adaptation (PNA)

### KEY POLICY GAPS:

- Forest conservation regulations

### KEY POLICY DISTORTIONS:

- Land tenure insecurity, particularly for women

**KEY CONTRIBUTORS TO PROJECT SUCCESS:**

- Agroforestry and NTFPs are already widely practiced.
- They require very few inputs, training, investments, or technologies to get started.

**KEY RISKS AND BARRIERS TO SUCCESS:**

- Lack of training and capacity to optimize return on investment (ROI)
- Little or no access to improved planting materials
- Overexploitation of forest resources
- Land tenure insecurity, particularly for women

**PUBLIC INSTITUTIONAL FRAMEWORK:**

- Ministry of Environment Green Economy and Climate Change
- Directorate General for Green Economy and Climate Change (DGEVCC)
- National Tree Seed Center (CNSF)
- Public universities, such as the University of Ouagadougou and the Nazi Boni University
- Research institutions including the DEF, the Environmental Institute for Agricultural Research (INERA), and the Centre National de la Recherche Scientifique et Technologique (CNRST)
- Ministry of Health
- Land Degradation Neutrality Target Setting Programme, to which Burkina Faso became a signatory in 2016 by setting its national voluntary goals and identifying measures to achieve them by 2030<sup>260</sup>

**POTENTIAL NGO COLLABORATORS:**

- Tree Aid
- Action Contre la Faim
- Food and Agricultural Organization of the United Nations (FAO)
- United Nations Development Programme (UNDP)
- SOS Sahel
- La Fondation l'Occitane
- La Croix Rouge
- Aide et Action
- Netherlands Development Organisation (SNV)
- Action Against Desertification<sup>261</sup>

**KEY DIGITAL AGRICULTURE TECHNOLOGIES:**

- Mobile finance services, along with digitized farm records to support credit line establishment
- Smart contracting for transparent and equitable land tenure processes
- Mobile extension services, enabled by big data, machine learning, and mobile technology, to support best practices and disseminate research and development outputs
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support management decisions<sup>262</sup>
- Mobile platforms, enabled by big data, machine learning, and mobile technology, to support peer knowledge exchange, input supply, and product sales at fair market rates

<sup>260</sup> Zida and M., "Reshaping the Terrain."

<sup>261</sup> Sacande and Parfondry, "Non-Timber Forest Products."

<sup>262</sup> The World Bank Group, "Agriculture Observatory."

Related projects provide a strong knowledge base and lessons learned. Current projects include:

- **Programme de Croissance Economique dans le Secteur Agricole (PCESA)**
- **Local Forest Communities Support Project,**<sup>263</sup> supported by World Bank, 2015-2020, US\$4.5 million. This project aims to:
  - Strengthen the capacity of local communities in the targeted region to participate in Reducing Emissions from Deforestation and Forest Degradation (REDD) programming
  - Restore 2,000 hectares of forest
  - Increase the monetary or non-monetary benefits to 8,000 households from forest products and non-timber products
  - Ensure 3,500 households have adopted sustainable land management practices
  - Target 50,000 beneficiaries
- **Project to Preserve and Improve the Productivity of Shea Fruit (PPAK)**
- **Programme d'Investissement Forestier (PIF)**
- **Action Against Desertification,** to undertake beekeeper training and restoration of degraded lands with a focus on fodder and NTFP species. Example achievements include:<sup>264</sup>
  - Nearly 2,800 hectares of degraded land restored using herbaceous fodder and multifunctional tree species in 2017
  - 1.2 metric tons of fodder grasses harvested per hectare, generating comparable revenue to millet and maize in 2018
- **Opportunités et Risques pour les Productrices de Karité dans les Parcs à Karité du Burkina Faso**

Relevant completed projects include:

- **Inventaire Forestier 2 (IFN2)**
- **Sustainable Land and Forestry Management Project,**<sup>265</sup> supported by World Bank, 2012-2018, to foster sustainable land and forest management and support the restoration and protection of natural resources, forests, and ecosystem biodiversity
- **Project for the Improved Management and Sustainable Use of Non-Wood Forest Products (NWFPs) in Burkina Faso,**<sup>266</sup> supported by the FAO, 2008-2010, to sustainably manage NTFPs in order to enhance food security, nutrition, and household income (amount undisclosed)
- **Projet d'Amélioration de la Productivité Agricole et de la Sécurité Alimentaire (PAPSA)**
- **The Biocarbon and Rural Development (BIODEV) Project,** to increase carbon sequestration in forest and agroforestry systems
- **Decentralization of Forest and Woodland Management Project,** supported by World Bank, 2014-2019, US\$ 26.26 million, designed as national REDD+ strategy. The project successfully:
  - Improved land use planning and economic activities around forest and woodland resources, with emphasis on engagement of women
  - Established guidance, best practices, and knowledge management structures around sustainable natural resource management
  - Reached almost 1 million beneficiaries, reduced deforestation, reduced forest degradation, and brought about concomitant emissions reductions.
- **Restauration des Forêts avec des Espèces Alimentaires en Vue d'Accroître les Capacités d'Adaptation des Communautés Locales du Burkina Faso au Changement Climatique**

<sup>263</sup> World Bank, "Local Forest Communities Support Project."

<sup>264</sup> Sacande and Parfondry, "Non-Timber Forest Products."

<sup>265</sup> World Bank, "Sustainable Land and Forestry Management Project."

<sup>266</sup> FAO, "Small and Medium Scale Forest Enterprises."

## FINANCING DEVELOPMENT

**Public Financing Opportunity:** Environmental Intervention Fund

**International Financing Opportunities:**

- Global Environment Fund
- Green Climate Fund
- World Bank
- African Development Bank (AfDB)
- Swiss government
- Organisation for Economic Co-operation and Development Scheme for the Certification of Forest Reproductive Material<sup>267</sup>

**Private Financing Opportunities:**

- Banque Agricole du Burkina
- Ecobank
- Bank of Africa
- Coris Bank International
- United Bank for Africa (UBA)
- La Banque pour le Commerce, l'Industrie et l'Agriculture du Burkina Faso (BICIAB)
- Orabank
- Credit unions (*caisses populaires*)
- La Société Financière de Garantie Interbancaire du Burkina (SOFIGIB)
- PlaNet Finance
- Terrafina

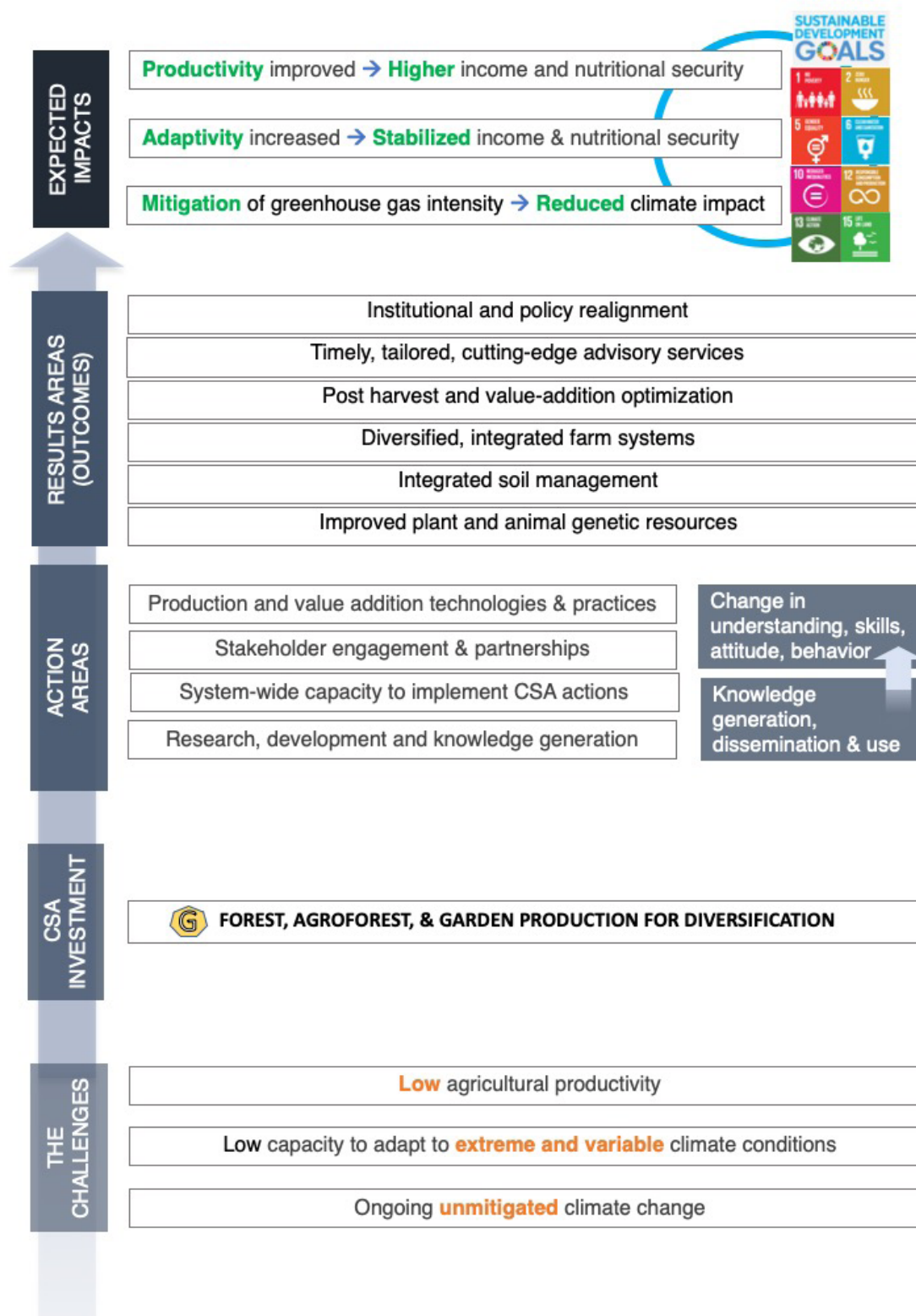
**Potential Private Sector Collaborators:**

- AarhusKarlshamn, AAK
- Integrated Palm Oil Group
- Fagligt Fælles Forbund (3F; United Federation of Danish Workers) Institute of Fundraising
- OLVEA Group
- Agrifaso

<sup>267</sup> Sacande and Parfondry, "Non-Timber Forest Products."



## THEORY OF CHANGE



## A.5 Building Capacity In Climate-Smart Agriculture

### PROJECT SUMMARY

**OBJECTIVE:** Fully integrate national climate-smart priorities into Burkina Faso's agricultural research and extension programs and build robust extension mechanisms for delivering timely, practical climate-smart information to farmers and other stakeholders through highly accessible channels.

**REGIONS:** National

**CLIMATE-SMART AGRICULTURE (CSA) PILLARS:** Adaptation, Production, Mitigation

**PROJECTED BENEFICIARIES:** 500,000

**KEY CSA INVESTMENT ACTIVITIES:**

- Training at national and regional levels for:
  - Transparency
  - CSA technical capacity
  - Production and management of information, particularly on water resources
  - Development of agricultural services and climate information services
- Establishment of evidence-based climate-smart research programs
- Timely, practical, and tailored extension services oriented toward climate-smart actions
- Timely, practical climate information services

**PROJECT HIGHLIGHTS:**

- Cost-efficient, high-impact project cutting across sectors and boosting the national economy
- Establishes robust research and extension services to augment farmer productivity, adaptivity, and mitigation in the face of climate change
- Empowers individuals to continue to advance Burkinabe climate

### JUSTIFICATION

**The implementation of sustainable CSA solutions is predicated on knowledge of and capacity for climate-smart practices.**<sup>270</sup> Climate-smart solutions begin with the human, financial, and technical capacities of research organizations to produce new technologies, products, information, and innovations. These research outcomes must then be translated into practical, actionable, and digestible formats, and delivered to farmers and other stakeholders by accessible channels in a timely manner via a robust, multi-pronged extension system.

**Strong agricultural research and extension networks are the primary predictors of agricultural productivity growth in Sub-Saharan Africa.** Development and dissemination of new technologies account for 51% of productivity gains; improved trade and marketing policies account for 20%, and reductions in conflict for 18%.<sup>271</sup> Climate information services are particularly helpful to farmers facing erratic weather patterns.<sup>272</sup> Timing of advisory services and the integration of top-down, value-chain business approaches with bottom-up, smallholder, traditional approaches is also crucial to effectiveness.<sup>273</sup>

**Burkina Faso has notable research and development capacities.** It is one of the few African nations to have accomplished the African Union and United Nations target of investing 1% of agricultural

<sup>270</sup> Bikienga, "Elaboration d'un Profil de l'Agriculture Climato-Intelligente Pour Le Burkina Faso."

<sup>271</sup> World Bank, "Transforming Agriculture for Economic Growth, Job Creation and Food Security."

<sup>272</sup> ECOWAS, "Intervention Framework for the Development of Climate Smart Agriculture under the West Agricultural Policy (ECOWAP/CAADP) Implementation Process," June 15, 2015.

<sup>273</sup> Innovations for Poverty Action, "Evidence for Agriculture in Ghana."

GDP in agricultural research. This goal has been accomplished in significant part due to donor and development bank funding.<sup>274</sup> Burkina Faso's agricultural research investment budget has been steadily rising since 2007 and reached 48.5 million 2011 US \$ in Public-Private Partnership (PPP) funding in 2017. In that same year, the country had 311 full time-equivalent agricultural researchers on staff, 99% of whom held an advanced degree. The publicly funded National Institute for Environmental and Agricultural Research (INERA) is at the heart of the country's agricultural research system, and the Institute of Research in Applied Science and Technologies (IRSAT) also holds a prominent role.<sup>275</sup>

**The Burkinabe government has made significant efforts to support the dissemination of new research findings to farmers.** Burkina Faso's unified National System of Agricultural Extension (SNVA), established in the 1990s, has traditionally employed highly structured farmer training programs. Over the past decade, human and financial resource restrictions have catalyzed a shift toward decentralization and lower-input methodologies wherein extension agents take on the role of facilitators. Farmer field schools, demonstration plots, workshops, radio and television broadcasts, written materials, and farm visits in alignment with seasonal crop cycles are prominent components of this new approach.

**Nevertheless, a gap remains between demand and supply of extension services.** In 2010, the government adopted the *Système National de Vulgarisation et d'Appui Conseil Agricole* (SNVACA) policy framework to help address this gap through pluralistic, demand-driven extension services. Non-profits, the private sector, farmer cooperatives, and the Regional Chambers of Agriculture are increasingly filling the gap. The National Federation of Naam Groups (NFNG), which is composed of 5,482 farmer groups organized into 82 unions and 11 inter-unions, is particularly prominent among these. The Farmer Confederation of Burkina Faso is also growing in importance.<sup>276</sup> Farmers generally indicate satisfaction with both public and private credit, input, market access, and technical support services, but rate the quality of private services higher than that of public services. This suggests preliminary public support for the new scheme and highlights opportunities for public services to garner lessons learned from other service providers.

**Mobile phone network access is improving rapidly in Burkina Faso.** The mobile network now covers most of the country, and there are about 84 mobile phone subscriptions per every 100 inhabitants. If all urban residents have mobile phone subscriptions,<sup>277</sup> it follows that just over half of rural residents have mobile phone subscriptions. Electricity access is a significant barrier to further expansion of mobile phone services; currently only about 10% of the rural Burkinabe population has electricity access.<sup>278</sup>

**Internet access rates are significantly lower, primarily due to high costs.** There are approximately 20 mobile broadband Internet subscriptions per 100 inhabitants, and about 14% of the population uses the Internet. 1 gigabyte of mobile broadband costs about 14% of the gross national income (GNI) per capita, or US\$92.<sup>279</sup> This would be the equivalent of paying nearly US\$8,500 per gigabyte in the United States. Burkina Faso ranks 49 out of 61 developing countries worldwide in terms of Internet affordability, and 48 out of 61 in terms of Internet infrastructure and access. Current infrastructure

<sup>274</sup> Magne Domgho, Neya, and Stads, "Burkina Faso."

<sup>275</sup> Centre Pour les Energies Renouvelables et l'Efficacite Energetique de la Cedeao, "Institut de Recherche En Sciences Appliquées et Technologies."

<sup>276</sup> Statistical, Economic, and Social Research and Training Center for Islamic Countries, "Strategy for Agricultural Extension in Burkina Faso."

<sup>277</sup> Data, "Urban Population (% of Total Population) - Burkina Faso"; Data, "Urban Poverty Headcount Ratio at National Poverty Lines (% of Urban Population) - Burkina Faso."

<sup>278</sup> Data, "Access to Electricity, Rural (% of Rural Population) - Burkina Faso."

<sup>279</sup> Alliance for Affordable Internet, "Burkina Faso."

provides about 2,810 bits per second bandwidth per user.<sup>280</sup> Given the significantly lower rates of poverty in urban areas (approximately 14%, versus 47.5% in rural areas),<sup>281</sup> and given also that around 30% of the Burkinabe population is urban,<sup>282</sup> Internet access among smallholders is likely negligible.

**Mobile-based solutions have been successful in providing services to rural Burkinabe populations.**

Mobile banking has met with significant success in Burkina Faso; Orange's mobile banking service alone has nearly 50 times more access points than well-established traditional bank networks.<sup>283</sup> The Mobile Data for Moving Herd Management and Better Incomes (MODHEM) project aims to provide geo-satellite derived information services to 100,000 pastoralists' households and 200,000 farmers' households in Burkina Faso to improve food security.<sup>284</sup> Orange has partnered with the private electricity company Société d'Infrastructures Collectives to provide mobile smart electricity metering in rural areas in order to reduce incidences of loss of service.<sup>285</sup> Consistent electricity service enables farmers to further and more reliably leverage mobile and other electricity-based technologies.

**Mobile-based information services hold promise in terms of providing actionable climate-smart information to farmers and other stakeholders.**

The success of other mobile-based services targeting rural Burkinabe populations suggests that mobile services may offer an important opportunity significantly to broaden the reach of governmental extension services in a highly economically efficient manner.<sup>286</sup> Indeed, the Burkinabe Ministry of Agriculture and Water Development announced digital agricultural services as a key component of its policy in 2017.<sup>287</sup> Climate, weather, market, and extension information can all be effectively provided to smallholders via Short Message Service (SMS) and voice services. Timeliness, personal relevance, and delivery are crucial to the success of such services.<sup>288</sup>

## PROBLEM STATEMENT

**Burkina Faso's national agricultural research program is not yet fully aligned with existing climate-smart policies.**

Climate-smartness and research are both well-supported by Burkinabe national policy. However, they remain significantly disjointed in practice. This is particularly true regarding climate and weather advisories. There remains a dearth of tools for collecting climate information, managing it, translating it into advisories, and distributing it in a timely manner through accessible channels.<sup>289</sup> Mechanisms for building and sustaining inter-institutional dialogue, inter-sectoral coherence, and local financial resource mobilization are also greatly needed.<sup>290</sup> On the national level, higher and sustained government funding would enable research programs and infrastructure maintenance outside the scope of the donor funding on which research is currently heavily reliant. Donor funding, in turn, can be reevaluated to align more closely with government-defined priorities.<sup>291</sup>

**Additionally, the country's waning extension workforce has created a gap that prevents new technologies and information from reaching farmers.**

There is a significant opportunity to

<sup>280</sup> 2017 Global ICT Development Index, "Burkina Faso."

<sup>281</sup> Data, "Urban Poverty Headcount Ratio at National Poverty Lines (% of Urban Population) - Burkina Faso."

<sup>282</sup> Data, "Urban Population (% of Total Population) - Burkina Faso."

<sup>283</sup> Sawadogo, "The Success of Mobile Banking in Burkina Faso."

<sup>284</sup> GeoData for Agriculture and Water, "MODHEM Burkina Faso."

<sup>285</sup> Orange, "Smart Metering Solution in Burkina Faso."

<sup>286</sup> Owusu, Yankson, and Frimpong, "Smallholder Farmers' Knowledge of Mobile Telephone Use."

<sup>287</sup> Digital Agriculture Convergence Lab, "Digital Technologies for Farm Advisory Services in Africa."

<sup>288</sup> Karanasios and Slavova, "How Do Development Actors Do 'ICT for Development'?" ; Barnett et al., "External Evaluation of Mobile Phone Technology-Based Nutrition and Agriculture Advisory Services in Africa and South Asia," February 1, 2019; Farmerline LTD, "Farmerline Launches New CocoaLink Service"; Palloni et al., "Paying for Digital Information"; CCAFS, "10 Best Bet Innovations for Adaptation in Agriculture: A Supplement to the UNFCCC NAP Technical Guidelines"; CCAFS, "Climate Services for Farmers"; CCAFS, "Climate Services in Agriculture."

<sup>289</sup> ECOWAS, "Intervention Framework for the Development of Climate Smart Agriculture under the West Agricultural Policy (ECOWAP/CAADP) Implementation Process," June 15, 2015.

<sup>290</sup> ECOWAS.

<sup>291</sup> WASCAL, "Climate-Smart Capacity in Burkina Faso," 2019.

strengthen the link between research and extension in Burkina agriculture. The number of national extension agents on staff has been in decline since the 1990s and now stands at approximately 1 agent per every 1000 farmers. In contrast, the World Bank's standard ratio is 1 agent per 800 farmers.<sup>292</sup> This degree of understaffing prevents the timely and effective dissemination of information and capacity-building services to farmers.<sup>293</sup>

**Significant access inequalities in the current advisory system perpetuate poverty and poor productivity.** There are significant barriers to diversity within research and extension institutions; just 19% of national agricultural researchers were women in 2014, up from 13% in 2008.<sup>294</sup> Gender norms, patriarchal values, time poverty, and illiteracy also reduce farmer access to extension services, particularly for women farmers. Seniority, religion, class, and position within the household further reconfigure advisory services access.

**Even farmers who have access to extension services are often very limited by external circumstances in their ability to receive and implement advisory recommendations.** Restrictive land tenure, a lack of profitable markets and safe harvest storage, poor financial services, and low household incomes prevent farmers from taking risks and changing established practices.<sup>295</sup> Consequently, advisory services increase these farmers' knowledge but do not improve their outcomes. In contrast, farmers with extensive social networks, many years of experience, large farm sizes, securer land tenure, good access to financial services, group memberships, and greater general knowledge are much more likely to participate in extension programs and to adopt new practices. These farmers are also much more likely to view their farms as businesses rather than as a cultural way of life.<sup>296</sup>

**Existing digital agricultural information services are not well adapted to rural smallholders.** As of 2018, there were 15 technology-based farmer information services available in Burkina Faso. Of these, 11 required an Internet connection. Of the remaining 4, 2 provide price and market information via SMS. The remaining 2 offer call center or pre-recorded interactive voice response services.<sup>297</sup> Farmers are often more hesitant to use call functions due to higher prices and unclear pricing structures.<sup>298</sup> This suggests distinct untapped opportunities in terms of digital provision of climate-smart information.

## ECONOMIC AND FINANCIAL ANALYSIS

**Table A-5.1 Cost Benefit Analysis with and without Climate Risks**

Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI*	BCR (SD)*
<b>With Climate and Pest Risks</b>					
500,000	18	52.5	62	1.06	0.71 (4.80)
<b>Without Climate and Pest Risks</b>					
500,000	18	140.4	80	2.95	1.91 (5.05)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

<sup>292</sup> Feder, Ganguly, and Anderson, *The Rise And Fall Of Training And Visit Extension*.

<sup>293</sup> Bikienga, "Elaboration d'un Profil de l'Agriculture Climato-Intelligente Pour Le Burkina Faso."

<sup>294</sup> Magne Domgho, Neya, and Stads, "Burkina Faso."

<sup>295</sup> Barnett et al., "External Evaluation of Mobile Phone Technology-Based Nutrition and Agriculture Advisory Services in Africa and South Asia," February 1, 2019.

<sup>296</sup> Danso-Abbeam, Ehiakpor, and Aidoo, "Agricultural Extension and Its Effects on Farm Productivity and Income."

<sup>297</sup> Digital Agriculture Convergence Lab, "Digital Technologies for Farm Advisory Services in Africa."

<sup>298</sup> Karanasios and Slavova, "How Do Development Actors Do 'ICT for Development'?" Chidiac, "Achieving Impact at Scale Through ICT-Enabled Extension Services in Ghana"; Weyori et al., "Agricultural Innovation Systems and Farm Technology Adoption"; Etwire et al., "An Assessment of Mobile Phone-Based Dissemination of Weather and Market Information in the Upper West Region of Ghana."

**Table A-5.2 Financial Analysis**

Values are the percentage change with and without project. Values derived from the Evidence for Resilient Agriculture (ERA) and other secondary sources.

Change with Investments for Capacity Building for CSA			
Technology	Yield	Gross Returns	Costs
<b>Capacity Building for CSA</b>			
<b>Household</b>			
Agricultural Weather Advisories	8 (6.5)		
Improved CSA Extension	27.3 (8.7)	56.1 (30.9)	25.7 (23.3)
<b>Mean of All Technologies</b>	<b>17.7 (7.5)</b>	<b>56.1 (30.9)</b>	<b>25.7 (23.3)</b>

**Table A-5.3 Values for Estimating the Number of Beneficiaries**

Investment	Budget (US\$, billions)	Cost per Beneficiary (US\$)
Capacity Building for CSA	55.0	110

## ECONOMIC AND FINANCIAL ANALYSIS

### Alignment to Nationally Determined Contributions

Strong Alignment	Partial Alignment					
Information Management Advisory Services	Governance Reform	Financial Services	Improved Farming Technologies, Conservation Agriculture	Water Conservation and Irrigation Management	Post-Harvest Handling and Processing	Restoring Forests, Agroforestry
<b>Little or No Alignment</b>						
Management and Conservation of Soils and Fertility		Renewable Energy		Livestock and Aquaculture Productivity		

### RELEVANT POLICIES:<sup>299</sup>

- National Rural Sector Program (PNSR 2) 2016-2020
- National Adaptation Programmes of Action (NAPA) 2007
- Plan d'Action pour la Gestion Intégrée des Ressources en Eau (PAGIRE) 2003
- Développement Rural, Sécurité Alimentaire et Environnement<sup>300</sup>
- Le Système National de Vulgarisation et d'Appui Conseil Agricole (SNVACA) 2010<sup>301</sup>

### KEY POLICY GAPS:

- Lack of inter-sectoral coherence, coordination, and dialogue across key programs
- Low political will and commitment

**KEY POLICY DISTORTION:** NAPA implementation is hampered by a lack of funding.<sup>302</sup>

### KEY ASSETS FOR SUCCESS:

- University degree programs in agricultural studies to train qualified agricultural extensionists (University of Ouagadougou [UO] among others)

<sup>299</sup> Bikienga, "Elaboration d'un Profil de l'Agriculture Climato-Intelligente Pour Le Burkina Faso."

<sup>300</sup> Consultations Nationales sur l'Eau, la sécurité alimentaire, "Rapport Final de La Consultation Nationale Sur l'eau, La Sécurité Alimentaire et La Nutrition."

<sup>301</sup> Statistical, Economic, and Social Research and Training Center for Islamic Countries, "Strategy for Agricultural Extension in Burkina Faso."

<sup>302</sup> ECOWAS, "Intervention Framework for the Development of Climate Smart Agriculture under the West Agricultural Policy (ECOWAP/CAADP) Implementation Process," June 15, 2015.

- Well-established agricultural research institute networks, including:
  - Institut National de l'Environnement et de Recherches Agricoles (INERA)
  - Institute of Research in Applied Sciences and Technologies (IRSAT)
  - National Forest Seed Center (CNSF)
  - University of Ouagadougou
- Strong governmental commitment to research and extension systems
- Strong farmer cooperative unions and Regional Chambers of Agriculture
- Strong alignment between nationally determined contributions (NDCs) and many national policies

#### **KEY BARRIERS TO SUCCESS:**

- Lack of inter-sectoral coherence and coordination regarding cross-cutting CSA topics
- Lack of high-level commitment to CSA
- Lack of funding for NAPA<sup>303</sup>
- Very low electricity penetration, which inhibits use of computer technologies and mobile devices to deliver services
- Persistent segregation and discrimination, particularly in terms of gender
- External circumstances that dissuade or prevent farmers from implementing recommendations, including:<sup>304</sup>
  - Restrictive land tenure
  - Unreliable access to profitable markets
  - Lack of safe harvest storage
  - Dearth of financial services such as loans and credit
  - Strong social and cultural norms that influence adoption of innovative practices

#### **PUBLIC INSTITUTIONAL FRAMEWORK:**

- Ministère de l'Agriculture et des Aménagements Hydrauliques (MAAH)
- Ministère de l'Environnement, de l'Économie Verte et du Changement Climatique
- Ministère de l'Eau et de l'Assainissement, Direction Générale des Ressources en Eau
- Secrétariat Permanent du Conseil National pour le Développement Durable (SP-CNDD)
- Secrétariat Permanent de la Coordination des Politiques Sectorielles Agricoles (SP-CPSA)
- Institut National de l'Environnement et de Recherches Agricoles (INERA)

#### **POTENTIAL NGO COLLABORATORS:**

- Regional Chambers of Agriculture
- National Federation of Naam Groups (NFNG)
- Farmer Confederation of Burkina Faso
- Alliance pour l'Agriculture Intelligente Face au Climat
- CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)
- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
- International Center for Tropical Agriculture (CIAT)
- Global Water Partnership<sup>305</sup>
- West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL)
- Christian Aid<sup>306</sup>

<sup>303</sup> ECOWAS, "Intervention Framework for the Development of Climate Smart Agriculture under the West Agricultural Policy (ECOWAP/CAADP) Implementation Process," June 15, 2015.

