ORGANIZING EXPERIMENTING FARMERS FOR PARTICIPATION IN AGRICULTURAL RESEARCH AND TECHNOLOGY DEVELOPMENT

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INTRODUCTION

Farmers who experiment with new ways of farming are an important resource helping rural communities to solve their farming problems Yet these experimenting farmers are generally unrecognized, unsupported, and disconnected from the often substantial investment in formal agricultural research Experimenting farmers are a neglected resource because conventional approaches to agricultural technology generation are top-down Technology is designed by scientists who make decisions about what to recommend to farmers without giving farmers any direct say in this process The conventional approach is like a doctor-patient relationship The researcher and extensionist (like the doctor) are supposed to formulate a prescription to cure the farmer-patient's ills But when the doctor or scientist cannot diagnose enough problems correctly nor formulate appropriate prescriptions because the needs are so many and diverse then this approach breaks down Developing technology which is suited to the particular, location-specific needs and problems of the 1 5 billion people who depend on complex diverse, risk-prone agriculture requires a different approach (Chambers, 1994)

One solution could be the establishment of a community-based capacity for carrying out adaptive research with the participation of farmers in identifying problems and in implementing technology testing There are an increasing number of experiences involving organizing groups of farmers, or working with existing farmer organisations to implement farmer participation (see for example Mattee and Lasalle, 1994, Muchagata et al 1994, Mushita, 1993, Drinkwater, 1994, Heinrich et al , 1991) The strategy of organizing groups of farmers to participate in adaptive technology testing is in part a response to concerns about how to reduce the costs of involving farmers in research when this makes heavy demands on the time of salaried professionals (researchers or extensionists) It also addresses the need to 'scale up' farmer participation in research and extension so that technology testing can be carried out in numerous, diverse micro-environments without incurring excessive expenses and compromising the quality of participation (Okali et al , 1993 Ashby, 1991, Bebbington et al , 1994)

Many questions have been raised about the viability of institutionalizing an adaptive research role for farmers and the constraints such efforts are likely to face (Bebbington et al 1994) Critics argue that farmers' traditional or folk experimentation is a form of knowledge generation superior to western science The strength of folk experimentation is making contingent, sequential adjustments over time to changing circumstances which are unpredictable (Richards, 1989, Scoones and Thompson 1994, Drinkwater 1994) This indigenous form of knowledge generation does not readily fit within models of controlled experimentation used by western science

A more useful analysis draws on understanding the nature of folk experimentation For example, farmers compare "treatments", but the check or control may be "in the farmers head" because farmers compare this year's performance with last year's Another comparison used by farmers contrasts results in a distant field with a nearby one or the results of adding a little bit more fertilizer to one furrow compared to the remainder of the field Folk experimentation involves replication, but this is typically mainly replication over time, in contrast to replication in space and time (characteristic of the scientific method) Moreover, farmers recognize confounding effects in folk experimentation For example, a small amount of seed of a new variety is typically nurtured and multiplied up in the more fertile home garden, then the next planting moves the new variety to testing in different types of soil, testing the genotype x environment interaction Only once performance is assessed in a variety of environments, are conclusions drawn about the likely performance of new germplasm in the farmers' environment

Experience shows that farmers' knowledge generation can draw on <u>both</u> the scientific method of controlled comparison <u>and</u> folk experimentation it is not an either-or dichotomy (see for example Uphoff 1992 282-3, Hardon and de Boef, 1993 67, Berg, 1993 Lightfoot 1987)

Another issue is whether the creation of a special group builds on existing authority structures or creates a parallel non-traditional structure and the extent to which such groups can represent the research agendas of different interest groups within the community or may indeed exclude particular groups (Bebbington et al 1994)

Experience with on-farm research shows that when formal criteria for selecting farmers to participate in research were not used, the resultant participants were usually more wealthy and politically active farmers (Merrill Sands et al , 1991 303)

Experimenters, or innovators who can afford to experiment, are likely to be the relatively better-off farmers, who have the skills, and resources (including power) to devote to a particular kind of knowledge-generation There is some experience with working with research-minded farmers, that suggests it is desirable to purposively select innovators who have the time and interest for experimentation (see for example Abedin & Chowdry 1989, cited in Merrill-Sands et al , 1991, Ashby et al , 1987)

The real issue is whether experimenting farmers who represent the local capacity for research in rural communities can be harnessed to a research agenda, defined at the community level, which is also useful to the very poor or to other interest groups, such as women who may have different priorities from the relatively better-off who carry out the local experimentation

