AgMIP The Agricultural Model Intercomparison and Improvement Project

ADVANCING CLIMATE RESILIENCE FOR AGRICULTURE IN SENEGAL: AgMIP-SUPPORTED POLICY AND ACTION

KEY MESSAGES

Diversify agricultural investments. *A national-level analysis in Senegal showed that investing in a portfolio of value chains including fish, horticulture, cereals, cotton and groundnuts advances national objectives of growth, reduced poverty, employment, and nutrition more effectively than would any single value chain.*

Promote climate-smart crops. *A case study of the Nioro region showed how local investment in longer-cycle seed varieties and adapted crop management can strengthen several of the highlighted value chains under climate change, increasing yields, reducing poverty, and improving food security, demonstrating the potential of targeted, context-specific adaptation strategies.*

Integrate national and sub-national assessments. *The project advanced a framework that could help policy and decision makers to anticipate climate risks by integrating sub-national assessments (which inform national projections based on the diversity of conditions across Senegal and guide local action) and national assessments (which refine analyses of sub-national outcomes and support national policy).*

Demand for information. *Policy and decision makers are asking for information that evaluates the impacts of adaptation strategies on policy-relevant outcomes such as growth, poverty, employment, and food security under different climate futures, with results specific to regional conditions and relevant to targeted national policy opportunities.*

Improve data. *Investment in accessibility, availability, and spatial and temporal coverage of data on rainfall, soils, crops, livestock, pests, diseases, and socio-economic factors is critical to support integrated studies that can provide the information that policy and decision makers are asking for.*

CONTEXT AND MOTIVATION

Stakeholders from Senegal

With a growing population and increasing climate risks, agriculture in Senegal faces major challenges to food security, rural livelihoods, and economic stability. These challenges are interrelated with systemic pressures including land degradation, water scarcity, soil salinization driven by sea level rise, and recurrent flooding. Effective adaptation requires science-based evidence regarding the risks and trade-offs between different adaptation strategies at the national level and across Senegal's diverse agro-ecological zones and socio-economic conditions.

The study titled "*AgMIP Demand-Scoping Study in Sub-Saharan Africa*," conducted by the Agricultural Model Intercomparison and Improvement Project (AgMIP) and led by researchers from IPAR, engaged representatives from the Ministry of Agriculture, Food Sovereignty and Livestock (MASAE), the Ministry of Environment and Ecological Transition (METE), ISRA, ANACIM, AICCRA, farmers' organizations, and development partners through interviews and two workshops held in Ghana and in

Senegal. The interviews asked policy and decision makers what science-based information they need. The workshops prioritized the science needs communicated in interviews and discussed how to improve collaborations between researchers and stakeholders to co-produce the science.

This policy brief summarizes key insights from the interviews and the workshops. It illustrates how AgMIP's Integrated National to Regional Assessments (INaRA) framework can be advanced by integrating the Rural Investment and Policy Analysis (RIAPA), a national economic model developed by the International Food Policy and Research Institute (IFPRI), into INaRA. This enhanced framework can provide the evidence base that policy and decision makers are asking for to help advance policy and investment responses to the climate crisis and to help transform the agricultural sector in Senegal.

STAKEHOLDER DEMAND

Participants in interviews and the workshop prioritized specific topics, highlighted in the green circle in Figure 1, on which they need improved scientific information to advance climate-resilient agriculture. Participants also proposed criteria that information on these topics should meet, outlined in the blue circles in Figure 1. For example, information on climate-resilient crop varieties and livestock breeds should assess their resilience over time as the climate changes, target specific policy and decision opportunities to introduce the new varieties or breeds, and evaluate return on investment and impacts of alternative choices on growth, poverty, food security, and equity.