<sup>304</sup> ECOWAS, "Intervention Framework for the Development of Climate Smart Agriculture under the West Agricultural Policy (ECOWAP/CAADP) Implementation Process," June 15, 2015.

<sup>305</sup> Consultations Nationales sur l'Eau, la sécurité alimentaire, "Rapport Final de La Consultation Nationale Sur l'eau, La Sécurité Alimentaire et La Nutrition."

<sup>306</sup> Thomson Reuters Foundation, "Building Resilience and Adaptation to Climate Extremes and Disasters."



- Institut de l'Environnement et de Recherches Agricoles (CARI)

#### KEY DIGITAL AGRICULTURE TECHNOLOGIES:

- Mobile extension services, enabled by big data, machine learning, and mobile technology, to support best practices and disseminate research and development outputs
- Mobile finance services, along with digitized farm records to support credit line establishment
- Smart contracting for transparent and equitable land tenure processes
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support management decisions<sup>307</sup>
- Mobile platforms, enabled by big data, machine learning, and mobile technology, to support peer knowledge exchange, input supply, and product sales at fair market rates

#### DELIVERY: SYNTHESSES OF IMPLEMENTATION EXPERIENCE AND BEST PRACTICE

##### Relevant projects provide a strong knowledge base and lessons learned. Current projects include:

- **Burkina Faso Agriculture Resilience and Competitiveness Project**,<sup>308</sup> funded by World Bank, 2019-2025, US\$261 million. This project aims to enhance agricultural productivity through irrigation development, land-tenure arrangements, input supply chain support, advisory services, producer group services, institutional capacity strengthening, emergency response services, improved market connections, access to finance services, and natural resource management for 150,000 beneficiaries.
- **Mobile Data for Moving Herd Management and Better Incomes (MODHEM)**,<sup>309</sup> funded by the Netherlands Space Office (NSO), led by Netherlands Development Organization (SNV), with a total budget of €3.944 (US\$4.383 million). It aims to provide geo-satellite derived information services to 100,000 pastoralists' households and 200,000 farmers' households to improve food security.
- **Strengthening Climate Resilience in Burkina Faso**,<sup>310</sup> funded by the World Bank, 2018-2024, US\$33 million. It aims to provide institutional capacity building, infrastructure development, and information and communications technology (ICT) development to deliver core hydro-meteorological and climate information services, including early warning and emergency response services.
- **Land Technology Solutions Project (LTS)**,<sup>311</sup> funded by The United States Agency for International Development (USAID), 2017-2020, US\$ 3.994 million. This project aims to improve land and resources governance and strengthen property rights for all members of society by using Mobile Applications to Secure Tenure (MAST) technology.

##### Completed projects include:

- **APTE 21**,<sup>312</sup> funded by the French government through the Agriculture et Gestion des Risques Climatiques: Outils et Recherches en Afrique (AGRICORA) program, 2016-2018. This project aimed to improve production, access, and use of local information regarding high impact weather events for smallholder farming in Ghana, Burkina Faso, and Senegal. It was led by WASCAL.

<sup>307</sup> The World Bank Group, "Agriculture Observatory."

<sup>308</sup> International Development Association, "Agricultural Resilience and Competitiveness Project."

<sup>309</sup> GeoData for Agriculture and Water, "MODHEM Burkina Faso."

<sup>310</sup> World Bank, "Strengthening Climate Resilience in Burkina Faso."

<sup>311</sup> LandLinks, "Land Technology Solutions."

<sup>312</sup> WASCAL, "APTE-21."



- **Increasing Access to Weather Information and Affecting Behavior Change**,<sup>313</sup> implemented by Christian Aid, funded by the UK Department for International Development (DFID), 2015-2018. It aimed to build the resilience of vulnerable communities to climate extremes and disasters in high risk locations of Burkina Faso through climate information and practical assistance with developing and implementing community resilience plans, nutrition training, irrigation, conservation farming, and post-harvest storage. It benefitted over 1.3 million people.
- **Supporting Burkina Faso Open Data Initiative and Addressing Drought Risks by Introducing Innovative Use of Data and Open Data Solutions**,<sup>314</sup> supported by World Bank, 2014-2016, US\$300,000. It aimed to support the implementation and launch of the country's open data platform, collecting and publishing key drought-related data.
- **Supporting Agricultural Technical Vocational Education and Training (ATVET)**,<sup>315</sup> implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the Comprehensive Africa Agriculture Development Programme, 2017-2019 (amount undisclosed). It aimed to develop agricultural technical and vocational training programmes for rice, sesame, and cashew value chains.
- **Strengthening Climate Information and Early Warning Systems in Africa for the Development of Resilience and Adaptation to Climate Change**,<sup>316</sup> implemented by the United Nations Development Programme, 2014-2018, US\$28.3 million. It aimed to enhance the capacity of hydro-meteorological services and networks to predict climatic events and associated risks, to issue early warnings, and to promote the transfer of this capacity.

## FINANCING AND MAXIMIZING FINANCE FOR DEVELOPMENT

**PUBLIC FINANCING OPPORTUNITY:** National Adaptation Program of Action (NAPA)

### POTENTIAL PRIVATE SECTOR COLLABORATORS:

- Orange Mobile
- Société d'Infrastructures Collectives (SICO)<sup>317</sup>
- Société Burkinabé des Fibres Textiles SOFITEX (for cotton) and other large processors and value-addition enterprises
- Private universities such as:
  - Institut de Gestion des Risques Industriel et du Développement Durable (INGRIDD)
  - L'Université Aube Nouvelle
  - Ecole Supérieur du Génie Rural et d l'Environnement (ESGRE)
  - Institut Panafricain pour le Développement (IPD)
  - Institut International d'Ingénierie de l'Eau et de l'Environnement (2iE)

### INTERNATIONAL FINANCING OPPORTUNITIES:

- Netherlands Space Office
- ECOWAS Bank for Investment and Development (EBID)

<sup>313</sup> Thomson Reuters Foundation, "Building Resilience and Adaptation to Climate Extremes and Disasters."

<sup>314</sup> World Bank, "Supporting Burkina Faso Open Data Initiative and Addressing Drought Risks by Introducing Innovative Use of Data and Open Data Solution."

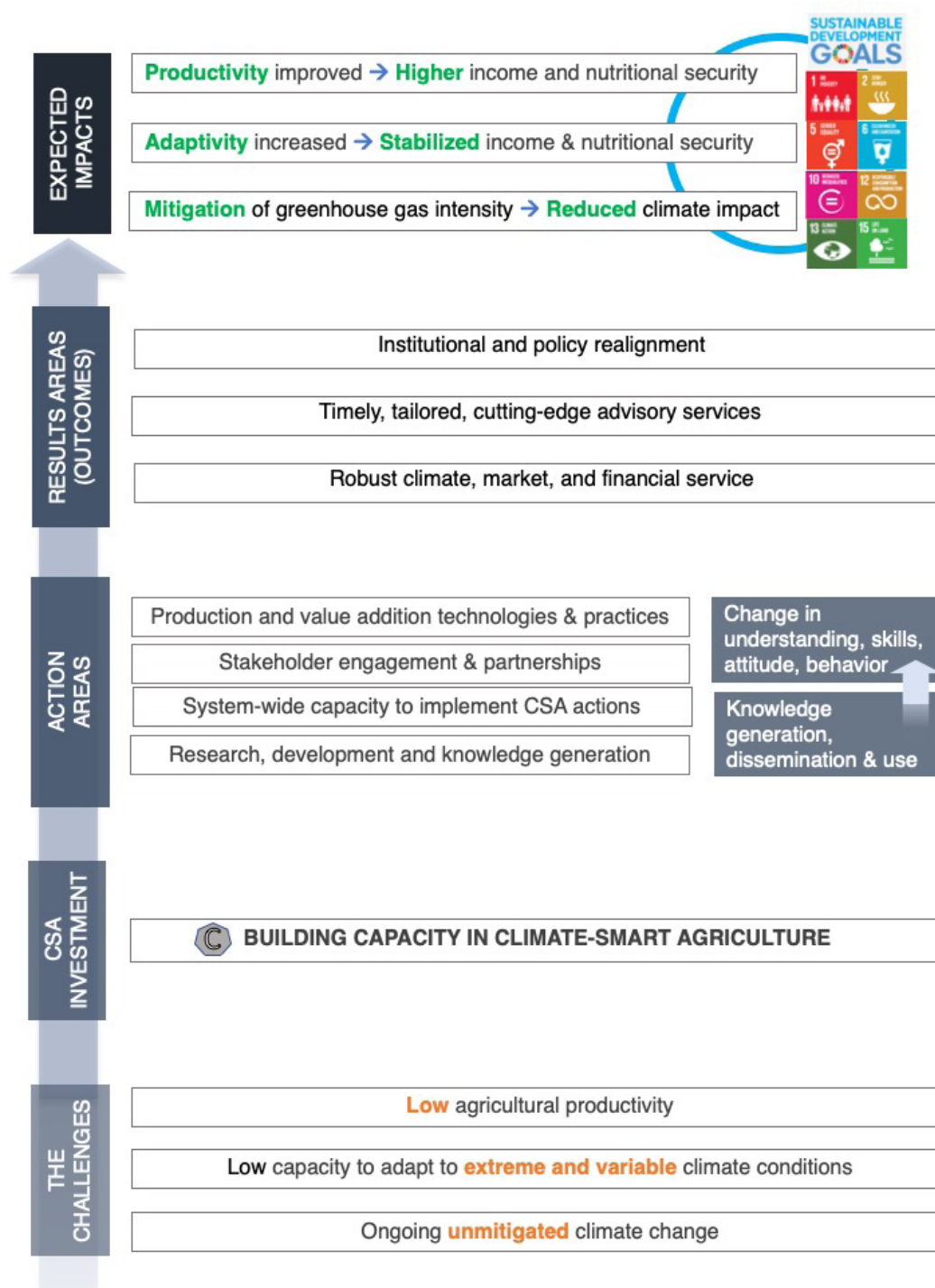
<sup>315</sup> World Bank.

<sup>316</sup> UNDP, "Strengthening Climate Information and Early Warning Systems in Burkina Faso | UNDP Climate Change Adaptation."

<sup>317</sup> Orange, "Smart Metering Solution in Burkina Faso"; Ngounou, "BURKINA FASO."

- Regional Agency for Agriculture and Food (RAAF)
- UK Department for International Development (DFID)
- Netherlands Development Organization (SNV)
- Permanent Interstate Committee for Drought Control in the Sahel (CILSS)
- Agriculture et Gestion des Risques Climatiques: Outils et Recherches en Afrique (AGRICORA), supported by French Ministry of Foreign Affairs and International Development
- West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL)
- World Bank

## THEORY OF CHANGE



## A.6 Sustainable Management Of Water Resources And Irrigation

### PROJECT SUMMARY

**OBJECTIVE:** Fully leverage Burkina Faso's water resources in sustainable ways to improve productivity, nutritional security, climate resiliency, and ecological health.

**REGION:** South Sudan

**CLIMATE-SMART AGRICULTURE (CSA) PILLARS:** Adaptation, Production

**PROJECTED BENEFICIARIES:** 100,000

**KEY CSA INVESTMENT ACTIVITIES:**

- Improvement or rehabilitation of existing infrastructure
- Protection of water bodies and associated ecosystems
- Establishment of irrigation and water infrastructure
- Capacity building for water use efficiency

**PROJECT HIGHLIGHTS:**

- This project will increase benefits to farm households by 56%.
- With a positive net present value (NPV) of 21%, the project will have a low success level even if risks become real.
- Increased yields and decreased flooding and erosion will be achieved through water management infrastructure.
- Adaptivity and innovation

### JUSTIFICATION

**Water harvesting and irrigation practices improve productivity and efficiency.** Worldwide, irrigated agriculture represents about 20% of agricultural land and contributes about 40% of crop production.<sup>318</sup> Water harvesting and irrigation largely unlink agricultural productivity from the vagaries of rainfall. This significantly increases agricultural production, food security, and price stability. It also opens up the possibility of export and reduces national dependency on imports and emergency food reserves. In a country like Burkina Faso with a strongly agricultural economy, this can result in marked improvements in quality of life, gross domestic product, gross national income, nutritional security, and other important measures of resiliency and stability.

**There is a significant untapped opportunity to leverage water harvesting and irrigation to increase productivity in Burkina Faso.** Nearly 4.4 million hectares of Burkinabe agriculture are rainfed, while just 25,000 hectares are irrigated. Another 4.6 million hectares of arable land remain untapped. About 29 billion cubic meters of water would be required to irrigate all the arable land in Burkina Faso (Figure 2, Column 1). While the country has just 18.5 billion cubic meters of renewable surface water and groundwater resources available (Figure 1, Column T), it currently uses only a tiny fraction of this total (Figure 1, Column C). Burkina Faso's economy is strongly oriented toward agriculture, resulting in a low industrial demand for water.<sup>319</sup> As such, nearly all the untapped water resources (an estimated 18 billion cubic meters) could be used to irrigate agricultural land.

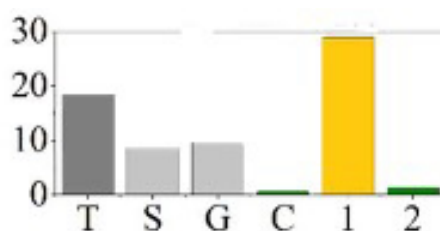
**Burkina Faso has diverse renewable water resources that enable highly site-tailored water management solutions.** This affords Burkina Faso significant flexibility in terms of resource options and also necessitates careful situational analysis to ensure project solutions are sustainable. Where

<sup>318</sup> Signs and McCartney, "Fish in Irrigation Systems: An Ancient Practice May Be the Way of the Future!," September 2, 2019.

<sup>319</sup> Abou Zaki et al., "An Index-Based Approach to Assess the Water Availability for Irrigated Agriculture in Sub-Saharan Africa."

dams and reservoirs are appropriate, multiple uses can be considered to ensure environmental and economic sustainability; for example, reservoirs and canals may be used for aquaculture.<sup>320</sup> In areas of low rainfall, high evapotranspiration, and rich groundwater resources, wells would be much more appropriate. About half of Burkina Faso's renewable water resources are groundwater. In contrast, about 1/3 of renewable resources in neighbors Ghana and Togo are groundwater, and about 6% of neighboring Benin's renewable resources are groundwater.<sup>321</sup> Where other solutions prove untenable, supplemental irrigation schemes during critical crop growth periods may be the best solution.<sup>322</sup>

**Figure A-6.1: Volume of Renewable Water Resources (10<sup>9</sup> cubic meters [m<sup>3</sup>])<sup>323</sup>**



T = total renewable water resources available

S = renewable surface water resources available

G = renewable groundwater resources available

C = current renewable water resource use

1 = water resources required to farm all arable land

2 = water resources required to increase farmed area using current rainfed method

**Surface reservoirs alone do not garner significant social benefits or economic return on investments (ROI).** Integrating some combination of energy production, agricultural irrigation infrastructure, livestock watering, and aquaculture is essential to the impact and profitability of reservoir projects.<sup>324</sup> These accompanying projects also offer diversified nutritional sources and generate new economic sectors, job opportunities, and opportunities for rural services such as affordable electricity. Several past dam projects have provided important lessons learned in this regard. The Bagré Dam project in the early 1990s is a particularly important example in which land allocation changes led to local conflicts. In contrast, the 2011 Pole de Croissance de Bagré Project featured explicit goals such as sustainable growth, enabling private investment, and increasing production and employment. The Samandeni Dam, inaugurated in December 2019, has also been designed and promoted with climate change and rural livelihood resilience in mind.

**Any given water management solution is not appropriate across all scenarios.** The feasibility and potential impacts of water projects vary widely depending on geography; time, especially given growing climate change impacts; the population served through economies of scale; and the type of system used. For example, locally available diesel or gasoline-run pumps cost about US\$430 per hectare, plus US\$31 in annual operation and maintenance. By contrast, solar powered pumps cost about US\$1,320 per hectare and would virtually eliminate operational expenses. However, repair and maintenance could be quite challenging given the lack of locally available materials. Depending on the population density of the area served, the per capita expenditure of these projects could vary by as much as 1900%.<sup>326</sup> In some cases, suboptimal solutions can also be extraordinarily costly. For

<sup>320</sup> Signs and McCartney, "Fish in Irrigation Systems: An Ancient Practice May Be the Way of the Future!," September 2, 2019.

<sup>321</sup> Abou Zaki et al., "An Index-Based Approach to Assess the Water Availability for Irrigated Agriculture in Sub-Saharan Africa."

<sup>322</sup> Nangia et al., "Supplemental Irrigation."

<sup>323</sup> Abou Zaki et al., "An Index-Based Approach to Assess the Water Availability for Irrigated Agriculture in Sub-Saharan Africa."

<sup>324</sup> Bazin et al., "Irrigation, Food Security and Poverty – Lessons from Three Large Dams in West Africa."

<sup>325</sup> World Bank, "Burkina Faso Access to Irrigation for Cotton Farming."

<sup>326</sup> Torbaghan and Burrow, "Small Town Water Supply Infrastructure Costs."

example, over 1/3 of the small dams built with government funding in the 2000s have failed due to extreme weather events, displacing communities and destroying livelihoods and infrastructure.<sup>327</sup>

**In some cases, improvements in existing infrastructure or improved use efficiency of existing water sources removes the need for new technologies. Improvements to existing wells in Burkina Faso have increased flow rates by up to 300%.**<sup>328</sup> Fully utilizing reservoir storage capacity, maintaining infrastructure, reducing water conveyance network losses, and optimizing field-level management have all been shown to improve water use efficiency.<sup>329</sup> Farmer capacity building through extension, along with sufficient institutional resources for maintaining and improving infrastructure, are crucial to fully leveraging existing systems and technologies.

**Land tenure and finance services must accompany robust extension in order enable the success of water management solutions.** Training in best management practices increases knowledge but does not enable behavior changes. Many farmers are unable to implement new knowledge without access to financing<sup>330</sup> and land security.<sup>331</sup> One study in West Africa found that farmers trained in a variety of small-scale irrigation technologies chose to implement low-cost technologies that improved profits by 154% rather than capital-intensive options that increased profits by 608% simply due to lack of access to financing services.<sup>332</sup> Furthermore, it is unreasonable for farmers who do not have tenure on their land to make long-term investments in infrastructure.

**The Burkinabe government is committed to sustainable water management for agricultural production.** The governmental Small Dams Project created more than 1500 small dam reservoirs. In the decade following construction, over 1/3 of these dams were destroyed in flood surges and other extreme weather events. The rural poor were disproportionately impacted by the loss of water resources during the subsequent dry seasons. In response, the government launched a dam rehabilitation scheme in 2015.<sup>333</sup> Gathering lessons learned from the failure of previous dams will be crucial to ensuring that future projects avoid similar issues.

**Burkina Faso has significant international commitment and support for sustainable agricultural water management.** In 2013 Burkina Faso became a signatory to the Dakar Declaration on Irrigation, which aims to increase investments in agricultural hydraulics through policy implementation and reform, and to reduce poverty and improve food security through irrigated agriculture. Meeting these goals would concomitantly achieve a portion of Burkina Faso's commitments to Pillar One of the Comprehensive Africa Agriculture Development Program, which relates to sustainable land and water management. Burkina Faso is also a member of the African Partnership for Agriculture Water and is part of the Sahel Irrigation Initiative of the Permanent Inter-State Committee to Fight Drought in the Sahel.<sup>334</sup> Burkina Faso is home to the Economic Community of West African States (ECOWAS) Water Resources Coordination Centre and hosted the development of the Guidelines for the ECOWAS Development of Water Infrastructure in West Africa Manual.<sup>335</sup>

## PROBLEM STATEMENT

**The vast majority of Burkina Faso's agriculture depends on rainfall.** This means that regular rainfall and good absorption of rain by the soil are necessary to support optimum agricultural yield;

<sup>327</sup> WASCAL, "Burkinabe Government Initiatives for Water Management," 2019.

<sup>328</sup> World Bank, "Burkina Faso Access to Irrigation for Cotton Farming."

<sup>329</sup> Sekyi-Annan et al., "Performance Evaluation of Reservoir-Based Irrigation Schemes in the Upper East Region of Ghana."

<sup>330</sup> Anang and Awuni, "Effect of Training on Small Scale Rice Production in Northern Ghana."

<sup>331</sup> World Bank, "Burkina Faso Access to Irrigation for Cotton Farming."

<sup>332</sup> Balana et al., "Economic and Food Security Effects of Small-Scale Irrigation Technologies in Northern Ghana."

<sup>333</sup> WASCAL, "Burkinabe Government Initiatives for Water Management," 2019.

<sup>334</sup> Global Water Partnership West Africa, "GWP to Collaborate with CILSS on Sahel Irrigation Initiative."

<sup>335</sup> Economic Community of West African States, "Guidelines for the Development of Water Infrastructure in West Africa."

in contrast, high rainfall variability leads to low agricultural yield. The effects of climate change are expected to significantly increase rainfall variability, implying periods of heavy rainfall and runoff, followed by periods of water scarcity and drought.

**Pollution, population growth, high evapotranspiration, and environmental degradation have also reduced water availability.** Deliberate water management, conservation, and resource use efficiency are necessary to create resiliency in the face of climate change-induced droughts, floods, and land degradation. Robust infrastructure, effective farmer training, good farmer access to financial services, augmented institutional capacity to deliver extension services, and strong inter-ministerial and inter-sectoral collaboration will be crucial components of successful efforts.

**Even after the appropriate site-tailored water management solution is identified, significant challenges remain.** Barriers to successful adoption of water management systems include limited farmer capacity, limited information on installing and maintaining systems, high system cost, limited institutional support, and negative perceptions of system sustainability and portability.<sup>336</sup> Cultural rules, norms, traditions, and taboos, as well as traditional practices and knowledge, may also challenge irrigation and water harvesting strategies.

## ECONOMIC AND FINANCIAL ANALYSIS

### ESTIMATES OF IMPACTS: PRODUCTION, RESILIENCE, EMISSIONS

For the purposes of this analysis, production of rice, vegetables, and maize were assumed. Rice and vegetables have very high return potential under irrigation as compared to cereals such as maize and should be prioritized for irrigation.

**Table A-6.1 Cost Benefit Analysis with and without Climate Risks**

Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
<b>With Climate and Pest Risks</b>					
100,000	56	-15.8	21	-0.35	-0.18 (0.67)
<b>Without Climate and Pest Risks</b>					
100,000	56	22.9	54	0.35	0.26 (0.98)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

**Table A-6.2 Financial Analysis**

Values are the percentage change with and without project. Values are derived from the Compendium and other secondary sources.

<b>Change with Investments for Sustainable Management of Water Resources and Irrigation</b>			
<b>Technology</b>	<b>Yield</b>	<b>Gross Returns</b>	<b>Costs</b>
<b>Sustainable Management of Water Resources and Irrigation</b>			
<b>Rice</b>			
Improved Varieties	11.6 (27.9)		
System of Rice Intensification	53.3 (5.0)	49.2 (12.7)	2.6 (6.7)
Irrigation	35.7 (17.2)	55.3 (95.4)	
Water Harvesting	37 (6.8)		

<sup>336</sup> Akuffobe-Essilfie et al., "Promoting Rainwater Harvesting for Improving Water Security."

Maize			
Improved Varieties	29.8 (9.6)	8.8 (15.8)	6.9 (2.8)
Water Harvesting	58.5 (3.1)		
Irrigation (Adding Season)	100		
Vegetables			
Irrigation (Improved Yield)	154		
Irrigation (Adding Season)	100		
Improved Varieties	38.6 (8.3)		
Mulching	31.4 (23.0)		
Crop Residue	28.0 (3.5)		
<b>Mean of All Technologies</b>	<b>56.5 (41.1)</b>	<b>56.8 (28.7)</b>	<b>21.2 (5.7)</b>

**Table A-6.3** Values for Estimating the Number of Beneficiaries

Investment	Budget (US\$, billions)	Cost per Beneficiary (US\$)
Sustainable Management of Water Resources	65.0	650

#### ESTIMATED PROJECT COSTS

Project costs were based on average costs per beneficiary following a typology of investments' cost effectiveness derived from expert opinion. Investments typically range between US\$200-900 per beneficiary (see Annex E).

#### CLIMATE MODELING

These are the projections for the crops in the water project without assuming that the investments are made.

		YIELD: Percentage Change from No Climate Change Scenario					
Crops	Baseline Value (TM)	Low Emissions		Medium Emissions		High Emissions	
	2018	2030	2050	2030	2050	2030	2050
CER-Maize	861.9	-9.79	-19.24	-8.80	-17.15	-11.10	-21.58
CER-Rice	89.2	-0.71	-1.45	0.11	0.03	1.15	2.27
F&V-Vegetables	665.8	-7.73	-14.51	-6.22	-11.76	-7.13	-13.16
Product	Baseline Value (Ha)	AREA: Percentage Change from No Climate Change Scenario					
	2018						
CER-Maize	861.9	-9.79	-19.24	-8.80	-17.15	-11.10	-21.58
CER-Rice	55.90	1.19	2.41	1.54	2.97	2.16	4.40
F&V-Vegetables	665.8	-7.73	-14.51	-6.22	-11.76	-7.13	-13.16

## ENABLING ENVIRONMENT: SITUATION ANALYSIS

### Alignment with Nationally Determined Contribution (NDC)

The table below shows the alignment with 10 NDC objectives.

Strong Alignment		Partial Alignment	
Water Conservation and Irrigation Management		Livestock and Aquaculture Productivity	
Little or No Alignment			
Improved Farming Technologies, Conservation Agriculture	Management and Conservation of Soils and Fertility	Governance Reform	Post-Harvest Handling and Processing
Renewable Energy	Information Management, Advisory Services	Financial Services	Restoring Forests, Agroforestry

### KEY ASSETS FOR SUCCESS:

- Vast untapped water resources
- Few inter-sectoral competing interests for water resources
- Roughly equal division of water resources between ground and surface, enabling flexibility in solution design
- Aligned international agreements and national policies
- Good existing knowledge base through previous projects

### KEY BARRIERS TO SUCCESS:

- Low financial capacity
- Scant mechanisms for capacity building and extension
- Highly site-specific solutions requiring significant upfront investment in diagnostics
- Lack of land tenure
- Divergence between government yield objectives and rural farmers' food security objectives
- Insufficient land access for farmers to leverage water resources in breaking poverty cycle<sup>337</sup>

### RELEVANT POLICIES:

- Plan National de Développement Economique et Social (PNDES)
- Code Forestier
- Code l'Environnement
- Programme National du Secteur Rural Phase 2 (PNSR 2)
- Plan National d'Adaptation
- Politique National de l'Eau

### ADDITIONAL INTERNATIONAL COMMITMENTS:

- Dakar Declaration on Irrigation
- Comprehensive Africa Agriculture Development Programme (CAADP) Pillar 1
- Agricultural Water for Africa (AgWA)
- Economic Community of West African States (ECOWAS)
- Sahel Irrigation Initiative of the Permanent Inter-State Committee to Fight Drought in the Sahel (CILSS)

### RELEVANT POLICY GAPS: -none identified-

<sup>337</sup> World Bank, "Burkina Faso Access to Irrigation for Cotton Farming."