Could this local capacity if linked effectively to research agencies, share the costs and expand the coverage of adaptive research, while ensuring that this is relevant to local farmers? How is community-based participatory research to achieve broad coverage which is cost-effective? Can a self-sustaining capacity and responsibility for promoting farmer participation be created in rural communities? How can linkages among these different actors be managed without increasing the transaction costs to an unwieldy extent? Little systematic work has been done on the costs of creating organisations at the community-level to fill this function, nor has there been much empirical assessment of the extent to which such organisations can increase coverage and improve targeting of adaptive research in a way which is self-sustaining (Axinn, 1994)

This paper reports on an effort to provide empirical data on some of these issues from action-research carried out in 1990-1994 by the IPRA project of the International Center for Tropical Agriculture (CIAT) with support from the W K Kellogg Foundation The project aims to assess the potential for institutionalizing a community-based capacity for involving farmers in carrying out adaptive research This paper reports results obtained on the devolution of adaptive research responsibilities to committees of experimenting farmers, the effects of scaling-up this approach to achieve broad coverage, and its cost

The paper is organized as follows The following section describes the procedures used for forming farmer committees and their activities Then results are presented, in relation to the evolution of the farmers committees over the four year period 1990-1994 The paper ends by pointing out issues that these raise for future application of this approach

METHODOLOGY

The project's strategy is to implement participatory research methods for adaptive technology testing, by forming committees of farmers based in rural communities to carry out technology testing together with public sector agricultural research and extension agencies, and intermediate organisations (NGO's and farmer cooperatives) Development of training courses and materials used for training farmers and staff of public sector and intermediate organisations for this purpose is integral to the strategy

The purpose of the farmers' research committees (Comites de Investigacion Agropecuaria Local or CIAL) is to mobilize local leadership among farmers to take responsibility for experimenting with technologies not known in their community In this way, the project aims to create "demand-pull" by clients of public sector and intermediate organisations, on agricultural research and extension, diversifying the type of technologies available, and increasing the number and rate of flow of technologies to resource-poor farmers, so improving adoption, farm incomes and welfare Experience shows that new technology selected with farmer participation methods is better adapted locally than that recommended by researchers working on their own (Sperling, 1993, Worede and Mekbib, 1993)

The project was initiated in a pilot area in Cauca Department, in southern Colombia Cauca is one of the poorest, lowest-wage departments in the country The pilot area is characterized by hilly terrain, poor infrastructure of roads and markets, and small farms averaging 5 ha in size (average cultivated area is less than 3 ha) All farms engage in a mix of commercial and subsistence production This is a marginal coffee production area, with infertile acid soils, often badly eroded Most farmers cultivate coffee, together with cassava as a cash crop, some maize and climbing beans are grown traditionally for subsistence Livestock are scarce (only 13% of farms have any cattle)

The project began the formation of CIALs in five communities (*veredas*), in 1990, the number increased to 18 communities in late 1991, to 32 in 1992-3 and then to 55 communities by 1994 A further 30 CIALs which were formed in Bolivia, Ecuador, Peru and Honduras by international trainees in the method, brought the total to 85 so far This paper reports information obtained from monitoring the 48 CIALs formed between 1990 to mid-1994 in the pilot area in Colombia, these CIALs cover an area of approximately 1605 Km^2, involving an estimated 50,000 families, and direct contact with over 4,000 farmers, of whom 220 participated in training as members of the CIAL or research committees

Each CIAL is formed with four farmers elected at a community meeting, which meets regularly during the first training cycle (or experimental period, usually equivalent to a cropping season of about six months) The first training cycle involves up to ten training visits by a support-farmer who has had at least one year of prior experience in CIAL Over the next cycle or cropping season these visits are progressively reduced in number, as the CIAL gains experience and carries out experiments with increasing autonomy (Box 1)

The support-farmer is backed up by an agronomist who provides input to statistical design of CIAL experiments and the analysis of data taken by the CIAL members At present in the project area, the 48 CIALs are attended by three support-farmers, backed up principally by one trainer-agronomist

RESULTS

This section of the paper reviews the results obtained during 1990-1994 from the organization of 48 CIALs or farmers' research committees in the pilot area in Cauca, Colombia The procedure for forming CIALs was developed in a pilot phase from 1990-1991 in which five farmers' research committees were established and trained in techniques for participatory diagnosis, planning and establishing replicated on-farm trials, participatory evaluation of technology, analysis and interpretation of results, budget analysis of the total cost of the trial and of the individual treatments Planning and presenting a short oral report on the results to the