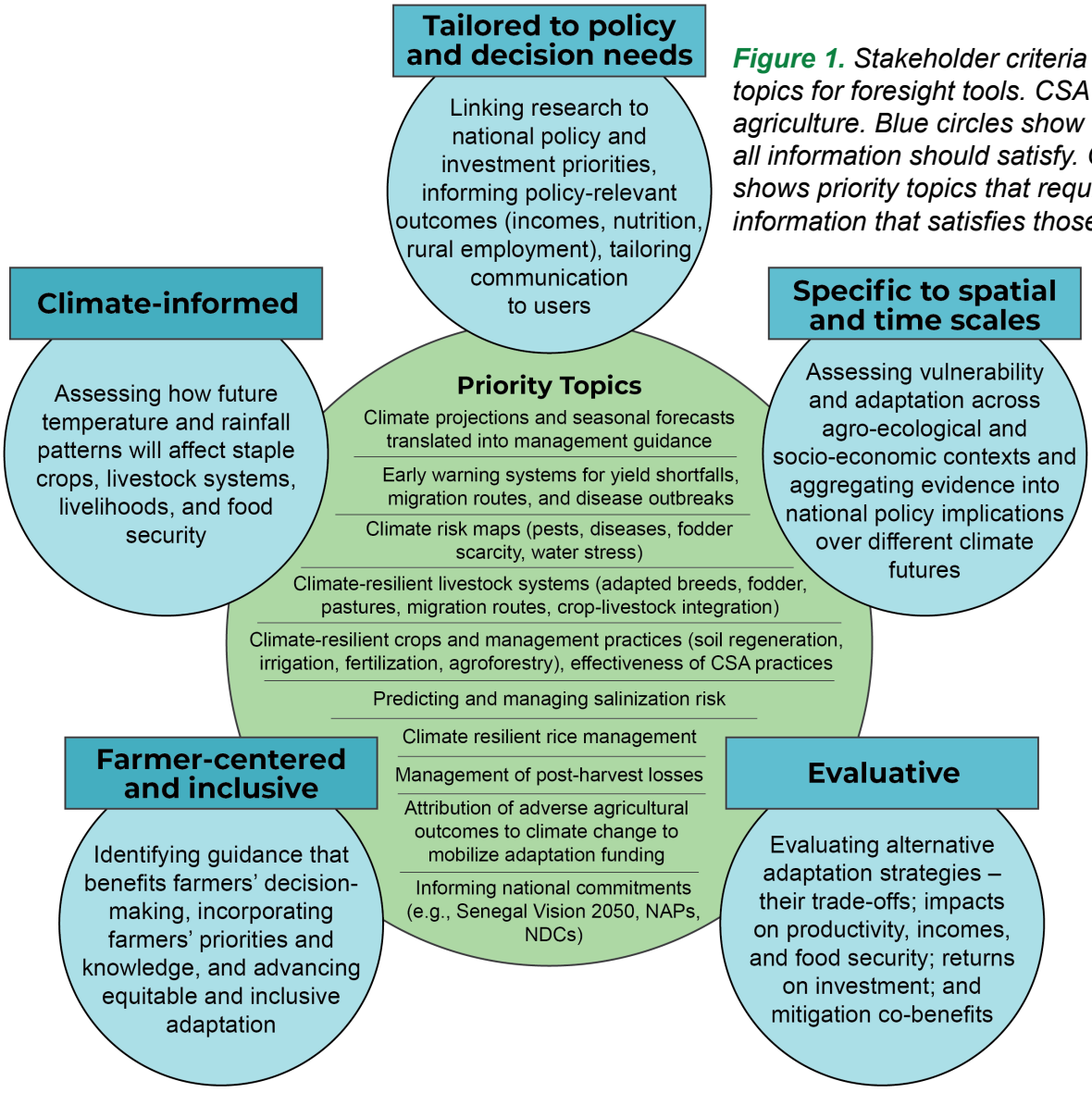

Figure 1. *Stakeholder criteria and priority topics for foresight tools. CSA = Climate-smart agriculture. Blue circles show the criteria that all information should satisfy. Green circle shows priority topics that require improved information that satisfies those criteria.*

INaRA: Integrated National to Regional Assessment Framework

AgMIP's Integrated National to Regional Assessment (INaRA) framework is well-suited to co-creating with stakeholders' information relevant to the topics prioritized by the stakeholders and satisfying the outlined information criteria, such as being climate-informed, tailored to policy and decision needs, specific to spatial and time scales, evaluative, etc. The INaRA framework links national and sub-national analyses in a coordinated, protocol-based process. The process begins with an assessment of current conditions, country visions, and policy commitments (NAPs, NDCs, national plans), and the co-development of national Representative Agricultural Pathways (RAPs) that define plausible futures and policy options (see top green box in Figure 2). A national economic model, such as RIAPA, then translates the national RAPs into economy-wide drivers and outcome indicators, including projected commodity prices, household incomes, investment priorities, and interactions across sectors, such as agriculture, trade, energy, and manufacturing, that matter for agri-food systems and rural livelihoods (orange box).