**KEY POLICY DISTORTIONS:** -none identified-

**KEY DIGITAL AGRICULTURE TECHNOLOGY:**

- Remote sensing, drones, GPS, and GIS for informing tailored water management approaches
- Internet of things and remote sensing for regulating water canals, reservoirs, and precision irrigation
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support decisions about surface water management in the face of extreme weather events<sup>338</sup>
- Mobile finance services, smart contracting for land tenure, and digitized farm records to support credit line establishment

**DELIVERY: SYNTHESSES OF IMPLEMENTATION EXPERIENCE AND BEST PRACTICE**

**Related projects providing foundational knowledge and lessons learned include:**

- Bagre Growth Pole Support Project (PAPCB),<sup>339</sup> supported by African Development Bank (AfDB), 2011-2020, US\$133 million plus additional US\$60 million in 2018. This project's aims include:
  - Extension of primary canal, surge tanks, and irrigation infrastructure
  - Construction of warehouse and post-harvest infrastructure
  - Training farmers in water and soil management practices
- **Participatory Natural Resource Management and Rural Development Project in the North, Centre-North and East Regions**,<sup>340</sup> supported by the International Fund for Agricultural Development, 2012-2021, US\$ 117.452 million. This project aims to reclaim degraded lands using soil water conservation techniques such as stone bunds, vegetative barriers, filter dikes, and zai micro-catchments.
- **Projet de Valorisation Agricole des Ressources en Eau Souterraine**
- **Projet Samendeni**
- **Pole de Croissance de Bagree**
- **Projet Leraba**
- **Burkina Faso Smallholder Irrigation Project**, supported by the Global Partnership for Results-Based Approaches (GPRBA), plus the International Finance Corporation (IFC) and World Bank collaborations, 2018-present, US\$ 5.85 million<sup>341</sup>

**Other relevant completed projects include:**

- **Water Management and Irrigation Activity**,<sup>342</sup> implemented by the Burkina Faso Compact, 2009-2014, US\$ 103.9 million. This project constructed 2,240 hectares of irrigated perimeter in the Di Department and provided land titles and leases to irrigated land recipients under the Rural Land Governance Project.
- **Small-Scale Irrigation and Water Management Project**, implemented by International Fund for Agricultural Development (IFAD),<sup>343</sup> 2007-2014, US\$ 16.3 million. This project aimed to:
  - Reduce rural poverty and improve food security through investment in strengthening access to irrigation water
  - Intensify and diversify sustainable agricultural production under irrigation and in the lowlands

<sup>338</sup> The World Bank Group, "Agriculture Observatory."

<sup>339</sup> OSAN Department, "Bagre Growth Pole Support Project."

<sup>340</sup> International Fund for Agricultural Development, "Participatory National Resource Management and Rural Development Project."

<sup>341</sup> Global Partnership for Results Based Approaches, "Burkina Faso Smallholder Irrigation."

<sup>342</sup> Millennium Challenge Corporation, "Improving Agriculture Through Irrigation in Burkina Faso."

<sup>343</sup> International Fund for Agricultural Development, "Https."

- **Projet Ziga** Phases 1 and 2
- **Projet Petit Barrage**, supported by the Burkinabe government
- **Low-Cost Drip Irrigation Kits**, supported by iDE Global
- **Agroecological Farming**, supported by the Association pour la Promotion d'une Agriculture Durable (APAD)
- **Community Investment Programme for Agricultural Fertility**, supported by the International Fund for Agricultural Development, 2003-2012, USD \$26.87 million. This project aimed to increase agricultural productivity through use of soil and water conservation techniques, soil fertility restoration, agroforestry, and the creation of a livestock corridor.

#### **PUBLIC INSTITUTIONAL FRAMEWORK:**

- Ministry of Water Resources
- Ministry of Agriculture
- Ministry of Environment, Green Economy, and Climate Change
- Public universities, such as the University of Ouagadougou and the Nazi Boni University
- National Institute for Scientific and Technological Research (CNRST)

#### **POTENTIAL NGO COLLABORATORS:**

- Association pour la Promotion d'une Agriculture Durable (APAD)
- iDE Global<sup>344</sup>
- Global Water Partnership West Africa<sup>345</sup>

### **FINANCING AND MAXIMIZING FINANCE FOR DEVELOPMENT**

**PUBLIC FINANCING OPPORTUNITIES:** Blended financing opportunities via the government and the Environmental Intervention Fund.

**PRIVATE FINANCING OPPORTUNITY:** Banque Agricole du Burkina (Agricultural Bank of Burkina)

#### **POTENTIAL PRIVATE SECTOR COLLABORATORS:**

- Millennium Challenge Corporation<sup>346</sup>
- Société Burkinabè des Fibres Textiles (Sofitex)<sup>347</sup>

#### **INTERNATIONAL FINANCING OPPORTUNITIES:**

- International Commission on Irrigation and Drainage (ICID)<sup>348</sup>
- Comprehensive Africa Agriculture Development Programme (CAADP)
- Agricultural Water for Africa (AgWA)
- Economic Community of West African States (ECOWAS) Water Resources Coordination Centre<sup>349</sup>
- Permanent Interstate Committee for Drought Control in the Sahel (CILSS)<sup>350</sup>
- Global Environment Fund (GEF)
- Green Climate Fund (GCF)
- World Bank
- African Development Bank (AfDB)

<sup>344</sup> iDE Global, "Demonstrating Leadership in Agriculture and Sanitation."

<sup>345</sup> Global Water Partnership West Africa, "GWP to Collaborate with CILSS on Sahel Irrigation Initiative."

<sup>346</sup> Millennium Challenge Corporation, "Improving Agriculture Through Irrigation in Burkina Faso."

<sup>347</sup> World Bank, "Burkina Faso Access to Irrigation for Cotton Farming."

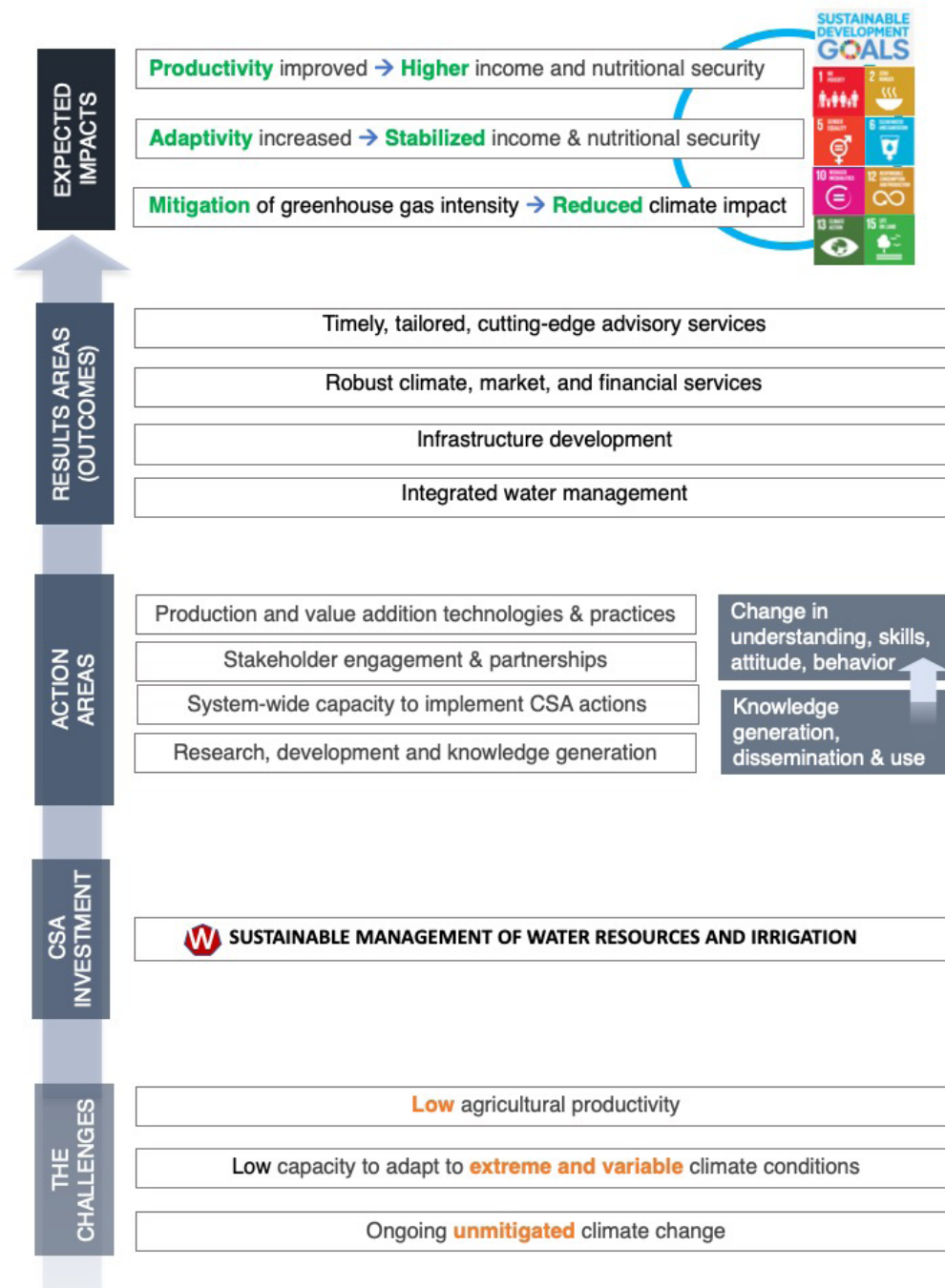
<sup>348</sup> International Commission on Irrigation and Drainage, "Dakar Declaration on Irrigation."

<sup>349</sup> Economic Community of West African States, "Guidelines for the Development of Water Infrastructure in West Africa."

<sup>350</sup> Global Water Partnership West Africa, "GWP to Collaborate with CILSS on Sahel Irrigation Initiative."

- West African Development Bank (BOAD)
- Global Partnership for Results-Based Approaches (GPRBA)<sup>351</sup>

## THEORY OF CHANGE



<sup>351</sup> Global Partnership for Results Based Approaches, "Burkina Faso Smallholder Irrigation."<sup>o</sup>

## A.7 Developing Climate-Smart Organic Value Chains

### PROJECT SUMMARY

**OBJECTIVE:** Develop a burgeoning niche market to create viable careers and shorten supply chains in peri-urban areas.

**REGIONS:** North Sudan, South Sudan

**CSA PILLARS :** Adaptation, Production

**PROJECTED BENEFICIARIES:** 60,000

**KEY CSA INVESTMENT ACTIVITIES:**

- Organic cotton, mango, and vegetable production
  - Develop heat, drought, and disease resistant varieties
  - Integrated soil fertility management
  - Post-harvest technology and infrastructure development
  - Improve access to bio fertilizer and bio pesticide inputs
  - Build capacity and awareness of organic production and marketing
- Solar powered garden irrigation

**PROJECT HIGHLIGHTS:**

- Benefits to farm households will increase by 54%.
- Resilience to climate and pest risks is low, with a positive NPV of 29%.
- Improved varieties, integrated soil management, post-harvest technology, improved access inputs, and capacity building will create resiliency in a growing market subsector.

### JUSTIFICATION

**Burkina Faso is becoming increasingly urbanized.** The country has one of the highest birth rates in the world, and the burgeoning population is increasingly moving to urban areas in search of viable careers.<sup>352</sup> Urban populations are heavily reliant on urban and peri-urban farmers for food. These farmers—who may be up to 100 kilometers from the city center—provide up to 36% of the city's total food demand and up to 90% of its fresh vegetables.<sup>353</sup> These value chains, nevertheless, suffer significant resource use inefficiencies, negative externalities, and discriminatory effects on vulnerable populations.<sup>354</sup> Diversification of markets and value chain development are key to meeting the growing food demands of urban populations and creating the jobs and economic benefits that workers seek.<sup>355</sup>

**The risk of agricultural chemical exposure has catalyzed an interest in organic food products in Burkina Faso.**<sup>356</sup> The benefits of organic agriculture in terms of both environmental impact and human health impact have been widely appreciated since the 1990s.<sup>357</sup> Organic products may thus represent an important opportunity to diversify the Burkinabe agricultural sector and develop relevant value chains.

**Producers are beginning to respond to this demand.** During the year 2016, land area under organic production more than doubled, from 24,268 hectares to 55,891 hectares (ha). At the same time,

<sup>352</sup> International Finance Corporation, "Creating Markets in Burkina Faso."

<sup>353</sup> International Finance Corporation; Gross and Jaubert, "Vegetable Gardening in Burkina Faso."

<sup>354</sup> "UrbanFoodPlus."

<sup>355</sup> International Finance Corporation, "Creating Markets in Burkina Faso."

<sup>356</sup> CNABio, "L'association CNABio."

<sup>357</sup> CNABio.

productivity per hectare increased because of training and support for farmers. The bulk of Burkinabe organic production—10,213 hectares—is of tropical and subtropical fruits such as mango.<sup>358</sup> Organic cotton accounts for an additional 3,731 hectares. Burkina Faso is the 7<sup>th</sup> largest producer of organic cotton in Africa, and accounts for 0.42% of the world's organic cotton. As of 2017, there were 26,626 organic producers in the country, 7,369 of which produced cotton.<sup>359</sup>

**Organic labelling has also recently emerged in Burkina Faso.** The Burkinabe Bio Systeme Participatif de Garantie is one of the first national organic labels in all West Africa. The certification process is overseen by the National Council for Biological Agriculture (CNABio), and the program is supported by Capacity Development for Agricultural Innovation Systems (CDAIS). Smallholder producers of fresh fruits and vegetables have been prominent among those farms already certified by the label.<sup>360</sup>

**Irrigation systems are key to unlinking farm productivity from the vagaries of climate change.** In rural areas, feasible irrigation solution options are limited by low access to services like electricity and to the tools and equipment necessary for system maintenance, operation, and repair. In urban and peri-urban areas, these access barriers are significantly lower, and concomitantly, the options for irrigation innovation are broader. Solar-powered irrigation is an excellent example of a solution that may be infeasible in most rural areas but could have strong potential in many urban and peri-urban areas.

**Land tenure and finance services enable innovative irrigation solutions.** Solar irrigation carries a high up-front investment and virtually no operational expenses.<sup>361</sup> In theory, the year-round production potential of irrigated systems and the strong, year-round demand from urban populations<sup>362</sup> could lower this financial barrier for urban and peri-urban producers. In practice, finance services, and in particular those tailored to the unique characteristics of agricultural production, are scant.<sup>363</sup> Even farmers trained in a variety of irrigation solutions are unable to implement new knowledge without access to financing<sup>364</sup> and land security.<sup>365</sup> One study in West Africa found that farmers trained in a variety of small-scale irrigation technologies chose to implement low-cost technologies that improved profits by 154% rather than capital-intensive options that increased profits by 608% simply due to lack of access to financing services.<sup>366</sup> Furthermore, it is unreasonable for farmers who do not have tenure on their land to make long-term investments in infrastructure.

## PROBLEM STATEMENT

**Despite strong demand, organic agriculture production has been low because of market and policy distortions.** Many producers are unable to fully leverage the domestic and international demand for organic products because of poor market linkages and a lack of capacity building. Organic certification, and international markets in general, demand significantly higher quality standards. Without gender-integrated capacity building, it is incredibly challenging for producers to become familiar with and meet these quality standards. For those that have met quality standards, poor access to the required organic inputs, and the higher costs of these inputs, remain a barrier.<sup>367</sup>

<sup>358</sup> van Melle and Buschmann, "Comparative Analysis of Mango Value Chain Models in Benin, Burkina Faso and Ghana."

<sup>359</sup> FiBL and IFOAM, "The World of Organic Agriculture - Statistics and Emerging Trends 2019."

<sup>360</sup> Capacity Development for Agricultural Innovation Systems, "Organic Certification Takes Root Thanks to Everyone Working Together."

<sup>361</sup> World Bank, "Burkina Faso Access to Irrigation for Cotton Farming."

<sup>362</sup> Karg and Drechsel, Atlas of West African Urban Food Systems.

<sup>363</sup> Yamegueu, Alokore, and Corso, "Potential of Microfinanced Solar Water Pumping Systems for Irrigation in Rural Areas of Burkina Faso."

<sup>364</sup> Anang and Awuni, "Effect of Training on Small Scale Rice Production in Northern Ghana."

<sup>365</sup> World Bank, "Burkina Faso Access to Irrigation for Cotton Farming."

<sup>366</sup> Balana et al., "Economic and Food Security Effects of Small-Scale Irrigation Technologies in Northern Ghana."

<sup>367</sup> Karg and Drechsel, Atlas of West African Urban Food Systems.

Transportation challenges further limit most producers' market linkages, forcing them to work with traders who hold purchase prices artificially low. This makes middle-men the primary beneficiaries of organic production and dissuades producers from investing in organic systems.<sup>368</sup> In the cotton industry, these issues are further exacerbated by the power of conventional cotton companies and government policies regarding the cotton sector.<sup>369</sup> Consequently, despite strong consumer and producer interest, just 0.5% of Burkina Faso land has been converted to organic agricultural production as of 2017.

**Climate change may put urban populations at significantly increased risk of food insecurity.**

Climate change is characterized by crop loss and drastic reductions in productivity across large geographic areas. Increasingly frequent and severe droughts, downpours, and floods threaten the stability of regional food supplies. Without irrigated urban and peri-urban agricultural systems, the entire urban population's food security is put at risk by the vagaries of precipitation under climate change.<sup>370</sup>

## ECONOMIC AND FINANCIAL ANALYSIS

### ESTIMATES OF IMPACTS: PRODUCTION, RESILIENCE, EMISSIONS

**Table A-7.1 Cost Benefit Analysis with and without Climate Risks**

Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, millions)	Chance Pos NPV (%)	ROI	BCR (SD)
<b>With Climate and Pest Risks</b>					
60,000	54	-5.1	29	-0.15	-0.08 (1.03)
<b>Without Climate and Pest Risks</b>					
60,000	33	21.8	54	0.48	0.33 (1.27)

**Table A-7.2 Financial Analysis**

Values derived from the Compendium and other secondary source.

Change with Investments for Organic Farming	
Technology	Yield (%) with project (without)
<b>Organic Farming</b>	
<b>Cotton</b>	
Organic Fertilizer	34.7 (11)
Crop Residue	5.3 (3.5)
Mulch	-5.1 (3.5)
Green Manure	-10.0 (4.7)
Irrigation (Improved Yield)	100
Irrigation (Additional Season)	100
<b>Mango</b>	
Addition of Mango Trees	10.0
Improved Storage	120 (20)
<b>Vegetables</b>	
Organic Fertilizer	56.2 (8.2)
Irrigation (in Season)	73.8 (16.7)

<sup>368</sup> van Melle and Buschmann, "Comparative Analysis of Mango Value Chain Models in Benin, Burkina Faso and Ghana."

<sup>369</sup> Métouolé Médà et al., "Institutional Factors and Farmers' Adoption of Conventional, Organic and Genetically Modified Cotton in Burkina Faso."

<sup>370</sup> Karg and Drechsel, Atlas of West African Urban Food Systems.

Irrigation (Additional Season)	100
Improved Varieties	38.6 (8.3)
Mulching	31.4 (23)
Crop Residue	28.0 (3.5)
Improved Storage	120 (20)
Crop Residue	28.0 (3.5)
<b>Mean of All Technologies</b>	<b>53.5 (45.6)</b>

**Table A-7.3** Values for Estimating the Number of Beneficiaries

Investment	Budget (US\$, Billions)	Cost per Beneficiary (US\$)
Organic Farming	50.0	833

#### ESTIMATED PROJECT COSTS

Project costs were based on average cost per beneficiary following a typology of investments' cost effectiveness derived from expert opinion. Investments typically range between US\$200-900 per beneficiary (see Annex E).

#### CLIMATE MODELING

These are the projections for the crops in the Organic Farming project without assuming that the investments are made. The three crops were cotton, mango, and vegetables; however, mango is not given its own category but instead is included in the tropical fruit category.

Crops	Baseline Value (TM)	YIELD: Percentage Change from No Climate Change Scenario					
		Low Emissions		Medium Emissions		High Emissions	
		2030	2050	2030	2050	2030	2050
COT-Cotton	290.1	-2.05	-3.69	-4.16	-7.37	-4.14	-7.05
F&V-Vegetables	665.8	-7.73	-14.51	-6.22	-11.76	-7.13	-13.16
F&V-Tropical Fruit	25.9	-0.68	-0.84	-3.34	-5.69	-3.68	-5.92
	Baseline Value (Ha)	AREA: Percentage Change from No Climate Change Scenario					
		2030	2050	2030	2050	2030	2050
COT-Cotton	584.26	-0.07	-0.05	-0.67	-1.24	-0.67	-1.19
F&V-Vegetables	665.8	-7.73	-14.51	-6.22	-11.76	-7.13	-13.16
F&V-Tropical Fruit	3.75	0.51	1.10	-0.12	-0.22	-0.27	-0.40

COT = cotton; F&V = fruits and vegetables

The CSA investment for Organic Farming will make all 3 crops more resilient.

#### ENABLING ENVIRONMENT: SITUATION ANALYSIS

#### Alignment with the NDCs

The table below shows alignment with 10 NDC objectives.

Partial Alignment				
Improved Farming Technologies, Conservation Agriculture	Water Conservation and Irrigation Management		Renewable Energy	Management and Conservation of Soils and Fertility
Little or No Alignment				
Governance Reform	Post-Harvest Handling and Processing	Livestock and Aquaculture Productivity	Information Management, Advisory Services	Restoring Forests, Agroforestry Financial Services

**ASSETS FOR PROJECT SUCCESS:**

- Strong domestic interest in organic products
- Robust international market demand for organic products
- Rapidly growing year-round urban demand for garden products
- Established, innovative organic certification process<sup>371</sup>
- Organic farming already practiced by some farmers
- Requires relatively little investment in training and infrastructure
- Uses existing technologies

**BARRIERS TO SUCCESS:**

- Lack of access to and availability of organic inputs<sup>372</sup>
- Significant market control by powerful conventional companies
- Policy that supports market control by powerful conventional companies<sup>373</sup>
- High dependency on external support mechanisms and poor access to the same<sup>374</sup>
- Current gap in extension service supply relative to demand<sup>375</sup>

**RELEVANT POLICIES:**

- System Participatif de Garantie by the National Council for Biological Agriculture (CNABio)<sup>376</sup>
- Plan National du Secteur Rural (PNSR 2)
- Programme National de Développement Économique (PNDES)

**KEY POLICY ISSUES:**

- Insufficient enabling policy environment for organic agriculture<sup>377</sup>
- Lack of mechanisms to ensure the quality and availability of organic inputs<sup>378</sup>

**KEY POLICY DISTORTIONS:**

- Various policies give large organizations overt powers over the cotton market, e.g. fixed pricing negotiated by the Burkinabe Interprofessional Cotton Association.<sup>379</sup> These policies may inhibit free-market development of in-demand organic industries.
- There is also a lack of sufficient extension services to meet demand.<sup>380</sup>

<sup>371</sup> Capacity Development for Agricultural Innovation Systems, "Organic Certification Takes Root Thanks to Everyone Working Together."

<sup>372</sup> Métouolé Médà et al., "Institutional Factors and Farmers' Adoption of Conventional, Organic and Genetically Modified Cotton in Burkina Faso."

<sup>373</sup> Métouolé Médà et al.

<sup>374</sup> van Melle and Buschmann, "Comparative Analysis of Mango Value Chain Models in Benin, Burkina Faso and Ghana."

<sup>375</sup> Consultations Nationales sur l'Eau, la sécurité alimentaire, "Rapport Final de La Consultation Nationale Sur l'eau, La Sécurité Alimentaire et La Nutrition."

<sup>376</sup> Capacity Development for Agricultural Innovation Systems, "Organic Certification Takes Root Thanks to Everyone Working Together."

<sup>377</sup> Kaegi, Bishof, and Luethi, "Organic Cotton Experiences. Learnings and Recommendations from Mali, Burkina Faso and Kyrgyzstan."

<sup>378</sup> Métouolé Médà et al., "Institutional Factors and Farmers' Adoption of Conventional, Organic and Genetically Modified Cotton in Burkina Faso."

<sup>379</sup> Babacar, "Cotton Prices Go up in Burkina Faso."

<sup>380</sup> Bikienga, "Elaboration d'un Profil de l'Agriculture Climato-Intelligente Pour Le Burkina Faso."



## KEY DIGITAL AGRICULTURE TECHNOLOGIES:

- Smart contracting for transparent and equitable sustainability certification
- Barcoding and blockchain for certification labeling and product tracing
- Mobile finance services, along with digitized farm records, to support credit line establishment
- Smart contracting for transparent and equitable land tenure processes
- Mobile extension services, enabled by big data, machine learning, and mobile technology, to support best practices and disseminate research and development (R&D) outputs
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support management decisions<sup>381</sup>
- Mobile platforms, enabled by big data, machine learning, and mobile technology, to support peer knowledge exchange, input supply, and product sales at fair market rates

## DELIVERY: SYNTHESSES OF IMPLEMENTATION EXPERIENCE AND BEST PRACTICE

Relevant projects offer a strong knowledge base and lessons learned. *Ongoing* projects include:

- **Capacity Development for Agricultural Innovation Systems (CDAIS)** to supports smallholders in getting certified by the National Council for Biological Agriculture (CNABio) under the System Participatif de Garantie label.<sup>382</sup>
- **Cashew Development Support Project in Comoe Basin for REDD+ (PADA/REDD+)**,<sup>383</sup> supported by the African Development Bank (AfDB), 2017-2021, US\$1.4 million, to enhance carbon sequestration through cultivation of cashew nuts, increase organic production of cashews, and create green jobs for women and youth.
- **Agricultural Value Chains Support Project in the Southwest, Hauts-Bassins, Cascades and Boucle du Mouhoun Regions**,<sup>384</sup> supported by the International Fund for Agricultural Development (IFAD), 2019-2025, US\$123.93 million. This project aims to:
  - Improve crop yield, beekeeping, and fish farming practices through improved access to certified seed, seedlings, fertilizer, and fingerlings.
  - Strengthen value chains of rice, horticulture, sesame, cowpeas, non-wood forest products, and fish.
  - Target 70,000 direct beneficiaries.

Completed projects include:

**Cotton Livelihood, Trade, and Equity Project (RECOLTE)**,<sup>385</sup> 2013-2018, led by Catholic Relief Services (CRS). This project :

- Supported farmers in the National Union of Cotton Producers of Burkina (UNPCB) with training to improve organic cotton production techniques.
- Helped develop the first organic cotton gin in West Africa and improve the quality and quantity of cotton seed.
- **Programme d'Appui à la Promotion de l'Entrepreneuriat Agricole (PAPEA)**,<sup>386</sup> 2003-2016, 3 phases. This project accomplished the following:
  - It supported certification of nearly 32,150 hectares of land as organic.
  - Estimates suggest this project reduced greenhouse gas (GHG) emissions by 8.5 million metric tons of carbon dioxide equivalent (CO<sub>2</sub>e), reduced chemical fertilizer use by 3.7 million

<sup>381</sup> The World Bank Group, "Agriculture Observatory."

<sup>382</sup> Capacity Development for Agricultural Innovation Systems, "Organic Certification Takes Root Thanks to Everyone Working Together."

<sup>383</sup> African Development Bank, "Cashew Development Support Project in Comoe Basin."

<sup>384</sup> International Fund for Agricultural Development, "Agricultural Value Chains Support Project in the Sud-Ouest, Hauts-Bassins, Cascades and Boucle Du Mouhoun Regions."

<sup>385</sup> Dofini, "Projet RECOLTE."

<sup>386</sup> Helvetas, "Small Farmers Build a Strategy for Their Future."

kilograms, and reduced chemical pesticide use by more than 28,000 kilograms.<sup>387</sup>

- Implemented by Swiss Helvetas Intercooperation and the Dutch Development Organization (SNV).
- **Improving Farmers Income and Food Security in Diversified Organic Production Systems in West Africa (SYPROBIO)**,<sup>388</sup> 2011-2015, funded by EuropeAid. This project focused on soil fertility, seed improvement, pest management, agronomy, and socioeconomics to benefit 100,000 farmers across Burkina Faso, Benin, and Mali.
- **Projet d'Appui aux Filières Agro-Sylvo-Pastorales (PAFASP)**,<sup>389</sup> 2006-2012, US\$66 million from World Bank. This project aimed to significantly increase export volume by providing field maintenance, training, and phytosanitary treatments to meet international export standards.
- **UrbanFoodPlus**.<sup>390</sup> This project aimed to develop site-specific, participatory innovations for improved productivity, food safety, and value chains.
- **Aide d'Urgence pour la Lutte Intégrée contre l'Invasion de la Chenille Légionnaire d'Automne**, supported by the AfDB, 2018-2019, US\$1.008 million. This project aimed to achieve sustainable management of the fall armyworm and reduced food crop losses.

