Tackling Key Issues for Smallholder Farmers: The Farmer Research Network (FRN) Approach

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Abstract

The Collaborative Crop Research Program (CCRP) of the McKnight Foundation supports collaborative agroecological systems research and knowledge sharing that strengthen the capacities of smallholder farmers, research institutions, and development organizations. The program is experimenting with a Farmer Research Network (FRN) approach, which aims to transform the agriculture and food systems by fostering context-specific agroecological intensification (AEI); care for culture, production ecology, and equity; and improve yields, nutrition, and sustainability. In addition, the FRN approach aims to transform the way that much of agricultural research and development is done: It promotes research as part of development, farmer influence on what is being worked on, more equitable relations, and a move from blanket recommendations to support farmers' understanding of agroecological principles and better decision-making. The approach is based on three main FRN principles:

- Farmers who represent the social and biophysical diversity of their communities participate in the whole research process.
- Research is rigorous, democratized, and useful, providing practical benefits to farmers as well as scientific evidence and insights on biophysical and social variation.
- Networks foster collaboration and opportunities for learning and knowledge sharing.

In our general FRN model, there is an entity that facilitates the collaborative network of farmer organization(s), NGOs and development projects, researchers/research institutions, and the private sector whenever possible. In this network, local knowledge, infrastructure, and social capital are combined with global scientific knowledge and innovations, and both enrich each other.

This chapter gives concrete examples for FRNs from CCRP's West Africa community of practice. In these FRNs, high levels of farmer participation and relatively large scales of operations are being combined, which makes the approach distinct from conventional agricultural research and from classical participatory research approaches. With the FRN approach, CCRP is trying to foster a paradigm change: Research should consider smallholder farmers as valuable research partners and no longer as "beneficiaries" or "passive adopters" of so-called "best-bet" technologies developed by researchers. The FRN approach encourages researchers to stop thinking about making recommendations and rather start thinking about supporting farmers in making choices to tackle the key issues they face.

Keywords

Principles-based approach · Farmer participation at scale · Option-by-context interaction · Local knowledge · Global knowledge · West Africa

1 Introduction

This chapter summarizes approaches developed and experiences gained in the Collaborative Crop Research Program (CCRP, www.ccrp.org) funded by the McKnight Foundation in West Africa (report available at https://www.mcknight.org/news-ideas/resource/advancing-together/). CCRP's vision is to contribute to a world where all have access to nutritious food that is sustainably produced by local people. CCRP does this through collaborative agroecological systems research and knowledge sharing that strengthen the capacities of smallholder farmers, research institutions, and development organizations. CCRP presently consists of three Communities of Practice (CoPs) in ten countries. The West Africa CoP of CCRP has existed since 2006 and focuses on sorghum- and pearl millet-based agricultural production systems.

2 The West Africa Regional Context

In West Africa, CCRP is working in Mali, Burkina Faso, and Niger. These countries rank 184, 182, and 189 (out of 189) for the 2019 Human Development Index (United Nations Development Program, 2019, http://hdr.undp.org/en/content/2019-human-development-index-ranking), and 51–66% of the human population live below the poverty threshold of 1.25 US$/day. The region is characterized by high human population growth rates (with the highest growth rate of 3.8% a year in Niger). An estimated 64–83% of the human population depend on agriculture, and these are mainly smallholder farmers. Farming systems are based on sorghum and pearl millet (and partially maize in the southern areas), associated with legumes (cowpea, groundnut, Bambara nut), combined with minor crops (fonio, sesame, hibiscus, and others), animal production, and trees or shrubs.

Major constraints in these agricultural production systems include:

- High interannual rainfall variability (e.g., 400–1000 mm/year at same site)
- Low soil fertility (low phosphorus and nitrogen availability, low organic matter)
- Increasing pressure on land and land degradation
- Biotic production constraints (downy mildew, head miner, midge, *Striga*, etc.)
- Widespread food insecurity and high vulnerability
- Severe malnutrition and hidden hunger
- Fragmented markets

To address these constraints, CCRP is funding research on agroecological intensification (AEI) which includes, for example, legume intensification, crop-tree-livestock integration, systems-oriented breeding (e.g., for breeding for intercropping, for fodder types or dual use of grain and straw), integrated pest management, development of local seed systems, local value chain development, gender- and nutrition-informed research, and risk management. The last is especially important as the first priority when working with highly vulnerable farmers should actually be

to do no harm. CCRP also focuses on social innovations that are often required to make technical innovations work at larger scale.

