OUTPUT 4. MATERIALS AND INFORMATION ON PARTICIPATORY RESEARCH APPROACHES, ANALYTICAL TOOLS, INDIGENOUS KNOWLEDGE AND ORGANIZATIONAL PRINCIPLES, DEVELOPED

Extension through farmer research: Local Agricultural Research Committees (CIALS) in Latin America

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Highlights

Book chapter written for a World Bank book entitled "Extension through Farmer Research: Local Agricultural Research Committees (CIALS) in Latin America"

Identification of the case

A CIAL is a committee of people who volunteer to carry out experiments in rural areas on behalf of their clients. The client group from which the committee comes may be a rural community, an agroenterprise, an interest group such as a women's group, or a producer organization. CIALs help foster equitable rural innovation by sharing the knowledge, experience and benefits that comes from experimentation, while at the same time sharing the inherent risks and costs.

The first step in forming a CIAL is when a group becomes motivated to do so through contact with a CIAL facilitator or hearing about the method from other farmers. The group then meets to elect a committee and to identify problems and opportunities, prioritize them and then mandate the committee to experiment on their behalf. The committee then designs experiments to meet this mandate. The CIAL method reduces the risk of financial loss if their experiments fail by stipulating that the trial plots should start small. In addition, the method reduces the risk of the committee recommending an inappropriate technology by stipulating that each trial should be replicated, and the promising trials be repeated for three seasons on larger and larger plots. All the steps in the CIAL process are shown in Figure 1.

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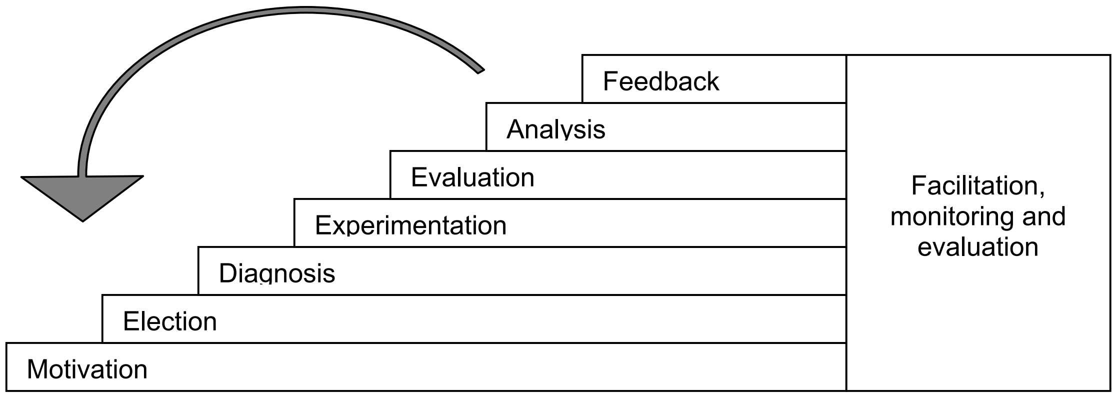

Figure 1: The CIAL process (Ashby et al.,2000)**.**

A team at the International Center for Tropical Agriculture (CIAT) developed the CIAL method in the early 1990s. The team had worked for more than five years to understand why resource-poor farmers in particular were not adopting technologies produced by formal-sector research. They concluded that if adoption rates were to increase, then farmers must be included earlier in the design, testing and local adaptation of new technologies. However, they recognized that to do this in the complex and risk-prone environments on which millions of farmers depend would be extremely costly and slow unless farming communities themselves took much of the initiative. Hence the team developed the CIAL method as a way of enabling farming communities to carry out their own on-farm evaluation and adaptation. One of the features of the CIAL method is that farmers should learn about and use the concept of experimental replication so that formal sector R&D can use their results and thus become more sensitive to the needs of poor rural communities.

Although CIALs were designed to be a cheap way for a research and extension service to expand their reach, CIALs do have costs associated with them. The main costs are training the facilitators who support the process, and providing the CIALs with a small research fund (Ashby et al. 2000). The costs of setting up a CIAL for the period 1990-1998 were estimated to be US$670 for the first year and US$325 per year for the next 5 years. The return on investment was estimated conservatively at 78%. This is likely to be much higher now, however, because costs of setting up and sustaining CIALs have been greatly reduced through "learning by doing." For example, it has been found that experienced farmers can adequately train facilitators much more cheaply than salaried professionals, and under the right conditions one facilitator can support up to 50 CIALs. First year start-up costs now range from US $25-$500 per CIAL, in cash or kind (Ashby, 2003).

Impact

CIAT began by establishing five CIALs in Cauca Province in Colombia in 1990, with funding from the Kellogg Foundation. By late 1991 the CIAT team had established a total of 18 CIALs, and this number grew to 55 by 1994. CIAT has also trained trainers from other countries and other organizations, including the International Institute of Rural Reconstruction (IIRR), National Autonomous Institute of Agricultural and Livestock Research (INIAP) in Ecuador, Potato Research Program (PROINPA) in Bolivia, Corporation, Colombian Institute of Agricultural and Livestock Research (CORPOICA) in Colombia and Participatory Research in Central America (IPCA). These organizations then went on to set up their own CIALS, and as a result there are now more than 250 active CIALS in 8 Latin American countries (Figure 2) and an unknown number of adaptations of the approach in sub-Saharan Africa and Asia, including China. As of 2002, 57% of the known CIALs were supported by non-government organizations and a third by government organizations. The others were facilitated by consortia of two or more cooperating organizations.

