RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security

CGIAR CCAFS

Info Note

Assessing climate change adaptation needs in the agricultural sector

Experiences from the CGIAR Research Program on Climate Change, Agriculture and Food Security

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Key messages

- In the **agricultural sector there is an especially urgent need to develop and disseminate adaptation prioritization tools** given the prominence of the sector in INDCs to the Paris Climate Agreement.
- Adaptation practitioners in the sector are increasingly **considering a more holistic view of adaptation** planning that, from early in the prioritization process, takes in to account food security considerations and mitigation co-benefits.
- There are several **growing sources of data on agricultural adaptation**, including: Climate-Smart Agriculture (CSA) Country Profiles, CSA Compendium, and evidence from Climate-Smart Villages.
- The CSA Prioritization Framework (CSA-PF) was **designed to help countries prioritize adaptation interventions in the agricultural and water sectors**, drawing on known practices to develop adaptation portfolios that can be scaled out.
- **Cost-benefit analysis (CBA) alone should not serve as a proxy for prioritization**. It is critical that CBA analyses are complemented by qualitative assessments of barriers to adoption and an assessment of environmental and social impacts of adaptation strategies.
- **Prioritization frameworks are only as good as the data entered into them**. National research institutions must plan long-term experiments or data collection schemes to measure the impacts of adaptation interventions on farming systems and to provide future inputs into adaptation prioritization.

1. Defining adaptation needs

As noted in the IPCC's 5th Assessment report, climate change adaptation needs are "the gap between what might happen as the climate changes and what we would desire to happen." Adaptation needs can be derived from a variety of factors including the nature of the climate impacts experienced and projected; an assessment of the geographical areas and users that adaptation interventions should be prioritized for; the criteria/indicators used to evaluate and prioritize options; and the timeframe for adaptation, among other considerations.

While adaptation needs can refer to the underlying socio-economic conditions or hazards affecting a system, for the purpose of this brief **"needs" refer to practices, services, policies or a range of best-bet adaptation interventions** that can be scaled out and used to attract investment and funding and that are determined through prioritization methodologies.

Figure 1. National Adaptation Planning Meeting for Kenya's Agriculture Sector. Photoo: S. Kilungu (CCAFS).

Decisions regarding the most appropriate adaptation strategies in a given country will necessarily result in tradeoffs across levels of operation, beneficiaries, and even sectors. Securing sufficient funding to assess options and act on priorities is a challenge for low and middle income countries developing countries, as well as assembling the necessary information regarding the likely economic, social and environmental impacts of competing adaptation strategies. The synergies or tradeoffs that can occur in a portfolio of adaptation options comprising a comprehensive policy is also difficult to assess.

Box 1. Select resources for adaptation needs assessment and planning

CSA Country Profiles: Country briefs that include relevant agriculture sector context, analysis of potential climate-smart practices, institutional and policy background, and overview of CSA finance opportunities to help decision makers identify adaptation opportunities and prioritize actions of high interest. Briefs are currently available for countries in Latin America (Argentina, Colombia, Costa Rica, El Salvador, Grenada, Mexico, Nicaragua, Peru, Uruguay), Africa (Kenya, Rwanda, Senegal), Asia (Sri Lanka) and Europe (Moldova). Additional profiles are being completed for Ethiopia, Ghana, Mali, Niger, and Uganda. Link: https://ccafs.cgiar.org/publications/csa-country-profiles

CSA Compendium: A searchable web-based database of published scientific literature to date on the outcomes of CSA practices globally. Thousands of promising practices identified as potentially climate-smart are organized into five general themes: agronomy, agroforestry, livestock and aquaculture, postharvest management, and energy systems and can be searched by region. Link: https://cgspace.cgiar.org/rest/bitstreams/67313/retrieve

