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FRN DEEP DIVE REPORT

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Introduction

This objective of this document is to present a synthesis of the learning that was gained through part of the developmental evaluation process that involved four deep dive FRN projects, from 2015 to the end of 2017. The approach taken was to summarize the learning work done across the Deep Dive projects in different ways. After this introduction is a snapshot of each of the four FRN projects, followed by a synthesis of key learnings. The FRN principles were a guiding framework for the Deep Dive projects, and after the broad synthesis section, there is a section that synthesizes learning by principle, presenting some of the key insights that were gained through individual reflection and group discussions. We then present summary guidelines for each of the five stages of research. The appendices to this report include: a list of example tools from the Deep Dive projects; draft tools for continuing the Deep Dive process across the program; a set of 4-squares designed through this process for better understanding different types of FRNs; and a list of assignments used in the Deep Dive process.

Selection of Deep Dive projects

The Developmental Evaluation Deep Dive [DD] process worked with one FRN project from each of the CCRP regions. In each region, through conversations between the RTs and program staff, one project was selected to be part of the Deep Dive process. Considerations included, for example, the potential for learning about FRN principles and implementation processes, the availability of a person associated with the project to devote time to the DD, and the type of learning that was expected to be possible. The DD projects were:

- Fundación Valles Participatory Action Research (Andes – Bolivia) [PAR-FRN]
- FRN-NGO (East Africa – Kenya) [FRN-NGO]
- Best Bets III (Southern Africa – Malawi) [BBIII]
- Seed Systems (West Africa – Mali) [SS-Mali]

A snapshot of each of these Deep Dive Projects in provided in the next section of this report.

Deep Dive process

The Deep Dive process began in 2015 and consisted of regular phone calls (usually monthly) to share learnings about FRN work. Participating projects prepared presentations and other written assignments, which form the bulk of evidence for this synthesis. These included:

- Activities tables
- Overview and Observation tables
- Reporting against each of the three FRN principles
- Reporting on activities and learnings during each of the five research stages
- Interviews to gather narrative detail about the FRN process
- Providing detail on tools, methods, and processes used at various stages of the FRN projects
- Ideas for tools to continue Deep Dive learning across the program
- Sphaera building blocks

Please see Appendix IV for templates for these assignments, and Appendix II for the draft tools to continue DD learning. Appendix I contains a list of example tools provided by DD groups, many of which can be found on Sphaera.

Deep Dive Project Snapshots

The "snapshots" presented below are intended to provide an overview of the four deep dive projects, focusing on the context, the FRN partners, the research activities, and what each FRN project is helping the CCRP to learn. Each project—given its specific context and focus, the processes put in place and the actors involved—is a rich and fertile ground for learning.

Participatory Action Research FRN in Bolivia

Based on reporting by Maria Yumbla and Martha Caswell, as well as deep dive M&E work and interviews with project leaders

Context

This project operates in a very impoverished region of Bolivia (Chuquisaca & Cochabamba departments), where many members of farming households have migrated permanently. Farmers produce various crops, including potato, chile, maize and groundnuts, some for sale and some for household consumption. Groundnuts are often the only crop for sale and income and many farmers grow organically, specifically for the export market. This projects focuses on different themes of interest to these farmers, such as seeds, pests, diseases, and climate.

Partners

This project was developed through a collaboration between Fundacion Valles and University of Vermont's Agroecology and Livelihoods Collaborative. Some farmer groups that work with FV also participate, and several Bolivian university students collaborate in the field.

Research activities

PAR-FRN is a project being conducted with organic peanut farmers in four communities in the Bolivian departments of Chuquisaca and Cochabamba. This project has placed a strong emphasis on developing an inclusive and participatory process, rather than on making quick strides in the agronomic research. The first phase involved understanding the social, agronomic and economic context, using a variety of techniques, such as facilitated workshops, participant observation, surveys and more. For example, workshops were held with farmers using agricultural calendars to identify the main issues they face and then to prioritize topics to research. The farmers mapped out the chronological progression and connections between climate variation and pest/disease pressure throughout the year. During this phase, project leaders took time to build trust and to gradually introduce new ways of communicating and interacting to help shift power dynamics embedded over years of top-down approaches.

Research activities include monitoring the interactions among insect life cycles, climate and level of damage to crops, and testing various methods for controlling the main pest-s. Data was collected using ODK on smartphones, with assistance from field officers and students. Regular workshops are held in each of the four communities, providing opportunities for group reflection.

What this project is helping us to learn about FRNs

Each FRN project provides opportunities for learning on specific aspects of what it means to build and manage a farmer research network.

PAR requires time and skilled facilitation processes: PAR-FRN has taken a strong orientation towards emancipatory participatory action research inspired by Freire and others. In this project, PAR is seen as actively pushing against vertical power structures by giving space to and valuing the voices of all actors. As such, the main learnings from this project to date concern the processes that can be used to foster this. A first point is that these processes take time. They also require skilled facilitation and sensitivity to the scope and pace of change that is possible in the context. The hope is that this investment in creating environments of trust and encouraging participation will shift dynamics of exclusion and self-exclusion. That said, habits (such as top-down transfer of information), cultural traditions (regarding gender roles for example) and structural barriers (including the legacy of colonialism) make the goals of inclusion and true participation complicated to attain, beyond a sort of "token participation" in the form of attendance.

Paying attention to adult learning is important: This project explicitly emphasizes learning and transformative capacity building at all levels and among all actors. Thus, taking into account different learning styles is extremely important to help build the knowledge and confidence of participants. This again points to the importance of skilled facilitation and thoughtful methods and techniques that can be adapted to different learners.

Farmers are motivated by both the process and the solutions: Of course, farmers are interested in finding responses to their problems, but they also want to understand where the recommendations or tools come from. This enables them to be more autonomous in the process of choosing where attention should be directed and then in selecting the best solution. FRNs offer the possibility of being involved in a process rather than simply accepting ready-made advice (however good it may be).

Understand the context. This project took some time to gain an in-depth understanding of the context, including the community, organizational and agronomic contexts. It worked with farmers, field staff, and other partners to understand their practices, knowledge, priorities and constraints. This process forms a solid basis for all further work.

FRN-NGO in Western Kenya

Based on reporting by Beth Medvecky and Daniel Nyambok, as well as deep dive M&E work and interviews with project leaders

Context

FRN-NGO operates in Kenya's lake zone, one of the most densely settled parts of the country and a region where poverty, natural resource degradation and food insecurity levels are high. Challenges include scarce land and water resources, declining soil productivity, high pest and disease incidences, changing climatic conditions, and limited access to resources by women, who are the main drivers of agricultural production. Although people are highly dependent on farming for their livelihoods, rains are becoming less predictable and crop failures are more frequent.

Partners

The FRN-NGO project is led by Agriculture Improvement Support Services (AGRISS) NGO in collaboration with five other NGOs based in Western Kenya region:

1. Community Action for Rural Development (CARD) based in Migori county
2. Community rehabilitation and environmental protection programme (CREP) based in Kisumu county
3. Diocese of Homa Bay Agriculture and Environment Program (AEP) based in Homabay county
4. AVENE Community Development Organization based in Vihiga county and
5. Rural Energy and Food Security Organization (REFSO) based in Busia county.

Each NGO brings specific knowledge and experience from a different area as well as longstanding connections to farmers. NGO partners act as the interface between the farmer groups and research partners, facilitating linkages that support participatory processes. Key research partners involved in providing technical support and technologies to be tested include: Rongo University Sorghum Breeding Program (provided sorghum varieties for testing); and Kenya Seed Company (provided nine new varieties which are still being multiplied to be used later for testing).

Research activities

The project has undertaken several experiments over the past few years related to issues identified by farmers as priorities. In year 1, trials were conducted on various post-harvest pest management options, including solarization, sun drying and ash treatments. In years 2 and 3, trials of sorghum varieties that would grow well under changing climatic conditions and in different local contexts were carried out. These included varieties developed in Rongo University, 2 varieties from Kenya seeds, some commercial and some farmer varieties. In year 3, striga management options were tested, some of which could also improve soil fertility (uprooting, intercropping with desmodium or with legumes, adding manure/compost). In year 4 (current) bean trials of consumer-preferred varieties are being conducted to identify performance in different contexts.

Farmer groups generally have between 10 and 20 members. Some of these groups already existed. Most include both men and women, with some all-female groups. They hold regular meetings to discuss progress and in some cases work the plots together. Each experiment involved between 300 and 1000 farmers, generating large quantities of data. This has resulted in a certain amount of complexity in managing the data and understanding the many contextual factors that could influence results. A data manager has been hired for support with this aspect.