## KEY INSTITUTIONAL ARRANGEMENTS AND POTENTIAL COLLABORATORS

### PUBLIC INSTITUTIONAL FRAMEWORK:

- Conseil National de l'Agriculture Biologique (CNABio)
- Ministère de l'Agriculture et des Aménagements Hydrauliques
- Direction Générale des Productions Végétales (DGPV)
- Institut de l'Environnement et de Recherches Agricoles (INERA)
- Ministère de l'Urbanisme et de l'Habitat
- Ministère de l'Environnement, de l'Economie Verte, et du Changement Climatique
- Ministère de l'Industrie, du Commerce et de l'Artisanat
- National Council for Biological Agriculture

### POTENTIAL NGO COLLABORATORS:

- Capacity Development for Agricultural Innovation Systems (CDAIS)
- Union Nationale des Producteurs de Coton du Burkina Faso (UNPCB), which has a dedicated organic cotton unit
- Association Interprofessionnelle du Coton du Burkina (AICB) which serves as a platform for negotiations between the UNPCB, the government, and the cotton companies
- Catholic Relief Services

## FINANCING AND MAXIMIZING FINANCE FOR DEVELOPMENT

### PUBLIC FINANCING OPPORTUNITIES:

- Blended finance opportunities via the government and the Environmental Intervention Fund
- National Council for Biological Agriculture

### PRIVATE FINANCING OPPORTUNITIES:

- SINERGI BURKINA
- Textile Exchange

<sup>387</sup> Kaegi, Bishof, and Luethi, "Organic Cotton Experiences. Learnings and Recommendations from Mali, Burkina Faso and Kyrgyzstan."

<sup>388</sup> FiBL, "Syprobio-Improving Farmers Income and Food Security in Diversified Organic Production Systems in West-Africa."

<sup>389</sup> Ministère de l'Agriculture et des Aménagements Hydrauliques, "Projet d'Appui Aux Filières Agro-Sylvo-Pastorales (PAFASP)."

<sup>390</sup> "UrbanFoodPlus."

- Union of Vegetable and Fruit Producers (UFMB)
- Association des Professionnels de la Mangue au Burkina (APROMAB)
- Plateforme Nationale de Commerce Équitable Burkina
- Burkinabe Interprofessional Cotton Association (AICB)<sup>391</sup>
- Société Burkinabè des Fibres Textiles (Sofitex)<sup>392</sup>
- SOCOMA
- Faso Coton
- GEOCOTON
- Union Nationale des Producteurs de Coton du Burkina (UNPCB)

#### **POTENTIAL PRIVATE SECTOR COLLABORATORS:**

- Organic and Fairtrade Cotton Coalition West Africa
- Textile Exchange
- Union of Vegetable and Fruit Producers (UFMB)
- Association des Professionnels de la Mangue au Burkina (APROMAB)
- Plateforme Nationale de Commerce Équitable Burkina
- Europe-Africa-Caribbean-Pacific Liaison Committee (COLEACP) for assistance in compliance with European import standards<sup>393</sup>
- Burkinabe Interprofessional Cotton Association (AICB),<sup>394</sup> which sets cotton prices
- The three regional cotton groups providing inputs, value chain support, and advisory services:<sup>395</sup>
  - Société Burkinabé des Fibres Textiles (SOFITEX), western region, owned by GEOCOTON, the Union Nationale des Producteurs de Coton du Burkina (UNPCB), and the government
  - SOCOMA, eastern region, owned by GEOCOTON and UNPCB
  - Faso Coton, central region, part of the Industrial Promotion Services (West Africa) S.A.
  - The Association Professionnelle des Sociétés Cotonnières du Burkina (APROCOB) jointly represents these three groups.

#### **INTERNATIONAL FINANCING OPPORTUNITIES:**

- United States Department of Agriculture (USDA)
- World Bank
- African Development Bank (AfDB)
- United Nations (UN)
- Ecocert Burkina Faso<sup>396</sup>
- Organics International<sup>397</sup>

<sup>391</sup> Babacar, "Cotton Prices Go up in Burkina Faso."

<sup>392</sup> World Bank, "Burkina Faso Access to Irrigation for Cotton Farming."

<sup>393</sup> Sahel and West Africa Club Secretariat, "Mali – Burkina Faso Cross-Border Co-Operation: Operational Framework Proposals and Policy Recommendations."

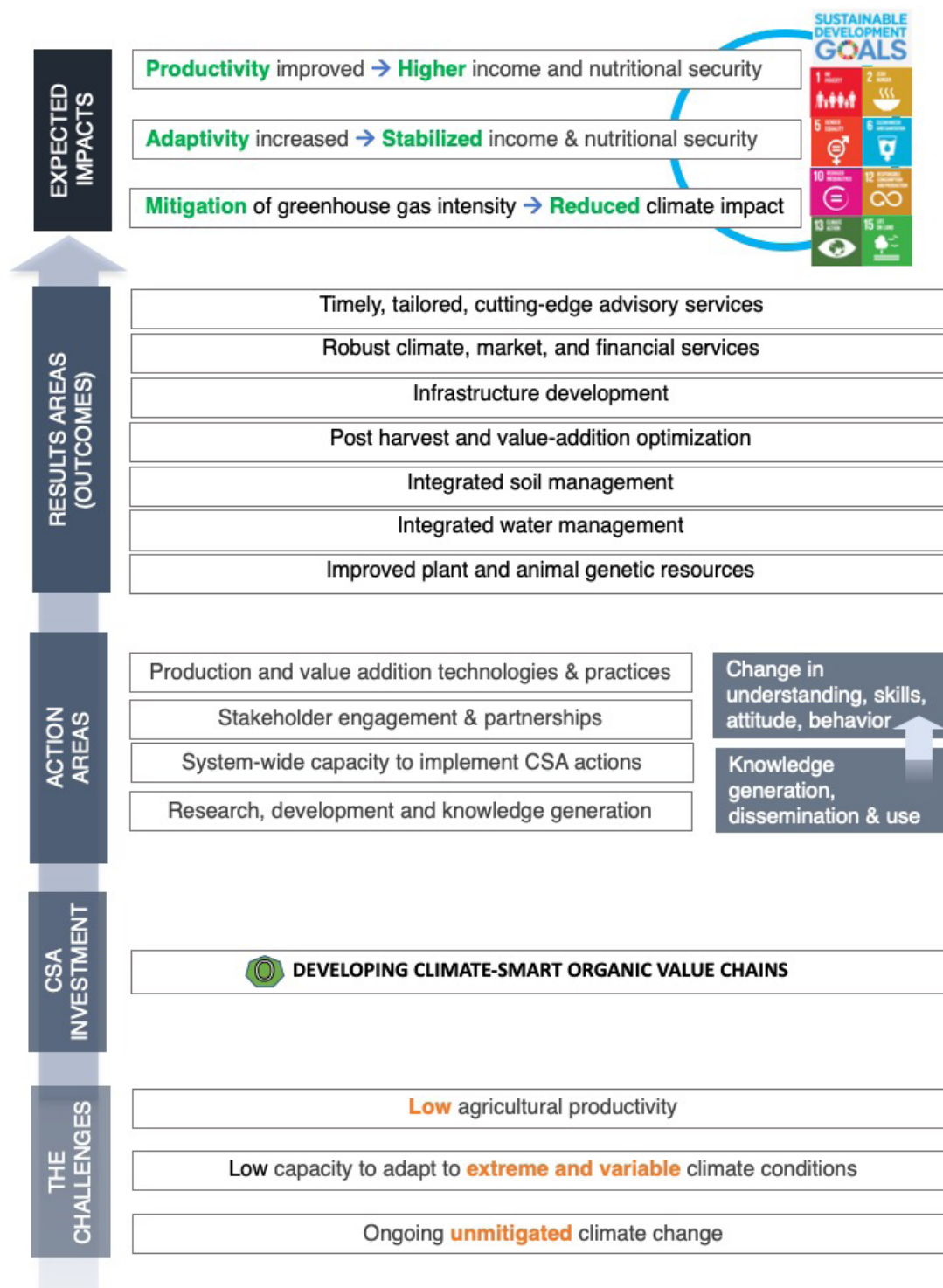
<sup>394</sup> Babacar, "Cotton Prices Go up in Burkina Faso."

<sup>395</sup> Métouolé Médà et al., "Institutional Factors and Farmers' Adoption of Conventional, Organic and Genetically Modified Cotton in Burkina Faso."

<sup>396</sup> Ecocert, "Agir Pour Un Monde Durable."

<sup>397</sup> Organics International and Its Action Group, "Cultivating Change."

## KEY INSTITUTIONAL ARRANGEMENTS AND POTENTIAL COLLABORATORS



## A.8 Developing Resilient Oil-Protein Value Chains

### PROJECT SUMMARY

**OBJECTIVE:** Strengthen the quality, yield efficiency, and value chains of oil-protein crops to sustainably meet domestic demands and support international market development.

**REGIONS:** North Sahel, North Sudan, South Sudan

**CLIMATE-SMART AGRICULTURE (CSA) PILLARS:** Adaptation, Production

**PROJECTED BENEFICIARIES:** 240,000

**KEY CSA INVESTMENT ACTIVITIES:**

For cowpea, soybean, and sesame:

- Improved seed varieties
  - Combining drought and pest resistance
  - Addressing standards and certification processes
- Improved value chains
  - Development
  - Integration
  - Infrastructure, particularly storage and oil processing
  - Economies of scale
- Optimized field management to maximize yield efficiency
  - Strengthen producer organizations
  - Build technical skills
  - Support robust basic farmer services (extension, climate, finance)

**PROJECT HIGHLIGHTS:**

- The project will raise income for 240,000 poor farming families by 39%.
- With an NPV of 60%, the project is likely to be successful even if risks occur.
- The project will improve access to quality seeds and enhance soil quality, soil fertility, and yields.

### JUSTIFICATION

**Oil-protein crops are well suited to Burkina Faso's climate.** West Africa's Sahel is characterized by a dry and hot climate with limited rainfall that impairs the production of many crops. Sesame, soybean, and cowpea are resilient crops well suited to suboptimal growing conditions.<sup>398</sup> Sesame and cowpea have short growth cycles, hence diminishing the risks associated with pests, disease, or climate damage. They perform well in heat and drought conditions.<sup>399</sup> Cowpea and soybean tolerate poor soils by fixing nitrogen from the air.

**Oil-protein crops hold significant marketing potential in Burkina Faso<sup>400</sup>.** International demand has been steadily rising along with urbanization, incomes in the region, and an interest in organic and niche health products. Burkina Faso has a comparative advantage in oil-protein crop production, and small agribusinesses are developing, particularly in the sesame subsector, in response to this growing demand. This entrepreneurship is partially enabled by the growing accessibility of telecommunication technologies. Nevertheless, the country's comparative advantage has not yet been fully leveraged.<sup>401</sup>

<sup>398</sup> Rivera, "Sesame Reaps Opportunity for West African Farmers."

<sup>399</sup> Dossa et al., "Enhancing Sesame Production in West Africa's Sahel," December 14, 2017.

<sup>400</sup> Tarfa et al., "Groundnut and Soybean Response to Nutrient Application in West Africa."

<sup>401</sup> International Finance Corporation, "Creating Markets in Burkina Faso."

**Developing oilseed value chains could reduce Burkinabe dependency on imports.** The nation produces about 65,000 mega tonnes (MT) of edible oil each year, almost entirely from cottonseed. There remains an 85,000 mega tonne demand gap that must be imported. Most commonly this comes in the form of palm oil from Côte d'Ivoire. Meanwhile, the amount of sesame and soybean oil produced remains small to negligible, in spite of the fact that the country has a competitive advantage in producing these crops.<sup>402</sup>

**Oil-protein crops are also very relevant to Burkinabe nutritional security.**<sup>403</sup> These crops are nutrient-rich, highly energetic sources of lean protein. Nevertheless, farmers tend to adopt them as cash crops, not food crops. Indeed, farmers generally cite market opportunities (45%) or hardiness and rapid growth cycles (41%) as their rationale for producing these crops, rather than their nutritional benefits. In fact, production area of sesame and cowpea crops is negatively correlated with production of the traditional staple food crops, including millet, sorghum, and maize.

**The economic benefits of oil protein crops in Burkinabe agriculture may be harnessed by mimicking the current structure of the cotton value chain.** This would include improving the rural investment climate, developing rural infrastructure, defining standards and certificates, and managing climatic risks. The cluster approach to value chain development has already been successfully tested in Burkina Faso.<sup>404</sup>

## SESAME

**Burkinabe sesame production has grown by 1,500%<sup>405</sup> over the last decade in response to international demand.** Production area in Burkina Faso has more than doubled from 90,000 hectares in 2010 to over 200,000 in 2015, and yield has reached about 150,000 tons in recent years. More than 90% of Burkinabe sesame is exported; OLAM is the primary purchaser. The marketing system is quite competitive; producers receive about 75% of the export value, which is dependent on global production.<sup>406</sup> Sesame also requires relatively little investment and labor, making it more profitable.<sup>407</sup> This has made sesame in many ways more attractive for farmers than cotton, the longstanding Burkinabe cash crop.<sup>408</sup> About 17% of Burkinabe farmers now produce sesame.<sup>409</sup>

**International sesame demand may deter improvements in domestic Burkinabe sesame production and value chains.** One recent project for sesame value chain development in Burkina Faso found that the price and demand for crude sesame were so high that local storage and processing facilities were not commercially attractive. Export as a crude product provided generous margins for producers, collectors, and exporters. This project also observed that conventional sesame prices were peaking above those of organic sesame.<sup>410</sup>

**There are significant opportunities for improved sesame yield in Burkina Faso.** In one study, farmer managed trials showed that 75 kilograms of NPK 14:23:14 fertilizer per hectare increased yields by 75% and provided a 320% return on investment. The use of improved seed varieties returned 1,900% on investment as compared to recycled seed.<sup>411</sup>

<sup>402</sup> Chemonics International, "Burkina Faso Staple Food and Livestock Market Fundamentals," September 2017.

<sup>403</sup> Tarfa et al., "Groundnut and Soybean Response to Nutrient Application in West Africa."

<sup>404</sup> International Finance Corporation, "Creating Markets in Burkina Faso."

<sup>405</sup> Rivera, "Sesame Reaps Opportunity for West African Farmers."

<sup>406</sup> International Finance Corporation, "Creating Markets in Burkina Faso."

<sup>407</sup> WASCAL, "Climate-Smart Oilseed Projects in Burkina Faso," 2019.

<sup>408</sup> International Finance Corporation, "Creating Markets in Burkina Faso."

<sup>409</sup> Kpadonou, Barbier, and Denton, "New Crops for a New Climate: Understanding Farmers' Behavior towards Sesame and Cowpea Crops in the Sahel."

<sup>410</sup> Common Fund for Commodities, "Development of Export-Oriented Sesame Production & Processing in Burkina Faso and Mali (CFC/FIGOOF/27) –."

<sup>411</sup> Common Fund for Commodities.

## COWPEA

**Cowpea is a leguminous nitrogen-fixing crop that is resilient to hot and drought-prone climates, such as Burkina Faso.** It is a primary source of protein in Burkinabe diets, and along with sorghum, millet, maize, rice, and small ruminants, is a main source of food and income for most Burkinabe households.<sup>412</sup> About 35% of Burkinabe farmers produce cowpea.<sup>413</sup> Average consumption of cowpea per capita in Burkina Faso is nearly 13 kilograms annually, and it is particularly valued as a high-energy food during periods of heavy farm labor. Nevertheless, cowpea is very income elastic, and terms of trade for cowpea versus cereals are largely in favor of cowpea. As such, many rural households prefer to sell it at favorable prices rather than consume it themselves.<sup>414</sup>

**Traditionally, the Sahelian agroecological zone of Burkina Faso has been characterized by intercropped pearl millet or sorghum with cowpea.**<sup>415</sup> However, cowpea is increasingly becoming a market-oriented crop in Burkina Faso, thanks in part to value chain promotion through several governmental projects. The shift from food crop to cash crop has implied a move away from traditional intercropping toward monocropped cowpea systems.<sup>416</sup> Nevertheless, production is still highly contingent on and heavily impacted by climatic conditions.<sup>417</sup>

**Burkina Faso now exceeds self-sufficiency in terms of cowpea production by about 33% and is tapping into the significant foreign demand for cowpea.** Burkinabe cowpea production has increased from 253,190 metric tons in 2007 to 554,286 metric tons in 2016. Roughly 1/3 of total yield is consumed domestically and an additional 1/3 is exported. The remainder is used for seed or animal feed, or is lost post-harvest. Cowpea is also an integral part of the 10,000 mega tonne intervention stock established in 2005, managed by the Société Nationale de Gestion des Stocks de Sécurité Alimentaire du Burkina Faso and financed by the national government. This stock is intended for use in subsidized and low-cost programs for vulnerable populations and in high-volatility years; the procedures for use offer significant flexibility.<sup>418</sup>

**There is currently very little processing of cowpea crops, and prices are highly volatile.** Across the value chain, cowpea marketing channels are controlled by the same actors driving cereal marketing networks—collection, assembly, and distribution. The primary sources of value chain market supplies are domestic production, collectors, semi-wholesalers, and retailers. 90% of the market demand for cowpea is from urban areas, and the remainder is from regional export markets, including Côte d'Ivoire, Ghana, Togo, Benin, and Nigeria.<sup>419</sup> Cowpeas are highly perishable, and there is a lack of effective storage infrastructure or alternative preservation methods. This forces growers to sell their crops immediately after harvest, creating a supply glut and very low prices. Subsequently, prices skyrocket due to over-demand in the off-season.<sup>420</sup>

**Studies have uncovered important opportunities to increase cowpea productivity in Burkina Faso using existing technologies.** Several studies have shown that synthetic fertilizer, organic fertilizer,

<sup>412</sup> Muñoz-Amatriaín et al., "Genome Resources for Climate-Resilient Cowpea, an Essential Crop for Food Security."

<sup>413</sup> Kpadonou, Barbier, and Denton, "New Crops for a New Climate: Understanding Farmers' Behavior towards Sesame and Cowpea Crops in the Sahel."

<sup>414</sup> Chemonics International, "Burkina Faso Staple Food and Livestock Market Fundamentals," September 2017.

<sup>415</sup> Siebou et al., "Pearl Millet and Cowpea Yields as Influenced by Tillage, Soil Amendment and Cropping System in the Sahel of Burkina Faso."

<sup>416</sup> Ouédraogo et al., "Farmers' Willingness to Pay for Climate Information Services."

<sup>417</sup> Chemonics International, "Burkina Faso Staple Food and Livestock Market Fundamentals," September 2017.

<sup>418</sup> Chemonics International.

<sup>419</sup> Chemonics International, "Burkina Faso Staple Food and Livestock Market Fundamentals," September 2017.

<sup>420</sup> Chemonics International.



and zai pits greatly improve yields of cowpea-millet intercropped systems.<sup>421</sup> Genotype significantly influences the crop response to various treatments<sup>422</sup> Studies have also shown that during erratic rainfall years, cowpea variety K VX 61-1 performs the best; in contrast, cowpea K VX 396-4-5-2D is optimal in well-distributed rainfall years. However, the drought resistant K VX 61-1 is prone to insect attacks in storage and hence is not yet a viable solution. Improved storage facilities and additional varietal research could address this obstacle, and climate forecasting and extension services would support farmers in determining which variety to use in any given year.<sup>423</sup> In addition to yield, producers also have genotypic preferences based on their region of production. Farmers in the Sahel emphasize early maturing and drought resistant varieties; farmers in the south prioritize seed color and plant type. There are only slight gender differences in these preferences.<sup>424</sup>

## SOYBEAN

**Soybeans grow in the same climate regions as maize and cotton, Burkina Faso's longstanding primary commodity crop.** As a nitrogen-fixing legume, soybean requires relatively little fertilizer and can be grown in rotation with other crops to help maintain soil quality. Soy also requires less pesticide than cotton, and is an excellent nutritional source for both humans and livestock.<sup>425</sup>

**The Burkinabe national government has ranked development of the soybean sector as a national priority.** The government, in coordination with NGO stakeholders, aims to increase current production levels of 20,000 metric tons per year to 100,000 metric tons by 2022. Achieving this goal would stimulate the economy, improve human nutritional security, and increase the availability of quality animal feed in the country. For example, the Ministry of Livestock estimated a 74% gap in animal feed demand as of 2018 and acknowledged that this gap could be filled by domestic supplies, of which soybean is key.<sup>426</sup> Soy is also becoming part of local diets, including yogurts, flours, baby food, soumbala, and kebabs. Similarly, export demand to Ghana, Côte d'Ivoire, and other West African nations is growing.<sup>427</sup> As of 2019, soybean production had already increased to 31,314 metric tons.

## PROBLEM STATEMENT

**Climate change threatens oil-protein crops in Burkina Faso.** Erratic rainfall, increased droughts, and poor soil fertility constrain production of cowpea and sesame.<sup>428</sup> Sesame farmers may lose 3-6% of their income just due to the loss of pollinating insects.<sup>429</sup>

**Structural changes would enable the development of oil-protein crop value chains.** A poor rural investment climate, weak value chain integration, lack of integrated infrastructure, poor standards and certification processes, and water and climatic risks preclude the development of these value chains. Policy efforts have, in particular, failed to increase the production of soybean due to the lack of infrastructure needed to process it in Burkina Faso.<sup>430</sup> Organizing industries to create economies

<sup>421</sup> Sanou et al., "Combining Soil Fertilization, Cropping Systems and Improved Varieties to Minimize Climate Risks on Farming Productivity in Northern Region of Burkina Faso"; Sombié et al., "Effect of Organic (Jatropha Cake) and NPK Fertilizers on Improving Biochemical Components and Antioxidant Properties of Five Cowpea (*Vigna unguiculata* L. Walp.) Genotypes"; Siebou et al., "Pearl Millet and Cowpea Yields as Influenced by Tillage, Soil Amendment and Cropping System in the Sahel of Burkina Faso."

<sup>422</sup> Sombié et al., "Effect of Organic (Jatropha Cake) and NPK Fertilizers on Improving Biochemical Components and Antioxidant Properties of Five Cowpea (*Vigna unguiculata* L. Walp.) Genotypes."

<sup>423</sup> Sanou et al., "Combining Soil Fertilization, Cropping Systems and Improved Varieties to Minimize Climate Risks on Farming Productivity in Northern Region of Burkina Faso."

<sup>424</sup> Ishikawa et al., "Characteristics of Farmers' Selection Criteria for Cowpea (*Vigna unguiculata*) Varieties Differ between North and South Regions of Burkina Faso."

<sup>425</sup> WASCAL, "Climate-Smart Oilseed Projects in Burkina Faso," 2019.

<sup>426</sup> WASCAL.

<sup>427</sup> Byrne, "Soybean Production Is a National Priority for Burkina Faso."

<sup>428</sup> Ouédraogo et al., "Farmers' Willingness to Pay for Climate Information Services."

<sup>429</sup> Stenchly et al., "Income Vulnerability of West African Farming Households to Losses in Pollination Services."

<sup>430</sup> Ouédraogo, Baraton, and Monteiro, "SIATOL: Evaluation d'impact a 360°."



of scale, fostering the creation of storage spaces, strengthening producer organizations, building technical skills, and establishing robust basic farmer services (including extension, climate, and finance services) will also be foundational.<sup>431</sup>

**Genotypic innovation could revolutionize oil-protein crop production in Burkina Faso.** Sesame, cowpea, and soybean are already well-adapted, low-input, resilient crops. They hold great promise in terms of the opportunity to develop varieties with higher yield potentials and greater pest and disease resistance.<sup>432</sup> In particular there is a lack of quality soybean seed availability,<sup>433</sup> and genomic resource development for cowpea has lagged behind most other major crops.<sup>434</sup> Similarly, there is a need to identify the major diseases and pests that affect sesame production.<sup>435</sup> The country has initiated an extension program of improved varieties, but the effort to replace the local seed system has to date had a relatively low impact.<sup>436</sup>

**The growth of the oilseed market in Burkina Faso has caused some producers to change their climate-smart production practices.** For example, the practice of fallow is negatively associated with sesame crop adoption. Since sesame is less nutrient and fertilizer demanding than most crops, land constrained farmers tend to grow sesame on poor lands as a substitute for fallow.<sup>437</sup>

**There are notable trade-offs in prioritizing oil-protein crops in Burkina Faso.** Crop diversification is historically one of the more common practice adopted by farmers to cope with both climate and market risks in the Sahel. When diversification integrates cash crops, it implies a re-allocation of the available limited resources away from food resources. When pests or climate threats cause crop losses, or markets are unstable and crops cannot be sold at the expected prices, this can result in local food insecurity. On a broader scale, a national slowdown in cereal grain production could alter food prices, nutritional security, and import dependency.<sup>438</sup>

**Women farmers are being pushed out of oil-protein crop production.** Cowpea and sesame are traditionally women's crops, from production through processing. As these crops have gained economic value, they have become men's crops. Now, about 40% of sesame producers are women. Additionally, men tend to have larger land areas for sesame and higher yields per land area. This suggests that women farmers are more resource-restricted in general, and particularly in terms of cash crops. Soybean value chains, which remain largely undeveloped, are still the responsibility of women.<sup>439</sup>

**Female-led households are less likely to adopt sesame and cowpea production.** This could be a result of women's generally higher interest in family food security, which underlies their preference for the production of staple food crops. It could also be a result of women's more limited access to resources that would enable them to diversify into non-staple crops. In both cases, the root of the issue needs to be addressed in a culturally appropriate manner in order to effect substantive change toward climate-resilient, economically viable food systems.<sup>440</sup>

<sup>431</sup> International Finance Corporation, "Creating Markets in Burkina Faso."

<sup>432</sup> Dossa et al., "Enhancing Sesame Production in West Africa's Sahel," December 14, 2017; Muñoz-Amatriáin et al., "Genome Resources for Climate-Resilient Cowpea, an Essential Crop for Food Security."

<sup>433</sup> Ouedraogo, Baraton, and Monteiro, "SIATOL. Evaluation d'impact a 360°."

<sup>434</sup> Muñoz-Amatriáin et al., "Genome Resources for Climate-Resilient Cowpea, an Essential Crop for Food Security."

<sup>435</sup> Dossa et al., "Enhancing Sesame Production in West Africa's Sahel," December 2017.

<sup>436</sup> Bougma, Sawadogo, Hamed Ouedraogo, et al., "Overview of the Burkina Faso Seed System: Case of the Formal Seed System."

<sup>437</sup> Kpadonou, Barbier, and Denton, "New Crops for a New Climate: Understanding Farmers' Behavior towards Sesame and Cowpea Crops in the Sahel."

<sup>438</sup> Kpadonou, Barbier, and Denton.

<sup>439</sup> WASCAL, "Climate-Smart Oilseed Projects in Burkina Faso," 2019.

<sup>440</sup> Kpadonou, Barbier, and Denton, "New Crops for a New Climate: Understanding Farmers' Behavior towards Sesame and Cowpea Crops in the Sahel."

## ECONOMIC AND FINANCIAL ANALYSIS

### ESTIMATED IMPACTS:

- Reduced greenhouse gas (GHG) intensity of oil-protein crops
- Greater inclusion of women in oil protein value chains
- Reconciliation of staple grain and high-energy oil-protein crops in terms of household nutrition
- Value chain development and consequent national economic growth
- Sustainable soil fertility

### ESTIMATES OF IMPACTS: PRODUCTION, RESILIENCE, EMISSIONS

**Table A-8.1 Cost Benefit Analysis with and without Climate Risks**

Mean No. Beneficiaries	Change in Yield (%)	Mean NPV (US\$, Millions)	Chance Pos NPV (%)	ROI	BCR (SD)
<b>With Climate and Pest Risks</b>					
240,000	39	32.5	60	0.62	0.44 (2.02)
<b>Without Climate and Pest Risks</b>					
240,000	39	106.1	90	2.19	1.44 (2.32)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

**Table A-8.2 Financial Analysis**

Values derived from the Compendium and other secondary source.

Change with Investments for Oil-Protein Crops	
Technology	Yield (%) with (without) project
<b>Oil-Protein Crops</b>	
<b>Sesame</b>	
Improved Varieties	
Organic Fertilizer	40.0 (8.0)
Inorganic Fertilizer	34.0 (5.0)
Agroforestry Alley Cropping	19.7 (9.0)
Intercropping	-11.7 (9.0)
<b>Soybean</b>	
Organic Fertilizer	162 (15)
Inorganic Fertilizer	61.3 (3.1)
Improved Varieties	57.2 (23)
Mulching	24.7 (4.5)
<b>Cowpea</b>	
Organic Fertilizer	50.6 (7.3)
Inorganic Fertilizer	25.5 (2.6)
Improved Varieties	-33.9 (10.2)
Mulching	43.0 (4.8)
<b>Mean of All Technologies</b>	<b>39.4 (8.5)</b>

**Table A-8.3: Values for Estimating the Number of Beneficiaries**

Investment	Budget (US\$, Billions)	Cost per Beneficiary (US\$)
Oil-Protein Crops	54.72	228

**ESTIMATED PROJECT COSTS:**

Project costs were based on average cost per beneficiary following a typology of investments' cost effectiveness derived from expert opinion. Investments typically range between US\$200-900 per beneficiary (see Annex E).