Climate-Smart Villages (CSV): Real-life laboratories, founded on the principles of participatory action research, that aim to generate greater context-specific evidence on the effectiveness of CSA practices, technologies, services and institutional arrangements. CSVs facilitate the co-development of scaling mechanisms towards landscapes, subnational, and national levels for CSA practices. CSVs have been established to identify practical steps that smallholder farmers and other stakeholders from local to sub-national level can take to adapt their agricultural practices to secure dependable food supplies and livelihoods, generating CSA-related outcomes. Since their inception, 36 pilot CSV sites have been established in 20 countries, and efforts are underway to scale up to 2,000 sites. Link: https://ccafs.cgiar.org/publications/climate-smart-villages-ar4d-approach-scale-climate-smart-agriculture

1.1 Adaptation needs in the agricultural sector

In the agricultural sector, there is an especially urgent need for support to assess adaptation needs and devise suitable adaptation strategies. Over 90% of Intended Nationally Determined Contributions (INDCs) to the UNFCCC's Paris Agreement that include adaptation selected agriculture as a priority sector for action (Richards et al. 2016), and suitable methodologies and tools can help translate these priorities into actions.

Fortunately, years of agriculture research for development has produced useful resources for adaptation needs assessment and planning in the sector (Box 1). Increasingly, adaptation practitioners are considering a more holistic view of adaptation that—from early in the prioritization process— takes into account food security considerations and mitigation co-benefits that can be realized as a result of adaptation actions. This is true of Climate-Smart Agriculture (CSA), or agricultural actions that aim to sustainably increase productivity, incomes and food security, adapt and build resilience to climate change, and reduce greenhouse gas emissions when possible, in a context specific manner.

2. Methodologies for assessing adaptation needs

Just as there is complexity in defining adaptation needs, there are several types of tools and methodologies to support countries to assess and prioritize adaptation needs. These range from comprehensive step-by-step frameworks to more specific tools designed to support isolated stages of the adaptation decision making process. Prioritization frameworks also differ in their level of application, some designed for national governments developing comprehensive plans and others for community level rapid-appraisal of adaptation interventions, and their degree of multi-stakeholder/community participation.

Here, we provide a detailed overview of the Climate-Smart Agriculture Prioritization Framework (CSA-PF), a flexible analytical framework, applicable across levels, for prioritization of adaptation/CSA options, as well as other prioritization tools developed under the CGIAR Climate Change, Agriculture, and Food Security (CCAFS) research program that are narrower in scope or level of application. We then provide examples of the application of these tools across CCAFS regions in Latin America, East and West Africa, and South and Southeast Asia.