Due to the diversity of farmer types and social contexts in West Africa, CCRP supports teams that try to offer diverse, context-specific AEI options to the diversity of smallholder farmers and enable them to choose what fits best into their respective context and aligns with their values and aspirations. Such a context-specific approach should be inclusive and serve the majority of smallholder farmers, including the most vulnerable and poor. CCRP favors strong farmer participation, including farmer-led research to increase research relevance and balance power relations. The program is experimenting with Farmer Research Network (FRN) approaches, which are outlined in the following sections. Diversified partnerships and integration of students and junior scientists in the projects are other priorities of CCRP.

Why There Is a Need to Change Present Research and Development (R + D) Systems Many years of work in the region led to CCRP concluding that:

- The current R + D system, based on researchers in research organizations developing technologies and then handing the know-how to extension agents and NGOs for "delivery" to farmers, has limited success.
- Understanding the heterogeneity of socio-ecological contexts of target farmers and its consequences requires working at large scale as small samples will not reveal the complexity.
- To understand option-by-context interactions, a representative database on the performance of AEI options in different contexts is required—this also requires a large scale of operation.
- There is a need to link technical and social innovations as well as local and global knowledge in order to be successful.
- Farmers need to be closely involved in all stages of R + D both as a principle of empowerment and to ensure research is relevant.
- Farmer organizations, nongovernmental organizations (NGOs), and development projects (and private sector) form a collective infrastructure and social capital which could support research at scale.

As a response, CCRP started experimenting with FRNs as alternative models for R + D.

3 Farmer Research Network (FRN) Approach

In the FRN approaches in West Africa, high levels of farmer participation and relatively large scales of operations are being envisaged, which makes the approach distinct from conventional agricultural research and also from classical participatory research approaches (Fig. 1).

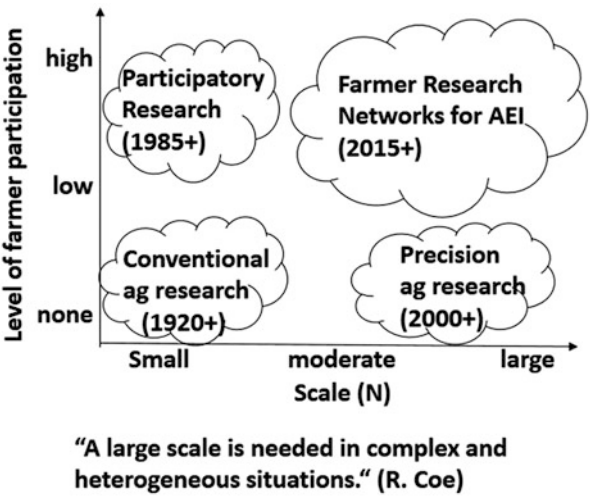

Fig. 1 Classification of different research approaches based on the scale of operation and level of farmer participation. (Based on Sinclair and Coe 2019)

3.1 Overall Vision of the FRN Approach

The FRN approach aims to transform the way that much of agricultural R&D is done to engage (rural but also peri-urban and urban) people in prioritization, observation, experimentation, and utilization of research results. Specific objectives include:

- Transforming agriculture and food systems:
  - Context-specific AEI
  - Care for culture, production ecology, and equity
  - Improved yields, nutrition, and sustainability
- Transforming the way we do R + D:
  - Research as part of development, not as a prior step
  - Farmer influence on what is being worked on
  - More equitable relations, moving away from an "expert/recipient" relationship
  - "Extension": from blanket recommendations to support for understanding of principles and better decision-making
  - Support farmers to bundle and adapt AEI options

A general model of such an FRN approach in the CCRP context is centered around large-scale farmer experimentation and observational research with a basket of diverse AEI options (technical and social) and applying a set of principles (Fig. 2, Table 1). There is an entity that facilitates the collaborative network of farmer organization(s), NGOs and development projects, researchers/research institutions, and even the private sector whenever possible. In this network, local knowledge and social capital are combined with global scientific knowledge and innovations, and both enrich each other. Also, farmer priorities and knowledge are used in farmer-participatory action research and help to update farmers' priorities and knowledge. Global knowledge is used in the participatory research, and results help to refine the

