Chapter 2

Scaling Up and Out the Impact of Agricultural Research with Farmer Participatory Research[1]

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Introduction

We can no longer claim that participatory research is a marginalized activity, because a sizeable amount of both budget resources and human capacity is invested in it. According to a survey in 2000, the Consultative Group on International Agricultural Research (CGIAR) reported 144 projects that involved participatory research, with a total budget of US$65 million (PRGA, 2000).

Despite many claims about the impact of participatory research, only a few published studies exist in the literature. The anecdotal evidence of the impact of participatory research needs to be verified, especially if we are interested in its mainstreaming. For the approach to be institutionalized, decision makers need to have good evidence, that is, what works, what does not, and with what impacts, and how participatory research and gender analysis (PRGA) may or may not contribute to scaling out and up.

This chapter uses examples from empirical impact studies that the CGIAR Systemwide Program on Participatory Research and Gender Analysis (SWP-PRGA) Program and the Impact Assessment Unit of the International Center for Tropical Agriculture (CIAT) have conducted in collaboration with many partners to illustrate how and when user participation has potential for contributing to the processes of scaling up and out the impact of agricultural and natural resource management

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(NRM) research. Scaling out in this context implies the geographical spread of PRGA methods through replication and adaptation, and scaling up is taken to mean the adoption of PRGA methods at a higher organizational level (Menter et al., this volume). The scaling up and out of methodological innovation is integrally linked to perceived benefits of the method over conventional methods of agricultural technology development.

The chapter is divided into three sections. The first provides the context for the empirical examples by outlining what implications participatory research has for scaling out and up the impact of agricultural and NRM research. Next, some empirical examples are drawn from two plant-breeding projects and two NRM research projects. The concluding part summarizes some key lessons emerging from empirical results.

Conceptual Framework

Many definitions are available of the types of PRGA, but a basic distinction is always made between functional and empowering approaches. Many of these typologies define PRGA in terms of the nature of the communication, interaction, and decision-making process between scientists and end users (Biggs, 1989; Lilja and Ashby, 1999).

The impacts of PRGA are influenced by the nature of this interaction, but also at which stage of the innovation this interaction takes place.[2] Why does the nature of the interaction and the decision-making process matter? It is assumed that the type of participatory research approach (functional or empowering) and the stages when it was applied, influence the process of innovation, and lead to some intermediary process impacts. For example, the research objectives of projects are consistent with the needs of clients because they are involved in the project planning. This allows the feedback of information back to research, and social and human capital formation impacts, such as that the participating clients are empowered to carry out some of their own experiments, and seek and find solutions on their own.

From this process, which is shaped by the participatory approach used and stage of research when applied, some benefits will accrue from research outcomes (adoption) or technology impacts. The adoption impact will influence the welfare outcome of the project in terms of who benefits, or how benefits are distributed among the end-users of the technology.

The process and technology impacts can contribute to both scaling out and scaling up of impact. Feedback to research can help in the process of scaling up the research methodology, because it can change priorities and

2. Technology innovation is a process in which the problems are identified, solutions are found and tested, and as a result, the target group adopts a technology or other type of innovation.

practices within research and development (R&D) institutions, and hence influence the technology design and process or scaling out. The research process, which builds local capacity to experiment and adapt (human and social capital impacts), individually and/or collectively, is a benefit in itself, but can also help the scaling out process of technology adaptation. If collective action is important, then social capital impacts are very relevant to scaling out technology.

Technology impacts are particularly relevant to scaling out. Obviously, having a better technology makes it more likely that people will adopt it, in greater numbers, and at a faster rate. Targeting the technology towards specific beneficiary groups increases the probability that it will be adopted, and generates impact among users.

Examples of Scaling Out and Up

Scaling out the impact of barley breeding

The International Center for Agricultural Research in the Dry Areas (ICARDA) has used decentralized-participatory barley (*Hordeum vulgare* L.) breeding in Syria since 1996.[3] The barley breeding program has evolved from centralized to decentralized breeding, and then to decentralized participatory breeding. The latter began when the initial 208 barley lines were planted on farmers' fields in nine villages throughout Syria in 1997. The participatory barley breeding at ICARDA can be described as currently operating at a "sustainable rate". That is to say, that it is not in its transition stage, but that the participatory research has been institutionalized in the breeding program. Participatory breeding methods are now used in ICARDA's work in Syria, Tunisia, Morocco, Yemen, Eritrea, Egypt, and Jordan.