What this project is helping us to learn about FRNs

Each FRN project provides opportunities for learning on specific aspects of what it means to build and manage a farmer research network.

FRN can indeed generate OxC (but it takes a lot of work!): Because FRN-NGO has a large network of farmers across many different agro-ecological zones, it has helped to test the potential of the FRN concept to reveal important patterns and insights, that is, a variety of options for different contexts. This complexity, however, has also shown the importance of putting in place robust, well-designed data management processes, and of supporting farmers, field staff, NGO partners and researchers with these processes. Having a number of trials being done simultaneously, with two growing seasons, makes the process very labor-intensive. Understanding how best to support the work, as well as recognizing the limits on what can be done, are part of the learning process.

Scaling happens through social networks: Another aspect we are learning about with this project is the concept of embedded scaling. In this project, scaling is happening "naturally" within the community when certain varieties are clear winners—or rather, it is happening "socially" as farmers share seed from a variety that performed well with their social network, thus scaling out that variety, and contributing to seed and food security.

Keep it simple: Like some other FRN projects, we are learning that simple comparisons that are not too labor-intensive seem to work best with farmers. They are able to see how a technology performs under their own conditions relative to what they already know or are doing. In this way, learning-by-doing, learning under local conditions, and starting with simple experiments seem to be the most engaging and relevant approaches to take.

Farming is embedded in culture: Having FRN groups in different zones doing the same trial can also reveal cultural issues that can influence the work, such as norms around who can plant where, when, on what land, with whom, and more. Creative and culturally-sensitive approaches to deal with such obstacles can be developed with community members.

Network diversity is important: In a project like this one, with multiple research and NGO partners, it is important to recognize the differing priorities each partner has, and to work with their strengths in order to learn to work effectively together.

Best Bets III FRN in Malawi

Based on reporting by Frank Tchuwa and Kate Wellard-Dyer, as well as deep dive M&E work and interviews with project leaders

Context

Productivity on smallholder farms in Malawi is generally very low. Yields of the main subsistence crop, maize, are substantially below what could be achieved with improved crop management. Soil fertility is declining and so the productive capacity of farms is being eroded. Low incomes mean that few farmers can afford to purchase inorganic fertilizer and numbers benefitting from government input subsidies have fallen drastically. Individual land holdings are small and in many areas only one crop can be grown per year. Erratic rainfall – floods and dry spells – also impact on crop production. As a result, a large number of people do not produce enough food to meet their needs. They also lack diversity in their diets and this has adverse impacts on the health of farm families. The incidence of stunting in children under five years of age averages 46%.

Partners

This project is led by LUANAR (Malawi) and Natural Resources Institute (UK).

Research activities

The project has carried out research into ways in which legumes can be incorporated into maize-based cropping systems in three districts in the country (Mzimba, Kasungu and Ntcheu). The aim has been to achieve multiple benefits of improved soil fertility, enhanced crop productivity, diversified incomes and better family nutrition. The project has researched so-called 'doubled-up' legume systems and farmers in the target areas have shown interest in growing a groundnut/soybean/cowpea-pigeon pea intercrop

in rotation with maize. This system saves labor, adds nitrogen and organic matter to the soil and thus increases the yield of the maize crop, and contributes to more diverse diets and income sources for farming households.

Best Bets III FRN grew out of a previous phase of this research in which farmer groups tested new technologies using multi-environment trials (MET). In the current phase the MET continue to do this but FRN have been established as a more farmer-focused innovation mechanism. In some cases, a MET and an FRN operate in the same location. The FRN model is being studied through an action research approach in which it is being compared with participatory models such as farmer field schools, farmer research teams and the established lead farmer system. The project works with farmer groups and seeks to enhance their capacity to innovate. The initial farmer groups in the FRN are now expanding, comprising 15 groups of up to 20 farmers.

Farmers are free to choose from the list of technologies they draw up jointly with researchers and extension. These include technologies developed through formal research and farmers' traditional and recently conceived practices (e.g. incorporation of tobacco and bean residues instead of legumes; using urine instead of inorganic fertiliser). Farmers are responsible for setting up and managing the trials. In some cases FRN members form subgroups to work on each other's plots. Farmers collect agreed data in notebooks, assisting each other and discussing recordings at group meetings. Organized learning and sharing activities include field days and joint reflection and learning days. The research process is facilitated by experienced facilitators and supported by extension specialists from LUANAR.

What this project is helping us to learn about FRNs

Power dynamics can affect experimentation. This includes intra-household power relations such as a husband planting on his wife's experimental plot.

Social capital is important in the smooth functioning of an FRN. This suggests that FRN are likely to be most effective when based on networked groups of farmers rather than building a network of individual farmers.

Depth of farmer engagement and quality of experimentation improves with time. Knowledge and skills on agronomic practices and research principles and practice and confidence in making presentations increases with each season. This means that facilitators need to support the research capacity building process.

Implementation of FRN activities is affected by non-availability of field extension personnel. This is due not only to the low extension worker-farmer ratio but also to lack of interest in learning FRN concepts, which may be new and require a change in usual extension tasks, and different facilitation skills.

Distance between group members and villages impacts on the FRN process. Subgroups form organically in individual villages where members interact regularly; however, when meetings are held in different villages many farmers do not attend. Thus, whilst cooperation is enhanced between subgroup members, there is a challenge in scaling the network.

Develop strategies for recognising farmer research. Farmers in Kandeu expressed interest in having their research publicized through local radio or newspapers or presenting to FRN in other districts. There is need to develop strategies for recognizing farmers in the research and dissemination process.

Seed systems in Mali, and other West-African countries

Based on reporting by Eva Weltzien-Rattunde and Mamourou Sidibe, as well as deep dive M&E work and interviews with project leaders

Context

Mali and the Sahel region in general is ranked among the lowest on the United Nations Human Development Index, with high population growth, large proportions of rural populations, and high levels of malnutrition including micronutrient deficiencies. The Seed Systems project in Mali is a long-term project now led by Baloua Nebie, after Eva Weltzien-Rattunde retired from ICRISAT in 2016. It focuses on various aspects of participatory breeding for improving sorghum and millet-based systems in the Sahel region. The project has from its inception in 2006 worked with a network of large farmer organizations in all three Waf CoP countries. The research network orientation taken by this project was seen as a promising approach for building capacities for expanding farmers' seed systems. One key aspect was to expand farmers' capacities in terms of increasing the crop and varietal diversity in their systems. A network of variety testers, seed producers and seed marketing specialists was built within these farmer organizations to enhance the reach of the seed.

Partners

For the FRN Deep Dive activities, only the Malian partners and activities of the Seed System III project were concerned. The main partners were Cooprosem (A farmer seed cooperative in Siby commune, started in 2003), Institut d'Économie Rurale (IER), ICRISAT and ULPC (a union of farmer cooperatives in the Dioila district, started in the late 1990's for cooperative grain marketing), with ICRISAT. This collaboration started in 2000, and has received support from the McKnight Foundation since 2006 for the sorghum breeding and seed system activities.

Research activities

The Seed System III project objectives were to identify institutional and social measures that contribute, limit, and/or sustain farmer managed seed enterprises and it focused specifically on tools for communication for that enhance uptake of new varieties or hybrids of traditional cereal crops by small scale farmers in Mali, as well as initiating studies on gender relevant consequences resulting from the dissemination of specific cultivars of sorghum and associated crops.

The partners identified key components of sustainability for seed enterprises managed by farmers and their organizations: Continued varietal improvement, capacity for local seed sales, as well as the functioning of the farmer union and its ability to serve its members effectively.

Thus, in Phase III, the partners continued to work on building skills and refining tools for farmer managed variety identification for future seed production, in addition to initiating specific studies and actions around seed sales and organizational effectiveness with the farmer cooperatives and union.

Thus, a number of simultaneous activities needed to take place on both the agronomic level and on the organizational level. For example, work was done on varietal development and testing, not only for sorghum and millet but also for several legumes, and farmers applied the tools to other crops of their own choice. They have developed a process for identifying varieties appropriate for specific contexts (OxC). The farmers have developed tools and approaches to provide other farmers with information about the new varieties what will likely perform best in their farm system. Data collection has been simplified so that a limited number of field visits are required (trial fields are often far from the home). Data on harvest yields are collected and culinary tests are conducted in the trial villages. Gender differences in terms of varietal needs and knowledge about specific traits are highly significant.