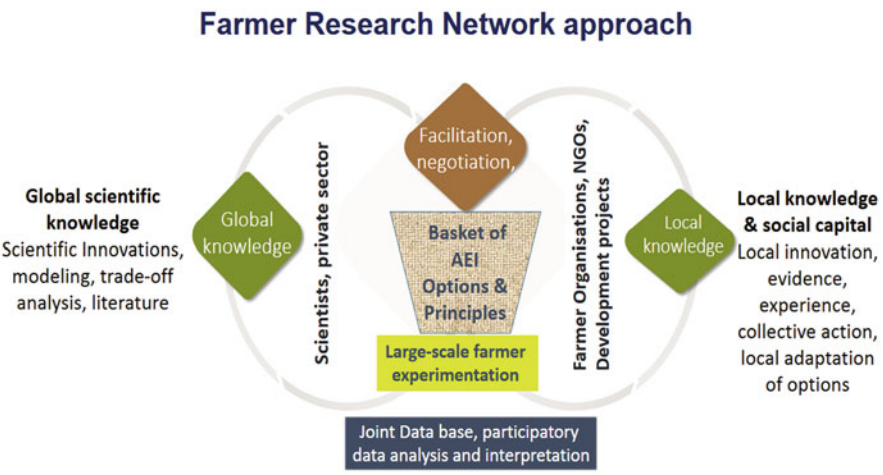

Fig. 2 A general model of the Farmer Research Network (FRN) approach as seen by the Collaborative Crop Research Program (CCRP) in West Africa. (Source: CCRP Leadership Team)

Table 1 Principles for FRNs (Source CCRP Leadership Team 2018)

About...	Principles
Farmers	Farmers who represent the social and biophysical diversity of their communities participate in the whole research process.
	1.1 Farmer groups set research priorities and influence the research agenda. 1.2 Farmer groups and organizations are engaged throughout the research process, from diagnosis, design, implementation, analysis, and communication. 1.3 Efforts are made to include resource-limited and otherwise marginalized groups.
Research	Research is rigorous, democratized, and useful, providing practical benefits to farmers as well as scientific evidence and insights on biophysical and social variation.
	2.1 Research effectively addresses farmers' problems and opportunities. 2.2 Research is based on sound and appropriate designs and protocols and involves participatory data management and analysis methods that can reveal patterns and suitable options across diverse agroecological and social contexts. 2.3 Research is informed by the knowledge and interest of those involved, as well as relevant insights from other sources.
Networking	Networks foster collaboration and opportunities for learning and knowledge sharing.
	3.1 Networks foster genuine and authentic collaborative engagement. 3.2 Networks facilitate learning and knowledge sharing across farmer groups with similar agendas, interests, and constraints. 3.3 Networks engage in integrated monitoring, evaluation, and planning to guide inquiry, innovation, inspiration, learning, and sharing.

global knowledge base. Participatory data analysis and interpretation along with a joint database of experimental results, experiences, and knowledge would help to create these linkages.

3.2 FRN Principles

To serve the implementation of FRNs within its program, CCRP has developed some FRN principles, which aim to describe the core elements of the concept and which any FRN should be striving to follow (Table 1). These principles serve to help FRN members focus on what is most important, especially to ensure inclusion of and equity among the diverse farmers in our target region, research quality that includes both local and global knowledge and that is relevant to farmers, and networking as mechanisms for learning and knowledge sharing among all partners (Table 1).

At present, different forms and models for FRNs are evolving in CCRP's West Africa CoP. Three examples are given below. The CCRP program is supporting and enabling exchanges among these different networks in order to help them learn from each other's experiences. A similar process is used to learn from experiences with FRNs in other regions.

3.3 FRN Examples from the CCRP West African Program

Example 1: FRN Working on Seed Systems
This FRN around seed systems is coordinated by the Malian farmer organization ULPC (*Union Locale des Producteurs de Céréales de Dioïla*). It includes variety testers and seed producers grouped around seed committees, breeders from ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) and from the Malian IER (*Institut d' Economie Rurale*), agro-dealers and other seed sellers, the local community radio, and the national Malian extension service (Fig. 3).