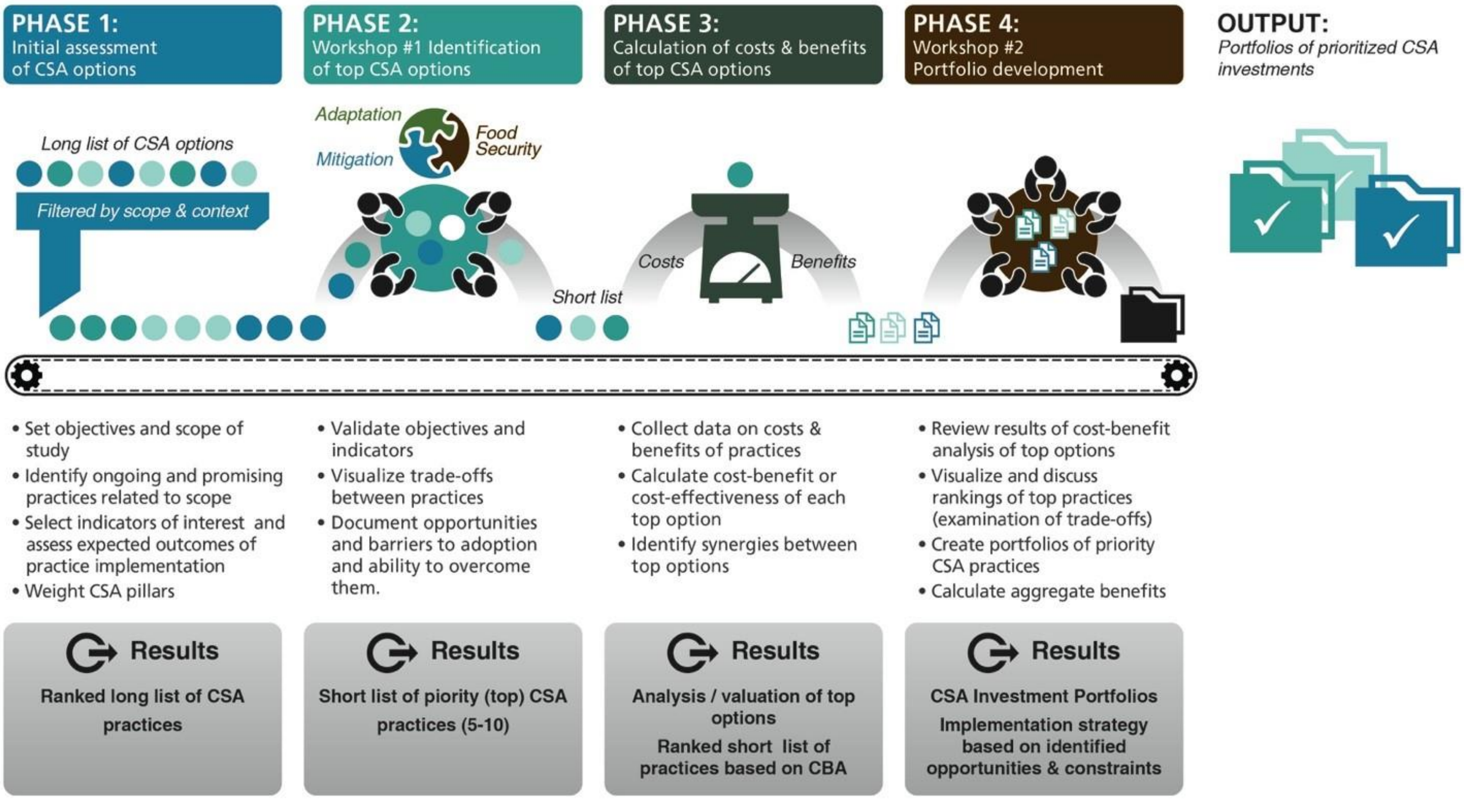

Figure 2. CCAFS-CIAT Climate-Smart Agriculture Prioritization Framework

2.1 CSA Prioritization Framework

The CSA-PF, developed by CCAFS and the International Center for Tropical Agriculture (CIAT), was designed to assist decision makers in identifying priority best-bet CSA investment portfolios that achieve gains in food security, farmers' resilience to climate change, and low-emissions development of the agriculture sector. The framework stakeholder driven and is divided into four phases: (i) Scoping and initial assessment of CSA options; (ii) Identification of top CSA options (workshop); (iii) Calculation of cost and benefits of top CSA options; and (iv) portfolio development and evaluation of barriers (workshop). While the framework was developed for the agricultural sector, it has potential utility to related sectors, especially water and land use.

Phase 1. Initial assessment of CSA options

The objective of the first phase of the CSA-PF is to identify key stakeholders and define the scope of the study (e.g. determining the production systems, agro-ecological zones, nature of climate change to be addressed, vulnerable areas, types of farmers targeted, transformative actions needed). Drawing on resources like the CSA Country Profiles, CSA Compendium, Climate-Smart Villages work, local expertise and knowledge and other data sources, a preliminary extensive list of relevant CSA practices (adaptation strategies) is created. Indicators for assessing the practices are then selected by stakeholders based on the outcomes they desire from interventions and practices are assessed and ranked according to these various metrics.