Box 1 Procedure for formation of a new CIAL

1 On-farm research and extension staff of the host institution receive training in the CIAL methodology and select communities or respond to requests from communities to form a CIAL The host institution may be the state agency or an NGO or farmer cooperative

2 The host institution calls a community meeting in which farmers make a group analysis of what it means to experiment with new agricultural practices, of local experience with experimentation and its results and of the purpose of a local research committee

3 If the community decides to establish a CIAL it elects a four-member committee of farmers recognized locally as experimenters, with leadership qualities defined together with the community, before the election

4 The CIAL conducts a diagnosis in one or more community meetings at which a topic for the CIAL experiment (eg a crop, cultural practice fertilizer use) is prioritized

5 In a planning meeting with their host institution s agronomist the CIAL defines the objective of their experiment the treatments and the check criteria for site selection, timing inputs, data needed to draw conclusions from the trial, responsibilities for different tasks In the first training cycle, a support farmer visits the CIAL on a regular basis, as these tasks are implemented

6 Once the experiment is planned, the CIAL carries out the activities involved from planting to harvest, managing the community's CIAL fund This is a collective rotating fund in which each CIAL has a share In Colombia the CIAL fund amounts to less than 50% of the value of a head of livestock in the pilot area (US$375 per CIAL at current exchange rates)

7 Once the experiment has been harvested the CIAL meets with the agronomist to draw conclusions from the data they have taken on their experiment, and plans the community meeting at which the CIAL will present its results

8 The community meets to hear an oral report by the CIAL of its activities results and financial status If appropriate the diagnosis is repeated to orient the CIAL s activities for the next season

9 In the second and subsequent cycles of experimentation two or three monitoring visits are conducted by the support-farmer

five CIALs which met as a group, and to each community was part of the process After the first training cycle (or cropping season), the agronomists in the IPRA project team began to gradually hand over each operation in the process to the farmers Monitoring visits by a sociologist were made regularly to assess how well the farmers were able to manage each operation, and to detect when follow-up training was required

On the basis of this experience, training materials in the form of twelve CIAL handbooks were prepared using discussions with the farmers involved, who helped to prepare the text and illustrations (see Appendix 1)

At the end of 1991, the second phase of formation of CIALs was initiated The project used the training materials to teach a course with NGO's in the pilot area, to prepare agronomists on their staff to establish CIALs As a result of the course, a further 13 CIALs were established using the training handbooks Monitoring by the project of this second phase now covered 18 CIALs, and included revision of the training handbooks as these were used in practice by the NGO trainees and their CIALs Based on this experience, the training handbooks were finalized, and in 1992 the project began to teach a regular course on the CIAL method to NGO trainees (who are university students doing a six-month agricultural extension practicum in the rural areas with the NGO), state extension agents and local community leaders

In a third phase a further 28 CIALs were formed in response to requests from communities and farmer associations In 1993 trainees in the course on the CIAL method included three farmers who were members of CIALs formed in the second phase These support-farmers were contracted (one by an NGO, one by a farmer cooperative, one by the project) to form the CIALs in the third phase

Devolution of responsibility for adaptive testing

One of the most important questions for the project is "what types of responsibility for location-specific technology testing can be successfully taken on by experimenting farmers organized in a CIAL?"

The 48 CIALs formed in the pilot area have been established successively by trainees coming fresh to the methodology This has allowed the project to evaluate the training requirements for setting up new CIALs, the rate at which CIALs can be progressively "detached" from their trainer, and the rate at which they can take over the responsibility for carrying out experiments in the absence of a trainer

Table 1 summarizes conclusions on the type of institutional support required by a fully-trained CIAL in the form of training and monitoring visits to carry out a crop-related on-farm experiment Our experience demonstrates that farmers' committees working on their own, confidently and accurately record results for separate treatments without confusing these when they are interested in the results When in the planning meeting, farmers have defined data they want to take, in measurement units that make sense to them, they are able to analyze these data to compare treatments, to assess germination rates and crop development For example height of maize plants was evaluated as too low (dogs can reach and steal cobs), medium, will withstand wind and resist lodging (desired), too tall (susceptible to lodging) Yield data is commonly processed by farmers in terms of yield per unit of seed, because they do not customarily use measures of area, although experimental plots are measured and staked out