The collaborative learning around seed dissemination options and its linkages to organizational effectiveness of the cooperatives advanced simultaneously. This involved training farmer facilitators, creating new structures (local seed committees), ensuring equitable sharing of benefits, while monitoring the application and modification of the unions' bylaws.

What this project is helping us to learn about FRNs

Each FRN project provides opportunities for learning on specific aspects of what it means to build and manage a farmer research network.

A strong network makes scaling easier: Seed Systems III has a large network of farmer groups and a long history of working with them. A major learning of this FRN is that when you have a strong existing network, one can easily fit options to contexts, as farmers are the leaders in these discussions and feedback sessions, defining contexts, and identifying and describing suitable options. One can also more easily add a new dimension of collaboration, such as seed production and dissemination, once new varieties have been successfully identified; or adding the work with other crops.

FRNs may require innovative approaches to build organizational effectiveness: Another major learning from this project is the importance of paying attention to organizational factors and of building organizational effectiveness. In discussions with relevant types of members it came out that the farmers' union had a centralized decision-making and communication structure, especially with respect to decisions related to seed sales. The creation of local seed committees was proposed and implemented, giving the farmer facilitators more flexibility and room for their own initiatives. These committees fostered more horizontal communication and sharing, as well as coordination between cooperatives in their *communes* (village-level). In this process, it became clear that the 'strength' of the union of cooperatives really depends on the level of engagement of the individual members in their own cooperatives.

Facilitation is crucial: Having local facilitators who are well-trained for variety testing and other research methods has made it possible to scale up. The number of tests increased, so research could be done with a large N. While this presents challenges in terms of compiling results and providing feedback, it would not be possible without the facilitators. They supervise the tests, collect the data, do planning, manage protocols, and more, all in local language. These facilitators thus can assist individual cooperatives to take up initiatives, such as providing seed on credit to some members, or conducting demonstration plots under specific growing conditions in their area

Feedback and planning supports engagement: Holding end-of-season workshops (*bilans annuels)* is an effective way to engage not only the farmers, but other local actors, in many stages of the research

process. Participants represent different actor groups from the various villages or communities. At these workshops farmers present their experiences, impressions of specific trials, new varieties, seed production results and more. Researchers present an overview of the analyses conducted on the trial data from the past season. Based on these insights, using small working groups, the workshop proposes the activities, options and conditions for the next season. Once these options for new activities have been agreed upon by the workshop participants, the facilitators provide feedback to their village/community and elicit interests of individual to conduct specific types of trials, seed production or agronomic experiments.

Seed systems are social systems. In West African cultures, sorghum and millet seed is not sold. Seeds are given as gifts, or they are exchanged, but not for money. Moreover, it is considered a dishonor not to have one's own seed, as a good farmer is able to produce and keep seed from year to year. This project used farmer engagement and the power of the network to find solutions to these cultural constraints and help build a seed system that can disseminate new options for different contexts and support people's livelihoods.

Women must be involved: A final lesson about FRNs is concerning the importance of ensuring that women can engage at each stage and attend each event. In Mali (and elsewhere) women and men do not have the same production priorities, constraints, and ways of working. Therefore, they do not have the same needs in terms of varieties. In addition, women's role in the household places them in a central position to have an impact on nutrition. This project therefore made it a condition that a group of women be involved in all trials.

Synthesis of Findings

Analysis of the data from the Deep Dive process surfaced five key themes that held importance across all research stages:

1. There is a need to shift perceptions, attitudes, and beliefs of all stakeholders in order to create an environment that supports authentic farmer engagement across the research process. This involves understanding and addressing horizontal and vertical power dynamics.
2. Farmers and others learn best by doing—and this is most effective when stakeholders are "doing" together.
3. There is a need to develop processes and tools that are inclusive and appropriate; good facilitation is key.
4. Bonding and bridging social capital play an important role in the FRN.
5. Understanding and working with the social issues, and addressing socio-economic diversity, is important for the success of the FRNs.

These themes are explored in more detail below.

Shifting Perceptions, Attitudes, and Beliefs

Engagement of farmers in research has grown increasingly more participatory over the past decades, moving from researchers working on research stations to researchers working in farmers' fields, to researchers engaging farmers in aspects of the research process, e.g. providing feedback during participatory varietal selection and engaging farmers in implementing certain aspects of the research process. Farmer Research Networks push the concept of farmer engagement to an entirely new level, with a principle that that states "farmers who represent the social and biophysical diversity of their communities participate in the whole research process".

The Deep Dive projects understood this principle to address "authentic" farmer engagement, meaning farmers were full partners in the research process rather than simply assisting the researchers in ways that were easy or convenient. With this understanding, it became apparent that a paradigm shift was necessary across all stakeholders in order for the FRNs to develop into truly inclusive networks in which farmers feel empowered as equal partners to contribute to rigorous and democratized research. Across the Deep Dive projects, the attitudes and beliefs of researchers, extension agents, and NGOs were identified as a barrier to full farmer partnership. There is a prevailing belief that farmers lack the capacity to do research, and that, in order to engage framers in an authentic way, the trade-offs in relationship to research rigor are too high. Compounding this issue is the finding that farmers themselves often didn't believe they had the capacity to do research.

The Deep Dive projects learned that engaging all stakeholders from the early stages of the research—i.e. the prioritization and scoping stage—provided an opportunity to not only ensure that famers' needs and interests were being addressed, but also supported a shift in beliefs and attitudes across all stakeholders. For the farmers, when they were engaged in setting the research agenda, they were more motivated by the research, and had a greater sense of ownership. This process seems to be easier when an existing network is used, while it seems to take longer when building a new network, as social relations and trust is built. Moreover, it has proven helpful, even necessary, to contribute to building strong organizational capacity to support this work.

Taking the time to meaningfully engage with farmers from the beginning of the research process sets the stage for the skill-building necessary as the research progresses from prioritization to research design and implementation, to data analysis and interpretation, and finally to scaling. As farmers engage in each stage, their confidence and ownership builds. The Deep Dive projects all talked about this as an interactive process, and they reported that farmers' self-confidence grows iteratively; as farmers engaged across the stages of the research process they began to integrate research principles into their own ways of knowing, and became more confident in themselves as "researchers" without compromising the knowledge and farmer experimentation that has guided their own farming practices over generations.

Equally important is the process for engaging other stakeholders in a way that reinforces farmers' abilities and rights to be research partners; as with the farmers, this is best done from the beginning stages of the research. Building confidence and self-esteem among farmers, and mutual respect among all actors is crucial to the authentic collaboration needed to create horizontal relationships. The shift in perceptions, attitudes, and beliefs must include community leaders, professors, students, technical advisors, extensionists, and others.

For the Deep Dive projects, the work of shifting perceptions, attitudes, and beliefs was intentional and iterative. They talked about building the capacity to bring different forms of knowledge into dialogue, and, across all stages of the research, developing and implementing activities that ensure that differently positioned actors are in regular conversation with one another. Understanding and addressing the power relationships at play, both among farmers and among different stakeholders in the network, was a critical step in creating an environment where equal partnerships could be fostered.

Different actors may need different supports to build technical capacity and horizontal relationships – not only will differently positioned farmers have different constraints and different priorities that should be considered, but technicians, researchers, NGO workers and others all will have their own priorities. For the Deep Dive projects, it was important to maintain an open dialogue with everyone around the 'what', 'how', and 'why' of the research process and the objectives of the FRN. This often happened through scheduled moments for 'reflection'., such as farmer group meetings, farmer-to-farmer extension, feedbacks to communities by implementing NGOs/researchers, CoP meetings and organizing cross group exchange visits. This observation, however, highlights some of the limitations on ideal FRN processes, which are often dependent on regular, active engagement by extension staff and field workers. Since their time and availability is limited (sometimes by geographic distances and numbers of communities), certain activities cannot be carried out or else the number of farmer groups needs to capped.

Learning by Doing

The Deep Dive projects reported that continuous doing and learning together across the network fosters trust and authentic engagement; rather than just saying that farmer inclusion is an important value, it was important to demonstrate that value by planning activities that put farmers and other stakeholders in equal dialogue with one another while engaging together in the research process. Skilled facilitation that is responsive to differences in learning styles is critical in this process.