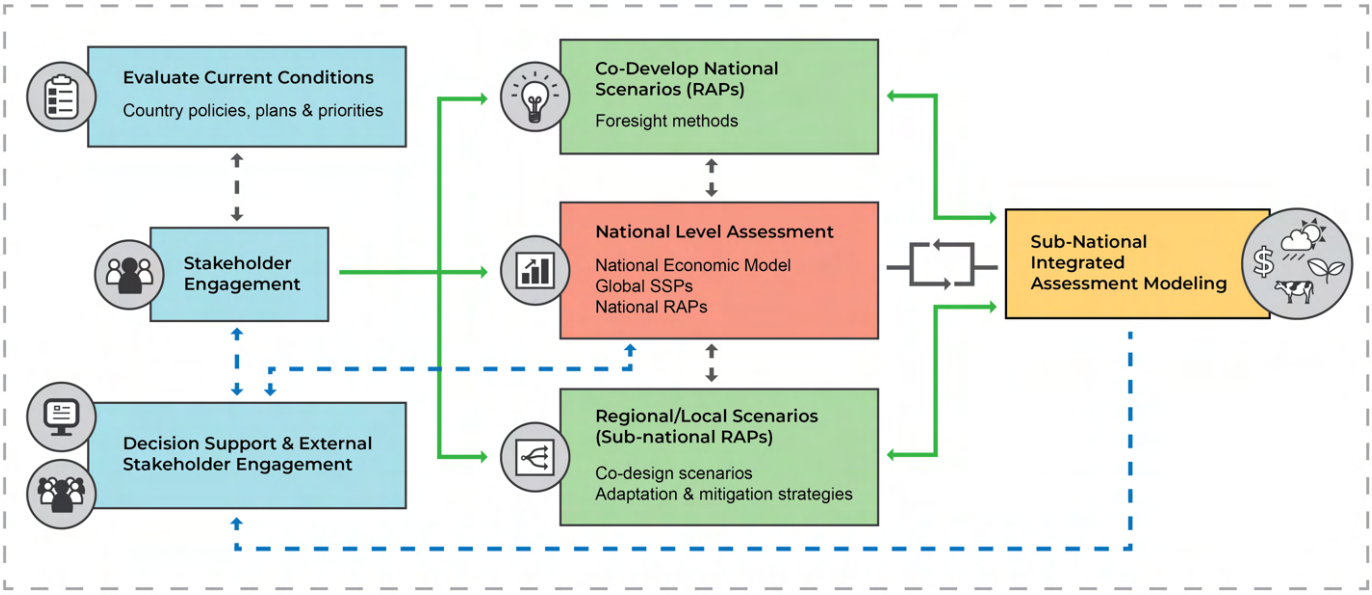

Figure 2. *AgMIP INaRA Framework. SSPs = Shared Socioeconomic Pathways.*

National outputs inform regional teams as they co-develop with stakeholders sub-national RAPs and adaptation packages for priority production systems, crops, and livestock (bottom green box). Climate, crop, livestock, and economic simulations assess how farmers may be affected by climate change, adaptation options, or policy interventions under alternative socio-economic and climate scenarios. The Multi-Dimensional Trade-off Analysis (TOA-MD) model then quantifies impacts on farmers' vulnerability and livelihoods, while also evaluating trade-offs among socio-economic, environmental, and biophysical outcomes (yellow box).

Integration with RIAPA ensures that farm-level productivity shocks can be traced through to macroeconomic outcomes most relevant for policy, such as GDP, household incomes, employment, and poverty. This two-way exchange of scenarios, data, and results creates a cross-scale evidence loop: regional findings update national projections, and national signals refine regional scenarios.

Aligned with the stakeholder insights described above, the INaRA approach is demand-driven, with research questions defined by stakeholders and aligned with national development objectives. National modeling captures economy-wide linkages within and across the agri-food system, while regional assessments deliver the local, actionable evidence needed to target value-chain investments and policy measures. Stakeholders in Senegal identified this cross-scale capability as a major strength. The INaRA framework provides a foresight platform that helps decision makers anticipate and address risks and trade-offs.

CASE STUDY: Connecting National Priorities and Local Adaptation to Strengthen Senegal's Agri-Food Systems

RIAPA: National Value-Chain Prioritization

Senegal needs to invest wisely in agricultural growth in order to transform its food systems, reduce poverty, create jobs, and improve diets. Using IFPRI's RIAPA model, a recent study examined how accelerated growth in different value chains – driven by agricultural investments – could affect these goals (Pauw et al., 2023). Results show that no single value chain delivers all desired outcomes, but a balanced portfolio yields the greatest overall benefits.