Monitoring of the 48 CIALs showed that of the 15 activities detailed in Table 1, a fully-trained CIAL (with two cycles of experience) required training support in four activities at most In phases I and II, two of these required the presence of a trained agronomist planning, including the statistical design, and analysis of results Two visits by a support-farmer were identified as desirable to check that plot selection is consistent with the experimental objectives, and to ensure that data at mid-term or harvest evaluation is taken accurately Monitoring visits routinely involve a visit by a support-farmer to the community diagnosis and community report meetings By phase III the support- farmers were beginning to take over responsibility for support of planning the CIALs trials, and the analysis of results, by bringing the plans and later the results to a meeting for this purpose with one of the host institutions' agronomists

Most of the CIALs' research questions can be addressed by single factor experiments (eg 6-10 varieties superimposed on local cultural practices, or 3-4 fertilizer or pest control treatments) This makes support of trial planning and analysis feasible for paraprofessional farmers, together with a check of the design and interpretation provided by an agronomist (In practice training was required as much to reinforce skills of trainee agronomists to design and analyze on farm trials, as to teach these skills to farmers)

The research agenda defined by the CIALs is evolving from principally germplasm-based strategies (the search for new crops and varieties) at the beginning, to an interest in cultural practices once a viable new crop or locally adapted varieties have been selected by their experiments Most recent experience shows that the paraprofessional farmers can support CIALs in the design of a two-factor experiment planting density x fertilizer dosage is one example of a design set up by a CIAL without the intervention of an agronomist

Table 2 shows the rate of increase in activities carried out by CIALs independently of institutional support in the form of training by the agronomist or support-farmer The data on the first cycle show how the number of training visits required has gone down from 17 needed to develop the method and the training materials in Phase I to 10 training visits in Phase III Training sessions follow the activities outlined in Table 2 In practice, the number of training visits has been reduced, because some activities listed in Table 2 such as obtaining inputs, and repeated activities like observation or evaluation of the experiment, can be carried out independently by the farmers even during the first training cycle

Table 2 shows that the newest CIALs formed in Phase III are operating by cycle 2 with an average of 4 visits for training and support The 5 pilot CIALs formed in Phase I have continued to increase their autonomy by the last cycle, pilot CIALs were operating with only 2 support visits (one for planning the experiment, one for analysis of results) by the paraprofessional farmer

In conclusion, the project's experience demonstrates that the training of farmer research committees can be accomplished in two cycles (ie during two experiments), and that the fully-trained CIAL can take over responsibility for the majority of the activities required for farmers to implement on-farm experiments

Experience in 1993-4, in phase III, indicates that support-farmers (with two cycles of experience as a CIAL member) who are contracted as support farmers can provide almost all of the training and monitoring support required for formation and maintenance of the CIALs' experimentation in the form of simple on-farm trials This is permitting the agronomists involved in the project to delegate the planning and analysis needed to routinely support fully-trained CIALs, as well as the process of CIAL formation [1]

The next issue of importance is the quality of the research carried out by CIAL's operating with this degree of autonomy

Quality of research conducted by CIALs

Evaluating the quality of farmers' research is related to the issues discussed earlier, of the usefulness to farmers of the scientific method as compared with folk experimentation The project's strategy is to combine both approaches a formal experiment is planned and established, but if farmers decide to make changes in treatments or alter the experiment along the way in the style of folk experimentation, then the only requirement is that this is a decision made in committee by the collaborating farmers

CIAL experiments have been established with a minimum of three replications (farmers), and on occasions are also replicated within each site, if an agronomist judged this to be advisable Trials have been established on land belonging to members of the CIAL, on communal land, or on land belonging to other farmers, and have included rental or share-cropping arrangements common in the community in question Site selection is a decision made by the CIAL, with a follow-up visit to check that the proposed sites are consistent with the experimental objectives identified in the planning activity Consequently, the trials are carried out with a variety of collaborative arrangements involving on occasions a group of community members who for example, donate labor for the trial, or an individual who sharecrops, contributing land or labor, and who gets a share of the harvest Observation and evaluation of the trials' progress may involve several experimenting farmers, identified by the CIAL committee members as knowledgeable experts in the topic chosen in the community's diagnostic meeting, who then take part in planning and implementing the replications There exists therefore, scope for farmers to intervene and to combine folk experimentation with the formal experimental design