**CLIMATE MODELING**

In contrast to the results below, a separate study recently indicated that expected increases in rainfall and temperatures could cause a 25% reduction in cowpea yields and fewer gains from constant levels of fertilizer soil amendments.<sup>441</sup>

CHANGE IN YIELD Crops	2018 Baseline Value (TM)	RCP4.5_SSP2		RCP6.0_SSP2		RCP8.5_SSP2	
		2030	2050	2030	2050	2030	2050
OLS-Soybean	4.8	-3.71	-7.07	-5.21	-9.48	-5.82	-10.18
PUL-Cowpeas	540.8	1.27	2.69	0.20	0.75	0.36	1.04
CHANGE IN YIELD Crops	2018 Baseline Value (Ha)	RCP4.5_SSP2		RCP6.0_SSP2		RCP8.5_SSP2	
		2030	2050	2030	2050	2030	2050
OLS-Soybean	3.72	-0.08	-0.21	-0.32	-0.64	-0.46	-0.94
PUL-Cowpeas	913.66	1.10	2.22	0.95	1.90	0.86	1.76

Crops	Net Trade Negative					
	RCP4.5_SSP2		RCP6.0_SSP2		RCP8.5_SSP2	
	2030	2050	2030	2050	2030	2050
OIL-Soybean Oil	-0.57	-1.07	-0.44	-0.85	-0.69	-1.36
OLS-Soybean	-1.16	-3.00	0.26	-1.65	-0.25	-2.52
PUL-Cowpeas	-10.84	-14.16	-5.41	-8.06	-6.97	-9.80

OLS = oilseeds; PUL = pulses; OIL = oil; RCP = representative carbon concentration scenario; SSP = Shared Socioeconomic Pathway

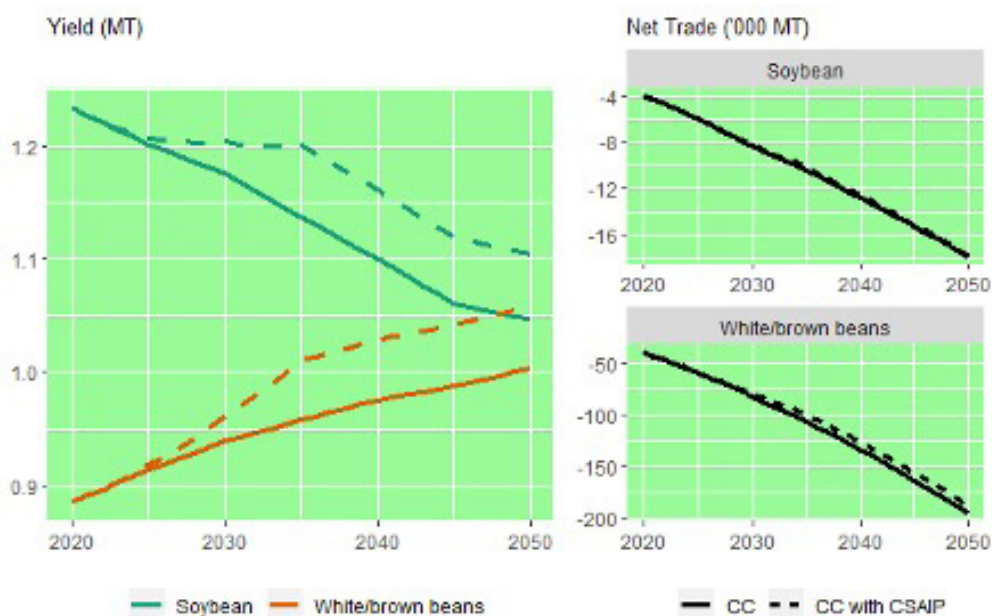
**POTENTIAL IMPACTS OF CSA INVESTMENTS**

**The Oil-Protein Crop CSA investment is projected to offset declining soybean yields and to enhance white and brown bean yields.** Soybean yield is projected to be one of the trajectories hardest hit by climate change. These CSA interventions could lay groundwork to offset a fledgling trade deficit in these products.

<sup>441</sup> Hidalgo et al., "Assessing Potential Climate Change Impacts in Smallholder Systems in Burkina Faso."

**Figure A-8.1: Impact of Oil-Protein Crop Investment on Yields and Balance of Trade**

Trajectories for soybeans and white and brown beans modeled using IMPACT under a Business-as-Usual Shared Socioeconomic Pathway (SSP 2) and a pessimistic representative carbon concentration scenario (RCP 8.5).



## ENABLING ENVIRONMENT: SITUATION ANALYSIS

### Alignment with Nationally Determined Contributions (NDC) Objectives

The table below shows alignment with 10 NDC objectives.

Partial Alignment						
Improved Farming Technologies, Conservation Agriculture		Water Conservation and Irrigation Management		Post-Harvest Handling and Processing		
Little or No Alignment						
Management and Conservation of Soils and Fertility	Governance Reform	Renewable Energy	Livestock and Aquaculture Productivity	Information Management and Advisory Services	Restoring Forests, Agroforestry	Financial Services

### KEY ASSETS FOR SUCCESS:

- Burkina Faso's competitive advantage on the international sesame market
- High nutritional value of oil-protein crops
- Rising domestic and international demand for oil-protein crops
- Nitrogen-fixing properties of cowpea and soybean
- Natural drought resistance and resiliency

### KEY BARRIERS TO SUCCESS:<sup>442</sup>

- Low accessibility to basic services (finance, extension, climate), particularly for women<sup>443</sup>
- Poor land tenure, particularly for women<sup>444</sup>

<sup>442</sup> Hidalgo et al., "Assessing Potential Climate Change Impacts in Smallholder Systems in Burkina Faso."

<sup>443</sup> Kpadonou, Barbier, and Denton, Fatima, "New Crops for a New Climate: Understanding Farmer's Behavior towards Sesame and Cowpea Crops in the Sahel."

<sup>444</sup> Gildemacher et al., "Lessons Learned in Burkina Faso and Mali."

- Removal of women from value chains as they become profitable
- Volatile pricing
- International demand and pricing for raw product that may disincentivize domestic value chain development
- Difficult seed certification processes<sup>445</sup>

#### **RELEVANT POLICIES:**

- Programme National du Secteur Rural (PNSR 2)
- Plan National de Développement Economique et Social (PNDES) (2016-2020)
- Rural Land Management Law (2009)
- Approximately 13.5% tax on imported palm oil<sup>446</sup>

#### **RELEVANT POLICY GAPS:**

- Lack of institutional arrangements to stabilize the market price of sesame
- No specific government policy or sizeable national investments to support local edible oil industry

#### **KEY POLICY DISTORTIONS:**

- The Seed Law (2006) requires revisions to better suit Burkinabe farmers by considering various knowledge levels on the part of seed producers<sup>447</sup>
- Land tenure systems must be made more robust and inclusive, particularly for women farmers.<sup>448</sup>
- Low transparency, definition, and accessibility in standards and certifications remain problematic.
- There is need for greater enhancement of the rural investment climate, especially via the existing 2009 Rural Land Management Law.

#### **Most Promising Supporting Digital Agriculture Technologies**

- Mobile extension services, enabled by big data, machine learning, and mobile technology, to support best practices and disseminate research and development outputs
- Climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support management decisions<sup>449</sup>
- Mobile platforms, enabled by big data, machine learning, and mobile technology, to support peer knowledge exchange, input supply, and product sales at fair market rates

### **DELIVERY: SYNTHESIS OF IMPLEMENTATION EXPERIENCE AND BEST PRACTICE**

#### **A strong foundation of related projects provides a robust knowledge base and lessons learned.**

##### **These include:**

- Accelerated Varietal Improvement and Seed Delivery of Legumes and Cereals in Africa (AVISA) Project with the International Center for Tropical Agriculture (CIAT),<sup>450</sup> funded by the Bill and Melinda Gates Foundation, led by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), February 2019-present.
- Sesame Marketing and Exports (SESAME),<sup>451</sup> funded by the United States Department of Agriculture, US\$24 million, 2016-2021. This project has the following aims:
  - To reduce poverty by increasing the incomes of poor rural farm families in Burkina Faso through enhancing the production, marketing, and export of sesame.

<sup>445</sup> Bougma, Sawadogo, Ouedraogo, et al., "Overview of the Burkina Faso Seed System: Case of the Formal Seed System."

<sup>446</sup> Chemonics International, "Burkina Faso Staple Food and Livestock Market Fundamentals," September 2017.

<sup>447</sup> Bougma, Sawadogo, Hamed Ouedraogo, et al., "Overview of the Burkina Faso Seed System: Case of the Formal Seed System."

<sup>448</sup> Gildemacher et al., "Lessons Learned in Burkina Faso and Mali."

<sup>449</sup> The World Bank Group, "Agriculture Observatory."

<sup>450</sup> "AVISA PROJECT."

<sup>451</sup> "Sesame Marketing and Exports Project," n.d., <https://lwr.org/country/burkina-faso>

- To improve the quality of sesame, to meet the high standards of the lucrative export market, and to enhance marketing efforts by working with farmers, cooperatives, buyers, and other stakeholders.
- To undertake in-field activities including planting methodology, organic compost production, cleaning and storage techniques, and bio-pesticides.
- To enable data collection, farmer profile creation, and tailored extension services by means of the TaroWorks mobile CRM platform.
- To impact 500,000 individuals directly or indirectly.
- **Projet d'Appui à la Promotion des Filières Agricoles (PAPFA)**, US\$71.7 million in funding from the International Fund for Agricultural Development (IFAD) and the Organization of the Petroleum Exporting Countries (OPEC) 2017-2024. This project aims to develop the value chains of rice, vegetables, sesame, and cowpea and to improve productivity for 57,000 households.
- **The Competitive Cashew Initiative**,<sup>452</sup> funded by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, US\$139 million, 2016-2020. This project has trained over 50,000 farmers, created more than 79,860 production jobs, and linked more than 4000 farmers with local processors.
- **Fondation Avril** in coordination with AGROPOL (the association responsible for international cooperation and development in the French vegetable oils and proteins sector) and the Burkinabe Ministry of Agriculture, together are working to develop and structure soybean value chains. The project aims to achieve 100,000 metric tons of annual production by 2022 with a focus on sustainable income for small farmers and women, food independence, and the agroecological benefits of nitrogen fixation.<sup>453</sup>
- **Soy-Maize-Poultry Sectoral Promotion Project**, funded by African Development Bank (AfDB).

**Other relevant completed projects include:**

- **Development of Export-Oriented Sesame Production and Processing in Burkina Faso and Mali (CFC/FIGOOF/27)**,<sup>454</sup> funded by OPEC, KIT, non-governmental organizations (NGOs) and the governments of both countries, US\$2,131,715. As part of this project:
  - 5800 Burkinabe farmers participated in farmer field schools.
  - Yield increases up to 75% have been attained.
  - 188 facilitators have been trained across both countries.
  - 4 collection centers have been established in Burkina Faso.
- **Agricultural Diversification and Market Development Project**, funded by World Bank, 2014-2016, US\$65.91 million. Among other activities, this project enhanced export of sesame through increased production and value chain performance and documentation.
- **Agricultural Commodity Chain Support Project**,<sup>455</sup> funded by IFAD, US\$16.68 million, 2006-2016. This project aimed at reducing rural poverty by improving access to growing markets for cowpeas, sesame, goat, sheep meat, onions, and poultry.

## KEY INSTITUTIONAL ARRANGEMENTS AND POTENTIAL COLLABORATORS

**PUBLIC INSTITUTIONAL FRAMEWORK:**

- Institute of the Environment and Agricultural Research (INERA)
- National Seed Services
- Fédération Nationale des Industries de l'Agro-Alimentaire et de la Transformation du Burkina (FAIB)

<sup>452</sup> GIZ, "Competitive Cashew Initiative (ComCashew)."

<sup>453</sup> Byrne, "Soybean Production Is a National Priority for Burkina Faso."

<sup>454</sup> "Development of Export-Oriented Sesame Production & Processing in Burkina Faso and Mali (CFC/FIGOOF/27)."

<sup>455</sup> International Fund for Agricultural Development, "Agricultural Commodity Chain Support Project Burkina Faso."

- Ministère de l'Agriculture et de l'Aménagement Hydraulique, in particular the Direction Générale des Productions Végétales

#### **POTENTIAL NGO COLLABORATORS:**

- Association pour la Promotion du Soja au Burkina (APDS/B)
- International Institute of Tropical Agriculture
- International Center for Tropical Agriculture
- International Crops Research Institute for the Semi-Arid Tropics
- L'Orange Bleue Afrique
- Breizh Kongred Burkina (BKB) France
- Medicus Mundi Italia
- Association de Solidarité et de Coopération Internationale
- Agropol
- Fondation Avril
- APME2A
- Comité Français pour la Solidarité Internationale

### **FINANCING AND MAXIMIZING FINANCE FOR DEVELOPMENT**

**PUBLIC FINANCING OPPORTUNITY:** Société Nationale de Gestion des Stocks de Sécurité Alimentaire du Burkina Faso

**PRIVATE FINANCING OPPORTUNITY:** SINERGI BURKINA

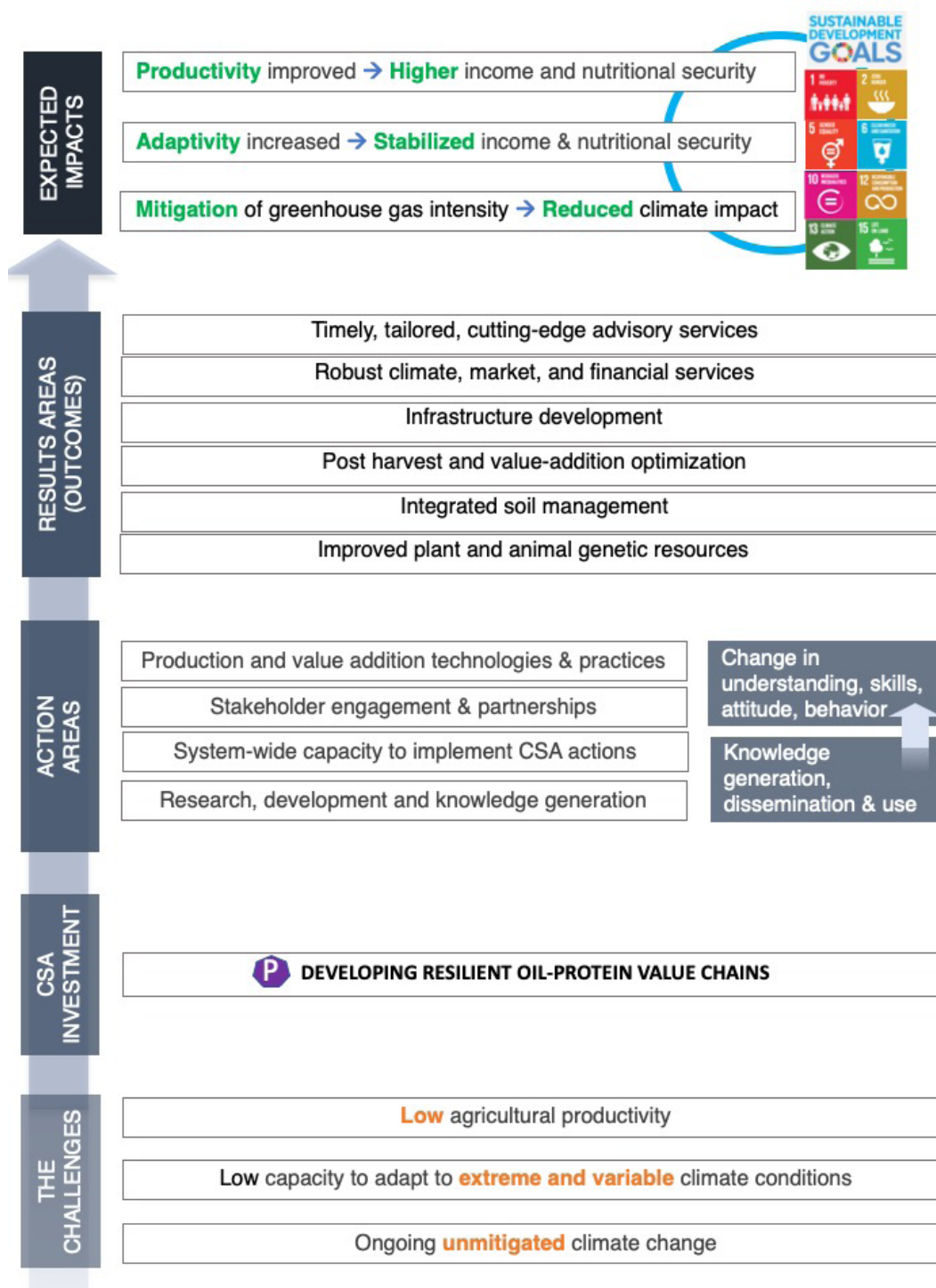
#### **POTENTIAL PRIVATE SECTOR COLLABORATORS:**

- Seeds suppliers
- Entreprises de Services et Organisations de Producteurs (ESOPs), such as:
  - Helvetas
  - Siatol

#### **INTERNATIONAL FINANCING OPPORTUNITIES:**

- United States Department of Agriculture (USDA)
- Bill and Melinda Gates Foundation
- Organization of the Petroleum Exporting Countries (OPEC) Fund for International Development
- International Fund for Agricultural Development (IFAD)

## THEORY OF CHANGE





## A.9 Integrated Soil Management For Agricultural Productivity And Environmental Restoration

### PROJECT SUMMARY

**OBJECTIVE:** Provide producers and extension agents with location-tailored information about soil characteristics and best management practice recommendations, as well as the tools, products, partnerships, and policy environment to implement those recommendations.

**REGIONS:** North Sahel, North Sudan, South Sudan

**CLIMATE-SMART AGRICULTURE (CSA) PILLARS:** Production, Mitigation

**PROJECTED BENEFICIARIES:** 200,000

**KEY CSA INVESTMENT ACTIVITIES:**

- Integrated soil fertility management capacity building
- Soil information system development and implementation

**PROJECT HIGHLIGHTS:**

- Improved agricultural soil fertility
- Concomitant increases in productivity, nutritional security, and economic growth that foster climate resilience
- Restoration of degraded lands, slowing of agricultural expansion, and greenhouse gas (GHG) mitigation

### JUSTIFICATION

**Soil health is essential to CSA.** Healthy soils regulate nutrient and water cycles, increasing the soil fertility while contributing to carbon sequestration, agricultural productivity, and buffering climate change and variability. Soil degradation<sup>456</sup> occurs because of unsustainable land management practices and may be exacerbated by climate change, weak policies, poor land tenure, and high food demands. Smallholder farmers, who rely on soil productivity for their nutritional and livelihood security, are especially vulnerable to soil degradation.<sup>457</sup>

**Agriculture generally has negative effects on soils.** Continuous cropping and tillage deplete nutrients and reduce carbon. Even with current rates of manure and fertilizer applications, African agriculture falls short of replenishing nutrient uptake by crops by at least 20 kilograms per hectare of nitrogen, 10 kilograms per hectare of phosphorous, and 20 kilograms per hectare of potassium annually.<sup>458</sup> As a result, soil degradation threatens at least 25% of African arable land and impedes agricultural production and intensification.<sup>459</sup>

**Burkina Faso's economy is threatened by soil degradation.** Growing food demand because of rapid population growth has driven significant agricultural expansion over the past 40 years.<sup>460</sup> Agricultural production expanded from 30% of total land area in 1971 to more than 44% in 2016.<sup>461</sup> During that same time, forest, savanna, and steppe land cover fell from 83% to 57%. Today, 9 million hectares of productive land, or 33% of the total national territory, are degraded. Agricultural expansion is expected

<sup>456</sup> Hermans et al., "1 Chapter 4: Land Degradation."

<sup>457</sup> Hermans et al.

<sup>458</sup> Stoorvogel and Smaling, "Assessment of Soil Nutrient Depletion in Sub-Saharan Africa: 1983-2000."

<sup>459</sup> Vanlauwe et al., "Looking Back and Moving Forward"; Jones et al., Soil Atlas of Africa.

<sup>460</sup> Neya et al., "Trade-off of Tree Conservation and Crop Production on Agroforestry Parklands in Burkina Faso."

<sup>461</sup> World Bank, "Agricultural Land (% of Land Area) - Burkina Faso."

to accelerate<sup>462</sup> and will be exacerbated by extreme weather events such as drought, flooding, and high winds.<sup>463</sup>

**Integrated soil fertility management (ISFM) is an effective way to regenerate soils with limited inputs.** ISFM is targeted, location-specific optimization of interactions between fertilizers, organic inputs, and improved plant varieties. ISFM helps regenerate degraded landscapes and is crucial to achieving soil fertility and crop productivity on degraded croplands. Identifying ISFM best practices for a given area requires significant location-specific knowledge of soil characteristics, such as soil type, depth, texture, fertility, organic matter content, and so forth. This information can be made available to large numbers of producers efficiently using soil information systems.

**Soil information systems (SIS) enable ISFM on a large scale.** The World Agroforestry Center (ICRAF) has developed spectral diagnostics using infrared and x-ray technology.<sup>464</sup> These systems enable rapid and low-cost analysis of soil properties and plant nutrients that can be applied at scale for digital mapping.<sup>465</sup> The level of detail, accuracy, and geographic scale that this technology offers at low cost promises to transform the soil management paradigm.<sup>466</sup> Organizations such as SoilCares,<sup>467</sup> the Africa Soil Information Service (AfSIS),<sup>468</sup> the Crop Nutrition Services Laboratory, the Bill and Melinda Gates Foundation, the One Acre Fund,<sup>469</sup> and FoodAfrica have leveraged ICRAF's spectral diagnostic technology to generate soil maps,<sup>470</sup> plan projects, and conduct testing services across Africa.

**Burkinabe soils can be very agriculturally productive under ISFM.** The Sudanian region consists primarily of sandy Entisols. Entisols often occur on alluvial plains and work well for agriculture, but are also prone to erosion.<sup>471</sup> The Sahel is generally characterized by Alfisols, which have naturally high fertility and good potential for agriculture. Nevertheless, this region has seen a steady decline in soil fertility due to increasing population pressure, an increase in livestock production, and a decrease in fallow periods.

**Burkina Faso has committed to stopping land degradation by 2030.** The country specifically wants to put an end to deforestation, improve the productivity of savannas and cultivated land, augment carbon stocks to at least 1% organic matter across 800,000 hectares, and restore at least 50% of the over 600,000 hectares of currently bare land areas.<sup>472</sup>

**Burkina Faso is a signatory to several international initiatives to address degraded lands.** These include the Global Soil Partnership, which focuses on restoring the fertility of degraded lands; the Great Green Wall Initiative aimed at combating climate change and desertification;<sup>473</sup> and the Land Degradation Neutrality (LDN) program, which works to sustainably manage and restore land to ensure ecosystem services and food security.<sup>474</sup>

<sup>462</sup> "Rehabilitating Degraded Land Is a Priority for Burkina Faso," Says FAO Director General | Action Against Desertification | Food and Agriculture Organization of the United Nations."

<sup>463</sup> EAP, "Enquete Sur La Productivite Agricole Au Burkina Faso."

<sup>464</sup> Soil-Plant Spectral Diagnostics Lab, "Network of Dry Spectroscopy Laboratories."

<sup>465</sup> World Agroforestry Centre, "Soil-Plant Spectral Diagnostics Laboratory."

<sup>466</sup> World Agroforestry Centre, "Testimonials."

<sup>467</sup> SoilCares, "Soil analysis for farmers."

<sup>468</sup> Africa Soils, "Africa Soil Information Service."

<sup>469</sup> One Acre Fund, "2017 Annual Report."

<sup>470</sup> ISRIC, "SoilGrids"; Africa Soils, "Africa Soil Information Service."

<sup>471</sup> Eswaran and Reich, "World Soil Map."

<sup>472</sup> The Global Mechanism of the UNCCD, "Country Profile Burkina Faso. Investing in Land Degradation Neutrality: Making the Case. An Overview of Indicators and Assessments."

<sup>473</sup> "Overview | Action Against Desertification | Food and Agriculture Organization of the United Nations."

<sup>474</sup> "The LDN Target Setting Programme | UNCCD."

**Burkinabe stakeholders practice techniques to help maintain land and soil quality.** In drier areas, practices such as half-moons and zai pits are aimed at improving soil moisture. In more humid areas, stone bunds control runoff and nutrient leaching. Mulching and agroforestry are also used in some areas of Burkina Faso. These practices have led to an overall improvement of the soil and of productivity.

## PROBLEM STATEMENT

**Land and soil degradation is a significant problem in Burkina Faso.** Loss of vegetative cover and topsoil and extreme floods and droughts are degrading lands and reducing productivity.<sup>475</sup> This fact in turn has had considerable negative impacts on both food security and economic growth. Rapid agricultural expansion has resulted. A lack of equipment and materials and an insufficient labor force for soil restoration technologies are hindering the implementation of restoration and conservation management.<sup>476</sup>

**Burkinabe smallholders have limited access to amendments to improve soil fertility.** A lack of subsidies, poor infrastructure, low biomass production, and limited opportunities to acquire credit put the quantities of fertilizers necessary to optimize crop productivity out of reach for most smallholders. Ongoing efforts on the part of governments, non-governmental organizations (NGOs), and international organizations have significantly improved fertilizer access and usage in the last decade. Average fertilizer consumption has increased from 9.4 kilograms per hectare of arable land in 2010 to 521.8 kilograms per hectare in 2016. This remains far below the global average of 140.6 kilograms per hectare,<sup>477</sup> as well as below the amounts necessary to optimize crop productivity (i.e. fertilizer industry-recommended application rates).

**Burkinabe smallholders' degree of access to fertilizers creates demand for ISFM efforts.** While current fertilizer application rates are insufficient for improving yields alone, they are sufficient for ISFM-based targeted dosing of inorganic fertilizers as informed by a national SIS. Given current fertilizer access, such optimization of crop productivity via ISFM is crucial to achieving soil fertility and crop productivity.

## POTENTIAL PROJECT IMPACTS

### ESTIMATED IMPACTS:

- Improved agricultural soil fertility
- Concomitant increases in productivity, nutritional security, and economic growth that foster climate resilience
- Restoration of degraded lands
- Improvement in water retention and consequent conservation
- Slowing of agricultural expansion
- Concomitant GHG emissions mitigation

<sup>475</sup> Nyamekye et al., "Soil and Water Conservation in Burkina Faso, West Africa."

<sup>476</sup> Nyamekye et al.

<sup>477</sup> World Bank, "Fertilizer Consumption (Kilograms per Hectare of Arable Land)."

## ESTIMATES OF IMPACTS: PRODUCTION, RESILIENCE, EMISSIONS

**Table A-9.1** Cost Benefit Analysis with and without Climate Risks

Mean No. Beneficiaries	Change in Yield (%)	Mean NPV* (US\$, Millions)	Chance Pos NPV (%)	ROI	BCR (SD)
<b>With Climate and Pest Risks</b>					
200,000	29	72	71	1.35	0.9 (2.05)
<b>Without Climate and Pest Risks</b>					
200,000	29	128.9	83	2.46	1.61 (2.43)

\*NPV = Net Present Value; ROI = Return on Investment; BCR = Benefit to Cost Ratio; SD = Standard Deviation

## ECONOMIC AND FINANCIAL ANALYSIS

**Table A-9.2** Financial Analysis

Values are the percentage change with and without the project. Values derived from Evidence for Resilient Agriculture (ERA) and other secondary sources.

Change with Investments for Integrated Soil Management	
Technology	Yield (%) with (without) project
<b>Integrated Soil Management</b>	
<b>Millet</b>	
Organic Fertilizer	93.9
Mulching	81.4
Crop Residue	81.0
Agroforestry Alley Cropping	63.8
Agroforestry Residue	58.4
Water Harvesting	49.3
Crop Rotation	28.5
Green Manure	17.9
Reduced Tillage	2.2
Intercropping	-3.7
Parklands	-16.5
<b>Sorghum</b>	
Organic Fertilizer	79.9
Mulching	16.2
Crop Residue	30.5
Agroforestry Alley Cropping	2.0
Agroforestry Residue	22.5
Water Harvesting	8.5
Crop Rotation	26.2
Green Manure	44.6
Reduced Tillage	-11.9
Intercropping	2.2
Parklands	-20.6
<b>Mean of All Technologies</b>	<b>29.8</b>

**Table A-9.3** Values for Estimating the Number of Beneficiaries

Investment	Budget (US\$, Billions)	Cost per Beneficiary (US\$)
Integrated soil management	60.0	300

**ESTIMATED PROJECT COSTS:**

Project costs were based on average cost per beneficiary following a typology of investments' cost effectiveness derived from expert opinion. Investments typically range between US\$200-600 (See Annex F). Outside this range, the project is either unrealistic (if on the low end) or not cost efficient (if above the high end).

