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INCREASING THE IMPACTS OF PARTICIPATORY RESEARCH

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SUMMARY

Farmer participation in agricultural research can improve the efficiency and impact of the research. This functional component of participatory research includes the identification of traits that guide crop breeders' work. Participatory research can also lead to farmer empowerment, although when carried out by research organizations, direct empowerment is often limited to relatively few farmers. Farmer empowerment is, therefore, best carried out by development organizations whose longer-term interaction with farmers is likely to ensure that greater numbers of farmers benefit. Hence, research organizations ought to focus on the functional components of participatory research along with the empowerment of intermediate/partner organizations rather than the direct empowerment of large numbers of farmers.

INTRODUCTION

This paper discusses farmer empowerment as a primary objective of participatory research carried out by research organizations. Farmer participation in agricultural research can be defined as a systematic dialogue between farmers and scientists to solve problems related to agriculture, and ultimately to increase the impact of agricultural research. While internal rates of return and cost–benefit analyses may have been sufficient for the accountability functions of impact assessment, they do not satisfy those interested in knowing how and why a project affects farmers' lives. Impact assessment practitioners must now document a much broader range of project impacts, especially in the area of poverty alleviation.

One need is to identify the impacts of participatory research in agriculture on rural innovation capacity. Rural innovation can occur in two ways: firstly, when external, new technologies become more accessible, e.g. as a result of lower costs of adoption, and secondly, when a new technology is developed locally, e.g. due to an increase in the local capacity to adapt or develop new technologies. Different actors can be involved in reducing the costs of adoption of new technologies, e.g. research and extension organizations, private companies and farmers' organizations. The use of participatory approaches is one way of enhancing rural innovation capacity, whether through increased accessibility of externally developed technology, the joint

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development of relevant and appropriate technology by farmers and scientists, or through enhanced local capacity to address problems and devise solutions for them.

Participatory research is a tool to increase the efficiency and impact of agricultural science and technology. Its effectiveness depends on it becoming an integral component of the development and diffusion of agricultural innovations based on systematic feedback loops that link the 'formal' with the 'informal'. Participatory research can be divided into 'functional' and 'empowerment' purposes (Lilja and Bellon, 2006). The functionality of participatory research can be seen as having an upstream focus: in the case of participatory crop research, for example, it helps breeders identify the farmer-valued traits that breeding programmes should focus on. Meanwhile, the use of participatory approaches to enhance local capacity to analyse problems and seek out solutions can be referred to as the downstream 'empowerment purposes' of the research. Upstream empowerment on the other hand refers to the empowerment of partner organizations such as national agricultural research systems (NARS) and non-governmental organizations (NGOs) who are best placed, through their longer-term presence, to work with larger numbers of farmers.

Based largely on a case study from Mexico, this paper addresses the type of participatory research that research institutions should best focus on. While both the functional and empowering purposes of participatory research are desirable and important, one should be clear about the principal purpose of using participatory approaches, whether primarily to improve the efficiency and impact of agricultural research, or mainly as a means of empowering farmers or partner organizations. These choices have important consequences for how we target participatory research, who we involve in the process, and how we measure and assess impacts.

FROM TRANSFER OF TECHNOLOGY TO PARTICIPATORY RESEARCH

Technology diffusion: a process of social interaction and adaptation

Farmers' livelihoods, especially in regions beset by low endowments of natural, financial, social, human and physical capital, tend to be diverse and complex, with farmers reliant on non-agricultural and non-farm as well as agricultural and farm sources: complex and diverse livelihood strategies reduce farmers' vulnerability and enhance their security. Outsiders[1] often fail to appreciate the complexity of farmers' realities. Consequently, mono-disciplinary recommendations that reflect the technical focus of the expert adviser are often made to deal with what are, in fact, multi-faceted problems. Biggs (1990) describes this as the 'central source' model whereby knowledge, information and technology are generated from a central source (e.g. a publicly-funded research entity) and the information flow is linear: from researchers to farmers via extension agents.