In all aspects of the FRN, doing activities together as a network can help foster authentic engagement and collaboration, as well as help build farmer capacity for research. "Learning by Doing" is important at

all stages of the research. The Deep Dive projects found that there were particular challenges to fully engaging farmers in the research design and the data analysis and interpretation stages. Activities that include a range of stakeholders working together to think through rigorous research design that also considers farmers' interests and concerns, ensures that farmers are fully represented in this stage but also helps farmers learn and internalize research principles. Likewise, the Deep Dive projects found that, rather than assuming that farmers lack capacity for data analysis and that researchers must drive the analysis, it was effective to develop workshops and other activities to bring together diverse stakeholders to analyze together. When farmers were engaged in the research design, they were more invested in adhering to a rigorous approach in the implementation; and when they were engaged in the data analysis and interpretation, farmers were more eager to share their results and analyses with each other and with other stakeholders, building farmer confidence and capacity as well as providing the opportunity for further comparative analysis. Across all stages, learning by doing is more effective when farmers have decision-making power in the process.

Through the process of learning by doing, farmers can learn principles of research that they can then continue to apply beyond the research project itself. If farmers are engaged, they develop an understanding of the benefits of research, adaptive capacity, and potential of research as an ongoing process that they are full participants in, in contrast to thinking about the research as "development aid" of which they are simply recipients. This is where a strong understanding of research principles instilled from the earliest stages of the research can help farmers internalize the purpose of research as a flexible process that can help to address any problem, but which may or may not work as anticipated. "Learning by doing" sets the stage for farmers to engage in continued learning through the research process, innovating new practices that share foundational principles.

One of the tensions that can arise is that farmers do not always adopt innovations as is, but sometimes make adaptations. However, this is consistent with a contextualized scaling approach, which is not about replication but, rather, about principles in context, adaptation, inspiration, and systems change/policy. Research principles have broader application than just the project's goals and strategies – it doesn't compromise rigor, necessarily, if farmers apply these research principles in a consistent way rather than strictly replicating the technique. Focusing on strict adoption or replication of a selected technology overlooks the specific adaptations farmers make to their contexts. Not every technology or innovation is going to be appropriate for every farmer, and important innovations and insights can come to light by studying who farmers adapt technologies.

Inclusive and Appropriate Processes and Tools

Across all research stages it is important to develop and utilize tools and processes that are aligned with farmers' capacities, and that address the needs of other stakeholders. It takes time and attention to develop these tools and processes, and is best done with the engagement of stakeholders across the network. Appendix I provides a list of tools used shared by Deep Dive projects (to date).

The Deep Dive projects discussed the importance of adapting methods and tools to both accommodate and strengthen the research capacity of farmers. Using appropriate tools and processes should begin with how farmers are engaged in prioritization and scoping. As discussed above, this builds motivation and ownership in the research process. When farmers are engaged, they can participate in developing simple and accessible tools across all stages of the research process including data collection, analysis and synthesis, interpretation of results, and scaling.

While the Deep Dive projects were fairly comfortable with, and had effective tools and processes for engaging farmers in prioritization and scoping and then scaling, they found that there were fewer models and tools for engaging farmers deeply in research design, data analysis, and interpretation of results. It was clear that for farmers to be included in these latter stages, they must be fully engaged in the prior stages. For example, for farmers to engage in data analysis, they must have been involved in decision-making related to research design. This may mean simplifying or focusing research questions, especially early in FRN development. Tools need to be simple and practical, which may mean limiting the number of variables and selecting controls that make the ultimate analysis of the results of the experiment more accessible to farmers.

The lack of models and examples for farmer engagement in analysis and interpretation, and limited understanding by researchers about what it means for farmers to be doing analysis and interpretation, has surfaced important questions: do farmers have to replicate researcher-style analysis, or are there ways to encourage farmers to synthesize information from various sources to draw conclusions? What are the strengths that farmers have that can be useful in this stage? What can outsiders contribute to farmers' own experimental efforts? This points again to the shift in perceptions, attitudes, and beliefs that was discussed above. Engaging farmers in research design, analysis, and interpretation is an area that should be watched and documented as FRN projects develop over time.

All Deep Dive projects noted that the development of tools and processes across stages was not linear—it was an interactive process where learning sometimes pointed to the need to circle back to previous research stages and adapt. For example, the research priorities might change as farmers deepen their understanding through research design, or the design might be adapted as data analysis points to new questions, or to problems with the existing design. This iterative process helped to strengthen farmers' understanding of research principles. The Deep Dive projects observed the need for iterative learning and simple tools and processes, for example, when dealing with controls in the research. For example, some projects trained farmers on the principle of comparisons/controls in experimentation, and then allowed farmers to decide which control to use. While this iterative process is time-consuming, and some stakeholders might feel that it is more efficient to have those with expertise (i.e. researchers and extensionists) guide the process, the Deep Dive projects spoke to the value of taking the time to engage farmers deeply.

Finally, the Deep Dive projects all talked about the importance of working with farmers in diverse social and biophysical conditions such as wealth, gender, climate, and soil fertility; this points to the need to develop tools to collect data on both technical and social issues (including gender diversity), which can help inform later analysis. While all Deep Dive projects had a different approach to addressing diversity, the key aspect for all approaches was that the diversity of farmer characteristics, perceptions, experiences, and environments were captured in the data collection and integrated into the analysis.

Bonding and Bridging Social Capital

While it is obvious that social capital plays a role in meaningful engagement of farmers and the development of a functional network, the work with the Deep Dive projects has brought to light the idea that social capital also plays an important role in research rigor.

In relationship to famer engagement, both bonding social capital (relationship with socially homogeneous groups) and bridging social capital (relationships across socially heterogeneous groups)

are important. Farmers learn from each other and by learning together confidence in their skills grows over time. This might begin with the "natural networks" (farmers that have a prior relationship), but it has been important in the Deep Dive projects to facilitate farmer-to-farmer interactions across groups of farmers who are not already connected. Equally important is encouraging farmers to work together with other stakeholders. By working across the different groups, a project can help farmers develop the skills and confidence to effectively implement their own experiments over time – but it is a process that takes patience and close attention to power dynamics.

In relationship to network development, bridging social capital is pivotal. As all actors in the network work together, not only are farmers empowered to take a meaningful role in the research, but the network is strengthened to better solve real problems. The network learns by doing and reflecting together. Building a strong and effective network requires that all aspects of the FRN emphasize learning by doing, together.

The importance of social capital within the network is especially pointed in relationship to scaling of innovations. Options for sharing and scaling should be discussed among all stakeholders, because it is important to understand and address the challenges and opportunities for scaling innovations. Developing activities such as workshops or field days for participating farmers to present their results can again help to facilitate interactions among different stakeholders and encourage scaling out to other, non-participating farmers, not only in terms of practices but also in terms of networking with other stakeholders. This can be strengthened by engaging local communications networks, either through informal information sharing or through radio or print media, which can help to share innovations effectively.

One of the more interesting findings across the Deep Dive projects is the role that social capital plays in research rigor. Deep Dive projects reported that farmers often work together and, in addition to helping one another, they hold each other accountable to the research design and activities that were agreed upon. This social capital is essential for ensuring that protocols are followed.

Integration of Social Issues, Socio-Economic Diversity

Integrating social issues and addressing social-economic diversity in the research is important for the FRNs in a variety of ways: 1) it assures that the FRNs are including a diversity of farmers in the process; 2) it sheds light on options by context from a socio-economic perspective; 3) it helps address power dynamics across network stakeholders and across different groups of farmers; and 4) it helps build understanding of how different forms of knowledge can inform and enhance the research process.

The Deep Dive projects discussed the need to pay attention to different levels of farmer participation depending on subgroup. For example, farmers of different wealth levels may not be comfortable working together, or participants with different levels of literacy may need to be paired together.

In addition to affecting farmer participation, socioeconomic diversity can affect constraints and priorities. All the deep dive projects discussed the importance of grounding the research in local contexts, including locally-defined socio-economic and biophysical diversity. Certain steps help to ensure rigorous, democratized research that is focused on understanding variation/diversity:

- Identify the population of farmers you are working with
- Characterize the socio-economic and biophysical diversity

- Identify main problems farmers face
- Identify the dimension of the farm system you are studying (crop, P&D, shifts towards AEI systems, etc.)

With the above defined, it then becomes possible to think through the specific parameters that will lead to research that is 'rigorous, democratized, and focused on understanding biophysical diversity.'