The coordinating farmer union ULPC, created in 2001, presently includes 43 cooperatives with around 1000 producers, half of whom are women. ULPC has seven input stores in the areas it operates, and its seeds are distributed nationally. The cooperative has been recently featured by the Access to Seeds Index Initiative (https://www.accesstoseeds.org/meet-the-leading-seed-producing-cooperatives-of-mali/, accessed in December 2018). The main objective of the seed network around ULPC is to increase smallholder farmers' access to new varieties and quality cereal and legume seed in the target area of Dioila in Mali. Network functions include:

- Strengthening the collaboration and networking among farmers and building capacity for organizing group activities and thus help to share and adapt technical innovations to work at larger scale
- Testing of new varieties
- Production and decentralized commercialization of sorghum and legume seed

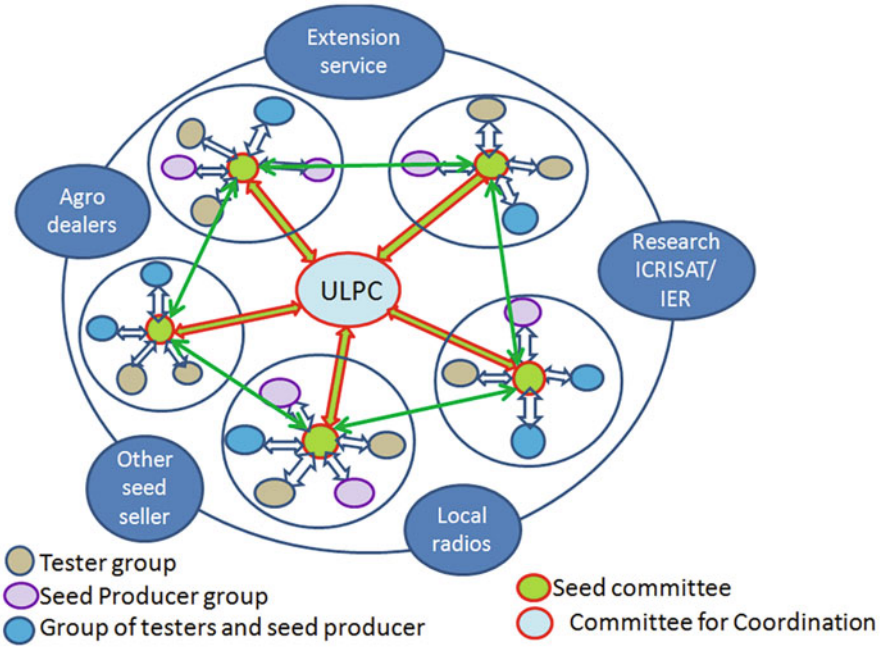

Fig. 3 Structure of the FRN in Mali focusing on seed. (Source: Weltzien E, Guindo S, Sidibe M, CCRP Seed systems project)

- Digital data collection tools
- Establishment of databases on varietal performance and seed production/marketing using digital data collection tools
- Joint interpretation of results and planning of seed production
- Development of farmer-friendly information and communication tools

More information about this "networking for seed" project can be found at https://www.ccrp.org/grants/networking4seed/. The long-term collaborative approach between farmers and breeders is also described by Christinck et al. 2019 and Weltzien et al. 2019.

Example 2: FRN to Develop Pathways to Agroecological Intensification in Southern Mali

This CCRP-funded FRN creates linkages between local and global/scientific knowledge. It is led by Wageningen University and implemented in cooperation with the Malian IER and the NGO AMEDD (*Association Malienne d' Éveil au Développement Durable*). Their approach combines participatory diagnosis, development of a farmer typology to better understand different farmers' context, context-specific on-farm testing of a basket of AEI options, and farmers' appraisal of these options combined with scientific scenario modeling at field, farm, and landscape levels for different farmer types (Fig. 4). Joint analysis and discussion of results from