Increasingly in agricultural research, practitioners use recommendation domains to target a particular cultivar or technology. Often associated with the farming systems approach (Dixon *et al.*, 2001) or sustainable livelihoods approach (Ellis, 2000), a

[1]In this paper, the term 'outsider' refers to anyone who is not a smallholder farmer. Outsiders include researchers and development practitioners, including extension agents (Bunch, 1982, p. 30).

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recommendation domain refers to areas or groups of farmers that share similar agro-ecological, social and economic conditions. Livelihood typologies can serve as socio-economic recommendation domains (La Rovere *et al.*, 2006). If a technology works and is appropriate for one site or group of farmers, there is more justification for introducing it to areas and groups of farmers that fall within the same recommendation domain.

Sumberg and Reece (2004) point out, though, that recommendation domains are often seen as a way to promote previously developed technologies more effectively rather than as a step in guiding the development of a technology. The use of recommendation domains may, therefore, still obscure the fact that farmers are innovators and experimenters: rather than merely adopting a technology, farmers tend to adapt it. Furthermore, farmers' modifications do not always coincide with the ideas or the intentions of those who originally developed or introduced the technology. Individuals, therefore, participate in social change not as passive subjects, but rather as social actors whose strategies and interactions shape the outcome of development within the limits of the information and resources available (Long, 2001; Sumberg *et al.*, 2003). It is, therefore, critical that end-users and other relevant actors are fully involved in the research process in order to ensure (as much as possible) that the technology complements their particular situation. Farmer participation is crucial to this process.

The importance of farmer participation in formal agricultural research became widely accepted in the 1980s and 1990s (e.g. Bunch, 1982; Chambers *et al.*, 1989; Okali *et al.*, 1994; Scoones and Thompson, 1994) and was taken up by plant breeders to meet more effectively the needs of clients, i.e. extend the success of modern crop improvement to marginal areas that had previously seen few benefits (Almekinders and Elings, 2001; Ceccarelli and Grando, 2007; Sumberg and Reece, 2004; Witcombe *et al.*, 2005a).

Widening the benefits of the Green Revolution

The success of the Green Revolution in increasing yields through the development and spread of modern high-yielding crop varieties and new agricultural practices is well documented (e.g. Evenson and Gollin, 2003). For example, improved varieties of rice and wheat spread quickly in tropical and subtropical regions with good irrigation systems or reliable rainfall. Yields of both crops increased substantially in these high potential areas, especially where farmers intensified the use of fertilizers and labour inputs. Impacts have been more limited in other crops and in more marginal regions (Ceccarelli and Grando, 2007). The latter are generally characterized by low yields and crop failure.

The 'traditional' approach to plant breeding that worked so well during the Green Revolution was characterized by scientists developing new crop varieties (often under high-input management conditions) that were then officially released and certified for commercial multiplication and distribution. The drawback of the conventional approach is that much of this material has been of limited relevance to farmers living in marginal areas; breeders have tended not to focus on material that may have been better suited to the heterogeneous agro-ecological and socio-economic conditions

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faced by many smallholder farmers (Ceccarelli and Grando, 2007; Maurya *et al.*, 1988).

Farmers living in areas with low agricultural potential and heterogeneous agro-ecological conditions value adaptation to low soil fertility, drought, resistance to pests and diseases, and storability of grains and seed. Even if they are high yielding, modern crop varieties may not be attractive to farmers unless they also possess other characteristics that farmers consider important. In order to develop germplasm that better suits farmers' needs, multiple traits must often be considered. Participatory crop research is a way to overcome some of the limitations of conventional crop research by, for example, incorporating farmers' considerations regarding the traits that better address their needs and preferences.

However, identifying these multiple traits and assessing their relative importance to farmers is not a simple task. Unlike their counterparts in the developed world, where markets are relatively efficient and the value of different crop traits is reflected in prices, many small-scale farmers in the developing world operate under conditions of imperfect markets, where prices do not reflect the value of traits to them. The desirable traits, which may be obvious to the farmers, may not be easily recognized by outsiders. Participatory methodologies can play an important role in identifying and valuing these traits. This information can then be fed back into the design and development of new varieties that generate benefits for farmers (Morris and Bellon, 2004).