Summary

The Deep Dive projects have provided insights into the development and implementation of FRNs. Based on the experiences of these projects we have learned that creating an environment that fosters the knowledge, skills, and relationships that underpin a functional FRN is a complex process. This process often requires different approaches than what has been the norm in agricultural research, and it invites all stakeholders to question their assumptions and engage in new ways. The next section provides a synthesis of learning by the three FRN principles, which provides a different lens on some of the themes presented here, and uses specific examples from the Deep Dive projects to describe what the projects have learned about adhering to the principles.

Synthesis by principle

This section provides some additional detail on the learnings by principle. These findings have been summarized from the reporting done by the deep dive group. There is some overlap, as we are learning that these three main principles are connected in many ways to each other, making clear-cut boundaries difficult to draw. Some of these take up points made in the section above, providing more detail and some examples from projects.

As a reference, the farmer research network principles, as well as the main aims are presented below:

Farmer Research Network aims and principles

The Pathway to Change puts forth the following aims for Farmer Research Networks:

a) To increase the agency and capabilities of rural communities to engage in research and innovation processes, with spillover benefits for improved agency in general;
b) To increase the collective capacity of the R+D system to gather, share and interpret observational and experimental data, and thus to build the evidence base for agro-ecological intensification (AEI);
c) To support AEI of smallholder agriculture.

Guiding principles and operational principles
1. **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.
2. Research is rigorous, democratized, and useful, providing practical benefits to farmers as well as 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 agro-ecological and social contexts.
2.3 Research is informed by the knowledge and interest of those involved, as well as relevant insights from other sources.
3. 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.

Principle 1

1. Farmers *who represent the social and biophysical diversity of their communities participate in the whole research process.*

This first Guiding Principle centers on farmers. Their participation in the whole research is particularly important given the history of some agricultural research that has involved farmers in more instrumental ways, sometimes without providing practical feedback that is relevant for their farming practice. The operational subprinciples describe three specific features of representative farmer engagement: 1) farmer groups set the research priorities, 2) are included at every stage, and 3) represent resource-limited and otherwise marginal groups. Deep Dive projects expressed a range of experiences with this set of principles. But the common threads running through all reporting is that **farmers were most involved when research was relevant, accessible, and well-facilitated**.

Relevant

As principle 1.1 suggests, from the very first stage of research, **understanding and attending to farmers' interests increases farmers' sense of ownership over the research**. To do so, for example, PAR-FRN engaged in a long-term scoping process that was attentive to power dynamics and supportive of farmer engagement, and that focused on building trust between farmers, researchers, and other stakeholders. However, it is also crucial to support these levels of engagement beyond just the initial stage, as stated 4 FRN projects principle 1.2.

The first principle applied to the development of an FRN suggests the importance of creating an environment for dialogue as all the stakeholders negotiate the research agenda. In order to maintain fidelity to principle 1.2, continued and active engagement from farmers at every stage of the research, there are adaptations that need to be made to the 'usual research process. There are some stages where farmer involvement was particularly challenging for Deep Dive projects, specifically study design and data analysis. These stages, which rely heavily on research principles, can be moments where researcher expertise is asserted in a way that excludes full farmer participation. In many cases, researchers tend to want to steer the agenda setting towards their area of expertise and/or control the research process, sometimes feeling that farmers lack the capacity to do legitimate research. These entrenched attitudes are hard to shift, but principle 1 guides project leaders to consider the farmer at every stage of work in order to build sustained and authentic engagement. Deep dive projects all reported challenges with fully applying this principle, but also found that there were rewards from ongoing learnings as their projects worked to incorporate this first principle into their work.

An example can be provided by FRN-NGO, which engaged in scoping exercises with farmers, but then reverted to a research design phase that was largely driven by researchers. This project reported farmers' frustration when their interests were ignored in the first implementation phase. After being told in the scoping stages that their interests were going to be central, it was confusing and frustrating

to later have researchers present a project that was designed without their input. From this experience, this project developed a tool for designing experiments with farmers. FRN NGO framed their learnings about principle 1 in their description of this tool: “the crucial issue is finding a balance between farmers’ own ways of experimenting and possible inputs of outsiders (field extension and researchers) in strengthening their design if they are to take part in every research phase.” In this guide, the project mentions the importance of limiting the number of variables and selecting controls that make the ultimate analysis of the results of the experiment more accessible to farmers, as well as the importance of considering the risks farmers take in experimenting in their fields.

Accessible

Projects reported the most success with continued and sustained engagement from farmers when they **acknowledged the research capacity of farmers, and adapted methods and tools to accommodate them.** The design should be accessible and simple, not only for data collection but also analysis and synthesis in later stages. These considerations will help ensure that farmers are able to influence all stages of the research, meaning that good planning in the design and inception phases that considers principle 1 is crucial for maintaining that engagement across more challenging phases, such as data collection and analysis. Steps need to be taken in earlier stages to ensure that it is possible for farmers to analyze the data. This may mean simplifying or focusing research questions, especially early in FRN development. Focusing on research that can provide practical results within a single season might be another way of helping farmers to see concrete benefits and internalize research principles. Additionally, research results need to be shared in a timely fashion to ensure continued farmer engagement. When reporting against principle 1, the FRN-NGO project advised: “Provide feedback to farmers within a short time otherwise they will continually demand it.” This process is somewhat different from how some researchers are accustomed to sharing learnings, but avoids the frustration that farmers may sometimes feel when they do not see the results of their research activities translated quickly enough into actionable insights.

Seed Systems-Mali also worked to balance farmer interests with the work of researchers. They emphasized the importance of remaining flexible in order to encourage farmer participation, stating that for principle 1, “the key learning is that the detailed understanding of the changes in the production systems, as well new opportunities that may arise are essential, and require continuous adjustments and revision of priorities.” Using this principle can help to remain flexible, future-oriented, and focused on farmer needs. In the case of research on developing varieties, it is important to “try to see with farmers into the future, what may happen with production systems, what knowledge they have, what researchers know can be changed or not. It is iterative.”

Seed Systems-Mali also designed activities that are sensitive to the range of farmer participants, specifically taking into account the needs of resource-limited and marginalized groups, as suggested in principle 1.3. Individuals in different social categories who are participating in research may have different constraints and priorities. In Mali, for example, women grow sorghum in fields that have extremely poor soil, so varieties need to be adapted to low levels of phosphorus. Seed Systems also discovered that women tend to choose sorghum varieties for their specific contribution towards avoiding food shortages throughout the year, and developed the concept of food yield, based on women’s evaluations of grain qualities.

Overall, a key insight—albeit an obvious one—is that agriculture is cultural. The way farming is practiced in different contexts is deeply embedded in culture, so processes like FRN need to be aware of and accommodating to local practices. In many, if not all, projects, adjustments have to be made, for example to take into account who can plant what, where, when and how; who is responsible for what crops and who processes food; who controls land and other resources; and much more.

Facilitation

In order to implement the principle of farmer participation, projects have realized the importance of having structures in place that are fully inclusive of farmers, with transparent decision-making processes. Good facilitation is therefore crucial to ensuring that farmers are engaged and included at all levels. Good facilitation ensures transparency and genuine collaboration. PAR-FRN explains good facilitation in these ways:

> Using PAR, we facilitate horizontal dialogues across all of the actors (farmers, students, technical advisors, etc.) during these full-group workshops. In addition, PAR works to actively push against vertical power structures by giving space and valuing the voice of all actors. PAR requires investment in creating environments of trust and encouraging participation that hopefully will shift dynamics of exclusion and self-exclusion. We believe that this habit of questioning everything and consistent time dedicated to reflection leads to 'aha' moments both individually and collectively within the group.

Best Bets III observed a similar phenomenon: "When farmers were given the powers to facilitate the activity (where experts largely observed the process), the level of farmer interaction was high. The farmers were open to each other, they guided each other, they admired each other's work, argued on contrary views or observations and criticized each other when things were not done right; they were able to draw lessons from the activity and even chose the treatments they wished to scale to their main plot"

A different mechanism is exemplified by Seed Systems-Mali, which holds annual feedback and planning workshops where farmers and other actors are brought together to discuss results and plan for the next season. This too requires good facilitation that is sensitive to local power dynamics and farmer needs. This project spoke of a process by which farmers became more confident to express their opinions and other stakeholders (researchers or officials for example) became more open to farmers' perspectives (they became *décomplexés*). In order to enable facilitators to engage in this style of facilitation training and capacity building is needed to support this process. Through a research process that is relevant, accessible, and well-facilitated, farmers can learn principles of research that they can then continue to apply beyond the research project itself. If farmers are engaged, they develop a sense of the benefits of research as an ongoing process in which they are full participants, rather than viewing research activities as aid that they receive. In their principle 1 write-up, FRN-NGO observed that, "Over time, farmers develop nuanced understanding of the difference between research and development. Research: finding solutions to the problems. Development: applying products of research that bring benefit."