According to ICARDA's current breeding approach, each year a large sample of barley lines are planted on a farmer's field in several locations, and they are called farmer initial trials (FIT). These barley lines are a random sample representing the initial stages of the breeding process, that is, lines that are normally planted at the research station. The lines represent different types of germplasm—2- and 6-row, modern and landraces, uniform lines and segregating populations, black and white seed color. The materials, which farmers select in the FIT, are then planted in the second year in fields of several host farmers at each location. These are called farmer advance trials (FAT). Material selected from the FAT enters the farmer elite trials (FET) in the third year. Each year, a new FIT is also initiated that sets off the advanced and elite trials in the subsequent years. The breeders' role is to make the initial crosses and

3. The results of the participatory plant breeding (PPB) at ICARDA have been widely published, see for example Ceccarelli et al., 2000. A complete impact study of the ICARDA PPB is forthcoming in 2003 (for preliminary results, see Lilja and Aw-Hassan, 2002).

increases on station, provide genetic material for the trials, and keep records about the agronomic characteristics of the lines. The farmers' role is to manage the trials, select, and record their selections. Breeders and farmers together discuss and decide what materials go to different trials.

Long, variable, and uncertain lags occur between commencing a research activity and generating useful knowledge (technology) and seeing it adopted, and hence yielding eventual research benefits. The ICARDA barley breeding case shows that the structure of participatory plant breeding (PPB) itself has the potential to reduce the R&D lag, and so corresponds to an early flow of research benefits, and ultimately higher returns to research investment.

Figure 1 shows the structure of PPB as compared to conventional breeding at ICARDA. It illustrates how the R&D lag differs between conventional and participatory approaches. The first 2 years of the research structure are the same, the crosses are made, and initial increases are made on-station. Then ICARDA's participatory barley breeding takes the lines to farmer selection in year 3, whereas on-farm testing in conventional breeding takes place 3 years later, in year 6. This means that decentralized participatory research has potentially a 3-year reduction research lag.