**CLIMATE MODELING**

The crops considered within the economic analysis for Soils were sorghum and millet.

Crops	2018 Baseline Value (TM)	YIELD: Percentage Change from No Climate Change Scenario					
		Low Emissions		Medium Emissions		High Emissions	
	2018	2030	2050	2030	2050	2030	2050
CER-Millet	1545.3	0.35	0.45	-1.55	-3.26	-1.46	-3.09
CER-Sorghum	2141.3	-4.30	-8.60	-4.14	-8.17	-5.01	-9.88
	2018 Baseline Value (Ha)	AREA: Percentage Change from No Climate Change Scenario					
CER-Millet	1484.28	0.83	1.43	0.45	0.68	1.13	2.06
CER-Sorghum	1657.07	-0.55	-1.22	-0.46	-0.95	-0.28	-0.62

The Soils CSA investment can make major improvements in the yields of millet and sorghum.

**ENABLING ENVIRONMENT: SITUATION ANALYSIS****ALIGNMENT TO NATIONALLY DETERMINED CONTRIBUTIONS**

This project aligns with the agriculture and water sector program of Burkina Faso's Nationally Determined Contributions (NDCs), particularly in terms of the promotion of zai pits, stone barriers, half-moons, manure as fertilizer, and assisted natural regeneration.

The table below shows alignment with 10 NDC objectives.

Strong Alignment			Partial Alignment			
Management and Conservation of Soils and Fertility			Improved Farming Technologies, Conservation Agriculture		Water Conservation and Irrigation Management	
Little or No Alignment						
Governance Reform	Post-Harvest Handling and Processing	Renewable Energy	Livestock and Aquaculture Productivity	Information Management, Advisory Services	Restoring Forests, Agroforestry	Financial Services

**RELEVANT POLICIES:**

- Plan national de Développement Economique et Social (PNDES)
- Code Forestier
- Code l'Environnement
- Programme National du Secteur Rural Phase 2 (PNSR 2)
- Plan National d'Adaptation
- Burkina Faso Land Degradation Neutrality (LDN) commitments<sup>478</sup>

**KEY POLICY GAPS:**

- Forest conversion and agricultural expansion regulation
- Consistent supply of high-quality inputs (planting materials and fertilizer)
- Economic incentives for land restoration

**KEY POLICY DISTORTION:** Land tenure insecurity, particularly for women

**KEY ASSETS FOR SUCCESS:**

- Grassroots buy-in because producers and extension agents are already familiar with soil conservation practices
- Robust governmental commitments and international support
- National fertilizer supply sufficient for ISFM practices

**KEY BARRIERS TO SUCCESS:**

- Fertilizer distribution may not reach all smallholders
- Limited organic matter soil inputs available
- Drought and flood events are increasing in frequency
- Land tenure insecurity curbs smallholder investments
- Low availability of quality planting material

**PUBLIC INSTITUTIONAL FRAMEWORK:**

- Ministry of Environment, Green Economy, and Climate Change
- Ministère de l'Agriculture et des Aménagements Hydro-agricoles
- Public universities, such as the University of Ouagadougou and the Nazi Boni University
- Centre National de la Recherche Scientifique et Technologique (CNRST)

**POTENTIAL NGO COLLABORATORS:**

- Tree Aid<sup>479</sup>
- Action Contre la Faim
- Food and Agriculture Organization of the United Nations (FAO)
- United Nations Development Program
- SOS Sahel<sup>480</sup>
- 6S de Ouahigouya
- Global Soil Partnership
- Great Green Wall Initiative<sup>481</sup>
- Land Degradation Neutrality (LDN) program<sup>482</sup>

<sup>478</sup> Bassiere, "Burkina Faso LDN Country Commitments."

<sup>479</sup> Tree Aid, "Burkina Faso."

<sup>480</sup> SOS Sahel, "Qui Sommes-Nous?"

<sup>481</sup> "Overview | Action Against Desertification | Food and Agriculture Organization of the United Nations."

<sup>482</sup> "The LDN Target Setting Programme | UNCCD."

#### KEY DIGITAL AGRICULTURE TECHNOLOGIES:

- Soil information services, enabled by big data, machine learning, and mobile technology, to support decision-making
- Mobile climate information services, enabled by weather stations, big data, machine learning, and mobile technology, to support decision-making<sup>483</sup>
- Mobile extension services, enabled by big data, machine learning, and mobile technology, to disseminate research and development outputs and support crop management decisions
- Mobile finance services, along with digitized farm records to support credit line establishment to enable investing
- Smart contracting for transparent and equitable land tenure processes

#### DELIVERY: SYNTHESSES OF IMPLEMENTATION EXPERIENCE AND BEST PRACTICE

**A strong foundation of related projects provides a robust knowledge base and lessons learned.**  
**Current projects include:**

- **NEER TAMBA**,<sup>483</sup> financed by the International Fund for Agricultural Development (IFAD), to increase households' resilience to climate change through soil and surface water conservation.
- **Projet de Développement Rural Intégré de la Zone Périurbaine de la Capitale (PDRI/ZPC)**
- **Soil Protection and Rehabilitation of Degraded Soil for Food Security (ProSoil)**,<sup>484</sup> implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2014-2023, to promote soil protection and rehabilitation. This project has achieved a 40% increase in crop yields in the target project region.
- **Projet de Sécurité Alimentaire et d'Adaptation aux Changements Climatiques par la Récupération des Terres Dégradées dans le Nord du Burkina Faso (PSA-RTD) Phase II**<sup>485</sup>
- **Action Contre la Désertification (ACD)**,<sup>486</sup> funded by the Food and Agriculture Organization of the United Nations (FAO), 2016-present. To date, this project has achieved a number of key results:
  - 6,000 hectares restored
  - 4,400 hectares planted
  - 13 tons of seeds sown
  - 536,000 seedlings planted
  - 9,000 farmers benefitted
  - 9,900 people trained
  - US\$18,900 in income generated
- **Adaptation Base sur les Ecosystèmes (EBA)**<sup>487</sup>
- **Programme d'Investissement Forestier (PIF)**,<sup>488</sup> to reduce deforestation and degradation by strengthening GHG sequestration capacity.
- **Projet Intégrer la Résilience Climatique à la Production Agricole et Pastorale pour la Sécurité Alimentaire dans les Zones Rurales Vulnérables à Travers l'Approche Champ Ecole des Producteurs**

<sup>483</sup> "NEER TAMBA."

<sup>484</sup> giz, "Soil Protection and Rehabilitation of Degraded Soil for Food Security (ProSoil)."

<sup>485</sup> "Projet de Sécurité Alimentaire et d'adaptation Aux Changements Climatiques Par La Récupération Des Terres Dégradées Dans Le Nord Du Burkina Faso (PSA-RTD) Phase II."

<sup>486</sup> Food and Agriculture Organization of the United Nations, Biophysical and Socio-Economic Baselines.

<sup>487</sup> "EBA-FEM."

<sup>488</sup> "Programme d'investissement Forestier."

**Completed projects include:**

- **Community Based Rural Development Project,**<sup>489</sup> funded by World Bank in 3 phases: Phase 1, 2000-2006, US\$66.7 million; Phase 2, 2007-2013, US\$74 million; Phase 3, 2012-2018, US\$86 million. This project did the following:
  - Invested in soil and water conservation infrastructure to reverse the degradation of key resources and improve productive capacity by strengthening the capacity of villages and local governments to prioritize, plan, implement, and maintain community-based investments such as compost pits, stone bunds, and zai planting pits.
  - Achieved 213,320 hectares under sustainable land and forestry management, 4 million direct beneficiaries (51% women), a 50% increase in yields, restoration of degraded lands, reductions in erosion and the use of chemical fertilizer, and 332,921 trees planted with 55% survival rate, among other attainments.
- **Agricultural Productivity and Food Security Project,** funded by World Bank, US\$428 million, 2014-2019. This project achieved:
  - 5,000 hectares of soil conservation, the creation of 3,000 compost pits, and livestock and crop production programming.
  - 300,000 direct and indirect beneficiaries.
- **Programme de Croissance Economique dans le Secteur Agricole (PCESA),**<sup>490</sup> financed by the government of Denmark, US\$730,000, 2013-2018.
- **Programme d'Investissement Communautaire en Fertilité Agricole dans la Région de l'Est (PICOFA),**<sup>491</sup> financed by the African Development Fund (AFD), US\$8.59 million, 2004-2012, to improve food security and reduce poverty in eastern region via soil conservation and restoration, benefitting about 800,000 individuals on 20,000 farms.
- **Projet du Programme de Renforcement de la Résilience à l'Insécurité Alimentaire et Nutritionnelle au Sahel (P1-P2RS)**
- **Agricultural Diversification and Market Development Project,** funded by World Bank, US\$65.91 million, 2014-2016, to develop irrigation and marketing infrastructure among other activities.
- **Sustainable Rural Development Programme,** supported by IFAD, US\$34.21 million, 2004-2013, to build capacity for organizing, planning, and managing land via rehabilitating soils and constructing irrigation networks.
- **Erosion Control, Soil Fertility Protection, and Recuporation of Degraded Surfaces, Adaptation to Climate Change,**<sup>492</sup> implemented by GiZ, 2013-2019. This project achieved the following:
  - It protected against soil erosion by building stone lines, improving soil quality through compost production, and applying simple techniques for storing rainwater.
  - It trained 7,500 people in erosion control methods and provided 11,000 people with information and advice about climate change adaptation.
  - It planted 170,000 agroforestry plants and protected or reclaimed 18,000 hectares of watershed.
- **Sustainable Land Management Subprogram for the Centre-West Region,**<sup>493</sup> supported by the United Nations Development Programme, US\$10.36 million, 2010-2015. This program:
  - Enhanced adoption of sustainable land management practices and soil reclamation technologies based on local knowledge and innovative practices.
  - Generated institutional reforms to facilitate a favorable framework for uptake.
- **Programme d'Action National de Lutte Contre la Désertification (PAN/LCD)**

<sup>489</sup> Bank, "Burkina Faso - Third Phase of the Community-Based Rural Development Project."

<sup>490</sup> "Ministère En Charge de l'agriculture - Programme de Croissance Economique Dans Le Secteur Agricole (PCESA)."

<sup>491</sup> "Burkina Faso - Community Investment Project for Agricultural Fertility (PICOFA)."

<sup>492</sup> giz, "Erosion Control, Soil Fertility Protection and Recuporation of Degraded Surfaces, Adaptation to Climate Change."

<sup>493</sup> Government of Burkina Faso, "Additional Documents to the UNDP Project Document."



- Programme National du Secteur Rural (PNSR)
- Programme d'Action National d'Adaptation à la Variabilité et aux Changements Climatiques (PANA)

## FINANCING AND MAXIMIZING FINANCE FOR DEVELOPMENT

**PUBLIC FINANCING OPPORTUNITY:** FIE (Environmental Intervention Fund)

**PRIVATE FINANCING OPPORTUNITY:** Banque Agricole du Burkina (Agricultural Bank of Burkina)

### POTENTIAL PRIVATE SECTOR COLLABORATORS:

- Irrigation companies
- Timber and forest product processors

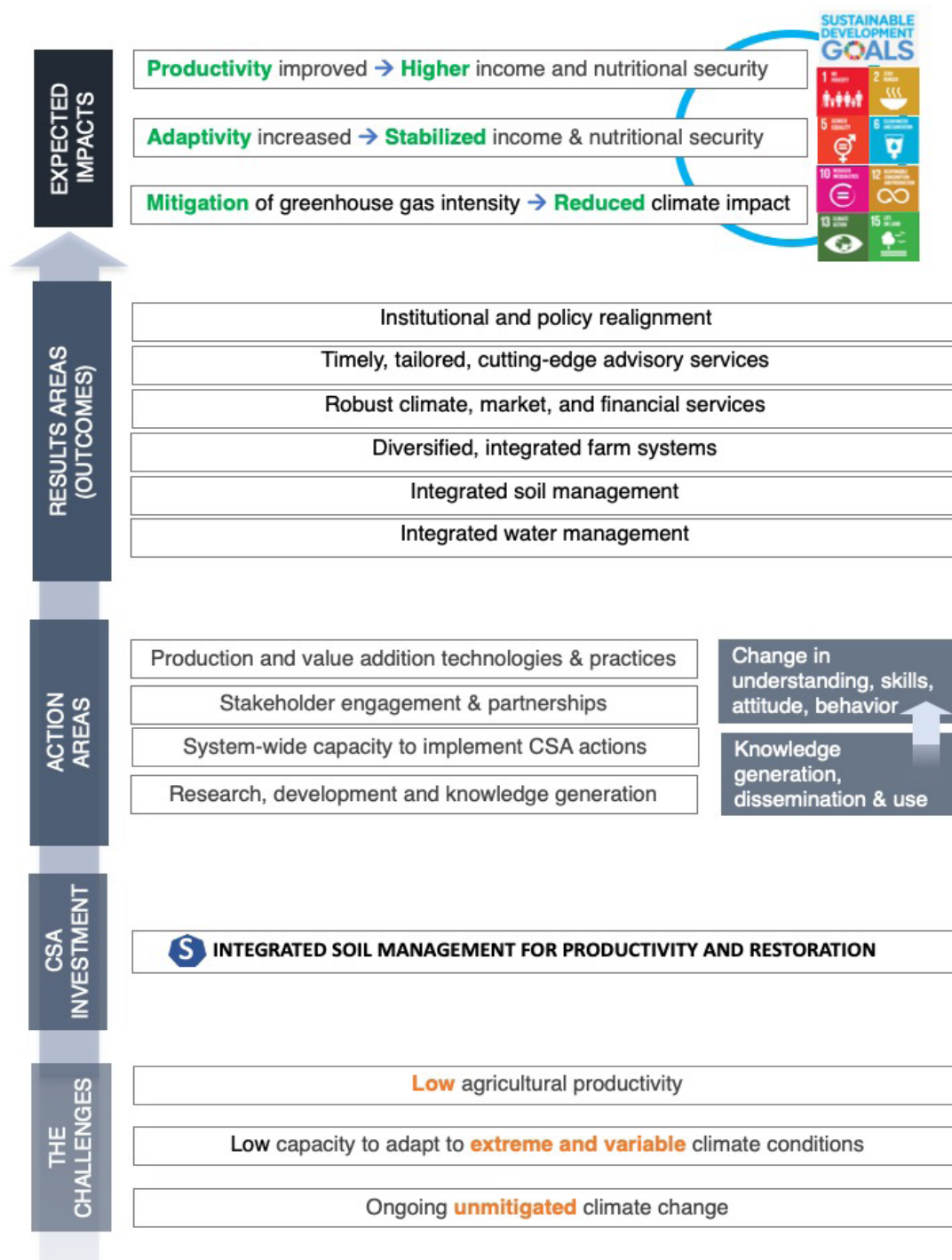
### INTERNATIONAL FINANCING OPPORTUNITIES:

- Global Environment Fund (GEF)
- Green Climate Fund (GCF)
- World Bank
- African Development Bank (AfDB)
- West African Development Bank (BOAD)
- International Fund for Agricultural Development (IFAD)
- Global Soil Partnership
- Great Green Wall Initiative<sup>494</sup>
- Land Degradation Neutrality (LDN) program<sup>495</sup>

<sup>494</sup> "Overview | Action Against Desertification | Food and Agriculture Organization of the United Nations."

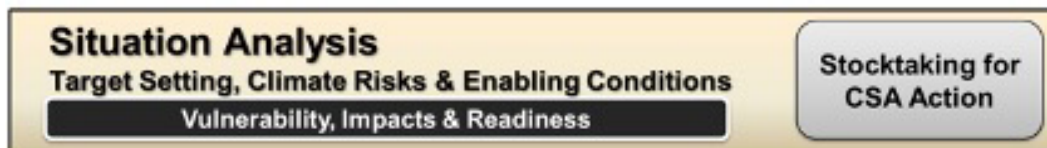
<sup>495</sup> "The LDN Target Setting Programme | UNCCD."

## THEORY OF CHANGE



# ANNEX B: Situation Analysis: Policy & Programmatic Context For Csaip In Burkina Faso

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A supportive policy context, enabling conditions, and financing are critical components of the situation analysis for CSA investments. This section briefly highlights:

## **B-1. International and Regional Commitments, Frameworks, and Plans**

### **B-2. National Policies, Plans, and Strategies**

### **B-3. Potential Financing Sources and Mechanisms for CSAIP in Burkina Faso**

## **B-1. Burkina Faso's International and Regional Commitments, Frameworks, and Plans**

- **UN Framework Convention on Climate Change (UNFCCC)**
- **Nationally Determined Contributions**
- **Comprehensive Africa Agriculture Development Program (CAADP):**
- **2014 Malabo Declaration on the Transformation of Agriculture** is a commitment to achieve the objectives set forth by the CAADP.
- **ECOWAS Regional Agricultural Policy of West Africa (ECOWAP) ECOWAP + 10** has a vision of modern and sustainable agriculture based on the effectiveness and efficiency of family farms and promotion of agricultural enterprises through the involvement of the private sector. It monitors the implementation of the New Partnership for Africa's Development (NEPAD), especially the CAADP.
- **UN Sustainable Development Goals (SDGs)** are a universal call to end poverty, protect the planet, and foster peace and prosperity by 2030.
- **Sahel and West Africa Program (SAWAP)**
- **West Africa Agricultural Productivity Program (WAAPP)** The objective of this program is to increase productivity in West Africa's major agricultural sectors in ways that are aligned with national and regional priorities.
- **Climate Change Fund** focuses on fostering resilience to climate change by building national, regional, and continental capacity through technical and financial assistance to African Union member states.
- **Africa Kaizen Initiative** seeks to bring about continuous improvements in quality and productivity via human-oriented approaches to fostering teamwork, self-reliance, creativity, and ingenuity.

## **B-2. National Policies and Plans**

These are key national policies and plans, and each of these has some alignment and linkage to all four of the following: climate change, adaptation, mitigation, and climate smart agriculture. In

addition to Burkina Faso NDC commitment (see Table C-3) , these policies are the most broadly supportive for the CSAIP:

- **National Adaptation Plan (NAP) 2012-** was developed to reflect improved approaches for integrating adaptation and resilience into medium- and long-term planning. It also considers the need for integration between disaster risk reduction and climate change adaptation. For example, it notes the need to build the capacity of the National Council for Emergency Relief and Rehabilitation (CONASUR, Conseil National de Secours d'Urgence et de Réhabilitation) and to involve a CONASUR representative as a sector focal point in the NAP process.
- **National Plan for Capacity Building on Risk Reduction and Response to Emergencies in Burkina Faso (2016-2020)** Designed by CONEDD, this plan places significant emphasis on the links between addressing climate risk and disaster risk reduction and response.

**Table B-2 Relevant Burkinabe plans, policies and frameworks supporting climate change, CSA pillars, and CSA**

Only those with at least one area of strong alignment or two areas of partial alignment are shown here.

<div>Strong alignment</div> <div>Partial alignment</div> <div>Little or no alignment</div>						
POLICY, STRATEGY, PLAN OR FRAMEWORK Name	Abbreviation	Date	Climate Change	Adaptation	Mitigation	CSA
National Rural Sector Program I	PNSR I	2011-2015				
National Rural Sector Program II	PNSR II	2016-2020				
Strategy for Accelerated Growth and Sustainable Development	SCADD	2011-2015				
Environmental Plan for Sustainable Development	PEDD	2004				
Burkina Faso Country Strategic Plan		2019-2023				
National Economic and Social Development Plan	PNDES	2016-2020				
National Climate Change Adaptation Plan	NAP	2012				
National Adaptation Programme of Action	NAPA	2007				
National Policy on Sustainable Livestock Development	PNDL	2010-2025				
Action Plan & Investment Program for the Livestock Sector	PAPISE	2010				
National Policy on Food Security and Nutrition	PNSAN	2011-2025				
Forest Investment Program	FIP					
United Nations Framework Convention on Climate Change	UNFCCC	1992				
National Action Plan on Integrated Water Management	PAGIRE	2011-2015				
National Program for Water Supply and Sanitation	PN-AEPA	2015				
National Plan for Capacity Building on Risk Reduction and Response to Emergencies in Burkina Faso		2016-2020				
National Climate Change Learning Strategy	UNCC :Learn	2016				
National Health Strategy	PNDS	2011-2020				
African Adaptation Program	AAP	2012				
Reducing Emissions from Deforestation and Forest Degradation Strategy	REDD+	2010				
National Forest Policy	PFN	1995				
United Nations Development Assistance Framework	UNDAF	2018-2020				

There are a number of other policies that show strong or partial alignment to at least two of the four components, including:

- **Strategy for Accelerated Growth and Sustainable Development (2011-2015)**
- **National Rural Sector Program (2011-2015)**
- **National Policy on Food Security and Nutrition (2011-2025)** This is one of the country's key strategies under the agriculture, water resources, and fisheries sector. The PNSAN identifies climate change as a main risk, and it includes actions to build the adaptive capacity of households under its objectives for building capacities that prevent and respond to food and nutritional crises.
- **National Action Plan for Integrated Water Management (Phase II) (2011-2015)** includes consolidation of knowledge and research on climate change and water as a key strategic axis.
- **National Sustainable Development Policy for Livestock (2011- 2025)** articulates the overall policy orientation in the livestock subsector, including climate change impacts as a key risk to the availability of food and water for livestock.
- **Action Plan and Investment Program for the Livestock Sub-Sector (2011-2015)** (PAPISE, Plan d'actions et programme d'investissements du sous-secteur de l'élevage) is the implementation framework of the livestock policy
- **Forest Investment Program**

Other policies that provide partial alignment or recognition to one component, often climate change:

- **National Health Strategy (2011-2020)**
- **National Program for the Provision of Drinking Water and Sanitation (2011- 2015)**
- **National Policy on Housing and Sustainable Development**

**Table B-3** Draft of NDC alignment with project investments

Note that the NDC Partnership Plan is currently being updated as part of an ongoing process, but as of publication, it was not yet finalized. There is a likelihood that things will be strengthened.

Strong alignment	Partial alignment	Little or no alignment							
NDC Components	Building Capacity	Finance	On-farm Biogas	Livestock	Forests Gardens	Organic Farms	Oil-protein	Soils	Water Mgmt
Improved farming technologies/ CA									
Conserve water & irrigation mgmt									
Soils: manage, conserve fertility									
Governance reform									
Post-harvest handle & process									
Renewable energy support									
Livestock & aqua-culture									
Info mgmt/ advisory services									
Restoring forests/ agroforestry									
Financial services support									

### B-3. Potential Financing Sources and Mechanisms for CSAIP in Burkina Faso

There are many donors (bilaterals, multilaterals, NGOs) working in Burkina Faso on issues related to climate change, agriculture, water or food security.

#### Financing Needed and Key Identified Potential Sources

Proposed Investments	Estimated PROJECT BUDGET (millions of USD)	Total Beneficiaries	\$/ Beneficiary	Results of Maximizing Finance for Development Analysis (Preliminary)
Capacity Building	\$55.0	500,000	\$110	Multi- and bilateral donor organizations
Finance and Insurance	\$40.0	200,000	\$200	Multi- and bilateral donor organizations; ABB
Oil-Protein Crops	\$55.0	240,000	\$228	Multi- and bilateral donor organizations
Sustainable Livestock	\$37.5	150,000	\$250	Multi- and bilateral donor organizations; private sector commercial producers/processors
Integrated Soil Management	\$60.0	200,000	\$300	Multi- and bilateral donor organizations; ABB
Forest, Agroforest, and Garden	\$55.0	180,000	\$306	Multi- and bilateral donor organizations; ABB; over 10 private sector donors identified
Water Resources and Irrigation	\$65.0	100,000	\$650	Multi- and bilateral donor organizations; ABB
Organic Farming	\$50.0	60,000	\$833	Multi- and bilateral donor organizations; many private sector possibilities
On-farm Biogas	\$55.0	65,000	\$846	Multi- and bilateral donor organizations; ABB
<b>Total</b>	<b>\$472.5</b>	<b>1,695,000</b>		

ABB= Agricultural Bank of Burkina, a private bank

More specifically, here are financing sources identified by projects, ranked:

	WATER	SOILS	BIOGAS	ORGANIC	PROTEI N	LIVE- STOCK	CAPACITY	DAMS	FINANCIAL	FORESTS & GARDENS	
<b>Public Financing Opportunities</b>											
Blended - _ GOEP & Environmental Intervention Fund	1			1						1	3
RE (Environmental Intervention Fund)		1	1					1			3
National Biogas Program			1								1
National Council for Biological Agriculture				1							1
Société Nationale de Gestion des Stocks de Sécurité Alimentaire du Burkina Faso					1						1
Investment Programme for the Livestock Sector						1					1
National Adaptation Program of Action							1				1
Burkina Social and Economic Development Fund							1		1		2
Women's Entrepreneurial Activities Support Fund							1		1		2
<b>International Financing Opportunities</b>											
World Bank	1	1		1		1	1	1	1	1	8
African Development Bank (AfDB)	1	1	1	1		1		1		1	7
Global Environment Fund (GEF)	1	1	1			1		1		1	6
Green Climate Fund	1	1	1			1		1		1	6
Economic Community of West African States Water Resources	1					1	1	1			4
Permanent Interstate Committee to Stop Drought in the Sahel	1					1	1	1			4
West African Development Bank (BOAD)	1	1				1		1			4
Netherlands Development Organization (SNV)	1	1					1				3
International Commission on Irrigation and Drainage (ICID)	1							1			2
Comprehensive Africa Agriculture Development Programme (CAADP)	1							1			2
Agricultural Water for Africa (AgWA)	1							1			2
Global Partnership for Results Based Approaches (GPRBA)(w)	1							1			2
IFAD		1			1						2
United Nations Clean Development Mechanism			1	1							2
USDA				1	1						2
Global Soil Partnership		1									1
<i>Great Green Wall initiative(1)</i>		1									1
<i>Land Degradation Neutrality (LDN) program(1)</i>		1									1
World Bank's Carbon Initiative for Development			1								1
Bill and Melinda Gates Foundation					1						1
OPEC Fund for International Development					1						1
Netherlands Space Office							1				1
ECOWAS Bank for Investment and Development (EBID)							1				1
Regional Agency for Agriculture and Food (RAAF)							1				1
UK Department for International Development (DFID)							1				1
River Basin Organization Strategies								1			1
Banque Islamique de Développement (BID)								1			1
Banque Arabe de Développement Economique en Afrique (BADEA)								1			1
Fond Koweïtien pour le Développement Economique Arabe (FIDEA)								1			1
OPEC Fund for International Development (OFID)								1			1
Banque d'Investissement et de Développement de la CEDAO (BIDC)								1			1
Fond Social de Développement (FSD)								1			1
FinMark Trust									1		1
International Finance Corporation (IFC)									1		1
United Nations Environment Programme (UNEP)									1		1
Fonds International de Développement Agricole (FIDA)									1		1
World Food Program (WFP)									1		1
Organisation Meteorologique Mondiale (OMM)									1		1
Swiss Government										1	1
<i>Op for Economic Co-operation and Development Scheme for the Certification of Forest Reproductive Material</i>										1	1

Here are a sample of projects that have recently, or are currently, being implemented in Burkina Faso. The agricultural CSAIP investments that are potentially relevant are shown in *italics*.

- **World Bank (WB)** - Burkina Faso Agriculture Resilience and Competitiveness Project
  1. a. 2019-2025, total project costs US\$261.90 million
- **World Bank (WB)** - Strengthening Climate Resilience in Burkina Faso
  1. 2018-2024, total project costs US\$33 million

2. The development objective of this project is to improve the country's hydro-meteorological, climate, and early warning services as well as to improve access to such services for targeted sectors and communities
- **International Fund For Agricultural Development (IFAD) - Agriculture value chains promotion project**
    1. 2017-2024, total project costs unspecified
    2. The project will focus on the regions of Boucle du Mouhoun, Cascades and Hauts-Bassins. It targets 57,000 households, of which 27,500 households will receive production support; 27,000 will be assisted in setting up or consolidating rural microenterprises; and 2,500 will be supported in value chain development.
  - **International Fund For Agricultural Development (IFAD) - Participatory Natural Resource Management and Rural Development Project in the North, Centre-North and East Regions**
    1. 2012-2022, total project costs unspecified
    2. The goal of this project is to improve the living conditions and incomes of almost 200,000 rural households that are among the poorest in Burkina Faso, enabling them to increase their autonomy and expand their role in building economic and social sustainability.