This strong understanding of research principles, instilled from the earliest stages of the research through the creation of structures and activities that are sensitive to farmer interests, needs, and abilities, can help farmers internalize the purpose of research as a flexible process that can help to address any problem. This process builds an understanding that can then be applied to other situations

and problems they may have. Principle 2 builds on the farmer-centeredness of this principle to describe what effective FRN research looks like.

Principle 2

***Research** is rigorous, democratized, and useful, providing practical benefits to farmers as well as insights on biophysical and social variation.*

Principle 2 characterizes the research aspects of a farmer research network. The operational subprinciples describe the crucial features of research for an effective FRN: it addresses farmers' problems, while being rigorous, participatory, and informed by the knowledge of all involved stakeholders. **This principle suggests the importance of local contexts, being flexible, and adapting research methods to fit farmers' capacities.**

Local Context

All the deep dive projects reported that **the identification of research topics (priorities) needs to be based in local contexts, including locally-defined socio-economic and biophysical diversity.** To represent farmer diversity, they reported the importance of understanding the categorization that is meaningful locally as a way of addressing farmer problems, maintaining fidelity to principle 2.1. Building a nuanced understanding of local biophysical and socio-economic diversity can be used to engage a range of participants who are representative of the community during the scoping stage, and also to understand the local criteria represented among those already engaged. By involving a diversity of farmers, research quality is enhanced and the research can be refined on a continual basis, to ensure it is adaptive to farmers' contexts and needs.

Best Bets III designed and implemented a wealth ranking exercise for local farmers, to better understand the range of farmer types in the communities where the project is implemented, in order to design research activities with groups representative of the range of farmers and their concerns. Project leads explained that "basically, instead of going [to a community] with prior understanding of answers we want to get, we engage farmers in that process, and involve them in articulating about their situation." This sort of full situational analysis takes 2-3 months (or more), which requires resources and patience. If a project desires speedy results, there are tradeoffs. Deep Dive projects have noted that sometimes, in the interest of making quick headway on the research front, farmer engagement is sacrificed, which compromises principle 1. Going slowly may ultimately be the best way to go quickly, to ensure that farmer interests are represented in the entire research process in a truly participatory way.

In another example, PAR-FRN used agricultural calendars as a tool to facilitate learning with farmers about local concerns and practices. This exercise allowed researchers to get a full picture of farmer activities across the year and in response to specific constraints, and led the project to see that the problems they initially planned to focus on were not the same as farmer priorities.

Principle 2.3 encourages projects to work with farmers in diverse social and biophysical conditions and to plan to collect data on both technical and social issues, which can help inform later analysis. Gender diversity is one dimension of social diversity that is important to pay attention to. For example, Seed Systems-Mali found that in order for their research to effectively "include women, it is essential to take their requirements, priorities and perspectives into account: selecting under low P conditions before entering new varieties into these trials; working with gender-differentiated groups for the evaluation of the first stage of trials. Conducting grain quality evaluations with women, and culinary evaluations with

women and men." Since women in that context grow under different conditions and for different ends (the least fertile soils, and as a market crop to get cash to purchase ingredients for the sauce – men being responsible for providing most of the staple grains eaten at home), their interests and values are markedly different and must be considered.

Flexibility

To balance rigor with democratization, as encouraged in principle 2.2, the **data collection tools need to be practical for farmers to use, and need to focus on the most useful data for farmers** – and therefore require negotiation and flexibility among all actors. Deep Dive projects reported success with adapting data collection tools and processes as needed from year/season to year/season, depending on how well they work for farmers.

Achieving data uniformity when working with farmers in different social and biophysical contexts is not always possible, though there are steps that help support those efforts. One interesting observation is that social capital is essential for research rigor. Deep Dive projects reported that farmers often work as groups, helping each other and making sure each person is following agreed protocols. Best Bets, for example, noticed that groups of farmers would monitor each other's fields and intervene if other farmers veered too far from the established protocols.

Dialogue among stakeholders is also important for quality research, as suggested by principle 2.3. Discussions on how to do research and why research needs to be done a certain way helps to facilitate consistent practices for data collection and record keeping. It may be that farmers already have a good sense of the importance of some research principles, such as comparing results from different treatments. However, even with the adaptations made to accommodate farmers' interests and abilities, this principle directs projects to ensure that research is still based on sound research principles and procedures – informed by the values and interests of researchers as well as farmers.

Certain steps help to ensure rigorous, democratized research that is focused on understanding variation. Deep Dive reporting often focused on the importance of controls during this stage of the research. For example, Best Bets III trained farmers on the principles of comparisons/controls in experimentation, and then allowed farmers to decide which control to use. However, even with that understanding, effectively implementing a control still presents challenges. The concept of a control is not always easy to explain to people with little prior exposure to scientific principles. Best Bets III reported that "questions which were being raised included, what should this control look like? Do we all have enough land for the control? Do we all have the materials needed for establishing the control? Is there enough labour to establish and manage a plot whose results you already know that there will be poor performance?" Sometimes research principles are at odds with farmers own conditions; rather than having farmers imitate a research design because an outsider says it's the correct way to do it, it seems more effective to plan activities that share the reasoning behind having a control plot, so farmers understand why it's necessary. In this way, the quality of experimentation and research capacity improves over time.

Adaptability

As monitoring and data collection tools are implemented, pay attention to how farmers are using them, and adapt as needed. Recognize research capacity of farmers and adapt methods and tools to accommodate them. For example, rather than relying exclusively on written data collection methods,

appreciate that useful insights can come out through discussion. Discussion is a valuable resource especially when literacy levels are low and farmers depend on memory. FRN-NGO applied this observation in its creation of data collection tools for farmers. The project developed a visual tool for understanding and documenting different types of bean pests. This project worked with a large number of farmers and collected a large amount of data, eventually hiring a data manager, so it was especially crucial that they figure out an efficient and consistent way for farmers to record results.

It is also important to consider other barriers to effective use of data collection tools. Technological issues related to internet access and cell phone use/connectivity may need to be addressed for effective implementation. Considering some of these barriers, FRN-NGO decided to have clear distinctions between what farmers are responsible for collecting (ratings on pests and diseases, grain yield, taste and preference) and what NGO extension officers are responsible for (household and individual data and soil fertility). This project then identified a system to collect and store data, ultimately relying on a data manager to help facilitate this process while still making data collection procedures accessible to farmers.

There may be an assumption that farmers aren't capable of rigorous analysis – and if 'rigorous analysis' is defined as running regressions through SPSS, that is probably true. But farmers are capable of other sorts of analysis, and considering this capacity is crucial in developing activities to ensure that farmers analyze the data in such a way that answers the questions that are most pressing to them. This often requires some skillful facilitation. PAR-FRN reported that "after this initial phase, the farmers will have enough ideas/experience to design their own research activities. In all aspects of the FRN we are emphasizing learning by doing; meaning that while we are explaining the concepts of research, we are also carrying out simple research activities (eg. collecting larvae, then having a reflection about why we are doing this [research topic], how we are doing this [methodology] … This contributes to improved understanding by the actors, both in terms of the research objectives and the importance of their own participation in the process of collectively defining the problem, the research questions, and then working together toward solutions."

It is important to consider that farmers do not always adopt innovations as is, but sometimes make adaptations. **It doesn't necessarily compromise rigor if farmers apply research principles in a consistent way rather than just reproducing the technique.**

Best Bets III described how they adapted notions of rigor when designing their monitoring activities:

> There are variations among different typology of farmers and different farm systems regarding the area of scaling (size of field)… Our research tools will focus on observing scaling of ISFM principles rather than the traditional focus on adoption of technologies where the emphasis is on observing how similar the farmers have applied the technologies to the recommendations provided by formal research institutions. This is based on our observations that farmers do scale the principles which suit their contexts, yet agricultural experts tend to give a blind eye to the principles and focus on their recommendations.

Oftentimes focusing on complete adoption of a selected technology overlooks the specific adaptations farmers make to their contexts. Not every technology or innovation is going to be appropriate for every farmer.

Flexible and adaptable research, centered on farmers' own contexts and concerns, helps to facilitate the creation of projects and practices that adhere to Principle 2. Rigorous and useful research comes from approaches that balance researcher interests and skills with those of farmers. This balance emerges from adherence to Principle 3, which elaborates on how networks of diverse actors come together to engage in the research process.