The most promising investment areas or value chains include fish, horticulture, cereals, cotton and groundnuts, as shown in Figure 3. Fish and rice are particularly effective at generating income growth and creating jobs in the downstream agrifood system. In contrast, horticultural value chains are more effective at reducing poverty and improving diet quality. Groundnuts have a more balanced effect on all four outcome areas. These findings highlight the importance of supporting a broad mix of value chains while recognizing the special promise of pulses to reduce income risks from climate change.

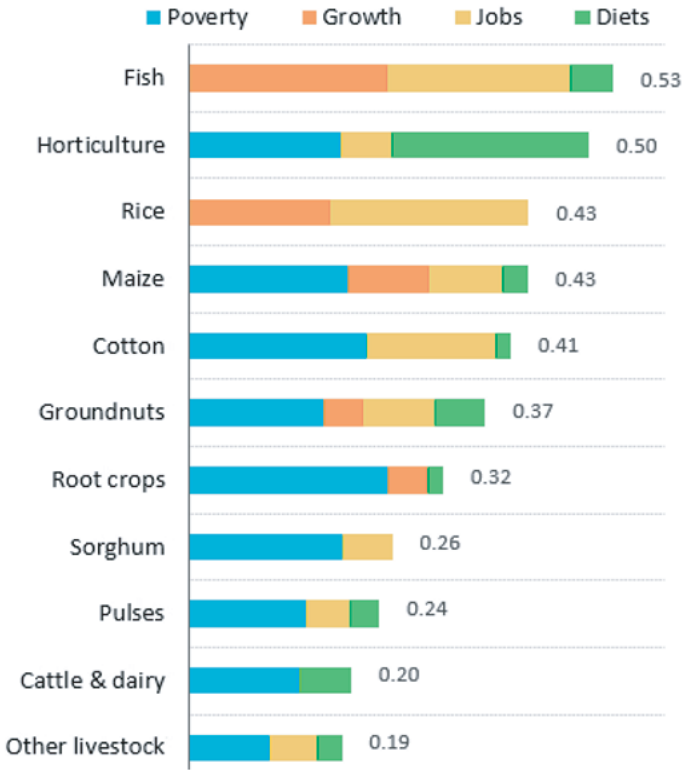

Figure 3. *Index ranking value chains (VCs) based on effectiveness at reducing poverty, growing agrifood systems, creating jobs, and improving diet quality. Source: RIAPA model results adapted from Pauw et al. 2023.*

Regional Integrated Assessment of Vulnerability and Adaptation to Climate Change in Nioro, Senegal

The AgMIP Regional Integrated Assessment (RIA) focused on the Nioro production system, where many of these nationally important commodities are central to farmers' livelihoods (MacCarthy et al., 2021). Maize and groundnuts were identified as being particularly vulnerable to climate risks. Combining climate, crop, and economic analyses with farmer and stakeholder input, the RIA tested adaptation packages to manage these risks (Figure 4). Practices such as improved fertilizer use, optimized plant density, and longer-cycle seed varieties were found to significantly boost cereal yields, raise farm incomes, and reduce food insecurity – cutting the share of households unable to afford a nutritionally adequate food basket by up to 30-57% among farmers with livestock and 16-38% among those without (Hathie et al., 2021; Valdivia et al., 2021). These results demonstrate that strategic investment in improved crop genetics, management practices, and livestock systems can offset climate damages, improve farmers' livelihoods, and support Senegal's food security and climate resilience.