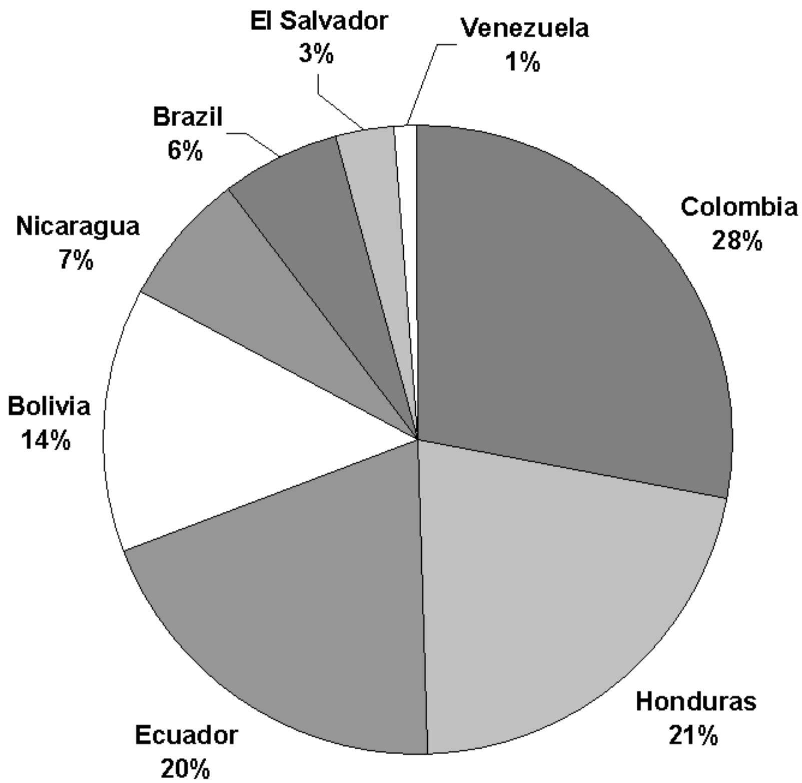

Figure 2: The countries that are hosting CIALs in Latin America.

During the CIAL diagnostic process, most communities assign first priority to research on their major food crops (Figure 3). Thus in Honduras most CIALs are working on common beans and maize—the two most important ingredients of the local diet; while in the Andean regions of Ecuador and Bolivia, communities prioritize potatoes and broad (faba) beans. In the few areas with good food security, CIAL research covers a broader range of themes (Figure 4). Under these conditions committees seek to raise incomes by taking up new crops or adding value to traditional ones through improved processing.

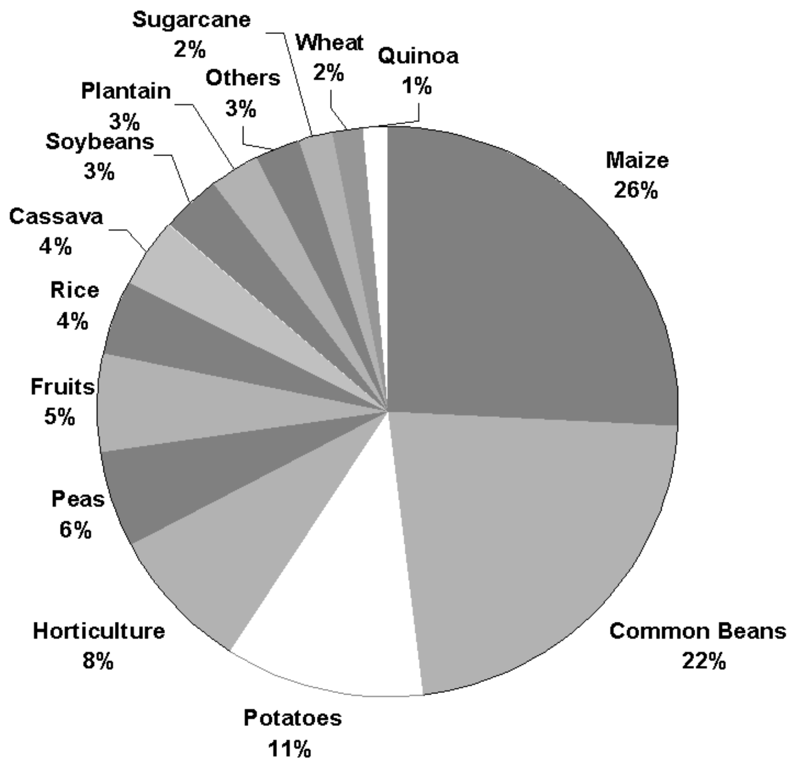

Figure 3: Crops researched by 250 CIAL communities in Latin America.

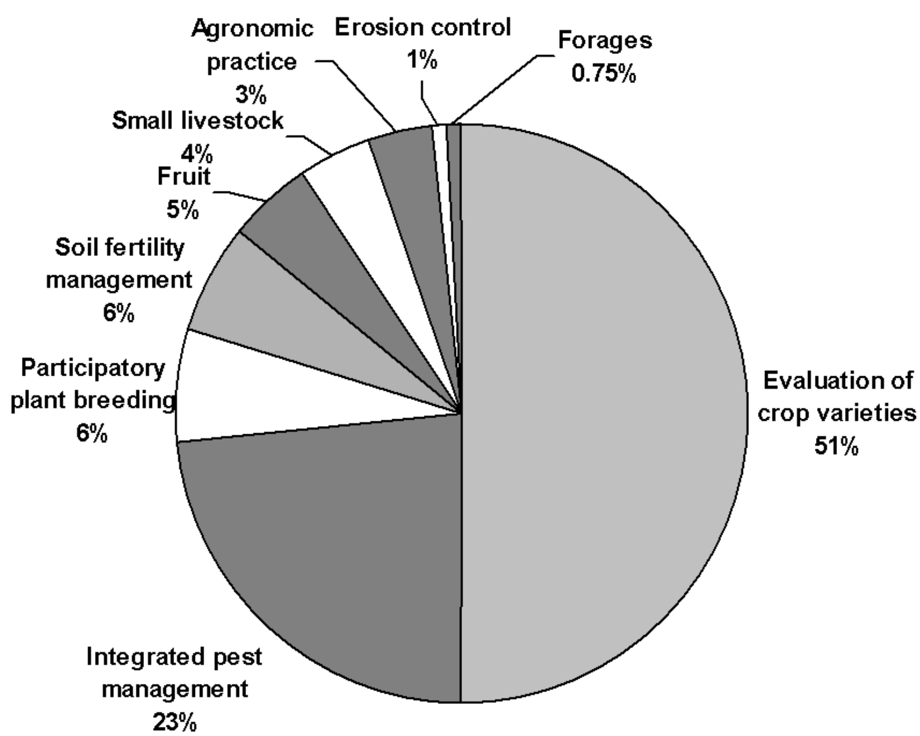

Figure 4: Research themes chosen by 250 CIAL communities in Latin America.