Principle 3

Networks *foster collaboration and opportunities for learning and knowledge sharing.*

Principle 3 describes the networks that are built through FRN work. The operational subprinciples characterize these networks as 1) fostering genuine collaboration, 2) facilitating learning and sharing, and 3) engaging in integrated monitoring, planning, and evaluation. In many ways this third principle provides a framework for project stakeholders at all levels to come together to develop a network that ensures fidelity to principles 1 and 2. Key considerations include: understanding the shape and characteristics of the network; learning by doing together to shift mindsets for all stakeholders in the network; and paying attention to formal and informal methods of scaling.

In many ways, the networking principle was the most challenging for the Deep Dive projects to report on. Early in the FRN process, some CCRP stakeholders had the sense that the network in the FRNs was to help facilitate 'large N' studies, networking data from a range of farmers to provide important options by contexts, enriching research results. When reporting on Principle 3, Deep Dive projects rarely mentioned this sort of 'large N' work; rather, their emphasis was on processes of face-to-face interactions that facilitate scaling and ensure adherence to the farmer-centered and research-oriented first and second principles. Thus, in thinking about the network, they thought about networking people in order to work together, rather than networking structures that could share data broadly.

Network Characteristics

Deep Dive projects represent a range of types of networks. **While there is no single correct type of network for effective FRN work, these differences in networks are important in thinking through best strategies for fidelity to the first and second principles.** Crucial distinctions include: size of network; whether the network existed prior to the project; geographic distance and cultural differences among networked actors; and network functions within the broader agricultural community. In Appendix III we present four-squares outlining the range of FRN types, including network size, experimental approaches, and origin of research topics.

For example, Seed Systems-Mali was an existing project focusing on participatory breeding; incorporating FRN work was seen as a way to help further develop these farmers' seed systems, enhancing existing networks amongst farmers, seed producers, and seed marketing specialists. The network aspect of this project, then, explicitly focused on continuing to bring a range of actors together to build organizational capacity around seed systems. The fact that this project had long-term experience working with farmers and other stakeholders around these questions facilitated the enhancement of a large network; it helped to illuminate new networking structures important to the development of sustainable, culturally appropriate seed distribution systems, such as the creation of local seed committees that decentralize decision-making processes and support horizontal interactions among groups of farmers.

FRN-NGO is also a large-network project participating in the Deep Dive process. Unlike Seed Systems, though, this project created a network from scratch, which took time and the building of social relations between partners. This project works with five different regional NGOs to test a range of options around pest management and improved varieties; working with organizations already established in local communities helped to facilitate the extended reach of this project. The large number of participating farmers and the range of experiments the network conducted led this project to hire a data manager – an invaluable addition to any FRN project working with large and complicated data sets.

Both PAR-FRN and Best Bets III involved smaller networks, leading to different opportunities and challenges. Working with an already established cooperative of organic peanut farmers along with other local research organizations, PAR-FRN spent a long time in the early stages developing relationships and trust among these differently positioned stakeholders. Organizations were familiar with Participatory Action Research, but still needed some work to help 'outside experts' appreciate the power held by farmers in this research project. For this project, adherence to Principle 3 meant careful observations of network interactions in order to better understand how closely Principles 1 and 2 were being followed.

Best Bets III, like Seed Systems-Mali, was an established project in the region. Working with farmers in three different districts led to considerations of how best to encourage networked interactions among farmers in different areas. Ultimately this project found that working with 'localised networks' of farmers at the same village level, while also facilitating specific activities (joint experimentation, field visits and field days, and presentations of results) effectively bring together this range of different, local networks. Additionally, local social institutions and experienced facilitators were crucial to enabling the evolution to an FRN model of research, suggesting the importance of including a range of local stakeholders in FRN activities, not just those specifically oriented towards agriculture.

The important differences between the networks of each of the Deep Dive projects suggest that this principle has the most flexible interpretation. Rather than suggesting a network look a particular way in order to be an effective FRN, fidelity to this principle requires questioning how best to develop a network that fosters adherence to principles 1 and 2. The network, including not only farmers but also a wide range of actors, collectively engages in activities that help to ensure fidelity to the first two principles.

Shifting Mindsets

It is crucial to work towards a shared understanding within the network that farmers are capable and competent to conduct research. This shared understanding across the network is what ensures fidelity to principle 1. Building mutual respect among all actors is crucial to facilitating horizontal interactions and authentic collaboration. **A range of actors participating in the network must be included when working towards this cognitive shift: not only farmers but also community leaders, professors, students, technical advisors, extensionists, and others.**

An important first step for fostering the genuine collaboration suggested by principle 3.1 is building the capacity among all stakeholders to engage as equal partners. Deep Dive projects all reported that **continuous doing and learning together fosters trust and authentic engagement through interactions across the network**; the value that farmer inclusion is an important should be demonstrated through activities that are focused on equalizing power dynamics among farmers and other stakeholders. This process entails shifting mindsets regarding who can carry out rigorous research. PAR-FRN conducted "a

workshop on beliefs and myths held by all of us about who can carry out rigorous research and who is prepared to respond to issues associated with agricultural production." FRN-NGO found that these sorts of joint activities among a range of stakeholders leads "farmers to feel that their core farming issues are being addressed," again suggesting the importance of the network and its activities in supporting fidelity to principle 1.

This process also has important implications for fidelity to principle 2. **Effective research design that fully includes farmers has activities that involve learning by doing, especially at the study design stage.** Encouraging farmers to work together with other stakeholders across the research process contributes to building the skills and confidence for all stakeholders to implement their own experiments over time; this is a process that takes time, but it the Deep Dive projects found that it was time well spent. The above practices contribute towards improved understanding by the actors, both in terms of the research objectives and the importance of their own participation in the process of collectively defining the problem, the research questions, and then working together toward solutions. **This process of learning by doing together builds the capacity to bring different forms of knowledge into dialogue**. Deep Dive projects continue to develop and implement activities that ensure that all stakeholders are in regular conversation with one another. It is important to maintain an open dialogue with everyone around the 'what', 'how', and 'why' of the research process and the objectives of the FRN in order to build and reiterate a shared understanding of principles and purposes.

Scaling

The FRN research process not only impacts participating farmers, but also the broader local community. **If farmers are fully engaged in research, and if research is rigorous and democratized, scaling and expansion of the FRN activities is embedded in the research process**, ensuring fidelity to principle 3.2. Paying attention to how things are informally scaled among non-participating farmers can help to illuminate the aspects of the research that farmers find compelling and useful. FRN-NGO, for example, observed informal scaling through natural social networks, sharing seed from varieties that performed well in the FRN experiments.

Local communications networks, either through informal information sharing or through radio or print media, can help to share innovations effectively and offer a public recognition of the research efforts of local farmers. Support for building or enhancing these local communications channels can help scaling. Developing activities such as workshops or field days for participating farmers to present their results can again help to facilitate interactions between different stakeholders and encourage scaling out to other, non-participating farmers, not only in terms of practices but also in terms of networking with other stakeholders beyond their peer farmers. Seed Systems-Mali, for example, uses these sorts of group events to analyze and share results, involving a range of stakeholders. Indeed, the efficacy and importance of the farmer organizations has had an impact on the larger agricultural community. The project has observed the seed organizations distributing seed following more local conventions (gifting, rather than selling), and farmers who aren't members of the core organizations conducting their own experiments on varieties, with the support of participating farmers.

PAR-FRN also observed many benefits of this process in terms of scaling out research activities:

> Many of them [farmers] engage in other, further activities, beyond what had planned. [This] includes scaling, policy, infrastructure, new research, change in practices of researchers, etc. After

this initial phase, the farmers will have enough ideas/experience to design their own research activities.

This ability to apply research principles to local problems is a crucial outcome of FRN work, and the network seems to be the vehicle for supporting this capacity. It appears that a strong network supports effective, contextualized scaling. The third principle emphasizes what the network must look like to ensure fidelity to principles 1 and 2. All three principles combined work towards building a research process that is equitable, bringing farmers fully into a research process based on sound, adaptable research principles that can then be applied to a range of problems by bringing together the different capacities and resources of network partners.

Farmer Research Networks should be true collaborations, with research questions and processes that address farmers' most pressing concerns while also contributing to the building of the global knowledge base. The principles discussed above outline considerations that can lead to the most effective ways for co-creating knowledge and for building smallholder farmer capacity to be lead agents for change.

