Info Note

Future research needs on climate change and food and nutrition security

Summary of findings of the CCAFS Working Paper: A synthesis of the work of CCAFS and partners on climate change and food and nutrition security

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Key messages

- Much previous work on the linkages between climate change and food and nutrition security (FNS) use implicit frameworks that emphasize yields and production rather than more appropriate metrics such as household-level food access, utilization and stability.
- Key knowledge gaps include the impacts of climate change on FNS outcomes, pathways of impact, and the impacts of climate-related interventions such as climate-smart agriculture and safety net programs.
- Future research designs linking climate change and FNS should use 'food system' frameworks, use food access metrics, develop robust causality, assess impacts on different groups, and more directly address stability dimensions of FNS.
- Challenges to implementation of future work include funding for a broader interdisciplinary agenda and overcoming institutional constraints (short time horizons for results and lack of input from human nutritionists).

CCAFS and partners have undertaken numerous activities and produced a considerable number of outputs of various kinds with the overarching goal to "catalyse positive change towards climate-smart agriculture, food systems and landscapes, and thereby contribute to the SLOs [System-level outcomes] on poverty alleviation, food and nutritional security." A recent synthesis of the work of CCAFS and partners on food and nutrition security (FNS) discusses the contributions in detail. The synthesis was developed based on written materials and consultations with the CCAFS Program Management Unit, the CCAFS Flagships' staff and CCAFS Regional programs. This Info Note highlights the knowledge gaps identified through the synthesis and recommended future actions.

Limitations of previous work on climate change and FNS

In much previous literature (including studies by CCAFS and partners) there appears to be a commonly-held *implicit* framework that focuses on climate change impacts on crop yields and thus leads to the recommendation that the goal should be developing technologies or management practices that will offset crop yield decreases. Although yield-increasing technologies and practices are likely to be important, this perspective is overly simplistic and could be misleading. First, the perspective of many human nutritionists is that *food availability* (as only roughly proxied by yields) should not be conflated with overall food security, particularly given the need to focus on additional dimensions such as *food access* and *stability*, or the more nutrition-related concept of *utilization*. Nicholson et al (2021) noted that:

> *"… capturing own production on farms or production at regional scales is not sufficient for understanding households' and individuals' experience of food insecurity, which entails considerable access to markets, dependence on food prices, and interactions with diverse food environments."*

Second, this implicit framework generally does not distinguish between different types of farmers and how they might be affected differently—all climate change impacts seem to be assumed to be negative for all

farmers and consumers, although Duffy et al. (2017) note that "the identification of potential trade-offs between CSA portfolios and food security goals for different categories of farmers" will be important. This implicit framework also focuses primarily on the farm level, without consideration of the broader "food systems" approach discussed in Fanzo et al. (2017). There is a large literature in agricultural economics that suggests yield-enhancing technologies may not always benefit farmers when scaled up, so even under climate change this probably should not be assumed. Many studies do not refer to specific (measurable) nutrition-related outcomes, only very generalized concepts like "food and nutrition security". This makes the work more difficult to link to indicators and targets from the Sustainable Development Goals (SDGs), the CGIAR or programs such as CCAFS. Finally, there is a limited recognition of the importance of context-specific empirical evidence regarding climate-related interventions, such as climate-smart agriculture technologies and practices or climate-smart safety nets.

Key knowledge gaps

The work of CCAFS and partners acknowledged many knowledge gaps in written outputs or through comments provided during the synthesis process. Priorities for knowledge to improve FNS outcomes under climate change include understanding the impact of climate change on FNS and the impacts of climate-related interventions on FNS include:

- Improved quantitative understanding of the impacts of climate (e.g. rainfall, temperature, flood, drought, heat) on FNS outcomes, particularly at household level (rather than aggregated regional analyses). The work of Cooper et al. (2019) is an example using a statistical approach without direct consideration of impact pathways;
- Improved quantitative understanding of the pathways of the impacts of climate change on FNS at the household level, including impacts not directly related to yields, production or farms. The 'food systems' frameworks proposed by Fanzo et al (2017) and Ericksen et al (2018) highlight the need to consider climate change impacts post-farm, and Ringler (interview data) noted that this would also include the impacts of climate on water access and quality, heat stress, and migration. There is also a need to understand how populations will be affected differently (per Salm et al. 2020) and the role that empowerment of women might play in mitigating negative impacts on FNS outcomes;
- Improved quantitative understanding of how interventions, especially CSA, affect household-level FNS outcomes as well as the other three pillars of CSA. The work of Radeny et al. (2018) is a first step by CCAFS in this direction, but the results of that study and others, e.g, ul Haq et al. (2021) suggest that the impacts of CSA on FNS may be highly variable and should not be assumed to be positive (or large). Other CCAFS efforts such as Digital Climate Advisory Services (DCAS) should also be evaluated, per comments from the staff of the flagship on Climate Information Services and Climate-Informed Safety Nets.