CIAT carried out an impact assessment of the 68 Colombian CIALs in 1998. The study found that: (1) CIALs directly resulted in more rapid technology adoption; (2) the CIAL process itself has led to people's learning useful skills and forming valuable social linkages; and (3) CIAL communities had experienced improvements in welfare. These welfare improvements came about partly by people starting agroenterprises based on the results of the experiments and the new skills and linkages they had developed. For example, some CIALs have started to produce commercially the seed of the best crops identified in their trials. Another source of welfare improvement has been that people in CIAL communities have been encouraged by the experimentation to try more new crops, and as a result have more crops and more varieties in their fields than farmers in similar villages without CIALS. This diversity enables villages with CIALs to cope better with risk. Moreover, the speed of technology adoption was faster in villages with CIALs, and the poorest strata of farmers were just as likely to adopt as the richer strata. Hence CIALs help communities benefit more quickly from improved varieties, whether developed by the formal research sector or the farmers themselves. The study also suggests that CIALs may improve food security because farmers in villages with CIALs reported fewer "hungry months" of seasonal food shortage.

An important impact of CIALs has been the inclusion of women in local research. As of 2003, nearly 60% of the committees have women members, and their participation has meant that factors critical to whether a community accepts a new technology such as cooking time and taste are included in farmers' evaluations. Women have been able to set up their own CIALS—one eighth of the CIALs are women only—and carry out research on topics of concern to women such as family nutrition. Women have also been able to benefit financially from CIAL research and in this way boost family incomes.

Another impact of CIALs has been on formal-sector research agendas. In Ecuador, for example, the national research and extension agency INIAP has worked with CIALs since 1996 and is now supporting 19 CIALs in one of its five regions. INIAP staff has learned that resource-poor farmers want to diversify their crops, and as a result INIAP is now putting less emphasis on potatoes and more on the crops that farmers are interested in such as the indigenous quinoa (*Chenopodium quinoa*), beans and *chocho*, a fodder legume (*Lupinus mutabilis*). Another effect is that the staff working with the CIALs is motivated by the good relationships they have developed with the communities through the CIAL process.

Although CIALs are influencing the research agenda of INIAP in Ecuador, this is the exception rather than the rule. In general, CIALs are not as well linked to formal-sector research as originally hoped for, and more work needs to be done in understanding why this is and how linkages can be strengthened.

The general lack of formal linkages to research and extension organizations has meant that the financial sustainability of CIALs is an issue. In part this is simply the challenge faced by all community-based organizations as state support for agricultural research and extension withers away. CIALs have developed a large range of mechanisms for replenishing their operating fund; however, these local initiatives probably need to be matched by a larger scale source of financial investment if they are to be sustained.

Twelve years of experience working with CIALs has shown that the main success factor is that the CIALs themselves and their host communities stick to the following basic principles:

- Relationships between the CIAL, the community and external actors are founded on mutual respect and accountability and shared decision-making.
- Partners in the research process share the risks of research.
- Research is conducted by comparing alternatives systematically.
- Knowledge is based on building experience and learning by doing.
- Research products belong to the community.

Another key success factor is adequate training of CIAL members in the participatory research process. In addition, Humphries et al. (2000) found that CIALs have been found to be more successful in communities where social capital is already high.

Sustainability and replicability

CIALs are not static entities. When the first research cycle is finished some CIALs will begin another cycle to investigate a new problem or opportunity, while others will cease research and may start to commercialize some aspect of the new technologies they have tested. For example, one CIAL in Cauca, Colombia, identified a high-yielding common bean variety, then in the following seven years produced 230 t of seed before the variety became susceptible to anthracnose (a fungus). The CIAL has now begun a second research cycle to look for new varieties of beans, including, for the first time, climbing types. Whether CIALs continue or not, the process permanently improves the capacity within that community to search for new solutions and to experiment. Actively seeking out solutions, experimenting and setting up agroenterprises are all key for the sustainability of rural communities in the current global context of climate change and more open markets.

One of the ideas when the CIALs were originally founded was that the committees would act as a feedback mechanism to National Agricultural Research and Extension systems (NARES). Since then, funding cuts has seriously weakened the NARES in Latin America. Nevertheless, the pendulum may well be swinging back as a new awareness has occurred of the role of the public sector in funding, but not necessarily delivering, non formal agricultural extension (Rivera, 2003). Experience with mature CIALs has shown that they can expand the reach of research and extension services to poor, remote client groups at a low cost. CIALs may be well placed to benefit from more public-sector funding to NARES. Indeed, evidence from Bolivia, Ecuador and Colombia shows that "mainstreaming" of CIALs is happening. Bolivia has recently reorganized its NARES. Rural municipalities are required by law to include farmers' perspectives in municipal development plans, and the CIALs are proving a useful mechanism to bring this about. In Ecuador INIAP has recently reorganized to work on organic agriculture using participatory methods. INIAP has realized that research and extension that does not take farmers' needs and experiences into account can be "like throwing money in the river";[9] and participatory

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[9] A direct quote from a senior INIAP staff member.

approaches, in particular CIALs, are necessary to maximize impact with the limited resources at INIAP's disposal.