(For a list of indicator tools see: https://csa.guide/csa/monitoring-evaluation-and-learning or https://cgspace.cgiar.org/rest/bitstreams/83141/retrieve)

Phase 2. Identification of top CSA options

The second phase of the CSA-PF seeks to narrow the initial long list of CSA options. This is done by engaging a broad group of agriculture development stakeholders in a workshop where participants analyze and discuss the indicator analyses of the long list of practices. The relative weighting given to each of the three pillars of CSA (adaptation, mitigation and productivity) can be shifted to modify rankings of practices for discussion among participants regarding prioritization criteria. This group will analyze the expected impacts that different land use practices/development trajectories will have on the CSA goals, as well as the scalability, feasibility and potential beneficiaries of each practice. At the end, a short list of high-interest practices (usually 10 or less) are selected for further analysis.

Phase 3. Calculation of cost and benefits of top CSA options

During the third phase of the CSA-PF the costs and benefits, and potential externalities, of each CSA option on the short list is assessed. There are numerous methods that can be used to conduct cost-benefits analysis (CBA), which need to tailored to the funders and implementers aims regarding use of the results from the prioritization process (Box 2).

Box 2. Approaches to Cost-Benefit Analysis of adaptation strategies

While there are excel and web-based tools designed by CCAFS for cost-benefit analysis (CBA) associated with the CSA-PF, there are many ways to undertake CBA. In fact, over the last decade cost analyses of adaptation have been widespread in climate change literature. Adaptation costing efforts vary widely in their scope and level of application. Generally speaking, we can differentiate between the following CBA support tools: (1) **global analyses** of investment and financial flows and integrated assessments models that seek to determine the global cost of adaptation and the impacts on the global economy of action/inaction; and (2) **national level analyses** that include the costing exercises associated with National Adaptation Programmes of Action (NAPA) and National Adaptation Plans (NAP) and the use of more sophisticated tools like computable general equilibrium analyses (also applicable at global levels), among others. For a summary of global and national CBA/costing approaches see: https://ciat.cgiar.org/wp-content/uploads/2013/01/policy_brief5_climate_change.pdf

More recently, site-specific methodologies for cost-benefit analysis have been developed. In the agricultural sector, this means undertaking CBA at the farm and community level. This bottom-up approach allows for more detailed, high-resolution assessments of cost-effectiveness and of scaling these interventions up and out. Here are three such examples:

a) In Guatemala, CCAFS researchers applied ‘probabilistic cost-benefit analysis’, or CBA that does not rely solely on a single average of return but rather a range of potential values. This approach more appropriately takes in to consideration the diverse interests present in a community and can help to assuage the value-laden assumptions common to most CBA analyses. Probabilistic CBA adopts an internal rate of return (IRR) approach that does not require specific definition of capital costs, only of returns on investment in the form net present value (i.e. a representation of the benefits over the lifetime of the intervention). An intervention is considered profitable when the IRR is higher than the discount rate used to determine net present value. Link: http://www.sciencedirect.com/science/article/pii/S0308521X16301160

b) In India, CCAFS applied a “willingness-to-pay approach” with farmers in state of Rajasthan across diverse rainfall zones. “Farmers' were organized into a group of 5-6 for discussion on [21] CSA technologies and then asked to score each technology from 0 to 3 scale (0 = no preferences, 1 = low preference, 2 = medium preference, and 3 = high preference)”. In a second phase, “for only those technologies that were highly preferred by the farmers in the scoring exercise, the study team conducted a bidding exercise using pseudo money”. Bidding exercises/scenarios in this way can effectively measure financial burden and identify reluctance to invest in the technologies. Link: http://www.sciencedirect.com/science/article/pii/S0308521X1630645X

c) Further highlighting the value of farm-level CBA analyses, in Kenya, CCAFS researchers applied an approach known as Participatory Social Return on Investment (PSROI). Social Return on Investment (SROI) is a CBA strategy designed to go beyond economic returns alone to measure the social and environmental impacts of an intervention. Application of ‘participatory’ SROI (i.e. SROI built in to a wider participatory process of adaptation prioritization) with farmers in Western Kenya determined that there was an approximate 70% reduction in the community valuation of intercropping when compared with expert –led desk-based valuations. This difference was attributed to a lack of knowledge about the intervention, misconception about the potential costs and benefits, and the risk-averse nature of the farmers. Link: http://link.springer.com/article/10.1007/s11027-014-9600-5; or https://ccafs.cgiar.org/publications/participatory-social-return-investment-psroi#.WEQ_3GWrw80