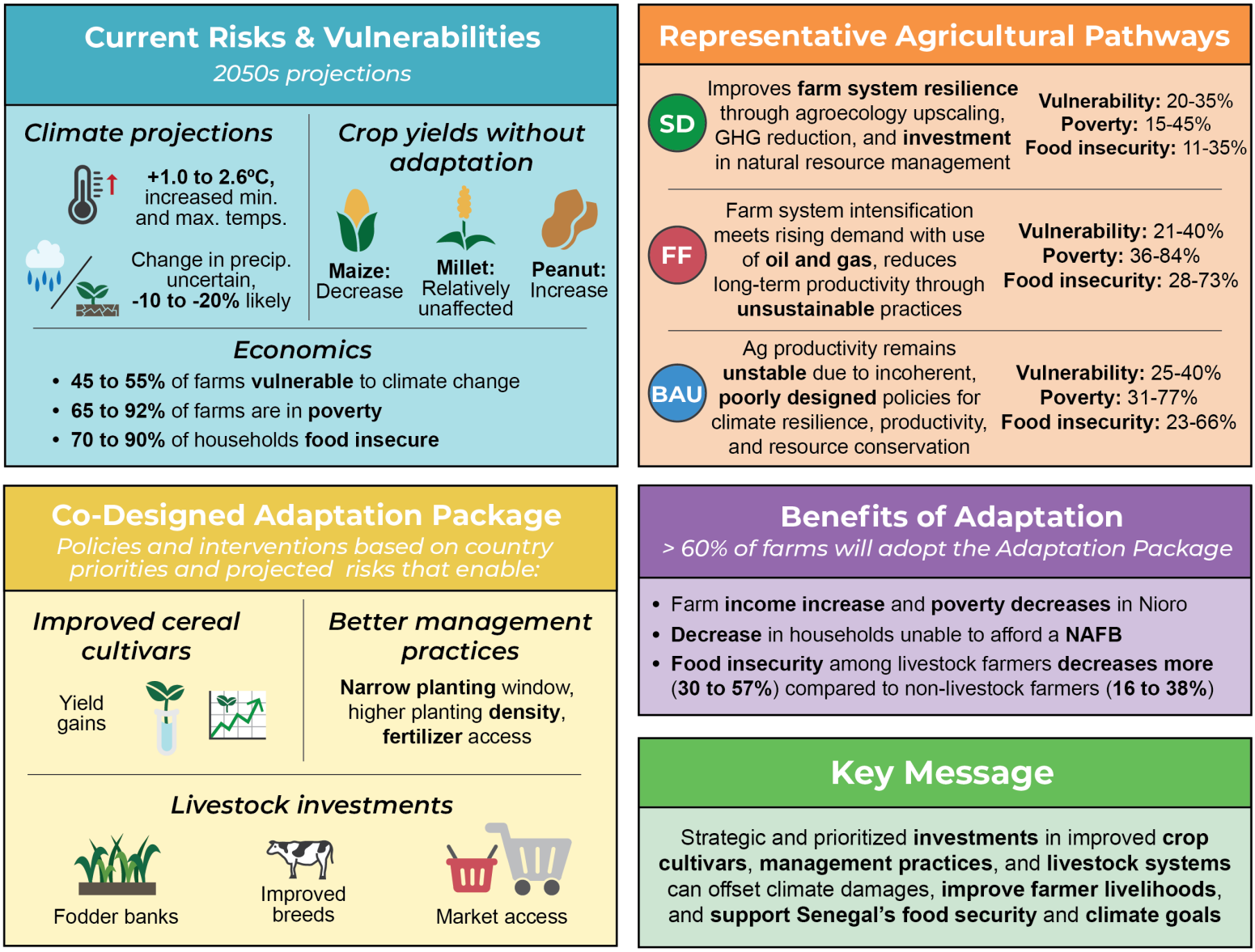

Figure 4. *Climate Change, Development Pathways, and Adaptation in Senegal: AgMIP Regional Integrated Assessment. NAFB = Nutritionally Adequate Food Basket.*

INTEGRATING RIAPA INTO INaRA

Although conducted independently, these two studies point to the benefits of linking national and sub-national analyses. RIAPA identifies which value chains offer the highest national returns, while the AgMIP RIA shows how local adaptation strategies can strengthen those same value chains under climate change. Integrating RIAPA into the INaRA framework would allow national priorities to guide scenario development and adaptation planning at the regional level, while sub-national results could feed back to refine national projections. RIAPA is a general equilibrium model that covers all sectors of the economy, it captures the broader economic linkages that influence agriculture, helping policymakers understand how investments in other sectors affect farming. This combined approach would also help tailor strategies to Senegal's diverse production systems and agro-ecological regions, ensuring that adaptation and investment decisions support both local realities and national development goals.

FUTURE DIRECTIONS

The following investment areas emerged from discussions between researchers and stakeholders during the workshop and the interviews as critical to improving the linkages between science, policy, and practice in order to accelerate progress toward climate-resilient agriculture in Senegal:

Strengthen science-policy linkages. *National policy processes in Senegal remain weakly connected to research. Strengthening the link between scientific evidence and decision making is essential to address climate risks, support agricultural transformation, and achieve national and global development goals.*

Data. *Investment is needed to improve access to reliable, well-documented data, with high spatial and temporal resolution. Data should be housed on a coordinated platform in standard formats.*

Capacity and coordination. *Stakeholders and researchers need improved capacity to co-create decision-relevant foresight tools and apply them in policy development and decision making, particularly at the sub-national level. Stronger coordination and collaboration between stakeholders and with researchers are also critical.*

Ongoing dialogue. *Stakeholders overwhelmingly called for continued dialogue and collaboration with researchers.*

Funding. *Funding should focus on priority policy and decision problems defined by stakeholders.*

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