Participatory crop research can involve scientists, farmers, extension agents, industry and consumers. One of the objectives is to facilitate quicker and more extensive uptake of new cropping technologies by shifting the focus of formal crop improvement towards the local level through direct stakeholder involvement at different stages of the breeding process (Ceccarelli *et al.*, 2003). In response, several formal plant breeding programmes have realigned research priorities towards issues affecting poor farmers in marginal areas. This realignment is taking place in the context of demands for plant breeders to find solutions to some of the key constraints to crop production faced by poor farmers throughout the world (Delmer, 2005) and at a time when funding for research is declining (Sumberg, 2005). There remains, however, the key question about what sort of participatory research is the most cost-effective for a research organization to pursue.

Typologies of participatory research

There are two main purposes for which participatory approaches are normally used in the field of development research[2]:

- Functional purposes involve increasing the validity, accuracy and particularly the efficiency of the research process and its outputs. Functional purposes essentially deal with the technologies that scientists should develop (Biggs and Smith, 2003).

[2]The functional and empowerment purposes of participatory research mirror the 'research-driven' and 'development-driven' farmer participatory research activities proposed by Okali *et al.* (1994).

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Identifying which crop varieties are popular with farmers and why facilitates the targeting of a breeding programme for greater impact. In this process, farmers learn from breeders and breeders learn from farmers (Witcombe *et al.*, 2005b). There are numerous examples of the functional purposes of participatory research being used in crop improvement, especially from South Asia (e.g. Witcombe *et al.*, 1999, 2005a) and the Middle East (Ceccarelli *et al.*, 2003; Ceccarelli and Grando, 2007).

- Empowerment purposes include downstream ones such as strengthening farmers' capacity to analyse opportunities and set priorities for change and innovation, e.g. strengthening farmers' skills and knowledge on the principles and practices of utilizing genetic diversity (Sperling *et al.*, 2001; Witcombe *et al.*, 2005b). Empowerment also includes upstream purposes such as strengthening the capacity of development organizations to work more effectively with farmers: effective partnership between researchers and development agents is critical for enhancing the impact of research (de Janvry and Kassam, 2004).

Furthermore, there is a gradient of participation and the costs and benefits of participatory research along this gradient need to be taken into account. Biggs (1988) proposes that there are four types of farmer participation: contractual participation is where scientists contract with farmers to provide land or services; consultative participation signifies that information is sought from farmers and other clients and scientists then develop solutions; collaborative means that there is some degree of task sharing between researchers and farmers, along lines determined by the formal research programme; while collegial means that researchers support a farmer-initiated and farmer-managed programme.

The most frequently observed degree of participation is consultative, i.e. participation that tends towards the 'passive' as opposed to 'active' end of many participation typologies (Pretty, 1995), but this need not necessarily be a problem: when the objective is empowerment, there is a need to involve farmers as much as possible in the research process and, hence, collaborative and/or collegial farmer participation is necessary (Johnson *et al.*, 2003). In the case of upstream functional purposes, much can be achieved through consultative participation (Witcombe *et al.*, 2005b).

The most important issue is to determine which type of participation best meets the need of the research/development agenda. In the case of participatory crop research, the potential benefits are clear: producing improved crop varieties both quickly and cost-effectively (Virk *et al.*, 2005; Witcombe *et al.*, 2005a). More attention, however, needs to be directed at the comparative advantage of the institution in question and the role it can best play in a participatory crop research programme. An institution's capacity to support and facilitate the functional and empowerment purposes of participatory research partly depends on the institution in question (Watts *et al.*, 2007): for example, a research organization may be more effective at enhancing the functional aspects of participatory research as opposed to the empowerment purposes. A development NGO, on the other hand, may be more effective at empowering farmers. Based largely on case study material from Mexico, the following sections

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explore the type of participatory research that 'research for development' organizations should best pursue.