**Table B-4 Relevant Burkinabe plans, policies and frameworks supporting climate change, CSA pillars, and CSA**

PROJECT	CSA RELEVANCE	(USD\$M)	TERM
<b>WORLD BANK</b>			
Burkina Faso Bagre Growth Pole Project	Design and construction of irrigation canals, works, and equipment for livestock in herding areas; fish processing and conservation plant	193	2011-2020
Support to the National Bio-digester Program (in support of SNV)	Increases the use of bio-digesters in rural household of Burkina Faso	6.6	2016-?
First Fiscal Management, Sustainable Growth & Health Service Delivery Development Policy Operation	Enhance livestock production and productivity	50	2019-2020
Livestock Sector Development Support Project	Improve farmers' access to quality inputs for raising better livestock.	200,000	\$300
Emergency Livestock Feed Access Project	Rehabilitation of water points; feed improvement	2.85	2013-2015
Decentralization Forest and Woodland Management Project	Supports climate change governance and knowledge management on best practices	26.26	2014-2019
Local Forest Communities Support Project	Strengthens capacity of locals to participate in REDD	4.5	2015-2020
Sustainable Land and Forestry Management Project	Protection, restoration, and sustainable management of natural resources		2012-2018
Agriculture Resilience and Competitiveness Project	Climate change adaptation through capacity building, irrigation development, and advisory services	261	2019-2025
Open Data Initiative	Data collection on climate related risks, e.g., droughts	0.3	2014-2016
Strengthening Climate Resilience	Supports delivery of climate information services	33	2018-2024
Financial Inclusion Support Project	Enhances agricultural financing for climate resilience	100	2019-2025
Agricultural Productivity and Food Security Project	Restoration of degraded lands and soils for improved production	428.07	2014-2019
Community Based Rural Development Project	Strengthens capacity of communities and improves degraded lands	226.7	2000-2018
Agricultural Diversification and Market Development Project	Climate adaptation through development of irrigation and marketing infrastructure	65.91	2014-2016



IFAD			
Participatory Natural Resource Management and Rural Development Project in the North, Centre-North and East Regions (Neer tamba) <sup>496</sup>	Strengthening resilience to climate change at the household, farm, and village levels through sustainable land development	117.45	2012-2022
Agricultural Value Chains Support Project in the Southwest, Hauts-Bassins, Cascades and Boucle du Mouhoun Regions <sup>497</sup>	The project will build CSA capacity	123.93	2019-2025
Agricultural Value Chains Promotion Project	Improve smallholder farmers' productivity; add value to agricultural products such as rice, vegetables, sesame, cowpea; and promote entrepreneurship to overcome slow growth in rural areas	71.7	2017-2024
Community Investment Programme for Agricultural Fertility	Increase agricultural productivity through use of soil and water conservation techniques, soil fertility restoration, and agroforestry	26.87	2003-2012
Agricultural Commodity Chain Support Project	Improving market access	16.68	2006-2016
Sustainable Rural Development Programme	Reversing degraded lands through construction of irrigation networks	34.21	2004-2013
Small-Scale Irrigation & Water Management Project	investment in strengthening access to irrigation water, & diversification of agricultural production	16.3	2007-2014
GIZ			
Energizing development (EnDev) – programme for energy access (25 countries)	Nationally Determined Contributions (NDCs) for reducing greenhouse gas emissions	--	2005-2021
Supporting Agricultural Technical Vocational Education and Training (ATVET)	Development of agricultural technical and vocational education and training	--	2017-2019
Soil Protection and Rehabilitation of Degraded Soil for Food Security (ProSoil) (7 countries) <sup>498</sup>	Measures the contributions of soil protection to climate change adaptation & mitigation using a climate monitoring system with the goal of promoting soil protection through climate finance	--	2014-2023
Promoting Competitiveness of Cashew Value Chain. The Competitive Cashew Initiative	Training farmers and linking them to processors	139	2016-2020
Erosion control, soil fertility protection, and recuperation of degraded surfaces; adaptation to climate change	increasing capacity to adapt to the impacts of climate change	--	2013-2019
Dutch Government			
National Biodigester Programme	Strengthens the contribution of the biodigester technology sector for the improvement of food security	--	2010-2019
USAID			
Land Technology Solutions <sup>499</sup>	Improve land and resources governance; strengthen property rights for all members of society in developing countries using the MAST mobile technology	3.99	2017-2020
UNDP			
Strengthening climate information and early warning systems in Africa to develop resilience and adaptation to climate change	Increase adaptive capacity to respond to the impacts of climate change; enable early warning for climatic events and associated risks	28.3	2014-2018
Sustainable Land management subprogram for the Centre-West Region	Enhance adoption for SLM practices	10.36	2010-2015

<sup>496</sup> IFAD, "Participatory Natural Resource Management and Rural Development Project in the North, Centre-North and East Regions (Neer Tamba)."

<sup>497</sup> IFAD, "Agricultural Value Chains Support Project in the Southwest, Hauts-Bassins, Cascades and Boucle Du Mouhoun Regions."

<sup>498</sup> GIZ, "Soil Protection and Rehabilitation of Degraded Soil for Food Security (ProSoil)."

<sup>499</sup> "Land Technology Solutions."

AFDB			
Support Project for Establishing an Agribusiness Bank (PACBA) <sup>500</sup>	Enhance agricultural financing; enable agricultural insurance by an ecosystem that mitigates risk in the sector; support the agro-industrial value chain to enhance local employment; enhanced resilience of agro-sylvo-pastoral households, wildlife, and fisheries to risks	10.86	2019-2021
Cashew Development Support Project in Comoé Basin for REDD+ (PADA/REDD+) <sup>501</sup>	Enhance carbon sequestration through cultivation of cashew nuts	1.4	2017-2021
Bagre Growth Pole Support Project (PAPCB) <sup>502</sup>	Train farmers on water and soil management practices	17.94	2015-2021
USDA & Lutheran World Relief			
Sesame Marketing and Exports (SESAME) Burkina Faso	Improve production and create efficiencies in the sesame value chain to maximize export opportunities by supporting all the value chain actors	24.2	2016-2021
FAO			
Project for the improved management and sustainable use of NTFPs	Enable sustainable management of NTFPs to enhance food security, nutrition, and household income	--	2008-2018

**Table B-5 Examples of financial mobilization in Burkina Faso**

Requirements	Focus areas	Timing	Eligibility criteria	Limitations
World Bank <sup>503</sup>				
<ul style="list-style-type: none"> <li>Alignment with the country's national economic and social development plan (PNDES)</li> <li>Supportive policy and regulatory environment</li> <li>Collaboration with private sector</li> </ul>	<ul style="list-style-type: none"> <li>Agriculture</li> <li>Environment</li> <li>Climate change</li> <li>Energy</li> <li>Land and forest management</li> <li>Health services</li> <li>Rural economic development</li> <li>Irrigation development</li> <li>Financing</li> </ul>	<ul style="list-style-type: none"> <li>Request for expression of interest</li> <li>Contract awards</li> <li>Invitation for bids</li> <li>Project timing depends on objectives</li> </ul>	<ul style="list-style-type: none"> <li>Poor country/developing country aiming at improving its economic development</li> <li>Developing country vulnerable to climatic risks and shocks</li> <li>Women and small entrepreneurs</li> <li>Smallholder farmers who anticipate to make productive investments</li> </ul>	<ul style="list-style-type: none"> <li>Funding is dependent on the capacity of the recipient</li> <li>Grants are provided through the International Development Association (IDA)</li> </ul>
United Nation Development Programme (UNDP) <sup>504</sup>				
<ul style="list-style-type: none"> <li>A coordination platform for sustainable partnerships</li> <li>A strong institutional and policy environment</li> <li>Implementing agencies and partnering organizations</li> </ul>	<ul style="list-style-type: none"> <li>Climate change resilience</li> <li>Sustainable land management</li> </ul>	<ul style="list-style-type: none"> <li>4-5 years</li> </ul>	<ul style="list-style-type: none"> <li>Government entities, NGOs, private firms, and community organizations</li> <li>Undertaking initiatives on the sustainability of natural resources</li> <li>Promotes transfer and adoption of adaptation technology</li> </ul>	<ul style="list-style-type: none"> <li>Co-financing with the national government, which is unpredictable</li> <li>Policy, institutional and financial barriers</li> </ul>

<sup>500</sup> AFDB, "Support Project for Establishing an Agribusiness Bank (PACBA)."<sup>501</sup> AFDB, "Cashew Development Support Project in Comoé Basin for REDD+."<sup>502</sup> AFDB, "Bagre Growth Pole Support Project."<sup>503</sup> <https://projects.worldbank.org/en/projects-operations/document-detail/P11966> <http://documents.worldbank.org/curated/en/436501556416837455/pdf/Burkina-Faso-First-Fiscal-Management-Sustainable-Growth-and-Health-Service-Delivery-Development-Policy-Operation-Project.pdf><sup>504</sup> [https://info.undp.org/docs/pdc/Documents/BFA/00059960\\_Additional\\_Documents\\_to\\_PRODUC\\_3970\\_SIP\\_Burkina\\_CPP\\_C-W.pdf](https://info.undp.org/docs/pdc/Documents/BFA/00059960_Additional_Documents_to_PRODUC_3970_SIP_Burkina_CPP_C-W.pdf); <https://www.adaptation-undp.org/projects/ldcf-ews-burkina-faso>

International Fund for Agricultural Development (IFAD) <sup>505</sup>				
<ul style="list-style-type: none"> <li>• Alignment with government's priorities</li> <li>• Compliance with IFAD's strategy, formalized in the Country Strategic Opportunities Programme (COSOP)</li> <li>• Collaboration with Burkina's Ministry of Economy and Finance</li> </ul>	<ul style="list-style-type: none"> <li>• Agricultural value chains</li> <li>• Food security</li> <li>• Soil and water conservation</li> <li>• Agroforestry</li> <li>• Natural resource management</li> <li>• Rural development</li> <li>• Climate change</li> <li>• Irrigation and water management</li> </ul>	<ul style="list-style-type: none"> <li>• Call for proposals on a rolling basis</li> </ul>	<ul style="list-style-type: none"> <li>• PDRD &amp; PICOFA intervention areas</li> <li>• Rural households living in monetary poverty and food insecurity</li> <li>• Women and youth</li> </ul>	<ul style="list-style-type: none"> <li>• Implementation of projects applies a general principle of subsidiarity that prioritizes local levels over global levels</li> <li>• Projects are overseen by a steering committee</li> </ul>
Food & Agriculture Organization (FAO) <sup>506</sup>				
<ul style="list-style-type: none"> <li>• Follows strategy for promotion and valorization of non-wood forest products in Burkina Faso</li> <li>• Stakeholder engagement (Forest Department of Burkina Faso, UNDP, CIFOR, UK NGO Tree Aid, and village communities)</li> </ul>	<ul style="list-style-type: none"> <li>• Forestry</li> <li>• Food and nutrition security</li> <li>• Economic development through income generation</li> <li>• Financing SMFEs</li> </ul>	<ul style="list-style-type: none"> <li>• 10 years</li> </ul>	<ul style="list-style-type: none"> <li>• Government institutions, NGOs, and community-based organizations focusing on natural resource management</li> </ul>	<ul style="list-style-type: none"> <li>• Funding targets SMFEs but very few are formally registered. Most are channels for awareness-raising and increasing the participation of those living near forests or protected areas. Other actors affiliated with SME are therefore locked out from funding</li> </ul>
United States Agency for International Development (USAID) <sup>507</sup>				
<ul style="list-style-type: none"> <li>• Burkina Faso strategies on land</li> <li>• Integration and use of the USAID Mobile Applications to Secure Tenure (MAST)</li> <li>• Partnership between government and private sector</li> </ul>	<ul style="list-style-type: none"> <li>• Land governance</li> <li>• Technology development</li> <li>• Food security</li> <li>• Women's empowerment</li> <li>• Natural resource management</li> </ul>	<ul style="list-style-type: none"> <li>• 3 years</li> </ul>	<ul style="list-style-type: none"> <li>• Government of Burkina Faso under ministries related to land and natural resources</li> </ul>	<ul style="list-style-type: none"> <li>• The funding disadvantages women since land ownership is complex in Burkina Faso (it is, however, sealing loopholes that could be gender biased)</li> </ul>
German Ministry for Economic Cooperation & Development (BMZ) <sup>508</sup>				
<ul style="list-style-type: none"> <li>• Working in cooperation with public and private sector actors</li> <li>• Engagement through education and information development</li> <li>• Alignment with the country's national energy targets and strategies</li> </ul>	<ul style="list-style-type: none"> <li>• Energy access and development</li> <li>• Agricultural production</li> <li>• Capacity building in agriculture</li> <li>• Soil protection and rehabilitation</li> </ul>	<ul style="list-style-type: none"> <li>• Each year BMZ issues grants to organizations</li> <li>• Projects duration ranges from 2-10 years</li> </ul>	<ul style="list-style-type: none"> <li>• Agricultural technical vocational education and training institutions (ATVET)</li> <li>• Energy ministries and other ministries dealing with energy</li> <li>• Governmental institutions, NGOs, and business associations dealing with farmers</li> </ul>	<ul style="list-style-type: none"> <li>• Activities of BMZ projects concentrate more on the southwest and east of the country, locking out other potential areas</li> <li>• Existence of external finance institutions which make budget implementation difficult</li> </ul>

<sup>505</sup> <https://webapps.ifad.org/members/eb/107/docs/EB-2012-107-R-15.pdf>

<https://www.ifad.org/documents/38711644/40049138/Burkina%20Faso%202000001925%20PAFA-4R%20Project%20Design%20Report%20July%202019/23e7a499-e15c-19c1-965f-de191cbca745>

<sup>506</sup> <http://www.fao.org/forestry/15445-0559761c9ebf687071bb4796f76d5c295.pdf>; <http://www.fao.org/forestry/enterprises/32949/en/>

<sup>507</sup> <https://www.land-links.org/project/land-technology-solutions/>; <https://ncbaclusa.coop/blog/in-burkina-faso-land-ownership-for-women-is-complex-but-key-to-a-more-gender-balanced-world/>

<sup>508</sup> <https://www.giz.de/en/worldwide/19011.html>; <https://www.giz.de/en/worldwide/40417.html>; <https://www.giz.de/en/worldwide/38328.html>

Netherlands Development Organisation (SNV) <sup>509</sup>				
<ul style="list-style-type: none"> <li>• Public-Private Partnership engagement</li> </ul>	<ul style="list-style-type: none"> <li>• Energy access</li> <li>• Climate change</li> </ul>	<ul style="list-style-type: none"> <li>• 3-4 years</li> </ul>	<ul style="list-style-type: none"> <li>• Local enterprises, NGOs, and government agencies in the energy sector</li> </ul>	<ul style="list-style-type: none"> <li>• Government has to contribute to the funding of the programs which at times causes delays</li> </ul>
United States Department of Agriculture <sup>510</sup>				
<ul style="list-style-type: none"> <li>• Multi-Stakeholder integration (exporters, farmers' cooperatives, processors, buyers, financial institutions, and government bodies)</li> <li>• Partnership between Cultivating New Frontiers in Agriculture, RONGEAD, Afrique Verte</li> </ul>	<ul style="list-style-type: none"> <li>• Value chain development for sesame</li> <li>• Market development</li> </ul>	<ul style="list-style-type: none"> <li>• 5 years</li> </ul>	<ul style="list-style-type: none"> <li>• NGOs &amp; government departments in the agricultural sector</li> </ul>	<ul style="list-style-type: none"> <li>• The funding is inadequate to boost sesame exports since cotton and gold are heavily relied upon as exports. Thus a lot of funding is still allocated on such major crops</li> </ul>
African Development Bank (AFDB) <sup>511</sup>				
<ul style="list-style-type: none"> <li>• Project coordination within the Ministry of the Environment, Green Economy, and Climate Change (MEEVCC)</li> <li>• Activities should fall within the strategic pillars of the National Economic and Social Development Plan (PNDES) and the Accelerated Growth and Sustainable Development Strategy (SCADD)</li> <li>• Alignment with AFDB strategy (2013-2022)</li> </ul>	<ul style="list-style-type: none"> <li>• Enhancing agricultural financing</li> <li>• Climate change and resilience</li> <li>• Women and youth empowerment</li> <li>• Water and soil conservation and management</li> </ul>	<ul style="list-style-type: none"> <li>• Funding is between 2 and 6 years depending on the intensity of the project activities and expected outputs</li> </ul>	<ul style="list-style-type: none"> <li>• Government ministries, NGOs, and private sector firms in the agricultural sector and environment</li> </ul>	<ul style="list-style-type: none"> <li>• Support is from several multi- and bilateral technical and financial partners</li> <li>• Financing of processing and marketing activities will create disparities in the local market and penalize non-beneficiary private operators</li> <li>• Government has to contribute a percentage of the funding from its own resources</li> </ul>

<sup>509</sup> <https://www.africabiogas.org/countries/burkina-faso/>

<sup>510</sup> <http://www.secheresse.info/spip.php?article63550>; <http://www.intracen.org/country/burkina-faso/trade-policy-and-market-access/>

<sup>511</sup> [https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Burkina\\_Faso\\_-\\_Approved\\_Cashew\\_Dev\\_Support\\_Project\\_in\\_Como%3%A9\\_Basin.pdf](https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Burkina_Faso_-_Approved_Cashew_Dev_Support_Project_in_Como%3%A9_Basin.pdf); [https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Burkina\\_Faso\\_-\\_Appraisal\\_Report\\_-\\_Bagre\\_Growth\\_Pole\\_Support\\_Project\\_PAPCB\\_%E2%80%93\\_05\\_2015.pdf](https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Burkina_Faso_-_Appraisal_Report_-_Bagre_Growth_Pole_Support_Project_PAPCB_%E2%80%93_05_2015.pdf)

# ANNEX C: Prioritizing Interventions: The Process From Long-Lists To Finalists



This section summarizes the process used in prioritizing investments, with sections on:

- C-1. Producing a Long List of Investments
- C-2. Producing a Short List of Investments
- C-3. CSA Investment Practices, Location, Risks, and Institutions
- C-4. Participants at the Prioritizing Workshop

## C-1. Producing a Long List of Investments

**Key strategic national documents (plan, strategy, policy) were reviewed by national experts to develop the long list of CSA investments.** The documents evaluated included the National Investment Plan for Agriculture (NAIP), Nationally Determined Contributions (NDCs), among other relevant documents listed in full in Annex B.

**Following the initial situational analysis, the prioritization process started with an inception workshop held in Ouagadougou, Burkina Faso on August 19-21, 2019.** The presentations at this workshop aimed at providing a broad situational analysis, surveying potential climate change impacts, and identifying the key climate risks in Burkina Faso. Participants, grouped according to subject matter expertise (e.g., agriculture, livestock and fishery, environment, services, and water and sanitation) were asked to identify CSA investments that apply to their areas of work (see Table C-1). The long list of investments identified were grouped using agriculture sub-sectors, namely, CSA services, crops, environment, livestock and fisheries, water and sanitation.

**Table C-1** Long list of investments

Long List of Potential CSA Investments	CSA Investment Prioritization Criteria				
	Climate risks, climate mitigation, and productivity	Finance and private sector engagement	Policies and institutions	Social benefits and safety nets	Total
CSA SERVICES					
Strengthening the technical capacities of actors in CSA	18	15	16	10	59
Development of agricultural services oriented towards climate-smart information	14	13	19	10	56
Development of financial and insurance products for the promotion of CSA	13	17	12	10	52

CROPS					
Sustainable intensification and diversification of agricultural productions through water management	18	19	24	13	74
Fruit crop development (mango)	18	18	21	10	67
Development of organic cotton production	15	16	20	11	62
Development of oil-protein crops (sesame, leguminous)	17	12	22	11	62
Development of organic and ecological gardening in peri-urban areas	19	11	19	13	62
Restoration of degraded land and soil conservation	18	10	23	7	58
ENVIRONMENT					
Improving ecosystem services for communities resilient to climate change through the promotion of eco-villages	18	15	20	15	68
Promotion of agroecology in rural areas to improve food security	17	15	21	11	64
Promotion of processing enterprises through the promotion of NWFP parks (Shea, gum arabic, baobab)	16	16	18	14	64
Strengthening the resilience of rural communities through decentralized and integrated forest management	15	13	20	13	61
Strengthening the resilience of vulnerable communities through the promotion of nutritious gardens	15	12	16	16	59
Reducing greenhouse gas emissions and adapting to climate change by promoting wood-saving technology and improving access to alternative and renewable energy	14	14	19	11	58
Strengthening national capacities for transparency in the AFOLU sector	12	12	15	9	48
LIVESTOCK AND FISHERIES					
Building resilience through the promotion of biogas	19	16	20	16	71
Sustainable development project for fisheries and aquaculture	13	19	20	16	68
Development of livestock intensification area	15	16	21	16	68
Livestock climate insurance	14	16	23	13	66
Conservation and selection of local cattle breeds	14	14	19	11	58
Control of emerging and re-emerging animal diseases related to climate change	12	15	18	13	58
WATER AND SANITATION					
Valorization of fecal sludge for agricultural and energy production	20	20	24	20	84
Rehabilitation of dams in a context of climatic variability for the resilience of populations	20	18	23	20	81
Adaptation to climate variability and change through construction of dams and hydro-agricultural infrastructure developments in Banwaly	20	18	23	20	81
Protection of water bodies and associated ecosystems to increase agricultural productivity (agro-silvo-pastoral)	19	16	23	20	78
Production and management of information on water resources in Africa	16	16	20	20	72

## C-2. Producing a Short List of Investments

The long list of potential investments was reduced by stakeholders through a process applying multiple filters and indicators to analyze investments. The identified short list of CSA investments from the first inception workshop was discussed with several stakeholders for further inputs. Based on inputs compiled from these discussions, a second workshop was organized on September 10, 2019, with subject matter and agro-ecological zone experts to validate the suggested short list of CSA practices (Table C-2)

**Table C-2** Final participant project recommendations

CSA investment	CSA investment components
<b>Sustainable intensification and diversification of agro-silvo-pastoral and halieutic productions through water management</b>	<ul style="list-style-type: none"> <li>A. Rehabilitation of dams in a context of climatic variability for the resilience of populations</li> <li>B. Protection of water bodies and associated ecosystems to increase agricultural productivity (agro-silvo-pastoral)</li> <li>C. Sustainable development project for fisheries and aquaculture</li> </ul>
<b>Enhance the use of organic residues for climate resilient communities</b>	<ul style="list-style-type: none"> <li>A. Building resilience through the promotion of biodigesters</li> <li>B. Valorization of fecal sludge for agricultural and energy production</li> <li>C. Promoting access to alternative and renewable energies</li> </ul>
<b>Sustainable intensification of livestock production</b>	<ul style="list-style-type: none"> <li>A- Conservation and selection of local cattle breeds</li> <li>B- Control of emerging and re-emerging animal diseases related to climate change</li> <li>C- Development of livestock intensification area</li> </ul>
<b>Improving ecosystem services for communities resilient to climate change</b>	<ul style="list-style-type: none"> <li>A. Promotion of processing enterprises through the promotion of NWFP parks (Shea, gum arabic, baobab)</li> <li>B. Promotion of forest value chains (NWFPs)</li> <li>C. Strengthening the resilience of vulnerable communities through the promotion of nutritious gardens</li> </ul>
<b>Capacity building of actors in CSA</b>	<ul style="list-style-type: none"> <li>A. Strengthening national capacities for transparency in AFOLU sector</li> <li>B. Strengthening the technical capacities of actors in CSA</li> <li>C. Production and management of information on water resources in Africa</li> <li>D. Development of agricultural services oriented towards climate-smart information.</li> <li>E. Building capacity for CSA funding mobilization</li> </ul>
<b>Development of financial and insurance products for the promotion of CSA</b>	<ul style="list-style-type: none"> <li>A. Crop insurance products</li> <li>B. Livestock climate insurance</li> <li>C. Promotion of climate-smart information</li> </ul>
<b>Sustainable development of organic farming</b>	<ul style="list-style-type: none"> <li>A. Development of organic cotton production</li> <li>B. Organic fruit crop development (mango)</li> <li>C. Development of organic and ecological gardening in peri-urban areas</li> <li>D. Promotion of agro-ecology in rural areas</li> <li>E. Small scale solar-powered irrigation</li> </ul>
<b>Development of oil-protein crops (sesame, leguminous)</b>	<ul style="list-style-type: none"> <li>A. Sesame (exportation)</li> <li>B. Niebe</li> <li>C. Soybeans</li> </ul>
<b>Restoration of degraded land and soil conservation</b>	<ul style="list-style-type: none"> <li>A. Scaling up of good practices</li> <li>B. Promotion of conservation agriculture technologies</li> </ul>

### C-3. Investment CSA Practices, Location, Risks and Institutions

Participants then considered each of the CSA investments to inform the development of the concept notes. They discussed leading institutions; the CSA practices that were needed; and the necessary scope of the project, its proposed geographic reach, risks, and other relevant information. They also involved key actors to aid in fostering the adoption of the CSA practices. For each actor, requisite changes in knowledge, skills, practices, and related activities were identified. This information was used to make more detailed project proposals and to articulate outcomes, activities, and other component of each investment or program. Workshop input, supplemented and developed where appropriate, was used to develop the project concepts found in Annex A. In addition, alignment of these investments with those proposed by the NDC Partnership was considered (see Chapter 4 and each proposed investment in Annex A).

### C-4. Participants at Prioritizing Workshop

The Climate-Smart Agriculture Investment Plan Development for Burkina Faso was on August 19-21, 2019. This meeting engaged many stakeholders, including one or more representatives from the following organizations:

- Ministère de l'Agriculture et des Aménagements Hydro-Agricoles (MAAH) – Membres du Comité d'Orientation et de Suivi (MAAH)
- Ministère de l'Eau et de l'Assainissement (MEA) Membres du Comité d'Orientation et de Suivi MEA
- Ministère de l'Environnement, de l'Economie Verte et du Changement Climatique (MEEVCC) –Membres du Comité d'Orientation et de Suivi (MEEVCC)
- Ministère des Ressources Animales et Halieutiques (MRAH) - Membres du Comité d'Orientation et de Suivi MRAH
- Secrétaire Permanent de la Coordination des Politiques Sectorielles Agricoles (SP/CPSA)
- Confédération Paysanne du Faso (CPF)
- Direction Générale de l'Economie et de la Planification (DGEP)
- Direction Générale de la Coopération (DGCOOP)
- Institut de l'Environnement et de Recherche Agricole (INERA)
- Laboratoire d'Analyses Mathématiques et de l'Informatique (LAMI)
- Secrétariat Permanent des ONGs
- Union Nationale des Producteurs de Semence
- Union Nationale des Producteurs de Coton
- Chambre Nationale d'Agriculture
- Projet HYDROMET-Burkina
- Secrétariat Exécutif du Fonds Vert pour le Climat -Burkina Faso (Premier Ministère)
- Coopération Luxembourgeoise
- Coopération Suédoise
- French Development Agency (AFD)
- International Fund for Agricultural development (FIDA)
- Food and Agriculture Organization (FAO)
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- Union Européenne
- Coopération Suisse
- Japan International Cooperation Agency (JICA)
- Ministère de l'Environnement de l'Economie Verte et du Changement climatique (GGGI)



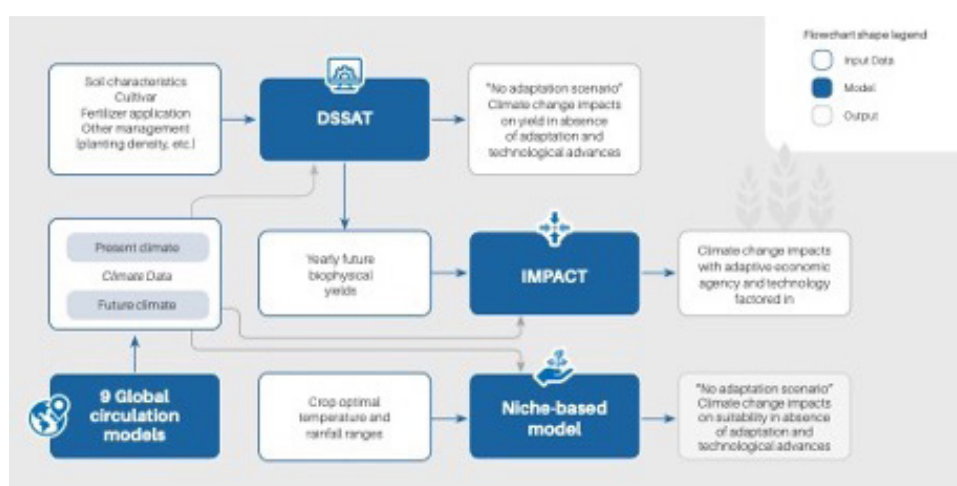
- United Nations Development Programme (PNUD)
- United States Agency for International Development (USAID)
- Banque africaine de développement (BAD)
- Permanent Interstate Committee for Drought Control in the Sahel (CILSS)
- International Union for Conservation of Nature (UICN)
- Alliance for a Green Revolution in Africa (AGRA)
- CNA-BIO
- Direction Générale des Productions Végétales (DGPV) – MAAH
- Direction Générale des Aménagements Hydraulique et du Développement de l'Irrigation (DGAHDI) – MAAH
- SP/CNDD (MEEVCC)
- Direction Générale des Productions Animales (MRAH)
- DGRH – Direction Générale des Ressources halieutiques (MRAH)
- PNB-BF : Programme National Biodigesteurs (MRAH)
- Programme d'Investissement Forestier (PIF)
- Projet Bagré Pôle
- Unité de mise en œuvre du Cadre intégré renforcé (MCIA)
- Chambre de Commerce et d'Industrie du Burkina
- Direction générale des études et des statistiques sectorielles MRAH,MEEVCC,MAAH
- Direction Générale des Infrastructures hydrauliques (MEA)
- DGRE (Direction Générale des Ressources en Eau) (MEA)
- SP/GIRE (Secrétariat Permanent GIRE) (MEA)
- SP/PNDES (Premier Ministère)
- International Center for Tropical Agriculture (CIAT)
- Climate Change Agriculture Food Security (CCAFS)
- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
- West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL)
- Banque Mondiale

# ANNEX D: Methodology For Integrating Climate Change, Crop Response, And Economic Impact

## D.1 Climate Change Vulnerability and Economic Impacts in the Agricultural Sector

This modeling presents highly summarized, country-specific results distilled from a region-wide analysis of the potential impacts of climate change on the future yields, suitability, and economic performance of key crops. Yields were modeled using the Decision Support System for Agrotechnology Transfer (DSSAT v4.5). Specific, regionally relevant varieties were selected for each crops and their genetic coefficients were incorporated into the DSSAT modeling process. It is important to keep in mind that the impacts of climate change on yield and suitability are modeled without consideration of changes in management and technology (i.e., these factors were held constant at current levels). DSSAT and niche-based results thus present a “no adaptation scenario” which does not explicitly incorporate ongoing investments in yield-enhancing technologies or the adaptive agency of farmers who can switch to alternative land uses in response to economic incentives. An economic impact assessment that does explicitly incorporate these factors is also included. This economic assessment was conducted using the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT).<sup>512</sup> DSSAT, EcoCrop, and IMPACT require baseline (i.e. present) and future climate data as inputs. The baseline climate was drawn from the Watch Forcing Dataset,<sup>513</sup> while the future climate input is an average of the output of nine global circulation models. A more detailed description of these modeling components is provided in the sections below. A visual schema of the overall modeling workflow is presented in Figure E-1.