The project has monitored the quality of CIAL's research with respect to three criteria (1) is the experiment interpretable by farmers and also statistically analyzable? (2) were farmers still satisfied that they could draw useful conclusions from the experiment, even if statistically unanalysable? (3) did farmers conclude that they could not draw useful information from the experiment? The evaluation asks therefore, if farmers perceive the experiments as useful for generating information, and as well, do the experiments have the potential to supply useful information to formal research and extension systems

Table 3 presents the results of this evaluation Of the 273 trial plots managed by CIALs during 1991-4, the percent of plots (replicates) that could be used for statistical analysis has averaged 75 percent In phase I, 91 percent of plots were judged interpretable by farmers, although fewer (84 percent) were statistically analyzable In Phase II, only 62 percent were statistically analyzable, although farmers still judged 89 percent to be interpretable for their purposes The reasons for this drop in percent statistically analyzable were detected in the self-evaluation exercise conducted with each CIAL In the second phase, CIALs were linked to trainee extension agents who were managing the supply of inputs for the CIAL experiments together with those for their NGO's credit program The credit program was plagued by delays in obtaining the funds for purchasing inputs given in kind to participating farmers, which resulted in delayed planting and subsequent loss of trial plots from the CIAL experiments The CIALs requested that they manage the petty cash fund for purchasing experimental inputs, and once this was put into operation, the capacity of the CIALs to implement their trials in a timely fashion improved significantly In phase III, the number of plots lost to analysis due to late planting decreased to three (managed by one CIAL), the remainder were lost due to other factors

In sum, the average success rate by statistical criteria is 75 percent or by farmers' criteria is 90 percent, in terms of carrying out trials judged locally useful for knowledge generation

Reasons why devolution succeeds or fails

Why is this degree of responsibility and accuracy in conducting adaptive trials achieved by resource-poor farmers who are very busy people, struggling to cope with running their own plots and farms? This is especially puzzling in view of the huge resources devoted in the past to training and equipping teams of on-farm (or farming system) researchers for whom obtaining farmer collaboration or participation in formal experiments was a major source of frustration (Lightfoot and Barker, 1988) Analysis of the success and failure of CIALs over the period 1991-1994, during which time 5 CIALs have become inactive (representing 11 percent of the total number formed) suggests that there are several determinants of the degree to which a CIAL makes a commitment to running its experiments with a minimum of institutional support

First, the CIAL's training must successfully impart the principle that the committee's objective is to experiment, to generate knowledge and to disprove or discredit unreliable recommendations If this objective is not clear, the CIAL members experience loss of purpose if an experiment shows that local practice is in fact the best available alternative to the innovation being tested Our experience shows truly impressive persistence of some CIALs in the face of several experiments which did not identify a promising innovation compared to local practice In this respect, contact among CIALs is an important ingredient of success, one CIAL benefits from the others' experimentation and is motivated by it [2]

Second, it is obviously useful for a CIAL to include one literate member who can read the CIAL handbooks aloud to the other members and who can keep records, and tally accounts because this facilitates the management process However, written records have proved important mainly to the host institution which is collating data from several CIALs Non-literate farmers recall complicated varietal code-names, the lay-out of treatments, and the differences among treatments with amazing facility if they perceive the information as important and useful to them Our experience suggests that literacy may not be a prerequisite for farmers to carry out the CIAL's adaptive research responsibilities, but it does mean that support by the paraprofessional may have to be more intensive over an extended period Nor does functional illiteracy prevent farmers from exchanging results with each other, since the oral tradition is strong in these communities

More critical to success, is identification in the group diagnosis of a problem or question for the CIAL's experiment which the farmers concerned want to answer, and which is of interest to the community This is why the monitoring visits at diagnosis and report-time are important to ensure that the committee feels accountable to its community, and at the same time, gets encouragement from the interest shown in its results The sense of community service and responsibility to the group welfare created and reinforced in these meetings is possibly the single most important determinant of successful completion of the experiment by a CIAL Monitoring shows that conflict in the community and/or conflict in the CIAL is conversely, most likely to result in an inactive CIAL For this reason, the approach includes use of a technique for periodic evaluation by the CIAL of how its members feel about each other and their relationship to their community, which can be used by the committee with or without the support farmer's presence