PARTICIPATORY CROP RESEARCH IN MEXICO

Since the early 1990s, the International Maize and Wheat Improvement Center (CIMMYT) has increasingly focused on problems that are of importance to farmers in marginal areas, e.g. drought tolerance, low nitrogen and acid soil tolerance, disease and pest tolerance, and yield stability. Through participatory crop research, CIMMYT has sought to improve maize (*Zea mays*) productivity while also maintaining or enhancing genetic diversity by increasing the benefits to farmers from growing local landraces (see Bellon, 2004). Specifically, CIMMYT has tested the hypothesis that participatory crop improvement can encourage Mexican farmers to maintain maize landraces by enhancing the benefits they derive from growing them (Bellon *et al.*, 2003; Smale *et al.*, 2003). A research project[3] was carried out in the Central Valleys of Oaxaca in southern Mexico, an agro-ecologically and ethnically diverse region recognized as within the centre of genetic diversity and domestication of maize (Matsuoka *et al.*, 2002).

The project developed and compared participatory interventions with small-scale farmers in six contrasting communities in the region[4]. The project served both functional and, to a lesser degree, empowering purposes. Through the project, farmers gained access to the diversity of maize landraces in the region, were trained in seed selection and management techniques, and learned principles to assist them in maintaining the characteristics of landraces they value. These interventions were the result of the application of both conventional and participatory research methodologies and were available to anybody who wanted to participate: open invitations and publicity encouraged farmers to participate. This approach was used to understand who participated, the incentives for participation, and how farmers benefited from participation. Unlike other participatory approaches, such as local agricultural research committees (CIALs) (Ashby *et al.*, 2000), in which groups are explicitly formed or tapped for participation, in Oaxaca no explicit effort was made to do this, though some local groups did participate on their own accord.

Samples of maize landraces representing the spectrum of maize diversity in the region were collected and evaluated jointly by researchers and farmers (Bellon *et al.*, 2003). A baseline survey with a random sample was carried out to obtain a representative sample of households in the communities. This sample served as a control group for comparing the results of the interventions between participant and non-participant farmers (Smale *et al.*, 1999). The joint evaluation of landraces and the baseline survey provided information that guided the development of the interventions. There was evidence that farmers valued many characteristics in their maize landraces,

[3]The research project was funded by the Canadian International Development Research Centre (IDRC), ran from 1999 to 2001 and was implemented jointly by CIMMYT and the Mexican National Institute of Forestry, Agriculture and Livestock Research (INIFAP).

[4]For an in-depth description and review of the participatory methods used see Bellon (2001).

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especially traits related to consumption, and that there was no 'best' or 'ideal' variety. Instead, farmers appeared to want a range of varieties, i.e. a range of diversity.

Through focus groups and the baseline survey, researchers learned which specific traits farmers valued most in a maize variety: that it tolerated drought, resisted insects in storage, and produced 'something' even in bad years. Given the resources available to the project, none of these traits was immediately amenable for breeding interventions, but each could be addressed through improved storage and seed selection practices. Current storage and seed selection practices were not meeting farmers' needs. In order to mitigate this, a training module on seed selection and storage was designed in order to provide general principles that farmers themselves could use. The approach followed Bentley's (1993) ideas about the interaction between local and scientific knowledge.

Through the project, farmers were able to examine and buy seed from 16 'elite' landraces[5], to attend training sessions on basic maize reproduction, principles of seed selection and on techniques for storing seed and grain. Additionally, they could purchase a metal silo. This technology was identified in one of the communities, but was unknown to the others. The project provided access to it as an option to improve storage of maize seed and grain. A sample of participating farmers was interviewed systematically to monitor the adoption of the seed purchased, the application of the knowledge gained and the use of purchased metal silos.

DISCUSSION

The participatory maize research in Oaxaca was designed to be more functional than empowering. It provided CIMMYT with data on: local seed selection and seed management practices, farmers' knowledge of maize reproduction, local uses and preferences with regards to maize and maize characteristics, importance of consumption characteristics and quality traits for market access. The research, therefore, contributed to an improved understanding of the mechanisms of local crop genetic resource management in a broad sense, its actors and the challenges they face.

The richness of data has played an important role in the further development of crop genetic resource improvement and conservation, both from a research perspective as well as from an extension and policy perspective. Moreover, it yielded important insights into different options for contributing to on-farm conservation of crop genetic resources, e.g. subsequent research by CIMMYT on farmer-induced hybridization between improved and local maize germplasm (Bellon *et al.*, 2005), the role of collective action in relation to on-farm conservation of crop genetic resources (Badstue *et al.*, 2006), and the genetic structure and diversity of local landraces under farmer management (Pressoir and Berthaud, 2004a, b).