Conclusion

In examining each FRN principle in-depth, this process has revealed how connected they are, and often difficult to parse out. The network partners and their priorities influence the research topic, design and process; the research process has an impact on how deeply farmers can be engaged, and often requires adjustments to facilitate their participation; and the ways in which a representative group of farmers are involved has repercussions on research design and process. All of these together challenge researchers, NGOs, field staff, farmer organizations and other stakeholders to question their usual ways of working and to work together to build new agreements, new relationships and stronger more connected networks. This often requires new "soft" skills: in facilitation, in negotiation and mediation, in attitudes, and more. And it also requires different skills that enable researchers to flexibly adapt their methods to the priorities and needs of farmers. In addition, all stakeholders may need to experiment with different ways to communicate findings, to scale out innovations, and to more generally share the new knowledge that is being generated through these FRN projects.

The deep dive process with these four groups provided a wealth of thoughtful reflections and observations that can be shared across all CCRP projects. It is, however, only a small sample of the FRN projects. There are many more, also making insightful observations and developing their own tools and methods. Each FRN project to date is unique and often quite different from the others. The potential for learning is great and is being realized through many different processes and in many spaces, from in-person conversations to groups discussions on-line, from working group meetings to CoP meetings, from global convenings to RMS workshops, and much more. This synthesis report is intended to contribute to that learning by providing a "deep dive" into a subset of projects who shared generously of their time and work.

Guidelines and Tools for FRN Work, by stages

Below we have pulled together some preliminary guidelines for developing FRNs, along with example tools provided by Deep Dive groups. Deep Dive projects reported on their activities and learnings for each of the five stages of research, presented in the 'flower framework' below.

One key learning from the DD work is that these stages of research overlap in the FRN process. Work in earlier stages needs to consider plans for future stages. Plans for work in later stages need to be adaptable, in order to incorporate learnings from earlier stages. The FRN research process may even not be linear; rather, projects may go back to earlier stages of work throughout the process, if necessary. The guidelines and tools below are not necessarily exclusive to the stages, but have been sorted in this way to emphasize the different considerations and activities appropriate for different moments in the research. The guidelines below are a preliminary set that could be built upon to develop a comprehensive set with input from a broader range of FRN actors.

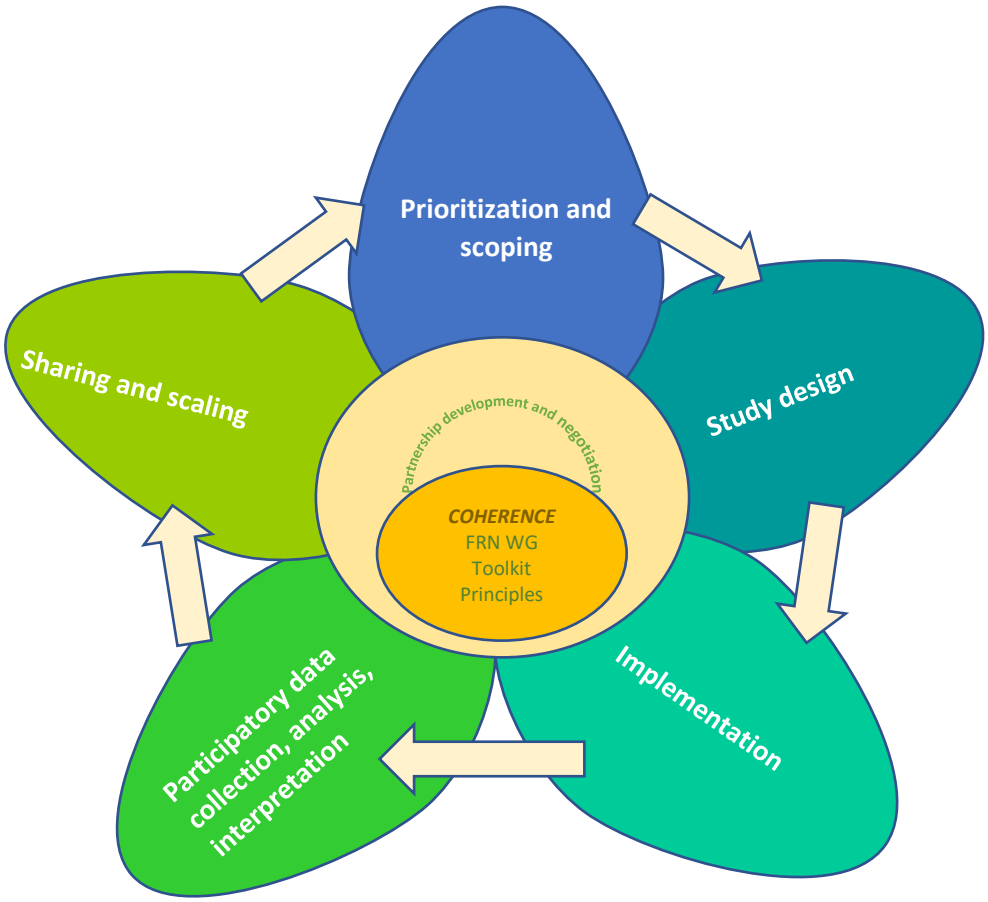

Figure 1: Flower Framework of Research Stages

PRIORITIZATION AND SCOPING

Guidelines

Establish FRNs based on reasonable alignment of interests among stakeholders. The operations of an FRN respects the agency of all FRN members.
Make efforts to understand barriers and facilitators to farmer participation, in order to design a project that is diverse and democratized.

Pay close attention to power dynamics within the network from the earliest stages.

Example Tools

BBIII *Tools for identifying farmers*: a set of tools including a wealth ranking exercise among farmers and community selection of farmers to participate

BBIII FRN *Diagnosis and designing/planning exercise*: an exercise to facilitate understanding of local context and to help define the research problem

FRN-NGO *Farmer Research Network Appraisal of preferred bean varieties*: a scoping exercise to help increase farmer information about best bean varieties

PAR-FRN *Agricultural Calendars*: a participatory tool to help determine which problems farmers are most concerned with.

STUDY DESIGN

Guidelines

Consider research design that can provide tangible results in a short span of time, including data collection protocols that will ensure that farmers are able to do analysis themselves without having to wait for researchers to report results.

Continue to work with farmers in diverse social and biophysical conditions, and plan to collect data on both technical and social issues.

Encourage farmers to work together with other stakeholders to design experiments, in order to help farmers develop the skills and confidence to effectively implement their own experiments.

Example Tools (methods, guides, literature, etc.)

FRN-NGO *Study Design with Farmers*: Two tools to engage farmers in study design in a participatory way.

IMPLEMENTATION

Guidelines

Put into place structures that are fully inclusive of farmers, with transparent decision-making processes.

As monitoring and data collection tools are implemented, pay attention to how farmers are using them, and adapt as needed.

Design activities with respect for a range of criteria. That is, some activities may be undertaken at a small, exploratory scale. Others may be undertaken at large scale.

Example Tools

FRN-NGO *Farmer engagement and experimental procedure*: Data collection and experimental protocols

FRN-NGO *Striga protocol*: Description of trials and process leading up to implementation

SS-Mali *Practical guide: Harvest procedure for pearl millet trials managed by farmers*: Instructions for farmers in experimental procedures

FRN-NGO *Experiment to compare new sorghum varieties*: Procedure for farmers to test sorghum varieties

DATA COLLECTION, ANALYSIS, INTERPRETATION

Guidelines

Take steps in earlier stages to ensure that it is possible for farmers to easily collect and analyze the data.

Consider the capacity of farmers to analyze data and facilitate the analysis process in such a way that it helps to answer the questions that are most pressing to farmers.

Develop workshops or other activities that bring together diverse stakeholders and forms of knowledge.

Tools

FRN-NGO *Sorghum Variety Trial Questionnaire:* Data collection form

SS Mali *Evaluation Sheet for small groups evaluating a trial*: Data collection form

SS-Mali *Sheets for taking notes*: To collect information at varietal selection events

SHARING AND SCALING

Guidelines

Discuss options for sharing and scaling with all stakeholders in order to understand and address the challenges and opportunities for scaling innovations.

Pay attention to informal scaling among non-participating farmers, to help illuminate which aspects of the research farmers find most compelling and useful

Develop activities such as workshops or field days for participating farmers to present their results to help facilitate interactions between different stakeholders and others in the community.

Tools

FRN-NGO *Tool for Farmer Exchange Learning*: An exercise to facilitate exchanges between different farmer groups.