Another motivating factor, is that managing a CIAL and experiments which command the respect of "outsiders" has proved to be a useful tool for "pulling in" the attention, and resources of institutions external to the community One CIAL has, for example, successfully negotiated a grant of land for a communal farm from the state land reform agency, on the strength of demonstrated management capacity and teamwork, others have attracted marketing arrangements with middlemen who previously would not journey to a distant village, but are now attracted by the quality and quantity of produce resulting from experimentation, yet others have persuaded the NGO's to introduce results of CIAL experiments into their credit programs The motivation to run an experiment autonomously is as much related to its organizational function as an interface with external organisations as its usefulness as a method of knowledge generation

Impact of CIAL trials

The results reported so far show that the 48 CIALs in the pilot area have, with a decreasing amount of institutional support carried out a large and increasing number of on-farm trials which farmers' consider useful for knowledge-generation and which are to a very large extent, statistically analyzable This section examines the impact of these trials

A rapid appraisal of the CIALs' impact showed that in 75 percent of the participating communities there was a perceived benefit from their CIAL in the form of new seed, new cultural practices or information about which recommendations to follow Of those CIALs with no perceived benefit, all but two were formed in phase III and are therefore newcomers with less likelihood of impact so far For example, one community asked its research committee to compare the state agency's recommendation to cover the ground under fruit bushes with black plastic, and a local practice for controlling nematodes The CIAL experiment shows to date, at least that the local practice is more effective under farmer management

State institutions in the pilot area set research and extension priorities on the basis of area devoted to different crops in the municipality thus in the pilot area, the priorities are cassava, pastures, sugar cane and coffee Small farmers' participating in the CIALs' diagnostic meetings had different priorities, as shown by the crops selected for CIAL experiments listed in Table 4

It is apparent that the communities identified a much more diverse research agenda than the institutions. For example, not one community prioritized cassava in their group diagnosis, although over 4000 farmers have participated in community meetings for this purpose. Diversity in the CIAL agenda reflects farmers' objectives to identify alternatives to traditional cash crops (coffee and cassava) and to increase their food-sufficiency by growing staples, such as potatoes, beans (a substitute for meat in the rural diet) and maize (used for feeding chickens, an important source of locally-produced protein, and as well an important ingredient of traditional staple dishes). Cauca department imports these staples from other parts of the country to meet its food requirements (SAG, 1989), so the local food self-sufficiency agenda reflects a regional problem.

At present, the CIAL are having some success in exerting demand pull and improving the diversity of technologies on offer via state and NGO programs. For example, in the NGO credit and technical assistance programs, maize and peas were introduced as a result of CIALs' experiments, and beans were given more importance. The municipal credit and technical assistance agencies (UMATA) also began to respond to farmers' priorities, especially once some of the CIALs started producing seed of varieties they had selected in their trials, which the UMATA recommended and distributed to other farmers. One UMATA recently began to use the CIALs' results for formulating recommendations to farmers participating in its credit program. Another responded to a CIAL's request for help in identifying peanut varieties for testing, by obtaining a selection of new varieties from ICRISAT through the national agricultural research agency.

An important development was the evolution of some of the CIALs which had successfully selected new locally-adapted crop varieties, into small seed-production enterprises delivering seed of these and of local varieties to farmers in the area. To date six CIAL have begun to produce seed from six varietal trials (with 23 replications) conducted over three years that have progressed to commercial-scale plots, for which they receive additional training in simple seed production, processing and quality-control techniques from the agronomist-trainer. This seed can be sold with state approval, when visits from the national agency responsible for seed certification are made, under the category of "farmer-improved seed."

Table 5 shows the amount of seed produced by the six CIAL seed enterprises. The CIAL seed is distributed locally in the village stores and weekend markets. An estimated 281 ha of maize, 3064 ha of beans and 3 5 ha of field peas (an entirely new crop introduced by CIAL experimentation into the pilot area) have been planted with CIAL seed More than 10,000 farmers have purchased CIAL seed, which over one planting season is estimated to have produced grain to a gross value of over US$2 million

Based on the yield differential between locally available varieties and those selected by the CIALs for seed production, this production represents an additional US$765,000 of gross income to local farmers from maize and beans, and a newly introduced income source worth over US$8000 to date from peas On a per capita basis, this represents an increment worth about one month of wage income in one planting season, to the farmers who purchased CIAL seed [3]

The seed enterprises also generate employment since they must hire additional labor to plant, harvest sort, clean and pack the seed in 1 to 5 kg sacks, also made locally by women The bean seed enterprises have for example generated an average of 20,000 labor days of employment locally over five seasons worth an estimated US$ 85,000 at current wage rates over the 5 years of operation