In Colombia CORPOICA, the national research program, started working with the methodology in 1996. CORPOICA has set up 46 CIALs in 7 provinces in Colombia, and as of 2001 was working with 30. A case study that looked at the institutionalization processes found that while the methodology receives official support within CORPOICA, the institutionalization process is being hampered by a widely held view that the CIAL methodology is an extension tool and not useful to scientific research (Mentor, 2002). Nevertheless, CIAL methodology has gained ground in CORPOICA among the scientists who have been involved firsthand.

Another mechanism for ensuring CIAL sustainability has been the setting up of so-called "second-order organizations." In Colombia, the CIALs in Cauca formed CORFOCIAL in 1995 as an umbrella association to protect and promote their interests. CORFOCIAL is funded from the interest on an endowment provided by an anonymous benefactor and has a staff of three paraprofessionals. It supports the CIAL process by providing training, helping in the formulation of funding proposals, facilitating visits to research organizations or to other CIALS, promoting the exchange of seeds and other products among CIALs, and organizing an annual meeting of its members. In Honduras the IPCA project[10] supported the formation of a federation of CIALs in 1998. The organization is called ASOCIAL and like CORFOCIAL is financed by an endowment fund. ASOCIAL carries out functions similar to CORFOCIAL. In addition, however, both individual CIALs and ASOCIAL provide savings and microcredit schemes to their members. Another difference in Honduras is that the annual CIAL meeting is regularly attended by researchers from the national agricultural programs making it likely that CIAL and formal-sector research in Honduras will become better integrated in the future (Humphries et al., 2000).

Lessons learned

One of the strengths of both CORFOCIAL and ASOCIAL is that that they are independent and thus able to put the interests of their members first. The CIAL members of these two organizations have played an invaluable role in showing the potential of the methodology. However, in order to mainstream the approach further, more CIALs will have to be established in existing organizations, groups or agroenterprises, with the associated risk that the CIAL methodology be compromised. Experience shows that if CIALs are established as part of a NARES, then the NARES staff must commit to the principle that a CIAL primarily serves the community it belongs to and not the NARES adaptive research or extension interest. NARES staff must also commit to regular contact, respect farmer research, be accountable and share decision-making.

Based on the CORPOICA case study, Mentor (2001) came up with the following recommendations for successful institutionalization of the CIAL approach:

- Identify natural allies—build a support base before attempting to convince skeptics.

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[10] Funded by the International Development Research Centre (IRDC), Ottawa, Canada.

- Use existing information on successes to create a demand for training.
- Use appropriate media for different audiences to build awareness of results.
- Give key stakeholders a role in deciding how to work with CIALs.
- Implement report-back and participatory evaluation at all levels to enhance institutional learning.
- Focus on learning from the process of working with CIALs as well as on the results.
- Gradually reduce the amount of time researchers dedicate to working with any one group of CIALs.
- Network experienced people and those who are just beginning CIALs to support expansion of the process and exchange ideas about adaptations of the approach.

Another key lesson learned is that while it is important to stick to the basic CIAL principles, which are listed in the next section, it is also important to encourage local adaptations. Some of the adaptations that have proved successful are listed below.

- Where short-term food security is a priority, begin by evaluating treatments in researchers' trials and subsequently share risk in more uncertain forms of farmer-run experimentation (Ecuador, East Africa).
- Run a collective production plot using proven technologies, testing risky technologies in the CIALs small experimental plots. The collective production helps compensate committee members for their time and helps increase the petty cash fund (Honduras, Colombia).
- Test and monitor innovations on farms without establishing formal experiments, especially useful with livestock or natural resource management practices (East Africa, Southeast Asia).
- Elect a large committee: in Northeast Brazil large committees sustained CIALs through periods of seasonal migration as those returning or remaining replaced migrant members. In Honduras, large committees made the human capital benefits accessible to a broader cross-section of the client group.
- Create a petty cash fund by providing the CIAL with experimental inputs in kind and then use profits from trials to fund the committee's activities. This enabled CIALs in Bolivia and Colombia to increase their petty cash fund.
- Form a CIAL to provide R&D on new products or processes for new or existing small agroenterprises.
- Run the petty cash fund as a revolving credit fund or as a small venture capital fund that makes loans for equipment that is rented out to the client group.

Experiences have shown that CIALs develop along one of two paths: they either continue to work as a volunteer research service on behalf of their communities or privatize the results of their research in an agroenterprise. Regular meetings in which the CIAL reports back to their community are important to ensure that they remain in contact with the community and follow along the first path. Nevertheless, if the CIAL does set up an agroenterprise then this can also bring benefits to the community and beyond through, for example, providing seed of new and proven varieties or crops. Indeed, one of the findings has been that the CIAL method is actually a very good way of initiating agroenterprise development, and CIAT is currently including market surveys in the CIAL method as a way of facilitating the process.

Finally, CIALs have proven themselves to be complementary to farmer field schools (FFS). FFS can build agroecological knowledge to make CIAL research more meaningful; e.g., when a community wants to experiment on different control methods of the white grub (*Diloboderus abderus*), a pest of potatoes. CIALs can generate locally adapted technology options to strengthen FFS (Braun et al., 2001).

Guidelines for replicating CIALs

Many features of the CIAL process such as the sponsoring organization, who facilitates, the size of the committee, the type of experimentation and the size of the petty cash fund can vary greatly, provided that sponsors, trainers, client groups, committee members and facilitators understand and adhere to these basic principles:

- Support CIALs to help poor farmers manage risky agricultural innovations, building on local experience. This means avoiding paternalistic protectiveness and supporting farmers in learning how to innovate over and above demonstrating technological "fixes."
- Ensure that the client group monitors and evaluates their committee and the facilitator through regular feedback. CIALs must share knowledge about their process and its results to ensure that research products belong to the wider community, not just to the committee members or the sponsor.
- Expand and rotate committee membership over time.
- Nest experimentation in social projects with short-term returns to sustain commitment in very poor, risk-adverse client groups.
- Encourage neighboring CIALs to visit or get together to reduce the costs of visiting geographically dispersed CIALs.
- Minimize costs of visiting CIALs by planning locations for their establishment; e.g., in Kenya and Colombia the national programs have located committees in target agroecological zones, easily reachable from an experiment station or municipal extension office.
- Train experienced farmers with prior experience in a CIAL as facilitators to reduce costs of facilitation, especially in the case of large-scale implementation.
- Develop capacity of CIALs to organize their own regional meetings and exchange results.
- Promote attendance of scientists and key R&D decision-makers at CIAL meetings to ensure their support for CIALs.
- Ensure that CIALs are making decisions about what is acceptable by ensuring that both they and their client group own and are responsible for experimental inputs (i.e., the CIAL petty cash fund).