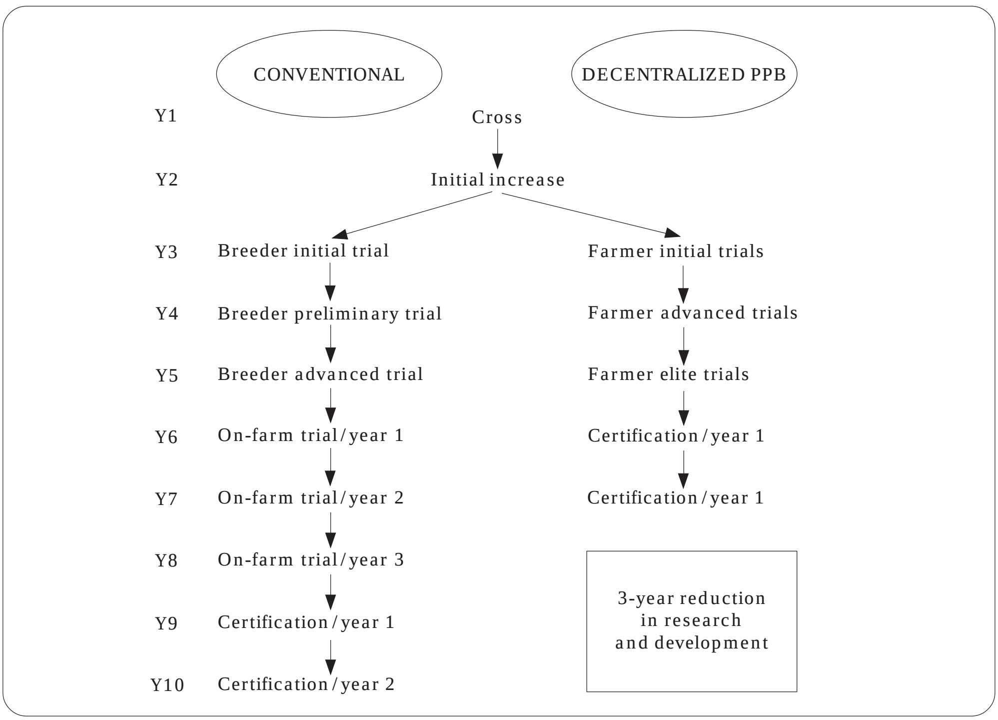

Figure 1. Structure of the past and current barley participatory plant breeding (PPB) program of the International Center for Agricultural Research in the Dry Areas (ICARDA).

The conventional breeding research lag is 8 years at the minimum. After 8 years, 2 more years of large-scale testing follow before a variety can be released. If single plant selections are made, then the pedigree method adds at least 3 more years because materials are not bulked until year 5.

One of the most robust findings of the economic theory of innovation diffusion is that the technology adoption follows an s-shaped curve (Mansfield, 1979). When the technology first becomes available, usually a small group of farmers will adopt immediately, or after short experimentation. These are known as "early adopters". As time passes, a much larger group of farmers will adopt, and they can be called "mainstream adopters". Lastly, a few farmers are always very slow to take advantage of new and emerging technologies, and often wait until the technologies are "mature".

The ICARDA case provides some evidence about how participatory breeding may increase returns to research by shifting the diffusion curve through adoption occurring earlier in time, as well as at a higher rate, and increasing the maximum area under cultivation in the new variety or in the numbers of farmers adopting. The speed of barley adoption developed under the conventional breeding program has been 3% per year, and the adoption ceiling for modern barley varieties developed through the conventional breeding program has been 25% of the barley area (Aw-Hassan et al., 2004).[4] A 2001 survey of 86 farmers, who took part in ICARDA's participatory barley evaluation research, assessed the adoption potential of the new barley lines the farmers had seen in the ICARDA PPB trials (Lilja and Aw-Hassan, 2002). The participating farmers expect a 26% yield increase of the new barley over their local variety; this is quite high over the breeders' moderate estimate of a 10% yield advantage. The participating farmers estimate that they will plant 69% of their total barley area in the new barley lines, after their own initial 2-year experimenting period. This 69% represents the adoption ceiling, and it is 44% higher than the 25% ceiling rate of the varieties developed by the conventional breeding program. The participating farmers were also willing to pay a 24% premium on the new barley seed over the locally available seed.

The results of the economic surplus model show that the discounted, research-induced benefits to Syrian agriculture from conventional barley breeding are US$21.9 million. The model results also show that the benefits in reduction in research lag and 10% yield increase, due to participatory research, increases total benefits by 90%. The higher adoption ceiling for the participatory breeding as compared to

4. A 5-year seed tracer study, done by ICARDA since 1994, which followed released varieties over time, was an important basis for modeling the adoption profiles for different breeding approaches, that is, the speed of adoption and the adoption ceiling, or the maximum amount of area planted in the new cultivar. The study tracked the adopting pattern of the seed that was distributed to 52 farmers in 1994 in five provinces of Syria, and the seeds were traced yearly until 1999.

conventional breeding increases the benefits a further 50%, and if we also allow for faster adoption speed, the benefits are increased by 260% compared to conventional breeding. These are *ex ante* estimations of the potential benefit of PPB, and realizing these benefits partially depends on the functioning extension and seed systems—since without them, autonomous diffusion may be slow, and the benefit forgone is then simply a cost.

The ICARDA 2002 barley breeding budget of US$1.5 million devotes 47% to personnel costs, 30% to overhead, and 23% to operational costs. Analysis showed that the shift from conventional to participatory research increased the operating costs by 56% (US$122,154). Further calculation shows that the move from conventional to participatory breeding only increases the total breeding budget by 2%.