This impact has been achieved by six CIALs formed early in the project There is no guarantee of course that the newer CIALs will repeat this experience by identifying new practices or germplasm with comparable impact The six CIAL which have developed into seed enterprises may have already captured the best opportunity, and the windfall profits from participatory breeding and seed production The impact of the newer CIALs may be more difficult to realize especially as Table 4 indicates, their research agenda is shifting emphasis from grains to perishables On the other hand, the recent introduction of field peas, via CIAL experimentation, suggests that there could be scope for a significant increase in impact from CIAL experimentation with high value crops

Scaling-up and the costs of the CIAL program

The results presented to this point show that a fully-trained CIAL can take responsibility for executing most of the activities involved in the management of the kinds of adaptive research trials required for the research agenda identified in the 48 participating communities The experimental results have been useful for knowledge-generation, and more specifically have contributed to increasing the diversity of technology tested as well as improving the rate of flow of technologies to the participating communities, with sizeable monetary benefits in the specific case of CIAL seed purchasers

One of the most important questions this research aimed to address was to what extent this type of farmer participation in research could be scaled up to achieve broad coverage, and at what cost Before participatory research became fashionable, critics often queried whether this approach was an expensive luxury, attractive on a case-by-case basis and when supported by highly skilled professionals, but not affordable for working with large members of farmers (Farrington and Martin, 1988)

In this section we present information on the potential of the CIAL method to increase the efficiency of salaried personnel working in on-farm adaptive research and extension, by decreasing the amount of time required for them to carry out on-farm trials We also examine the operating costs of the CIAL corporation, a second-order organization formed by the CIALs in Cauca, to provide some insights into the feasibility and costs of creating self-sustaining CIALs

One way of assessing the potential of the CIAL method to increase the efficiency of public sector or NGO programs carrying out adaptive research, is to compare the amount of the time required to conduct an on-farm trial with and without a CIAL Table 6 presents estimates of the mandays required and cost of manpower for an on-farm trial run by an extension agent, an on-farm trial run by a new CIAL in the first cycle of training, and by a fully trained CIAL The analysis is based on the activities in Table 1, for which we estimate that an extension agent would require 8 mandays for a trial with up to three replicates (sites) A new CIAL requires an average of 10 training visits by the support farmer plus one manday of extension agent input to do the same job A fully trained CIAL can carry out a trial with 4 mandays of support training from the support farmer and a fraction of the input from the extensionist, conservatively costed here at one day Estimates of the different manpower costs show that even training a new CIAL to carry out an on-farm trial is less costly than running a trial with a salaried professional, given the pay differentials for the pilot area More important, devolving an on-farm trial to a fully trained CIAL costs 60 percent less in manpower costs than running a trial using an extension agent

One of the implications of this figure is that adaptive research programs could potentially reduce their manpower costs for on-farm testing significantly (by up to 60 percent), by working with CIALs Alternatively, a given amount of professional manpower can be expected to at least double its coverage, that is to increase the number of on-farm trials and farmer groups attended, by working with CIALs

Important variables which affect the efficiency and coverage of adaptive research are the variability of micro-agroecological regimes, the density of the population and the type of terrain which affect the amount of time required for site visits Before going on to examine the current operating costs of the CIAL corporation, the socio-geographical context in which coverage obtained by the existing CIALs has been developed, needs to be described

Today, in early 1995, there exist a total of 55 CIALs scattered in nine municipios in the Department of Cauca in Southern Colombia (see Fig 1), which together compose an area of 6648 Km^2, with an average population density of 40 persons/Km^2 The communities of small farmers participating in the project represent an area of influence of approximately 1605 Km^2 in which the population is concentrated at a much higher density farm-level surveys show an average of 132 persons/Km^2, when the extensive cattle and forest holdings are not included[1] Communities are characterized by a land use of 0 25 ha of cropland per capita, a figure comparable to estimates for Bolivia (0 33 ha cropland per capita), Ecuador (0 25 ha per capita) or Peru (0 17 ha cropland per capita) (Pachico et al , 1994)

Since 1991, the CIALs in the project area have decided to meet on an annual basis to exchange results In this one or two day meeting, financed by raising money in their communities for transportation and lodging, CIALs give oral reports on their experiments exchange seed, swap notes about their host institutions, and formulate recommendations on how to improve their performance on goals they themselves establish in each meeting This experience prompted the election of a central coordinating committee (*junta*) in 1993, and then in 1994 led to the CIALs' decision to incorporate legally at the recommendation of the *junta* Donations were obtained which enabled the CIAL corporation to establish an investment fund, from which the corporation can draw up to 70 per cent of the interest (the remainder going back into the capital) for operating expenses This put the CIALs on a self-sustaining financial basis In addition the support farmers have begun to give courses to the municipal extension services