People interested in learning more about CIALs should visit the IPRA website (http://www.ciat.cgiar.org/ipra/ing/index.htm), where it is possible to download a book on CIALs (Investing in Farmers as Researchers) and 13 handbooks that deal with the different stages involved in establishing CIALs (http://www.ciat.cgiar.org/ipra/ing/cial_primers.htm). Details of a training of trainers module, available on CD, is given in the Appendix. Further information on CIALs, including a training of trainers module on CD, is available from Carlos Arturo Quirós (c.quiros@cgiar.org).

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A participatory procedure applied to selecting and developing forages with farmers (PPSF)

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Highlight

A participatory procedure applied to selecting and developing forages with farmers (PPSF), developed

Abstract

Although forages play an important role in smallholder production systems, conventional approaches to technology development for forages particularly legumes have not generally resulted in significant levels of adoption in Latin America and the Caribbean, Asia and Africa. Various factors have been identified that impede forage adoption directly or indirectly: (a) the unavailability of locally produced seed, (b) the lack of credit facilities for purchasing inputs such as seed, fertilizer and fencing, (c) distorted pricing policies, which do not guarantee economic returns to farmers, (d) poor infrastructure, which disrupts delivery of inputs and removal of outputs, (e) lack of adequate markets for livestock products, and (f) low levels of farmer participation in forage development. The need for developing participatory procedures that actively involve farmers in the research and scaling-up processes is evident. According to them, there is no doubt that the participatory procedure for selecting forages (PPSF) was successful in selecting and developing with farmers, forages suitable for smallholder production systems in Honduras, Nicaragua and Costa Rica. Technicians and scientists in similar biophysical and socioeconomic environments can use the methodology and information generated to design and select novel forage technologies. Moreover, it was possible to strengthen linkages among farming communities and technicians, development workers and researchers in the aforementioned countries, increasing mutual knowledge and benefits. The PPSF gave a sounder understanding of farmers' perceptions of their problems and opportunities, contributing toward building a stronger bridge between farmers' communities and national research institutes.

Introduction

Farmers usually employ more than one technology to address constraints and opportunities on their farms and in the market environment. These components are observed, compared and evaluated before being accepted or rejected. Farmers' decisions are based on criteria obtained from their own experience; in other words, this process can be described as farmers' research at the field level. Criteria can be defined as a basis for judging and making decisions on technology options (Guerrero et al., 1993).

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The research process carried out in experiment stations is also based on criteria, but the emphasis is on institutional and scientific objectives. Although this process has objectives such as improving the level of farmers' well-being and poverty alleviation, the technological components generated are not generally adopted by farmers because the technologies do not function in their fields (i.e., failure of technology) or do not respond to opportunities and constraints under farmers' conditions (i.e., not adapted) (Quirós et al., 1991). On the other hand, there have been cases where technological components rejected by scientists have given good results in the farmers' fields (Ashby, 1990*).* These observations reflect the fact that farmers' and scientists' criteria for selecting technology options are frequently different.

Despite the fact that forages play an important role in smallholder production systems, conventional approaches to technology development for forages— particularly legumes have not generally resulted in significant levels of adoption in Latin America and the Caribbean, Asia and Africa (Horne et al*.,* 1999*,* Peters et al*.,* 2001). Various factors have been identified that impede forage adoption directly or indirectly: (a) the unavailability of locally produced seed (seed in general available to farmers), (b) the lack of credit facilities for purchasing inputs such as seed, fertilizer and fencing, (c) distorted pricing policies, which do not guarantee economic returns to farmers, (d) poor infrastructure, which disrupts delivery of inputs and removal of outputs, (e) lack of adequate markets for livestock products, and (f) low levels of farmer participation in forage development (Thomas and Sumberg, 1995; Peters et al., 2001, 2003; Sumberg, 2002). Sumberg (2002) emphasizes the fact that agroclimatic, economic, socioeconomic and cultural conditions define the context of technology design and development and should, therefore, be fully integrated into the process of design specification.

The need for developing participatory procedures that actively involve farmers in the research and scaling-up processes is evident (Braun et al., 1999). This paper addresses this constraint by developing a participatory procedure applied to forage selection (PPSF), developed for conditions in Latin America and the Caribbean.

Understanding farmers' perceptions (criteria) about technological components has been successful in terms of attaining better opportunities for adaptation and adoption of forage technologies. Moreover, it has been possible to strengthen the linkages between farming communities and scientists using this strategy (Horne, et al., 1999*).*

Better understanding will emerge as to how each partner can take the initiative at different stages of the forage selection and adoption process according to their respective skills, experience and available resources. Utilizing these experiences, PPSF builds on the farmers' unique capacity to articulate precise preferences and to match varietal traits with specific environmental and socioeconomic niches. Finally, iterative feedback loops among all the actors will lead to mutual benefits.

Objectives

This paper describes a sequential procedure for implementing the participatory development and selection of forages, which is widely applicable and allows the analysis of quantitative data. The aim is to identify ideotypes requested by farmers as a basis for efforts to make these available to them, as well as to other farmers. The latter process of scaling up will be described elsewhere. The final goal is to identify and scale forage technologies, offering solutions to farmers' constraints and opportunities, integrating on-station and on-farm research with farmer participation.