[5]These landraces were selected by farmers and researchers interacting systematically, from 170 samples of maize drawn from the region, the CIMMYT and INIFAP genebanks and an improved local variety. The methodology employed is presented in Bellon *et al.* (2003).

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The Oaxaca project sought to stimulate local innovation capacity by engaging farmers in the testing and comparison of diverse maize materials under their own production conditions and management, and also by organizing practical training activities. In this way, the maize project contributed to farmer empowerment albeit of a relatively limited number of farmers. Almost 1000 farmers (75 % male and 25 % female) participated in at least one project activity during the three years of the project. The results showed that farmers valued diversity and were willing to pay for it. Over the duration of the project, 2726 kg of seed of 16 different maize landrace types were sold to a total of 371 farmers; with an average amount purchased of 4.3 kg/purchase (one farmer could purchase different landraces). An important consequence of the project was that, through the seed sales of 'elite' landraces, farmers were able to experiment with new landraces and to incorporate them into the repertoire of varieties they plant. In many cases, the seed of the 'elite' landraces was mixed with seed of their own landraces.

A total of 728 farmers participated in the training sessions. Participation varied greatly across the different topics treated, with the highest participation involved in maize reproduction followed by storage techniques and the lowest in seed selection practices in the field. Most farmers (77 %) reported that they perceived a benefit from the training sessions. The most common benefit (according to participants) was just to acquire knowledge, followed by improving crop production, understanding pollination and maize reproduction, having confidence to carry out practices, and improving seed selection.

The baseline and monitoring of participants allowed an economic analysis of the costs and benefits of participation (Smale *et al.*, 2003). This analysis showed that the decision to participate in the project was neutral to the wealth as well as to other social and economic characteristics. However, there was a gender bias in participation: women were far less likely to participate than men, and those who did were more likely to be poor. For farmers as a group, it was well worth participating. Seed purchasers benefited most. The total estimated net benefits to farmers participating in the project was $MX 398 000[6], with a benefit–cost ratio of nearly 3.8 to 1. Participants from richer households earned a larger proportion of the total than they invested, constituting a net transfer from those classified as intermediate in wealth, who were the biggest investors. The gender bias of participation was reinforced by the distribution of project benefits, since men appear to have earned an even larger share of the benefits than is represented by their investment.

Through the project, farmers gained access to seed and information about the range of maize diversity at the regional level. Farmers were willing to participate in interventions aimed at enhancing the benefits of maize diversity and hence participatory approaches were valuable for these on-farm conservation actions. They valued having increased access to maize diversity, as well as knowledge associated with it; but while they did invest and experiment with new maize types, they were

[6]Approximately US$ 41 000 in 2001.

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very unlikely to apply practices learned in training interventions, even though they considered acquiring new knowledge as valuable. There were measurable benefits to participation, and while participation in itself was not biased in terms of wealth or other socio-economic variables, it was in terms of gender and the benefits accrued from it were as well. Participation is neither costless nor socially or gender neutral, but it can generate substantial benefits to participants.

The impact of the project on local farmers was assessed again in 2006. A qualitative and quantitative comparison was made of changes in household livelihoods between the end of the project in 2001 and 2006 for both participants and non-participants in the project (La Rovere *et al.*, 2007). The impact assessment revealed that:

- Farmers consumed less maize than eight years previously, but there were only slight losses of maize populations. Farmers continued to grow mainly local maize varieties that have traits of specific interest (marketability, consumption, and drought-resistance). Farmers also still grew maize varieties that arose from crosses between landraces promoted by the project and farmers' local varieties.
- Through the training, participants had learnt, for example, about open pollination, diversity of landraces and alternative methods of storing seed (in silos). The benefits derived from this capacity building have progressively faded except for those lessons from specific training on storage and seed selection, including the use of metal silos (Manuel, 2005).

The slight reduction in the number of maize varieties being grown has to be seen in the context of an ageing rural population, largely caused by emigration of younger farmers, which may influence the degree to which indigenous knowledge is passed on to the next generation of farmers. Furthermore, drought caused the loss of some of the maize varieties introduced by the project.