Scaling up the impact of rice breeding

By 1996, the West Africa Rice Development Association (WARDA) had made significant and breakthrough advances in plant breeding by developing interspecific hybrid rice (NERICA, New Rice for Africa) by crossing Asian varieties (*Oryza sativa* L.) with traditional African rice (*Oryza glaberrima* Steud.). The same year, the WARDA upland breeder and production economist attended a seminal meeting of the SWP-PRGA at CIAT. The WARDA researchers then developed a 3-year participatory varietal selection (PVS) and breeding approach, which it implemented in its 17-member, national agricultural research systems (NARS) programs. In the first year, a centralized village plot is identified with local farmers, where a rice garden is established with about 60 upland or lowland rice varieties. Men and women farmers are invited to visit the plot as frequently as possible, but formal plant evaluations are held at three stages during the season. In the second year, each farmer receives the varieties s/he selected in the first year, and thus a new diversity of varieties enters the locality. During the second year, observers visit the field to record performance indicators and farmer appreciation of the varieties. At the end of the season, and in anticipation of the third and final year, the farmers' willingness to pay for seed varieties is elicited in order to derive an estimate of technology demand.

WARDA has been successful in scaling up participatory rice breeding in West Africa. By 2000, WARDA's national partners were conducting upland, lowland, and irrigated PVS trials in some 100 sites in 17 West African countries, and had involved more than 4000 farmers in the evaluation of improved rice varieties (Figure 2).

Input from farmers led to stated changes in the breeding program, and added value to scientists' work in terms of improving the understanding about farmers' preferences. This has led to real changes in breeding goals in 50% of the 17 West African national programs. In 25% of the cases, the breeders and social scientists from national programs said that they had not changed the breeding goals, but that the farmer input confirmed that their breeding goals were already consistent with farmers' needs (Lilja and Erenstein, 2002).

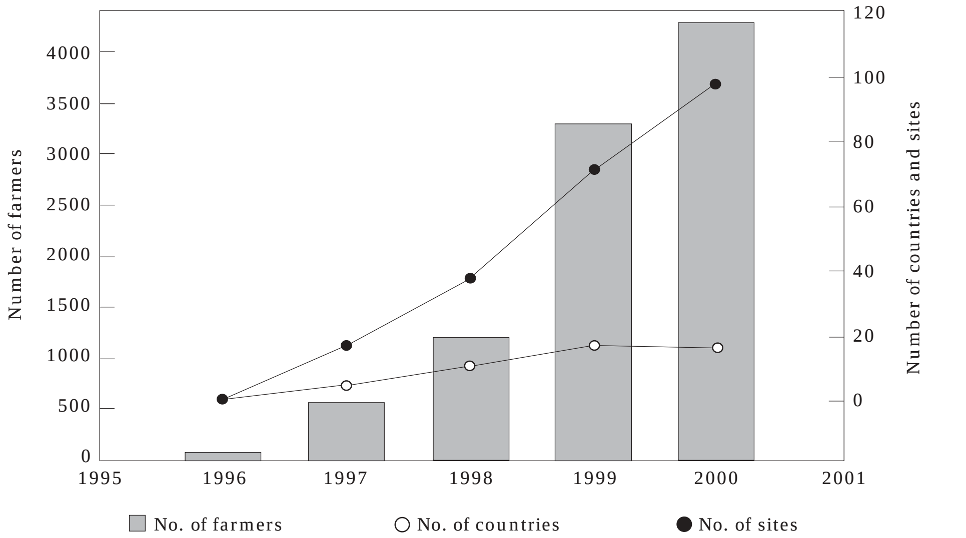

Figure 2. West African farmer participation in rice improvement research sponsored by the West Africa Rice Development Association (WARDA), 1996-2000. (Data from WARDA)

The 17 West African NARS all followed the same research design in their model. According to their common model, gender analysis (GA) was a required part of the research. All programs received training in GA, and half of all the farmer participants were purposely selected among the women. Sixty-nine percent of the breeders and social scientists said that doing GA and involving women participants had made a difference in terms of what they had learned, and its subsequent implications and changes to the rice breeding objectives. They cited several examples; one was that, in the past, breeders had selected out rice varieties with "spikes" or awns because they were not a preferred plant architecture type. Guarding against birds is women's responsibility, and given that their labor is limited, they prefer the longer awns. Having learned this, breeders now are including the long awn plant types to their breeding program.