This work capitalizes on earlier work with cassava, maize and beans, which resulted in a procedure to analyze data obtained in participatory evaluations and serve as an initial framework for developing a technology specific to forages (Hernández, 2000). Forages differ considerably from other crops as germplasm ranges from annual to perennial materials and forages have other multiple functions in the system (Humphreys 1994; Schultze-Kraft and Peters, 1997; Peters et al., 2001).

This paper describes this procedure and identifies strengths and limitations of the same.

Methods

The following research questions will be addressed in this study:

- Is it possible to develop a participatory procedure in order to identify farmers' selection criteria to be applied in forage technologies?
- Can information derived from this participatory procedure be analyzed and incorporated into the traditional research process?

Participatory procedures

Figure 1 summarizes the suggested sequential participatory procedure, focusing on the identification, analysis and synthesis of criteria and explanations obtained in interactions with farmers. The procedure was developed in an iterative process of training, validation and feedback among farmers, technicians and scientists working with NARIs, NGOs, development projects, ARIs and CIAT in Honduras, Nicaragua and Costa Rica. The forage options used were selected on the basis of earlier on-station and on-farm work carried out by CIAT and its collaborators in Latin America and the Caribbean.

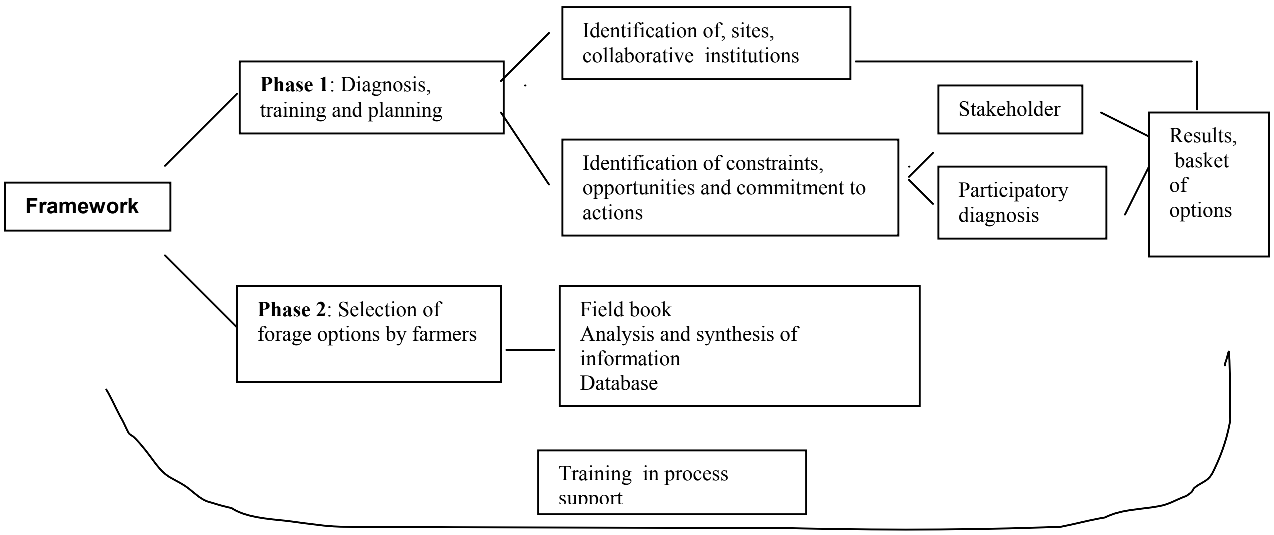

Figure 1. Description of the procedure and results.

The procedure consists of two phases thus far:

1. *Diagnosis, training and planning.* Identification of institutional collaborators and sites and exposing farmers (and technicians) to a range of forage options. This phase focuses on diagnosis, planning and training and the supply side of technologies; work with farmers is mostly consultative
2. *Selection of forage solutions by farmers and development of a field book.* In this phase forage options are selected; and descriptors, criteria, reasons, explanations and ideotypes obtained. Results are analyzed, systematized and generalized conclusions, drawn. Work with farmers is consultative and collaborative.

1. Phase 1

- Identification of institutional collaborators and sites. When selecting institutional collaborators, emphasis is placed on including diverse R&D institutions, working at different scales, from locally to nationally and internationally. Such diversity will not only allow the inclusion of different experiences and views, but also capitalize on the strength of each partner. An essential guiding principle and selection criterion is the interest in doing participatory work. Once collaborators are identified, experiences in PPSF and PME are assessed, and a corresponding training strategy, including training courses and follow-up workshops, is developed. The training process is an integral part of procedure development, particularly in the follow-up workshops, where approaches and methods employed and developed are validated and revised.

- Identification of constraints, opportunities and commitment to actions

- ⇨ Stakeholder analysis. Identifies interest groups at the watershed and community levels, differentiating age, gender, and experience (Ravnborg et al., 1997). Although in our case the initial focus was on livestock producers, the use of forages for soil fertility maintenance and soil conservation was included. Livestock, crop and mixed farmers participated. Focus groups included small- and medium-sized farmers although larger farmers sometimes benefited through contacts with these groups. It was also made clear to farmers and collaborators that there were no monetary benefits as part of the collaboration and that the immediate benefit was the access to improved technological options selected by farmers (most not yet available commercially). It was also pointed out to the farmers that success would depend on their active participation.
- ⇨ Participatory diagnosis. Restricted to agriculture, to complement the stakeholder analysis. The community identifies and prioritizes the main problems and opportunities for agriculture in their environment. Farmers look for research actions in order to find technologies to solve their field problems. Participatory diagnosis is a dynamic process done by groups of farmers in order to identify problems and possibilities of solutions. Farmers take decisions and actions as a commitment for them in a participatory diagnosis process (Ashby et, 1992).

- Selection of forage options. Different tools are used to evaluate forage options with farmers. Which tool to use initially depends on the stage in the participatory process, farmers' risk averseness in response to available resources and culture, and their experience with forages. Some approaches can be handled simultaneously.