**Figure D-1 Policy Brief Modeling Workflow**



<sup>512</sup> For details, see Robinson, S., Mason-D'Croz, D., Sulser, T., Islam, S., Robertson, R., Zhu, T., ... Rosegrant, M. W. (2015). The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT): Model Description for Version 3. SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.2741234> and Robinson, S., Mason-D'Croz, D., Islam, S., Cenacchi, N., Creamer, B., Gueneau, A., ... Wiebe, K. (2015, October 9). Climate Change Adaptation in Agriculture: Ex Ante Analysis of Promising and Alternative Crop Technologies Using DSSAT and IMPACT. Retrieved from [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2688063](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2688063)

<sup>513</sup> For details, see Weedon, G. P., Gomes, S., Viterbo, P., Shuttleworth, W. J., Blyth, E., Österle, H., ... Best, M. (2011). Creation of the WATCH Forcing Data and Its Use to Assess Global and Regional Reference Crop Evaporation over Land during the Twentieth Century. *Journal of Hydrometeorology*, 12(5), 823–848. <https://doi.org/10.1175/2011JHM1369.1>

## D-2. Present Climate Data and Future Climate Modeling

Historical weather conditions were reconstructed in growing areas across Burkina Faso from 1971 to 2000 using the Watch Forcing Dataset (WFD). WFD is a global dataset of daily weather data derived via extensive calibration and bias correction by the European Center for Medium Range Weather Forecasts 40+ year Reanalysis (ERA-40).

For the future period from 2020 to 2049, daily general circulation model (GCM) output was used from nine models in the Climate Model Inter-Comparison Project 5 archive.<sup>514</sup> All raw climate model output was downscaled to a 0.5° (about 50 km at the equator) resolution and bias-corrected with the historical WFD dataset. The nine selected GCMs (Table D-1) include one version per climate modeling institution and were selected as having the best performance for the region.<sup>515</sup>

**Table D-1** List of GCMs used in the modeling simulations.

GCM name	Institute	Country
BCC-CSM1	Beijing Climate Center, China Meteorological Administration	China
BNU_ESM	Beijing Normal University	China
CCCMA_CANESM2	Canadian Centre for Climate Modelling and Analysis	Canada
GFDL_ESM2G	NOAA Geophysical Fluid Dynamics Laboratory	United States
INM-CM4	Russian Institute for Numerical Mathematics	Russia
IPSL-CM5A-LR	Institut Pierre Simon Laplace	France
MIROC-MIROC5	University of Tokyo, National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology	Japan
MPI-ESM-MR	Max Planck Institute for Meteorology	Germany
NCC-NORES1-M	Norwegian Climate Centre	Norway

For the 30 years in the historical (WFD) and future periods (GCMs), daily maximum and minimum temperatures, solar radiation, and precipitation were extracted for use in DSSAT. For EcoCrop, daily maximum and minimum temperatures and precipitation were aggregated to the monthly timescale for use in the analysis. In DSSAT, atmospheric CO<sub>2</sub> concentrations were fixed at 380 ppm for both the historical and future periods in order to disentangle the projected impacts of changes in climate variables from the more uncertain impacts of changes in CO<sub>2</sub>.

Projected changes are considered by 3-month seasons for four relevant agricultural climate variables: precipitation, daily maximum and minimum temperatures, and solar radiation. These changes represent averages across the 9 GCMs for the future period relative to the baseline climate data in the historical period.

### NICHE-BASED MODELING OF CLIMATE CHANGE IMPACTS ON SUITABILITY

Niche-based modeling was used to evaluate changes in suitable area of key crops. Most niche-based modeling was conducted using EcoCrop, a niche prediction model based on the Food and Agriculture Organization EcoCrop database.<sup>516</sup> The EcoCrop model was originally developed by the Center for International Agriculture (CIAT) with support from Bioversity International and the

<sup>514</sup> CMIP5. 2014. Coupled Model Inter-comparison Project Phase 5. [online] Available from <http://pcmdi9.llnl.gov/esgf-web-fe/http://faostat.fao.org/> [Accessed in April 2015]

<sup>515</sup> For details on the assessment of GCM performance see Watterson IG; Bathols J; Heady C. 2014. What influences the skill of climate models over the continents? Bull. Am. Meteorol. Soc. 95:689–700.

<sup>516</sup> FAO. 2007. EcoCrop. Available online at <http://ecocrop.fao.org/ecocrop/srv/en/home>, checked on 14 August 2018

International Potato Centre (CIP). Its basic model uses optimal ranges of temperature and precipitation (based on the literature and expert advice) as inputs to determine the main environmental niche of a crop. The precipitation and temperature at each pixel is compared with the optimal range of the crop. If the pixel is within the optimal range, the suitability is 100%. If not, then the conditions are compared with the minimum and maximum absolute temperature and precipitation at which the crop can grow, creating a suitability index which is then expressed as a percentage. Like DSSAT, EcoCrop was run yearly for an historical period and a future period at a 0.5° spatial resolution in current and potential cultivation areas, excluding currently forested regions. A given pixel is said to be “suitable” for a given crop if its suitability value for that crop is greater than a threshold of 50%.<sup>517</sup> Five categories were defined to quantify changes in suitable area between current and future suitability (Figure E-2):

**Figure D-2: Categories quantifying changes in suitability**



## DSSAT MODELING OF CLIMATE CHANGE IMPACTS ON YIELD

**DSSAT is a process-based crop model that simulates crop development, water/nutrient balances, and final yields at the field scale.** DSSAT simulations require daily weather data, detailed information on soils, cultivars, planting dates and rules, applications of fertilizers and irrigation, and other agronomic information such as seeding density and row spacing. In this study, special care was taken to assign elevation- and daylight-adapted cultivars to pixels in a manner that reflects local variation across geography. DSSAT was run using a grid-based modeling framework at a 0.5° spatial resolution in current and potential cultivation areas, excluding currently forested regions.

**In order to calculate climate impact on yields, the DSSAT models were run for a historical baseline period (1971-2000) and a future period (2021-2049).** Due to inter-annual and decadal climate variability, a 30-year period is the standard unit to controlling for climate variability in each simulated period. Separate sets of DSSAT simulations were run for irrigated and rain-fed production. Finally, a yield shock value was calculated for each, based on the relative difference in yields between the baseline and future periods.

## SIMULATION PROCESSING AND AGGREGATION

**Yields and suitability values were estimated yearly for each of the 30-year periods in the historical and future analyses and for each GCM in the future period.** This resulted in 300 simulations for each pixel and crop (and irrigated/rainfed combination with DSSAT), resulting in millions of simulations in total (the exact number depends on how extensively the crop is grown). Mean yield and suitability were then calculated across the baseline and future 30-year periods. Modeling results are presented at both the pixel level (each pixel roughly representing a 0.5° by 0.5° square of the Earth's surface) and at the country level.

## ECONOMIC IMPACT MODELING

**Agricultural yields and production are not functions of climate and biophysical parameters alone, but also of economic incentives.** Based on the biophysical DSSAT and EcoCrop analysis, it appears

<sup>517</sup> This is done to ease interpretation and improve the usefulness of EcoCrop predictions. For similar approaches see Ramirez-Villegas J, Thornton PK. 2015. Climate change impacts on African crop production. Working paper No. 119. Copenhagen, Denmark, and CGIAR (2015) Developing beans that can beat the heat. Cali, Colombia.

likely that the impacts of climate change on key commodity/food security crops will be heterogeneous. That is, impacts may drastically reduce yields and suitability across broad swaths of territory but may also create pockets of increased yields and suitability. In terms of international trade, this amounts to a global rebalancing of comparative advantages in agriculture. The impacts of climate change anticipated by DSSAT and niche-based modeling do not account for this shifting landscape of economic incentives, nor for the individual farmer's prerogative to take action in response to changing incentives by adopting improved varieties and/or management practices, or by switching to other crops altogether. A natural question to ask, then, is what happens under climate change when the reality of economic agency is factored in? To what extent might the incentives created by international trade offset or exacerbate the (heterogeneous) worsening of biophysical suitability caused by climate change? The IMPACT model has been developed by the International Food Policy Research Institute to answer such questions.

**IMPACT takes the yields generated by DSSAT as part of its input but modifies the data year upon year endogenously by market forces and ongoing yield-enhancing research.** The extent of cultivated area dedicated to each crop is also endogenously modeled as a function of market incentives generated by global demand and supply, such that farmers are free to consider alternative land use options in response to worsening biophysical suitability for their current crop(s) in any given year of the modeled period. Assumptions regarding future economic growth, population growth, and agricultural research trends are codified in a variety of "Shared Socio-economic Pathways" (SSPs). Likewise, assumptions regarding future greenhouse gas emission trajectories are codified in a set of "Representative Concentration Pathways" (RCPs).

**For the policy briefs, IMPACT was set to SSP2 and RCP 4.5, generally considered (by the community of practice) to represent a "business-as-usual" trajectory in which agricultural research and greenhouse gas mitigation strategies continue at their current levels.**

# ANNEX E: Methods For Ex-Ante Financial And Economic Performance

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## E-1. The Model

### E-2. Data Sources

### E-3. Data Analysis

## E-1. The Model

**The costs and benefits of investments were modeled using standard cost-benefit analysis (CBA) and Monte Carlo simulations.** The model relies on an economic and financial analysis of expected inputs and outputs. A project's impact is monetized, discounted, and calculated annually, considering gradual adoption of project interventions by the target beneficiaries subject to the occurrence and influence of risks to implementation and benefits. The model assumes that benefits accrue for 20 years but investment costs principally are used in the first five years, with recurring costs equivalent to 10% of total investment each year thereafter.

**We used a probabilistic approach to account for uncertainty in project costs and benefits subject to climate risks and barriers to adoption.** Accurate estimates for these parameters are a major challenge in ex-ante impact assessments. Uncertainty is modeled in this CBA using a probability distribution (typically a metalog) that represents our degree of confidence around this estimate; it is also taken into account when calculating common indicators of CBA. The model applies the SIPMath standard developed by Probability Management Group.<sup>518</sup> The critical piece here is that the SIPMath standard offers a way to preserve statistical relationships in scenarios when they are run. The model was developed specifically for implementation with the CSAIPs of Ghana and Burkina Faso. It is based on the same structure utilized for CSAIPs in Mali and Cote d'Ivoire, which was adapted from Yet et al. (2016).

**In the following sections, we describe the development, parameterization, and running of the model.** The model has been coded using Microsoft Excel by World Agroforestry (ICRAF) and Probability Management Group. The source data for input values to parameterize the model are discussed below. The actual values used in the model are reported in the respective section. All data and the MS Excel model will be available on ICRAF's Dataverse.<sup>519</sup>

## E-2. Data Sources

The model requires six categories of data for each investment: (1) number of beneficiaries; (2) rates of adoption; (3) change of benefits with the project; (4) project costs; (5) risk frequency and severity; and (6) greenhouse gas impacts. Values for model parameters were defined based on a combination of expert knowledge and external data sources where available (Table E-1). Specific sources and approaches for each category are described below.

<sup>518</sup> <https://www.probabilitymanagement.org/s/SIP-Standard-Version-211.pdf>

<sup>519</sup> <https://dataverse.harvard.edu/dataverse/icraf>

**Table E-1** Sources of information for model parameters

Parameter	Expert Knowledge	External Data
Number of beneficiaries		x
Adoption rates	x	
Change in benefits with project		x
Project costs	x	
Risk frequency		x
Risk impact on project	x	

## NUMBER OF BENEFICIARIES

We used census data<sup>520</sup> and data from other surveys specific to project regions to estimate the potential number of beneficiaries (Table E-2). The number of beneficiaries includes both direct and indirect beneficiaries.

**Table E-2** The number of expected beneficiaries for each investment in the Burkina Faso CSAIP

Investment	Number of beneficiaries	Source of data
Sustainable water management	100,000	National Institute of Statistics and Demographics (INSD) 2016
Residues and biogas	65,000	INSD 2016
Livestock	150,000	GLSS 2014
Non-timber forest products	180,000	INSD 2016
Capacity development	500,000	INSD 2016
Insurance and finance	200,000	INSD 2016
Organic farming	60,000	INSD 2016
Oil protein crops	240,000	INSD 2016
Soil conservation	200,000	INSD 2016

## ADOPTION RATES

A project's scope is defined by its targeted total number of beneficiaries. A project's interventions are gradually adopted over a duration of the project, determining the accrual of benefits. The percentage of beneficiaries that adopt the project is modelled by the Bass model.<sup>521</sup> The Bass model relies on two parameters, the rate of innovation,  $p$ , and rate of imitation,  $q$ , to estimate the adoption rate (AR) over a specified time period  $t$  as shown below:

$$AR_t = \frac{1 - e^{-(p+q)t}}{1 + \left(\frac{q}{p}\right) e^{-(p+q)t}}$$

Broadly speaking, the rate of innovation can be thought of as the beneficiaries directly interacting with the project and the rate of imitation can be considered the indirect beneficiaries. These parameters were then estimated based using expert opinion based on a trajectory designed to map the likely and relative trajectories of implementation for each investment under the investment plan (Table E-3).

<sup>520</sup> Burkina Faso Living Standards Survey Round 6 2014

<sup>521</sup> Bass 1969

**Table E-3. Parameter values used for the Bass model to estimate annual adoption rates, respective to the number of beneficiaries.**

For both rates of innovation and adoption, higher numbers relate to more rapid adoption changing the functional form of the adoption curve.

Rates of innovation	Rates of imitation (q)		
	0.4	0.5	0.6
0.05	Biogas	Aquaculture	ntfp
0.1	Livestock	Oil crops, soil and water conservation, organic farming	
0.15	Insurance and finance		Capacity building

### IMPACTS WITH AND WITHOUT PROJECT

**Impacts of each investment were modeled against the counterfactual of no project.** Baselines of incomes before the project were based on agricultural census data that was standardized across the country to represent all farmers (US\$825). Returns over the project period without the project were adjusted for predicted climate impacts. They were modified based on estimated changes in agricultural productivity predicted with the IMPACT model respective to the relevant time period. Impacts with the projects were estimated based on change in income after project implementation based on financial analysis of various management practices and technologies relevant to each investment (Table E-4). Data for the financial analysis was derived from ERA (Evidence for Resilient Agriculture) a database comprising nearly 1,500 studies of farm-level management practices and technologies in Africa<sup>522</sup> and supplemented with additional external sources as needed.

**Table E-4 Financial analysis. Values are the percentage change with and without project.**

Values derived from the compendium and other secondary sources.

Commodity	Technology	Yield	Gross Returns	Costs
Sustainable water management				
Vegetables	Irrigation (improving yield)	154%		
	Irrigation (adding season)	100%		
	Improved varieties	38.6 (8.3)		
	Mulching	31.4% (23%)		
	Crop residue	28.0%(3.5%)		
Rice	Improved varieties	11.6% (27.9%)		
	System of rice intensification	53.3% (5.0%)	49.2% (12.7%)	2.6% (6.7%)
	Irrigation	35.7% (17.2%)	55.3% (95.4%)	
	Water harvesting	37% (6.8%)		
Maize	Improved varieties	29.8% (9.6%)	8.8% (15.8%)	6.9% (2.8%)
	Irrigation (adding season)	100%		
	Water harvesting	58.5% (3.1%)		
	Mean of all technologies	56.5%(41.1%)	56.8% (28.7%)	21.2% (5.7%)
Organic residues for biogas production				
Household	Income from biodigesters	10% ()		
Rice	Organic fertilizer	71.3% (8.5%)		
	Improved varieties	11.6% (27.9%)		

<sup>522</sup> Rosenstock et al. 2015



Maize	Organic fertilizer	80.6% (5.1%)	56.4% (12.3%)	38.4% (4.3%)
	Improved varieties	29.8% (9.6%)	8.8% (15.8%)	6.9% (2.8%)
Sorghum	Organic fertilizer	79.9% (5.8%)		
	Improved varieties	31.1% (7.8%)		
	Mean of all technologies	45.4% (28.4%)		
<b>Climate-resilient livestock production</b>				
Cattle (Meat)	Improved breeds	33.6% (6.4%)		
	Feed supplementation	37.2% (5.8%)	21.2% (1.1%)	27.4% (12.6%)
	Feed substitutions	6.0% (8.9%)	12.4% (14.4%)	-14.4% (8.4%)
	Improved pasture	31.3% (2.6%)		
	Animal health improvements	50.0%		
Goats (Meat)	Improved breeds	16.4% (6.0%)		
	Feed supplementation	32.8% (9.1%)	68.2% (5.1%)	16.1% (48.6%)
	Feed substitutions	9.6% (7.6%)		1.0% (8.0%)
Sheep (Meat)	Improved breeds	49.5% (3.8%)		
	Feed supplementation	61.3% (19.1%)	42.8% (12.5%)	
	Feed substitutions	7.1% (5.3%)		-9.1% (1.4%)
	Improved pasture	9.7% (11.4%)		
Cattle (Milk)	Feed supplementation	27.1% (7.3%)		
	Agroforestry fodder supplementation	32% (15%)		
	Improved breeds	118.6% (44.5%)		
Goats (Milk)	Feed supplementation	65.5% (36.7%)		
	Improved breeds	63.6% (12.3%)		
	Mean of all technologies	38.3% (28.5%)	36.2% (8.3%)	4.2% (20.9%)
<b>Non-wood forest products</b>				
Shea	Engagement in shea value chain		63%	
	Improved shea cultivation		44%	
Gum arabic	Engagement in gum arabic agroforestry		52.80%	
Baobab	Collection of Baobab fruits for use or selling		31.90%	
Nutrition garden	Addition of nutrition gardens		9%	
	Mean of all technologies		40% (15%)	
<b>Capacity building for CSA actors</b>				
Household	Agroweather advisories	8% (6.5%)		
Household	Improved CSA extension	27.3% (8.7%)	56.1% (30.9%)	25.7% (23.3%)
	Mean of all technologies	17.7% (7.5%)	56.1% (30.9%)	25.7% (23.3%)
<b>Insurance and financial tools</b>				
Maize	Implement CSA due to crop insurance	27.3% (8.7%)	56.1% (30.9%)	25.7% (23.3%)
Cotton	Implement CSA due to crop insurance	12.5% (12.3%)		
Cattle	Implement CSA due to livestock insurance	19.6% (4.1%)		
Goats	Implement CSA due to livestock insurance	16.5% (1.8%)		
	Mean of all technologies	19.0% (10.0%)	56.1% (30.9%)	25.7% (23.3%)

Organic farming				
Cotton	Organic fertilizer	34.7% (11%)		
	Crop residue	5.3% (3.5%)		
	Mulch	-5.1% (3.5%)		
	Green manure	-10.0% (4.7%)		
	Irrigation (improved yield)	100.0%		
	Irrigation (additional season)	100.0%		
Mango	Addition of mango trees	10.00%		
	Improved storage	120% (20%)		
Vegetables*	Organic fertilizer	56.2% (8.2%)		
	Irrigation (in season)	73.8% (16.7%)		
	Irrigation (adding season)	100.0%		
	Improved varieties	38.6% (8.3%)		
	Mulching	31.4% (23%)		
	Crop residue	28.0% (3.5%)		
	Improved storage	120% (20%)		
	Mean of all technologies	53.5% (45.6%)		
Development of oil-protein crops				
Sesame	Improved varieties			
	Organic fertilizer	40% (8%)		
	Inorganic fertilizer	34% (5%)		
	Agroforestry alleycropping	19.7% (9%)		
	Intercropping	-11.7% (9%)		
Soyabean	Organic fertilizer	162% (15%)		
	inorganic fertilizer	61.3% (3.1%)		
	Improved varieties	57.2% (23%)		
	Mulching	24.7% (4.5%)		
Cowpea	Organic fertilizer	50.6% (7.3%)		
	inorganic fertilizer	25.5% (2.6%)		
	Improved varieties	-33.9% (10.2%)		
	Mulching	43.0% (4.8%)		
	Mean of all technologies	39.4% (8.5%)		
Restoring degraded lands with soil and water conservation				
Millet	Organic fertilizer	93.9%		
	Mulching	81.4%		
	Crop residue	81.0%		
	Agroforestry alleycropping	63.8%		
	Agroforestry residues	58.4%		
	Water harvesting	49.3%		
	Crop rotation	28.5%		
	Green manure	17.9%		
	Reduced tillage	2.2%		
	Intercropping	-3.7%		
	Parklands	-16.5%		

Sorghum	Organic fertilizer	79.9%		
	Mulching	16.2%		
	Crop residue	30.5%		
	Agroforestry alleycropping	2.0%		
	Agroforestry residues	22.5%		
	Water harvesting	8.5%		
	Crop rotation	26.2%		
	Green manure	44.6%		
	Reduced tillage	-11.9%		
	Intercropping	2.2%		
	Parklands	-20.6%		
	Mean of all technologies	29.8%		

## PROJECT COSTS

**Project costs were based on average costs per beneficiary following a typology of investments cost effectiveness derived by expert opinion.** Investments typically range between US\$200-600/beneficiary. Outside this range, the project is either unrealistic (if on the low end) or not cost efficient (if above the high end). Note that while the investment in some things seems high, the costs per beneficiary reflect what needs to be invested at the farm scale, to start up, and to operate the project—in other words, all project investments. Each investment was then prescribed to one of three pathways: cost efficient, moderate, or très cher, with corresponding costs, estimated by expert opinion, of about US\$200, \$400 and \$600/beneficiary. These values were then multiplied by the target number of beneficiaries based on census data in the regions identified for the investments (see Beneficiaries above), providing an estimate of total costs (See Table E-5). Annual costs were then distributed equally for years one through five. Years 6-20 received 10% of annual budgets.

**Table E-5. Budgets and assumption for cost/beneficiary for each**

Investment	Cost/Beneficiary (USD)	Budget (Millions USD)
Sustainable water management	650	65.04
Residues and biogas	846	55.00
Livestock	250	37.50
Non-timber forest products	306	55.08
Capacity development	110	55.00
Insurance and finance	200	40.0
Organic farming	833	50.0
Oil-protein crops	228	54.72
Soil conservation	300	60.0
Average	413.67	52.48
<b>Total</b>	<b>3723</b>	<b>472.34</b>

## GREENHOUSE GAS BALANCE

**Estimates of changes in carbon stocks and greenhouse gas emissions (GHGs) were based on analysis using the EXACT model (FAO unpublished) and published literature when figures were not available from EXACT (see Table E-6).** GHG gas balance are typically quantified in tonnes carbon dioxide equivalent per ha (tCO<sub>2</sub>-eq/ha). However, the economic analysis operates on beneficiaries (persons). Given the size and diversity of farms in Burkina Faso, we assume that each beneficiary implements the interventions on one hectare (1:1). When estimates were not available from EXACT, other data sources were found to provide an estimate of potential impacts.

**Table E-6. Greenhouse gas balances used in the model**

Investment	Midpoint GHG (tCO <sub>2</sub> -eq/ha)	Assumptions
Sustainable water management	0.03	relies heavily on reduced tillage, crop rotation, and crop residue retention
Residues and biogas	0.53	tree rejuvenation and good horticulture, biomass production
Livestock	-0.69	minor emissions source due to increase in amount of manure
Non-timber forest products	-2.58	sequestration of carbon in biomass
Capacity development	0.21	no change in absolute emissions as project will catalyze sustainable intensification
Insurance and finance	0.25	no change in absolute emissions as project will catalyze sustainable intensification
Organic farming	0.04	assumed to be similar to existing practices as organic materials provide lots of C and N
Oil-protein crops	0.11	small accumulation with better soil management potentially offset with use of legumes and fertilizers
Soil conservation	1.25	small accumulation with better soil management, potentially offset with use of legumes and fertilizers

The value of the change in emissions and carbon stock was estimated based on the World Bank guidance note on Social Cost of Carbon. The World Bank's global social costs of carbon range between 40 and 80 USD/t CO<sub>2</sub>-eq. We used a midpoint of 50 USD/t and set the distribution such that 90% of selected values would be between 5 and 100 USD/t. It should be noted that the most current assessment of the social cost of carbon differentiates carbon values between 0.49 and 6.14 USD/t CO<sub>2</sub>-eq for Burkina Faso depending on the discount rate,<sup>523</sup> much lower than the value used in this study.

### E-3. Data analysis

As previously stated, economic performance was measured using standard CBA indicators: NPV, IRR, ROI, and BCR. NPV measures the incremental flow of net benefits (net cash flow) generated by the investments over the life cycle period. The NPV indicates the amount of wealth accumulated due to the investment. The NPV is computed as follows:

$$NPV = \sum_{t=1}^n \frac{B_t - C_t}{(1+r)^t} \quad (1)$$

where  $B_t$  is the benefit of CSA practice (CSA package) at time  $t$ ,  $C_t$  is the investment and recurrent cost of CSA practice (CSA package) at time  $t$ ,  $t$  is the time horizon (life cycle), and  $r$  is the discount rate (prevailing commercial bank prime lending rates).

The IRR is defined as the discount rate that makes the present value of the flow of future net benefits exactly equal to the initial investment, therefore setting the NPV to zero.<sup>524</sup> Any CSA investment with IRR exceeding the discount rate is viable<sup>525</sup>. The IRR is computed as follows:

$$NPV = \sum_{t=1}^n \frac{B_t - C_t}{(1+r)^t} = 0 \text{ when } IRR > r \quad (2)$$

<sup>523</sup> Ricke K, L Drouet, K Caldeira and M Tavoni. 2018. Country-level social cost of carbon. *Nature Climate Change*, 8:895-900.

<sup>524</sup> Juhász, 2011; Gittinger, 1982

<sup>525</sup> Mutenje et al., 2019

The midpoint of the distribution used for discount rate was 13% and it was allowed to range between 4% on the low side and unbounded on the high side. This means that 90% of values would be less than 19.5%

**4%      6.5%      13.0%      19.5%**

A sensitivity analyses was performed using probabilistic framework that provides both the most likely and extreme outcomes.

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## CLIMATE-SMART AGRICULTURE INVESTMENT PLAN BURKINA FASO