Some of the success factors for the rapid and large-scale institutionalization of participatory research in West Africa can be drawn from WARDA's experience. First, WARDA is a "unique" CGIAR center because it is an association of member states, and has a governing body of Council of Ministers, hence it benefits from constant and open dialogue with policymakers. Second, there is also an established pre-existing network of regional professionals, national program scientists, who are used to working together, and are often convened at WARDA for various planning and training exercises. This tightly knit group of professionals is used to working together, which further fosters and promotes peer acceptance of new approaches, and allows rapid movement to large scale in research efforts. The benefits of social networks for innovation diffusion are well-established phenomena in the sociology literature. Third, since 1997, all national program partners have received training (one breeder and one social scientist each) in PRGA methods at WARDA during the annual Participatory Rice Improvement and Gender Analysis (PRIGA) training, reporting, and planning week. In addition to advantages from continuous training in methods in building researchers' human capital, regular meetings reinforced group cohesion, which in turn fosters both peer acceptance of, and peer pressure for, innovations. Fourth, WARDA had a new exciting and superior technology (NERICA) to offer to the national programs and farmers. Farmers were engaged at a rather late stage of the research process—the adaptive stage. The breeders selected their best-bet varieties for testing with farmers and, in this case, their selections were highly correlated with farmers' preferences. Fifth, upland rice farmers in West Africa were faced with declining yields and lack of suitable planting materials, so there was an acute need for new cultivars in West Africa that undoubtedly contributed to increased acceptance of the NERICA. Sixth, national varietal certification and release boards in most West African countries were deemed inefficient and participatory research was seen as a method to bypass the inefficient system and go directly to the farmers. Seventh, WARDA gives each country a small grant each year (US$3000), which allows national programs to work off station and conduct PVS trials with farmers.

Scaling out soil fertility research

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Mother-Baby (MB) trial model is a methodology designed to improve the flow of information between farmers and researchers about technology performance and appropriateness under farmer conditions (Snapp, 1999). The methodology was initially developed and implemented to test legume-based soil fertility management technologies in Malawi in 1997. The mother trial is researcher-designed, and conforms to scientific requirements for publishable data and analysis. A baby trial consists of a single replicate of one or more technologies from the mother trial. A single farmer manages each baby trial on his or her own land. The MB trial design has gained significant popularity among researchers in recent years in several CGIAR centers, and hence it is important to consider its potential contribution to scaling out impact.

Because no formal dissemination program has been based on the results of the MB trials in Malawi, the spontaneous local adoption and diffusion in the communities where the trials took place is discussed here in order to consider the implications of the MB methodology to the scaling out of impact. Although lack of a diffusion program that addresses constraints, such as credit and seed availability, may limit observed adoption, spontaneous local adoption is usually a good indicator of the adoption potential of a technology. No spontaneous local adoption would suggest low probability of success even with a well-designed extension program.

In order to assess spontaneous adoption, a few weeks prior to the planting season, respondents were asked what they were planning to plant (Johnson et al., 2000). The survey of baby-trial farmers showed that only two out of 40 cases surveyed planned to adopt one of the legume best-bet technologies tested in the MB trials—maize (*Zea mays* L.)/pigeon pea (*Cajanus cajan* [L.] Millsp.) intercrop. However, evidence shows that farmers are testing the technologies, and shows a high level of partial adoption in terms of incorporating crop residue that was part of the technology package tested at the MB trials. The survey results also show that the MB methodology is associated with widespread dissemination of knowledge of the technologies through informal social networks. Although adoption of technologies tested remains limited, knowledge of the technologies is much more widespread. As expected, it is significantly higher in the project villages (varying from 45% to 96%) than in the controls; however, it is high in control villages as well (ranging from 36% to 70%).

Many people reported visiting the baby trials rather than the mother trials, which suggests that this methodology may be more effective than a traditional test or demonstration plot in disseminating information about new technologies.