Phase 4. Portfolio development and evaluation of barriers

The final phase of the CSA- PF brings stakeholders together again in a workshop/forum to review the analyses resulting from previous phases. This is done using a visualization tool demonstrating the tradeoffs and synergies of individual practices and packages of practices. The perceived constraints and barriers to adoption from the perspective of different stakeholder groups is also explored. Portfolios of practices are developed by stakeholders and can be accompanied by action plans. This phase recognizes that prioritization of CSA interventions extends beyond indicator assessments of expected outcomes and CBAs alone. The portfolios of options and suggested best practices with the greatest prospects of achieving desired outcomes as defined by stakeholders, such as maximized synergies, minimized negative externalities, or potential for uptake at scale, are selected by stakeholders for national, regional and/or local implementation.

2.2 CSA-PF Case Studies

Guatemala: In Guatemala, the CSA-PF was implemented in collaboration with the Ministry of Agriculture, Livestock, and Food (MAGA). In phase one, 24 potential CSA strategies were identified associated with maize and bean systems (most prominent cropping system) in five sub-national regions. Following a phase two workshop with 42 stakeholders from the region, CBAs were conducted on eight practices across three categories: agroforestry, agronomy and water resource management. Probabilistic CBA was used, with data collected through a survey of 200 farms and secondary literature. Social and environmental externalities were also considered and analyzed, including impacts of biodiversity, carbon sequestration and labor/employment. All CSA strategies, with the exception of one, were profitable over the lifetime of the interventions and contributed to improved biodiversity. The results of this analysis were explored with stakeholders in the phase 4 workshop and three portfolios of were developed by different types of actors (producers, government, research) demonstrating various criteria for addressing various tradeoffs between the CSA goals (productivity, adaptation, mitigation) and other priority outcomes for different sectoral actors. This example demonstrates how CSA-PF can be adopted by governments and integrated in to existing planning processes. Link: http://www.sciencedirect.com/science/article/pii/S0308521X16301160

Mali: In Mali, the CSA-PF was implemented by a non-governmental organization, the Malian Association of Awareness to Sustainable Development (AMEDD), with the support of the Agency of Environment and Sustainable Development (AEDD), in direct collaboration with government actors and donors from the beginning. In the phase one assessment, analysts identified 24 CSA strategies applicable across three regions of the country and assessed them based on 11 CSA indicators selected by stakeholders. In the second phase workshop, 9-10 practices were selected for each of the three regions, such as the fixation of dunes in the Sahelian region, sorghum-cowpea association for the Sudano-sahelian region, and contour fields for the southern region were identified. Eight interventions associated with the Sudanian zone were selected for CBA analysis over a five-year life cycle, focusing on impacts on the main crops found in the diversified farming systems (maize, millet, sorghum). Like in Guatemala, social and environmental externalities were considered, in this case carbon sequestration, gender, and social conflicts related to land access. In phase 4, two portfolios of priority CSA activities were developed, the first focusing on farm-level activities (e.g. sorghum and cowpea integration) and the second on a landscape level initiatives (e.g. development of rice cultivation valleys). Portfolios have been presented to the Malian parliament and integrated into ongoing programming. This example demonstrates the cross-level utility of the CSA-PF and potential integration with existing development initiatives through fostering stakeholder ownership. Link: https://cgspace.cgiar.org/rest/bitstreams/71151/retrieve