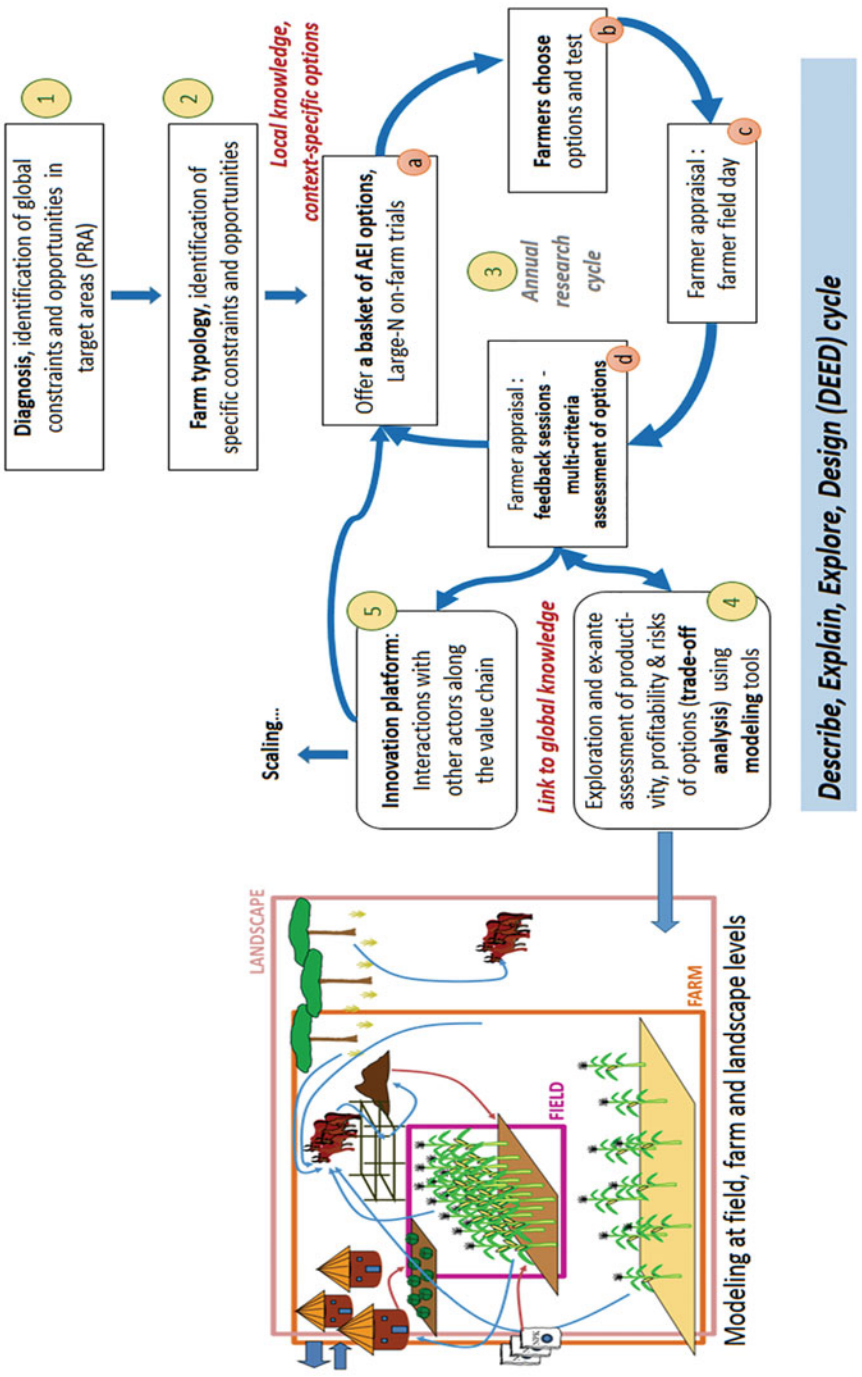

Fig. 4 Way of working within the CCRP-funded FRN to develop pathways to AEI. (Source, Katrien Descheemeaker, 2014, personal communication; Falconnier et al. 2017)

both on-farm trials and modeling results/trade-off analyses lead to farm-type-specific options for AEI and enhanced systems integration. More information about this "pathways to AEI" project can be found under the following link: https://www.ccrp.org/grants/pathways-to-aei-ii/.