  A range of forage options including grasses, herbaceous and shrub legumes were used as a basket of options. While introduced options are common across sites, in each location the currently used forager were included as controls.

- In later stages complementary options (e.g., Brachiaria hybrids and cowpeas), identified on the basis of farmers' preferences, constraints and opportunities were included in the evaluation.

- Nursery plots. This tool can be used for first exposure of farmers to new forage options. Nursery plots are small areas with a multitude of forage options where farmers are exposed to a breadth of potential technologies addressing constraints and opportunities. Farmers give feedback on the utility and deficiencies of forage technologies and can select the most promising options for their production environment. There is limited risk as plots are small and the farmers' input of resources is minor. The process is mostly consultative, with the farmers providing land for the nursery plots and investment of time in participatory evaluations.

  To assess the forage options, preference ranking in an open-evaluation environment is employed (Guerrero et al., 1993). Farmers rank technology options according to their objectives and give feedback, defining specific reasons for selection. The information provided by farmers in the ranking/open evaluation interviews is based on (a) criteria, (b) reasons and (c) scoring the criteria. Farmers' comments give insights into what they "see," what is significant and what is not, from his/her viewpoint. Wherever possible, links between farmers' explanations and technological characteristics will be explored. Participatory evaluations used in Latin America frequently use scales from good to poor. Probabilities of accepting or refusing technologies can be drawn from their scores/rankings (Hernandez, 2000). When starting in a new environment, the set of criteria, reasons and explanations is relatively ample; moreover, terminology varies among farmer groups and individuals. The development of a glossary of terminologies with technical explanations, analysis and stratification of results leads to a reduced set of descriptors for scaling up the approach in similar conditions (see below). Hence the process of obtaining a reduced set of wider applicable descriptors is crucial in reaching a maximum number of farmers under conditions of limited capital and human resources, biophysical and socioeconomic environments and cultural preferences.

Information at this stage is fed back to the scientists to focus and orient the development of novel forage options.

- Demonstration plots. To assist the process of farmer selection, it is often beneficial to combine the nursery plots with larger scale demonstration plots of "best-bet forage options" (i.e., with a high technological confidence level) to observe their potential use at the farm level (e.g., soil conservation and animal production evaluation). While farmers give feedback and can select technologies from such demonstration plots, farmers can adapt the technologies according to their own demands. Given that this scale involves a relatively high risk, scientists and technicians assume this risk, managing the trials during the phase of introducing technologies that have not been tested previously in the area.

- Expansion plots. Once farmers have identified the suitability of technology options, they are likely to expand the area dedicated to these new options. Such plots can then become additional demonstration plots, which may offer a "real life" comparison for other farmers in similar biophysical and socioeconomic environments . The management of such plots is farmer led. Cross visits to and farmer-to-farmer interaction at such demonstration plots are facilitated.

2. Phase 2

- ***Selection of forage solutions by farmers***

  ⇨ Test plots. Utilizing their own criteria, farmers select one or a limited number of technologies for testing on their farms in bigger areas. In Central America an area of 200-400 m2 has been found useful for this testing, but the size may vary according to specific production environments in other locations. Large livestock production is not yet possible to measure in such plots: however the effect of livestock on plants and the acceptance of animals can be assessed. Initial seed/planting material is provided to farmers, but with the clear indication that for further expansion, they need to produce or purchase their own planting materials. Hence this is also the stage where linkages to seed producers and formation of artisan seed production are facilitated. The test plots can serve as an initial basis for multiplication of planting material. The management and risk of the test plots is the responsibility of farmers; however they receive support from technicians and researchers.

Based on their experiences, farmers will or will not expand and adapt forage options on their farms. As part of monitoring and evaluation criteria, reasons and explanations will be further refined. Feed back and analysis on these processes is crucial for directing future on-farm and on-station research.

- Field book. This is used to analyze, systematize, stratify and validate results from the participatory and complementary agronomic evaluations. It includes the glossary of the terminology and a multivariate analysis of preference ranking, criteria, reasons, explanations and rating. The product is a further refinement and prioritization of descriptors and a definition of ideotypes for farmers in similar environments. Such information is highly useful to direct further on-station germplasm/breeding research as well as to enhance scaling into other areas.

Process support: Training

The incorporation of training in the participatory procedure is essential for the success of the approach. There are training components specific to institutional collaborators and to farmer collaborators. The first step is training institutional collaborators in participatory research tools and philosophy, forage technologies and monitoring and evaluation tools (which comprise both participatory and 'traditional' methods). This training commences once the collaborators have been identified and a work program has been agreed upon. In general training includes an initial, mostly theoretical training course, followed up by accompanied learning-by-doing during the research and diffusion process, with the greatest intensity during the first two years. The follow-up concentrates on the practical utilization of the tools based on a learning-by-doing approach, which also feeds back to improve the participatory procedure. Other training needs among institutional collaborators are identified during the research process and are addressed by the best qualified of the R&D partners or, if necessary, sourced outside. Training materials include manuals such as an instructional unit on the participatory procedure (Hernandez et al., in prep.), forage technology (Argel et al., 2002 a,b; Peters et al., 2003), monitoring and evaluation database tools (Franco et al., in prep.), and methods for facilitating artisan seed production (Cruz et al.., 2003). The aim of this training is not only to facilitate the R&D process per se but also to emphasize the empowerment of farmers and strengthening of all institutional research collaborators involved. It is important to acknowledge that the learning process is multidirectional (i.e., everybody learns from everybody) as well as iterative.

Results – Phase 1

Identification of institutional collaborators and sites

Identification of constraints, opportunities and commitment to actions

- Stakeholder analysis and participatory diagnosis. Stakeholder analysis and participatory diagnoses were carried out in the communities of Yorito, Sulaco and Victoria in Honduras; San Dionisio in Nicaragua; and El Puriscal in Costa Rica (CIAT 2000, 2001) .