The limited long-term impact of the project's training (beyond the use of the metal silos) suggests that the appropriate institutions to support and sustain an empowerment process either may not have existed or were not involved in the project. This should not come as a surprise as the participatory research conducted by CIMMYT was largely functional as opposed to empowering: CIMMYT did not have sufficient presence on the ground, neither did it establish effective partnerships with development organizations to ensure that benefits accrued to farmers in other communities.

The outcomes of the Oaxaca project raise a set of questions regarding the functional versus empowering purposes of participatory research:

1 Under what circumstances is it reasonable to expect participatory research projects to have a direct impact on farmer empowerment?
2 Should farmer empowerment be a primary objective of research organizations engaged in participatory research?
3 Should research organizations focus more on the empowerment of partner organizations, such as national agricultural research and extension organizations?
4 Should research organizations engaged in participatory research focus primarily on the functional purposes of that research?

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The Oaxaca example demonstrates that the benefits of using a participatory approach were first and foremost their ability to bring to the research process new and important perspectives. The contribution to local empowerment processes was less evident. Farmer empowerment should, perhaps, not be the primary objective of participatory research carried out by a research organization (as opposed to a development organization). While still desirable, it is reasonable to consider the possibilities of an increase in local innovation capacity and empowerment as an achievable result only when the participatory research process involves components that can be considered as development interventions, or where the research process takes place in close coordination with actual development interventions, e.g. action research.

Most participatory research initiatives carried out by research organizations do not, however, have sufficient presence on the ground, and do not involve the required interaction with farmers, to generate and support direct empowerment of more than a few farmers. The achievement of this would necessitate a longer-term and more direct interaction with farmers than that usually associated with the *modus operandi* of a research organization, i.e. projects of three to five years. In addition, the impacts of most participatory research (carried out by research organizations) on farmers' innovation capacity and livelihoods are seldom sufficient, in themselves, to justify the expenditure of the research process.

The most cost-effective way for participatory research processes to contribute to empowerment of larger numbers of farmers is by close coordination and collaboration with other development organizations that are better placed to link farmers and researchers by virtue of their relatively longer-term contact with farmers. These organizations include NARS, extension services, farmers' organizations and NGOs. With their development (as opposed to research) remit, they are better placed to ensure that research results reach greater number of farmers and that, in the process, more farmers are empowered.

There is much evidence of the value of working with and through more development-focused organizations. Stirling *et al.* (2006) suggest that the effectiveness of the Plant Sciences Programme (PSP) of the United Kingdom's Department for International Development (DFID) was partly determined by the Programme's ability to build long-term, in-country partnerships that ensured the effective adoption of its research outputs, i.e. upstream empowerment.

The experience of working with CIALs also points to the value of establishing strong collaborative links between researchers and development practitioners. CIALs are community-level organizations for helping agricultural scientists and farmers to collaborate on adaptive research (Bentley *et al.*, 2006). The CIAL model was developed by the International Center for Tropical Agriculture (CIAT) (Ashby *et al.*, 2000) and has been successfully used to test new crops and varieties. CIALs have also stimulated farmer empowerment in terms of farmers learning how to manage funds, plan time, launch micro-credit schemes, prepare proposals to access external resources, and deal with outside agronomists and professionals on a more equal basis (Braun *et al.*, 2000). Humphries *et al.* (2000) report on the experiences of a participatory plant breeding

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programme in Honduras, where a national research organization produced new bean varieties that were subsequently field tested by CIALs supported by a local NGO. The collaboration between the research organization, NGO and CIALs led to the development of high-yielding bean varieties along with farmer empowerment.

The International Center for Agricultural Research in the Dry Areas (ICARDA) has used participatory research in its barley breeding programmes in Syria. The research process has generated more relevant and often quicker results in terms of the development of barley varieties, and has increased farmers' skills and knowledge of barley breeding (Ceccarelli and Grando, 2007). Barley variety development and farmer empowerment have been enhanced as a result of the decision by ICARDA to decentralize its barley selection work to NARS and to work with development projects (Mustafa *et al.*, 2006).