Example 3: FRN to Intensify Pearl Millet-Based Production Systems in the Maradi Region of Niger

This FRN is centered around the Farmer Federation FUMA Gaskiya (*Fédération des Unions de Producteurs de Maradi*) in the Maradi region of Niger. FUMA Gaskiya was created in April 2002. Presently, the federation consists of 21 unions, 420 local farmer organizations, and a total of 12,000 members of which 55% are women. Since its creation, FUMA Gaskiya has been partner in several R&D projects funded by a wide range of donors. Since 2012, FUMA Gaskiya has also been leading its own research project funded by the CCRP. This represents a significant change in power relations in agricultural R&D, and our experience has shown that this can increase the relevance of the research as well as farmers' ownership of research results, leading to better impacts (Haussmann and Aminou 2016). The network coordinated by FUMA Gaskiya consists of two Nigerien farmer federations (FUMA Gaskiya and Mooriben), INRAN (*Institut National de la Recherche Agronomique du Niger*), four universities, two CGIAR (Consultative Group for International Agricultural Research) centers, and several different R&D projects (Fig. 5). This network has been evolving since 2002, reflecting the long-term engagement of all of the partner institutions.

The focus is on AEI of pearl millet-based production systems in Sahel, with special emphasis on the use of low-cost, local resources, which are easily accessible by women farmers. These include testing of new crops and cultivars for systems diversification, the use of sanitized human urine as fertilizer, partial weeding to save time and protect seedlings from sandstorms, seed balls to reduce planting risks, biological control of pearl millet head miner based on local parasitoids, and local cereal and legume processing into more nutritious, easy-to-cook products. Options assessed in this network cover the agricultural value chain from new varieties and seed to crop management options to local processing and value addition for income generation.

Ongoing activities within the FRN around FUMA Gaskiya include:

- Development of a basket of AEI options especially suitable for women farmers
- Implementation of large-*N* trials (by using the available infrastructure of the farmer federations) to test these AEI options in an inclusive manner and at a large scale ($N = 2655$ trials done by 1786 farmers in 2017)
- Risk assessment of the option tested and identification of context-specific options
- Development of an FRN application (FRN-App) for digital data collection and visualization of results
- Establishment of a typology of the farmer members of FUMA Gaskiya—as this is important to develop context-specific AEI options

Fig. 5 FRN around FUMA Gaskiya in the Maradi region of Niger. (Source: A.M. Aminou, H. Moussa, B. Haussmann, personal communication)

- Development of a database that combines the farmer typology with results from the large-*N* on-farm tests
- Development of locally adapted, farmer-friendly communication tools to share results from the on-farm trials with all participating farmers and the researchers

By conducting the on-farm evaluation of AEI options using large-*N* trials, the scaling of AEI options is embedded in the process. More information about this project can be found under the following link: https://www.ccrp.org/grants/womens-fields-iii/.

3.4 Selected Learnings from CCRP's Work with Smallholder Farmers

3.4.1 "Performance" Means More than Grain Yield on a Plot Basis

Often, agricultural researchers, including plant breeders, focus on yield as the main performance criterion. However, depending on farmers' individual contexts and production objectives, "performance" of any AEI option (or of a genotype) can mean many different things including:

- Final food yield (not grain yield per se)
- Nutritional quality and taste acceptability
- Early harvest to provide food in the hungry period
- Suitability as dual purpose or fodder crop
- Effect on associated crop in an intercrop
- Profitability
- Risk reduction potential (stable yield)
- Provision of ecosystem services
- Fit in the overall farming operations (in terms of costs, labor, and time)

These criteria need to be understood by the researchers in order to cocreate innovations, together with the farmers, that best serve farmers' individual production objectives and performance expectations.

3.4.2 Need to Understand Option-by-Context Interactions

Farmers' production objectives, performance indicators, and specific preferences are influenced by individual farmers' social context, for example, gender, age, ethnic group, production objective (food security versus marketing), individual access to input and output markets, farm type (with/without animals), farm resource endowment, and farmers' risk aversion. There is a need to better understand smallholder farmers' heterogeneity in order to develop context-specific AEI options. "One-size-fits-all" options that serve all smallholder farmers equally well rarely exist. Therefore, the R&D system needs to get away from global or national recommendations (e.g., nationwide crop fertilization recommendations) and develop mechanisms to strengthen farmers' capacity to choose agricultural intensification options that fit

best into their respective individual situations. Such "option-by-context (O × C) interactions" have often been neglected by the classical R&D system (Nelson et al. 2016; Descheemaeker et al. 2016). Understanding of O × C interactions (should) mean farmers making informed decisions about what is most appropriate for them rather than following recommendations developed by researchers.