Vietnam: In Vietnam, the CSA-PF served as the model for an alternative framework for the rapid appraisal of climate-smart practices. In its application, a baseline assessment of adaptation needs and potential options was conducted in 2014 in My Loi village. The 13 original practices were reduced to 10 based on their “climate-smartness” through phase 1 assessment through consultations with male and female villagers, local leaders and experts, field visits, and cost-benefit analysis using a net-present value approach. The top ten interventions were presented to the broader community in “CSA Fair” where 200 community members participated. Intervention posters were posted on the walls of an event hall and community members, following technical presentations on each practice, voted for the interventions they thought were most applicable to them. This included home gardening, intercropping, agroforestry, and livestock (pig) raising. Both, “CBA and the prioritization”, the authors note, “clearly show that women and men both want trees, but women preferred fruit trees and home garden development while men were more interested in forestry development”. This example demonstrates how the CSA-PF framework can be modified to suit local conditions, providing not prescriptive steps, but a broad guiding framework. Link: https://cgspace.cgiar.org/rest/bitstreams/78307/retrieve

2.3 Other Prioritization frameworks/tools for adaptation needs assessment

The CSA-PF is the result of learning from best practices in the area of adaptation prioritization, yet it is not the only CCAFS framework available to low and middle income countries. Other toolkits rely more heavily on agricultural modeling, or highlight specific aspects of adaption planning, like gender, and tend to be focused centrally on communities. Here, a range of alternative tools are provided:

CSA Prioritization (CSAP) toolkit: This approach to adaptation prioritization requires a detailed location-specific database on soil, crop varieties, cropping area, agronomic practices, irrigation and historical weather information along with socio-economic data. Future crop yields, water-use and emissions are then forecasted under different climate-scenarios using crop-modeling techniques. The approach identifies priorities for investment in: (i) crops best suited to delivering target growth under impacts of climate change on yields; (ii) technologies to deliver targeted increases in productivity, based on potential yield increases and the efficient use of resources; and (iii) locations for priority investment given an existing surplus of productive capacity. Link: https://cgspace.cgiar.org/rest/bitstreams/38402/retrieve

CSA Rapid Appraisal (CSA-RA) tool: “The Climate-Smart Agriculture Rapid Appraisal (CSARA) provides an assessment of key barriers to and opportunities for CSA adoption across landscapes by collecting gender-disaggregated data, perceptions of climate variability, and resource and labor allocation, as well as economic assessments at the household level. This approach combines participatory workshops, expert interviews, household/farmer interviews, and farm transect walks to gather and capture the realities and challenges facing diverse farming communities”. CSA-RA was piloted in Tanzania and Northern Uganda. Link: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/28703

“TargetCSA” Framework: TargetCSA is a national-level CSA prioritization tool that integrates stakeholder/expert opinion and quantitative data on vulnerability and CSA options to produce a portfolio of spatially-explicit CSA options. The method uses a workshop to identify vulnerability indicators and CSA practices and a survey to conduct a pair-wise comparison of those options (i.e. assigning numerical weights) that are then analyzed in a computerized optimization model to produce a ‘majority consensus’ that most closely reflects stakeholder preferences, or other scenarios. These preferences are then coupled with spatial data (.e.g. annual precipitation, literacy, soil organic matter etc.) to produce mapped indices demonstrating the highest areas of CSA potential. This approach is documented in Kenya’s agricultural sector. Link: http://www.sciencedirect.com/science/article/pii/S0308521X1530069X

“Generic” Framework: Notenbaert et al. (2017) offer a generic framework for CSA prioritization applicable for diverse operational levels and users. It follows four steps (1) Diagnosis and identification of potential options, (2) characterization of options, (3) identification of the recommendation domains (i.e. spatial mapping) and out-scaling potential of the options, and (4) ex-ante impact assessment of the alternative options. The framework is intended to be iterative and non-linear, and employ varying degrees of qualitative and quantitative data including expert opinion and spatially explicit data. The approach was documented in Tanzania’s livestock sector. Link: http://www.sciencedirect.com/science/article/pii/S0308521X16301962

Minimum Data Approach: Shikuku et al. (2017) combine a livestock model with a Trade-Off Analysis Model for Multi-Dimensional Impact Assessment (TOA-MD) to identify the potential rates of adoption for CSA strategy variations. In the case of rural Tanzania, farmers were divided in to strata, or groups, pertaining to local or improved cow ownership. Adoption of improved breeds and improved feeding strategies were determined by the TOA-MD model, producing economic, environmental and social impact indicators for adopters and non-adopters. Based on adoption rates, income, food security poverty and GHG emissions were then calculated. This ‘minimum data approach’ utilizes survey data, expert consultations, and secondary data as inputs in to the livestock and economic models. Link: http://www.sciencedirect.com/science/article/pii/S0308521X16302189