In terms of the magnitude of the benefits that the research process generates, the key is to work with researchers to enhance the efficiency of the research process and its outputs (functional purpose of participatory research). In terms of the extent or reach of these benefits, i.e. the number of farmers that benefit from the research products, the key is to work through development organizations that seek to enhance farmers' livelihoods by empowering farmers and ensuring that research products reach a larger number of farmers. In order to achieve this, a research organization's principal role is to make the research results (e.g. improved germplasm, agricultural technologies) relevant, appropriate and available to end-users, including development organizations (NGOs, private sector, farmers' organizations) and farmers. By virtue of their objectives, local presence and organization, development organizations are often in a better position than research organizations to sustain interaction and follow-up with larger numbers of farmers. The role of development organizations is therefore fundamental to the processes of empowerment and scaling up. Feedback loops contribute to an ongoing learning process among all the partners.

Rather than seeking to be a direct causal agent of empowerment and innovation at the farmer level, the role of participatory research carried out by research organizations may principally be to produce technologies and information, and to test methods and approaches. These in turn may feed into the generation of empowerment tools and initiatives through the activities of others, e.g. government and NGOs. These other organizations have comparative advantages in relation to their role as direct causal agents of farmer empowerment. In a climate of increasingly scarce financial resources, this approach to farmer empowerment and enhanced livelihood security may well be the most cost-effective.

CONCLUSIONS

Since the early 1980s, interest in participatory crop research has grown in recognition of its potential contribution to research efficiency and impact. Participatory crop research can contribute to improved understanding of farmers' crop genetic resources management, and lead to better targeting of research and policy, as well as practical recommendations for development interventions. At the same time, it is likely also to

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contribute to local capacity building and, in the case of the individuals who take part in the process, to the stimulation of human and social capital.

There is, therefore, a need to distinguish between research organizations that contribute to generating and increasing benefits, and development organizations whose principal role is to increase the reach of the benefits through greater farmer adoption/adaptation of technologies and empowerment. Ultimately, the partnerships between research and development organizations should translate into larger and wider impact. Unless the research process involves strong components of applied development interventions, or takes place in close coordination with practical development interventions (e.g. action research), the potential for impacts in terms of empowerment of large numbers of farmers can be expected to be limited in most cases.

Furthermore, the main objective of participatory research may unashamedly not be large-scale farmer empowerment: the majority of participatory agricultural research projects, including the CIMMYT project in Oaxaca discussed here, focus primarily on understanding the challenges that farmers face, their practices and priorities, and finding sustainable and viable solutions, and secondarily on empowering the farmers directly engaged in the research process. Scaling up the benefits of this research is more cost-effectively carried out by organizations engaged in longer-term development work. In terms of the empowerment of large numbers of farmers, the strength of research organizations may also be in 'research', i.e. research on improved ways to empower farmers and communities, rather than empowerment alone. A clear example of this is the work that has been carried out on CIALs.

Donors understandably call for evidence of impact of the research they fund, in terms of poverty reduction. The principal purpose behind the use of participatory approaches in agricultural research has implications for the assessment of research impacts and when this assessment should take place. Research organizations that focus on the functional side of participatory research can still show plausible associations between research outputs and aggregate impact. The key is to map out the chain of events that link research and agricultural development and that describe the patterns of change in farmers' livelihood strategies. This requires linking research outputs (e.g. improved germplasm) to their use by mapping the uptake by intermediate users (e.g. NGOs, farmers' organizations) to their eventual adoption and adaptation by farmers.

The Oaxaca case, in which an initial impact study conducted at project completion was followed by a more comprehensive impact study five years later, suggests that the impact of a project may be better measured after a longer time to capture more appropriately actual changes in livelihoods and natural resource management. Furthermore, when the objectives of participatory research are primarily functional, impact assessment should look primarily at the impacts of the participatory research on other research. This would include impacts in terms of policy development and technology development. If empowerment, however, is an explicit objective of the participatory research process, impact assessment should direct attention to the impacts of the research process on the skills, organizing capabilities, initiatives and livelihoods of the participating individuals and communities, and the extension efficiency and partner organizations' capacity to act as agents of change.

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