Future work by CGIAR scientists could address all of these knowledge gaps, but a priority would be to assess the interventions (like CSA, CSV and DCAS) that have been developed and implemented under the aegis of CGIAR organizations and partners. The evidence base with regard to linkages between CSA and FNS is too limited at present to provide reliable guidance for decision support or priority settings. However, previously developed conceptual 'food system' frameworks, (Ericksen et al., 2018) and data collection methods (Cramer et al. 2017) provide a strong basis for the design and implementation of future work.

Priorities for future work on climate change and FNS

This follows directly from the knowledge gaps in the previous section. A useful first step would include an updated systematic review of the current state of knowledge about linkages between climate change and FNS, and impacts of interventions such as CSA—extending and updating the work of Constas (2017) reported in Ericksen (2018). These reviews could further highlight knowledge gaps and opportunities for which knowledge-generating activities could be implemented and identify potential additional collaborators for future work.

Specific knowledge-generating priorities include:

- Quantitative assessment of the impacts of climate and climate change on FNS particularly at the household level;
- Quantitative assessment of the impacts of climate-related interventions on FNS, particularly at the household level;
- Quantitative and conceptual assessment of the impact pathways linking climate change and FNS at the household level, with a particular emphasis on post-farm activities, gender roles and empowerment, impacts on water access and quality, heat stress impacts on labor productivity and migration.
- Quantitative assessment of how policy initiatives can improve FNS outcomes in light of climate change, as well as funding requirements for implementation of knowledge-generating activities, relevant development programs and policy change.

For each of these activities, a common set of design principles is likely to apply, including:

- Use of a conceptual framework such as those in Bryan et al. (2018) and Fanzo et al. (2017) that consider elements other than agricultural production and multiple impact pathways between agriculture and FNS outcomes. A 'food systems' or 'value chain' framework (Nicholson et al. 2021) will be appropriate for many knowledge-generating activities and, when appropriate, implemented as participatory processes (Nicholson and Monterrosa 2021);
- Use of appropriate and specific metrics for measurement of FNS outcomes (e.g. those in Figure 3 and discussed in Appendix 1 of the Working Paper). Specifically, potential correlates such as yields, production or incomes can be measured but should not be used alone to make inferences about FNS. It will often be desirable to assess a number of FNS indicators, not only one and to align levels of analysis with metrics: availability is often considered at the national level, food access at the household level and utilization at the individual level;
- Research designs that result in robust casual inference, preferably implemented across a number of contexts to identify commonalities and facilitate comparisons. Study designs often should allow explicit assessment of synergies and trade-offs, for example, between FNS outcomes and other pillars of CSA and evaluate the impacts of scaling up (i.e. widespread adoption);
- Outcomes should be assessed for different groups based on characteristics such as those in the PROGRESS+ framework used in Salm et al. (2020). In particular, there may be differences in impacts for farm households who are net buyers of food versus net sellers of food. Previous studies (e.g. Nicholson et al. 2021) have noted that many farm households are net buyers rather than net sellers of staple crops. Impacts that affect non-farming households, for example, through market impacts of scaling should also be considered. Often, this will require additional input from social scientists regarding behavioral responses;
- The aggregated effects of scaling interventions should be assessed *ex ante* to better anticipate any unintended consequences. A large body of agricultural economics literature suggests that scaled technology adoption can result in lower incomes for farmers, especially those not adopting new technologies. Simões et al. (2019) provide an example of this with a dynamic analysis of scaled adoption of improved dairy cattle feeding;
- More attention to intertemporal dynamics and stability impacts of climate change and climate-related interventions, with statistical analysis of panel data and dynamic simulation models of appropriate spatial and temporal granularity;
- Coordination of knowledge-generating activities so that they provide greater synergies and align more closely with the stated targets and indicators of the CGIAR overall and for specific programs such as CCAFS.

Challenges of future work

Implementing knowledge-generating designs with these principles could face challenges. First, the above suggests an expanded set of activities with broader scope and a larger number of studies to allow comparisons and synthesis. This would require additional funding for both researchers with relevant expertise and for project implementation at a time when future funding streams and allocation priorities are uncertain. In addition, a number of the CCAFS staff interviewed for the synthesis identified institutional constraints, including: a) need to generate short-term results for fear of losing certain funding streams, b) incentives or requirements to use datasets from certain sources (and a limited number of countries), c) funding that constrained consideration of both climate and FNS linkages because their focus was on one or the other, and d) limited access to the expertise of nutritionists for study design. It is unclear at present how the evolving design of the OneCGIAR organizational structure might ameliorate (or worsen) these institutional constraints but identifying constraints may provide useful to identify potential steps to limit their impact. One approach to develop insights to facilitate future work on FNS-climate change linkages would be an invitational workshop for relevant CCAFS staff and external researchers. Objectives for the workshop could include: a) reviewing the accomplishments and limitations of CCFAS activities related to FNS, b) discussing knowledge gaps for climate-FNS linkages, per the suggestion for a systematic review above, c) further delineating institutional constraints within the CGIAR, and d) identifying opportunities and modalities for future FNS-climate change research and engagement in the new OneCGIAR institutional environment.

Further Reading

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About CCAFS Info Notes

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) brings together some of the world's best researchers in agricultural science, development research, climate science and Earth system science, to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security. Visit us online at **https://ccafs.cgiar.org**.

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