ICRISAT's initial experience with MB design is a case where scientists' best-bet technologies had very low farmer acceptability because farmers' opinions did not coincide with researchers about which technology was most preferred, based on farmer-defined criteria. Farmers preferred a technology that was lower yielding, but that was perceived to be less risky. The MB approach was successful in quickly "discarding" the technologies that were not acceptable to farmers. In order to appreciate this result, one needs to consider the costs avoided as a "benefit" from discarding technologies that have a low probability of succeeding. These costs would include the further development and dissemination of these best-bet technologies through the R&D channels.

Scaling up integrated sweet potato management

During 1995-97, the International Potato Center (CIP, the Spanish acronym), in collaboration with public and private sector groups, implemented a project to develop a protocol (curricula) for a sweet potato (*Ipomoea batatas* [L.] Lam.) farmer field school (FFS) in Indonesia. The project used participatory approaches at all stages of the research process: Needs assessment and project design, R&D of technologies and practices, design of farmer learning protocols applying the FFS approach, pilot-scale implementation of the sweet potato FFS, and monitoring and evaluation. The CIP project highlights the benefits of involving end-users in the research process at a very early stage of the research. The project changed its focus from integrated pest management (IPM) to integrated crop management (ICM) as a result of user input gained from individual and group interviews and detailed production data. The change involved broadening the scope of the field school curriculum from pest management alone to include varietal selection, seed and plant health, nutrient management, and economics and marketing.

To scale up (institutionalize) the sweet potato FFS model that was developed, and allow for large-scale farmer learning and implementation, staff from the national IPM Program's local NGOs underwent FFS facilitators' training. A survey of ICM-FFS participants in 2001 showed that the number of beneficiaries has increased because technologies are more relevant to farmers' priorities. As compared to the conventional IPM-FFS, farmers who attended the ICM-FFS liked the aspects of FFS curricula that were added because of the input from farmer researchers. The expansion from IPM to ICM increased the number of people that the technology reaches by increasing the range of problems for which the technology is relevant.

The farmers who attended the improved FFS benefited; in the analysis of the impact of the implementation of six sweet potato ICM FFSs, participation in ICM was associated with 44% higher net returns per hectare from sweet potato production. The results also show that the farmer-researchers who developed the FFS curricula benefited significantly from their participation in the research project; they formed strong bonds with researchers and with the other farmers, and continued to maintain them after the project ended. Their roles in their communities also changed, relative to other farmers and to officials such as extension agents. The farmer-researchers are sharing the benefits of their increased knowledge and skills with the rest of the community. However, it would be incorrect to interpret this as an increased human capital impact of participatory research alone, because it appears also to be a consequence of existing modes of social interaction (Johnson et al., 2000).

Conclusions

The empirical examples presented here lend support to some specific conclusions about the role of participatory research in scaling out and up the impact of agricultural research. The degree of confidence a researcher has on the best-bet technology options available to farmers should influence the decision about the stage of farmer involvement. Both WARDA and ICRISAT involved farmers at a very late stage in the innovation process, and offered “finished” or best-bet technologies, with different results. In WARDA’s case, NERICAs, which were developed through the conventional breeding approach, were quickly tested and found to have high farmer acceptance. This is also an example of how “conventional” research and participatory research compliment each other, and how participatory approaches can add significant value to conventional research processes. High farmer acceptance, combined with the acute need for new varieties, was one of the contributing factors to scaling up the participatory rice varietal selection methodology in West Africa. In contrast, ICRISAT quickly learned through MB trials that their best-bet technologies had low farmer acceptance, which benefited research in terms of costs avoided from developing technologies that had low farmer acceptance.

In contrast, both CIP and ICARDA involved farmers very early in the research process. When research and extension are farmer-led, or when participatory research has a specific empowerment or farmer capacity-building element, the process of participating and engaging in research can have a significant impact on farmers’ human and social capital, hence creating the basis for sustainable local innovation through enhancing learning capability and knowledge generation in rural communities.

Finally, the importance of social networks in the agricultural innovation process is evident, both in terms of formal networks, as in the case of WARDA, or informal, as in the case of ICRISAT. In West Africa, this wide professional network allows rapid information creation and dissemination. The members of this social network communicate with ease, which in turn promotes social support as well as social pressure to change.

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