3. Challenges and Opportunities in adaptation prioritization

When derived at through participatory processes and considered holistically alongside food security, productivity and mitigation co-benefits, countries can build robust portfolios of agriculture adaptation actions that are simultaneously relevant to those most vulnerable and attractive to donors.

The frameworks presented in this brief offer prioritization approaches that have been tested across continents and in a variety of unique field-level settings. They are not intended to be prescriptive, but rather to provide general guidelines for important considerations in the adaptation prioritization process. Implementation of these prioritization frameworks to-date has surfaced several important challenges and considerations:

First, a common challenge across all prioritization framework pilots is **presenting CSA options with sufficient resolution to be instructional but with ample flexibility to accommodate local realties**— CSA options are not, after all, ‘climate-smart’ in every setting. Therefore, for phase 3 ‘cost benefit analysis’ to be contextually appropriate, phase 2 ‘Identification of top CSA options’ must also allow for modification of promising strategies with respect to local opportunities and barriers to implementation. The continued use of these prioritization tools will ensure that the Convention’s technology mechanism prioritizes the most appropriate technologies for specific contexts.

Second, regarding the identification of indicators for measuring adaptation outcomes, **in some cases, indicators are too costly and time-consuming for rapid field assessments.** Key findings from CCAFS Programming and Indicator Tool indicate that mitigation co-benefits are seldom measured at field level. The most common indicators tend to be related to productivity—especially yields and farm income. Furthermore, there are very few indicators to address specific adaptation measures such as seed varieties or crop insurance. Also lacking are financial indicators on adoption of CSA technologies and practices, and indicators lacked the ability to show a change over time, or to measure specific changes in low/lean season.

Third, cost benefit analysis alone should not serve as a proxy for prioritization. It is critical that CBA analyses are complemented by qualitative assessments of barriers to adaptation adoption and an assessment of environmental and social impacts. For example, as demonstrated by CCAFS evidence in India, CBA can overestimate farmers' willingness to pay for costly up-front adaptation investments. Meanwhile, in Kenya, it was demonstrated that CBA desk studies may overestimate adaptation benefits compared to community level assessments. In all cases, practitioners should aim for the utmost transparency regarding the assumptions made in CBA calculations.

Ultimately, as demonstrated in Vietnam, CBA analyses are challenged by the fact that practices may be new to farmers or the particular geography and the costs and benefits are not known; and, second, that many CSA options involve integrated farming systems at the landscape scale where indirect competition and complementary effects may be misjudged. Analysis of trade-offs at the national level can aid decisions on best bets for agricultural investment under climate change. For example, de Pinto et al (2016) provided an analysis of trade-offs between profitability and emissions reductions for oil palm expansion, forest conservation and pasture management that informed the Intended Nationally Determined Contribution (INDC) submitted by Colombia. Link: http://www.sciencedirect.com/science/article/pii/S0305750X16304041

Finally, prioritization frameworks are only as good as the data available to them. National research institutions must plan long-term experiments or data collection schemes to measure the impacts, economic, social and environmental impacts of CSA/adaptation practices on farming systems and to provide future inputs in to adaptation prioritization, as these tools evolve and improve in sophistication. Robust monitoring and evaluation must also be put in place following the application of prioritization frameworks to capture data on implementation that can also inform future work.

For each of these prioritization challenges to be remedied, funding, capacity and technological gaps need to be addressed. **It is important that any local prioritization process gives consideration to the broader policy and economic landscape framing the local context**. Demand-driven policies that are mainstreamed in to existing development planning processes are important. The Framework Convention's finance mechanism must include support for robust adaptation needs assessments to properly mainstream these efforts.

Further Reading

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