- Livestock farmers as well as crop and mixed farmers were included although the focus is on smallholder livestock farmers. Although women and a wide age range (from approx 18 to 80 yr) participated in the original diagnoses, future work showed that in terms of livestock owners they formed a minority, not statistically significant for separate analysis.

- Participatory diagnosis. In the context of participatory development and selection of forages, the diagnosis was employed, not only to define demands and niches for forages and availability of potential options, but also to identify highly interested farmer groups and individuals with a high likelihood of benefiting from and hence maintaining the collaboration. The selected group was then given the responsibility of defining sites for the initial nursery plots, offering a basket of forage options.

Selection of forages by farmers

Combined analysis including all forage technologies offered to farmers

- Frequency analysis. Based on data from Honduras, a cross tabulation of frequencies with all forage technologies included (i.e., grasses, shrubs, herbaceous legumes and green manures) was computed. Results indicate that plant color was the most important criterion in the farmers' assessment. Across seasons this parameter was given more importance in the dry season as an indicator of the ability of the plants to stay green and retain their leaves. Plant growth was the next most important criterion, followed by cover, leafiness, competitiveness and production. In contrast to color, all these parameters had a greater importance in the wet season.

  Color was the most important criterion in all forage technologies. However, growth, especially in the establishment phase, was a more important criterion in grasses and shrub legumes; while cover was more important for herbaceous legumes and cover crops. Equally important for herbaceous legumes and cover crops were competitiveness, growth, leafiness and ability to function as green manure. For shrub legumes, possible use as firewood was another important criterion.

In conclusion, farmers selected forages based mainly on drought tolerance, ease/success of establishment and yield. Drought tolerance was the most important criterion, indicating the demand and potential for adoption of dry season forage species.

- Principal components analysis. Criteria were also analyzed using Principal Components Analysis (PCA). In the global analysis across technologies for the wet season, the first 3 PCs (principal components) explained 64% of the variation, which is a high percentage when analyzing participatory work.

  The wet season is defined by criteria for establishment and stability/ persistence:

  The analysis of dry season data across forage technologies shows a similar level of confidence, with the first three PCs explaining 66% of the variation:

  In the dry season fewer criteria are related to the selection of forage technologies by farmers, possibly as a reflection of the major importance of few parameters, responding to particular constraints for farmers at that time of the year.

Conclusions

There is no doubt that the PPSF was successful in selecting and developing with farmers, forages suitable to smallholder production systems in Honduras, Nicaragua and Costa Rica. Technicians and scientists in similar biophysical and socioeconomic environments can use the methodology and information generated to design and select novel forage technologies. Moreover, it was possible to strengthen linkages among farming communities and technicians, development workers and researchers in the aforementioned countries, increasing mutual knowledge and benefits. The participatory procedure developed gave a sounder understanding of farmers' perceptions of their problems and opportunities, contributing to building a stronger bridge between farmers' communities and national research institutes.

All participants-farmers, technicians and researchers-through the implementation of the participatory procedure gained increasing trust and knowledge. Farmers gained knowledge on superior forage germplasm and adapted and adopted selected options, technicians/scientists obtained useful insights to develop and drive design of new technologies design responding to farmers' conditions and expectations. Farmers adopting forages increased the capacity to take more risk by harvesting the benefits of technology adoption. More confidence was gained as forage based options adapted to their farming systems were identified and through the open interaction with technicians and /researchers. Many farmers are increasing areas of selected forages options. This environment of trust is anticipated to facilitate future research on more complex technologies as for example soil fertility improvement and evaluation of value added forages (i.e. hays, silages, leaf meals, forage-based concentrates).

The participatory procedure involved a series of steps that could be easily followed with anticipated outcomes. Thus, it was easy for technicians and scientists to adopt the participatory procedure, and they could obtain outcomes such as criteria, qualifications and reasons from farmers relatively rapid. The participatory procedure included careful research planning and the definition and supply of forage options appropriate to the vulnerable environments of the Central American hillsides. Diverse social actors such as technicians, researchers and interest groups were identified and their roles defined in a collaborative and integrative approach. The inclusion of producers in all processes as the design of research, diagnosis and the evaluation of forage options (supply) led to the selection of appropriate forages by farmers in a broad range of farming systems. Moreover, an understanding of farmers' perceptions (criteria) about forages options was acquired, focusing further research needs and allowing a higher likelihood of adaptation and adoption of forage technologies.

The coupling of a rapid participatory diagnosis with selection of farmers and farmer groups and complemented by secondary background information was efficient in focusing and initiating the research and development interaction and rapidly identifying interested farmer collaborators, leading to a high probability of technology adoption. The rapid procedure focuses initially on technologies where a good understanding of suitability of technology options exists but is limited when addressing highly complex technologies and an in-depth understanding of learning processes is needed. However the technologies supplied combined with the procedure may prove a good entry point for other, often more complex technologies as the rapid intervention with tangible results maintains interest and builds trust. The procedure is widely applicable, scalable and in this respect has advantages over many other methods in directing strategic research on identification of germplasm options. The procedure is well structured and can be used to analyze quantitative data with multivariate methods. As a result ideotypes based on criteria, reasons and explanations were defined. In fact, the participatory procedure developed in forages can be a suitable complement to other experiences of researches that are using participatory approach for developing forages technologies on farms. This participatory procedure offers a sequence procedure and some ways to analyze the information.

The participatory procedure is complemented by training strategies to establish a capacity on how to apply the procedure to forage technology development and selection, facilitating scaling-up of institutional capacity through the formation of strategic alliances.

Recommendations

The procedure needs further validation to define limitations for specific types of technologies and socioeconomic and biophysical environments. It is already acknowledging that the procedure needs to include small plot selection with animals at an earlier stage. This procedure could prove to be useful, not only for forage selection in Central America, but also for other contexts and technology options after appropriate validation and adaptation.

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