Furthermore, researchers (including breeders) often test their innovations under controlled, on-station, high-input conditions. These conditions mostly do not represent farmers' real-life context or only a subsample of farmers' diverse growing conditions. However, the selection efficiency depends on the correlation between performances in selection versus target environment. In case of crossover O × C interactions (when different options perform best in different contexts), selection in one context will only serve this particular context, and gains from selection may be zero or even negative (doing harm) for other contexts. Therefore, according to CCRP, O × C interactions must be considered by agricultural researchers working in heterogeneous target environments.

Factors that may cause crossover O × C interaction for various sorghum performance indicators:

- High-input "infields" versus low-input "outfields"
- Low-phosphorus versus high-phosphorus soil conditions
- Early planting versus late planting
- Healthy location versus biotic stress hot spot
- Pure stand versus intercrop
- Food security versus marketing objective
- Food, beer, fodder, or multiple production objectives
- Women's versus men's preferences
- Farmer with/without animals

Understanding the factors underlying O × C interactions requires a cocreation process, where researchers and farmers work together as equal partners. It can help to develop an appropriate "basket of options" along with associated information and principles for the diversity of smallholder farmers.

3.4.3 "Baskets of Options" and Informed Decision-Making by Farmers Instead of Fixed Recommendations

Since smallholder farmers' individual contexts are heterogeneous and dynamic, and changing over time, access to a "basket of options" that can be applied in flexible ways and adapted to local contexts and individual situations may serve smallholder farmers' needs better than fixed recommendations and so-called "best-bet" packages. To give an example, breeders could develop a basket of diverse variety options (e.g., early, medium, late maturing; grain/fodder/dual-purpose types; varieties with special nutritional value or for specific uses) instead of promoting just one or a few "best" varieties. Promoting inclusive smallholder farmer experimentation at scale with this basket of options and joint exploration of data can lead to a better understanding of principles that explain performance variation in

heterogeneous environments and can support farmers' (and researchers') decision-making processes. This is exactly what CCRP's FRN approach aims to promote in order to achieve the expected transformation of smallholder farmers' agriculture and food systems.

3.4.4 Further Learnings Related Specifically to FRNs

- Networks seem to be a key ingredient that makes FRNs different from other farmer research work: They can accelerate innovation and impact, they can influence nonmembers to incorporate AEI thinking and start a transition, they can support data collection and management, they can help circulate learning, and more. A strong network also makes scaling easier.
- FRN can and perhaps should be multifunctional: The FRN structure enables farmers and organizations they work with to address other issues that are important to them, such as savings and loans, social connections, marketing and value chain, etc. These may be key to spread technologies and ideas. And it highlights the adaptive capacity of this type of collective action.
- Facilitation is crucial, feedback and planning should support engagement of all network members, and women must be involved.
- FRN processes seem to be building farmers' capacity to collect data and to interpret results, as well as researchers'. Farmer organizations' and NGOs' capacity to support these collaborative learning processes is needed, and there is still much to learn.
- It takes time and trust to foster true farmer engagement, to understand local contexts, to identify locally relevant research topics, to facilitate transparent and inclusive decision-making processes, to build mutual respect among actors, and more. Work at the pace of trust.
- Working with FRN principles is becoming inherent in FRN projects; some principles seem better understood and integrated than others; this varies from project to project.
- FRNs may require innovative approaches to build organizational effectiveness.

4 Conclusion

With the FRN approach, CCRP is trying to foster a paradigm change: Research should consider smallholder farmers as valuable research partners and no longer as "beneficiaries" or "passive adopters" of so-called "best-bet" technologies developed by researchers. The FRN approach encourages researchers to stop thinking about making recommendations and rather start thinking about supporting farmers in making informed choices.

Within CCRP, grantees are striving to "walk the talk" by promoting development of context-specific AEI options and giving special attention to FRN that promise to be pathways for AEI, agricultural transformation, and improvement of smallholder farmer's livelihoods.

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