(UMATAS), which have contracted them to form small numbers of pilot CIALs elsewhere, paying up to 50 per cent of their salary, and so generating additional income for the corporation The following data on costs are taken from the CIAL corporation's annual operating budget, itself derived from the project's data on the costs of running the CIALs in 1994

There are very few published data on the costs of doing adaptive research with groups of farmers with which to compare the figures in Table 7 These show the total operating cost per CIAL ie per community per year at US$502, and an annual per capita cost ranging from $125 if we only consider the 220 farmers who are committee members, to under $1 based on the total population in the area of influence, to $6 5 per capita if we assume that only a third of the population in the CIALs' communities actually receive any contact with their CIAL's adaptive testing Based on the estimated number of purchasers of CIAL seed, the cost per capita would be approximately $3 The total annual operating budget of the CIAL corporation currently amounts to the equivalent of about two agronomists salaries at national program rates These figures compare favorably with costs cited by Nimlos and Savage (1991) of $36 per capita and $2664 per community annually for an extension program using village-level support farmers in Ecuador Also in Ecuador, Romanoff (1993 cited in Bebbington et al , 1994) reports the cost of forming groups of 10-30 members using farmer-to-farmer training mechanisms at around $3000 However, these groups were farmer associations for processing and marketing cassava, much larger and more complex than the CIALs [5]

With respect to coverage, figures cited by Schwartz (1994 11-12) range from 100 to 300 farmers per extension agent (private sector) to 3,000 per extension agent (public sector) from case studies in Nigeria, Kenya and Thailand Comparable figures for the CIAL corporation can be estimated at between 66 (direct contact with committee members) to around 3,000 (population of the CIALs' communities or seed purchasers for example) per salaried paraprofessional/agronomist However, since the CIALs do not at this time have a complete extension function, but a partial research/extension function facilitating the adaptation of technology, this comparison is not completely equivalent

One reason why the cost of forming and running CIALs is relatively so low may be that the procedures for creating these groups were formalized fairly early on in the process, into training materials that were written together with farmers and are easily used by farmers Use of these materials means that support farmers with practical experience in the procedures, who represent very low-cost manpower, can form and run CIALs with minimal external support Experience in Bolivia for example, suggests that the CIAL handbooks can be readily used to form and run CIALs by extensionists without prior training in the method (Soria personal communication 1995)

Nonetheless, the cost data presented here should not be viewed as conclusive, to the extent that further testing of the approach without the intervention of the originators (the IPRA project team) is underway, and will permit assessment of how robust and replicable the method is in different environments, with variant cost structures

Equity

An issue related to assessing the effectiveness of the CIAL method for broadening the coverage of adaptive research, is the question of how equitable is the distribution of benefits The project has yet to conduct a comprehensive analysis to address this question but survey data are available on a sub-population of 11 communities which provide some insight As discussed earlier, selection of CIAL members is predicated on the assumption that experimenting farmers are likely to be relatively better-off members of the rural community Moreover, the CIALs are not designed to involve a large population in research, the committee mobilizes a capacity to test technology within the community, on the basis of a limited participation in conducting the actual research Therefore, distribution of knowledge about a CIAL's activities rather than participation in it, is a more important test of the extent and nature of the coverage achieved

A comparison of three social strata differentiated on an index of well-being (Ravnborg 1994) shows that of the 64 farmers actively participating in eleven CIALs, 39% come from the upper stratum compared with 22% who come from the lowest stratum (Chi Square p = 0 046) Among the very poor, only 8% participate in CIALs compared with 17% of the upper stratum However, the community population is essentially one of small farmers and in this sub-sample there is no significant difference in farm size between those who participate in the Committees (average farm size is 4 4 ha) and those who do not (average farm size 3 5, probability of t = 0 1484) Knowledge of the CIALs is more evenly distributed 52 percent of the population surveyed knows of the CIALs, and there is no significant difference between the proportion of very poor people (49%) and the remaining two better-off strata (53%) who have this knowledge (Chi Square p = 0 491)

The key issue is to what extent special interest groups in the community are able to get their priorities onto the agenda defined in the community diagnosis which decides the problems on which the CIALs do research Monitoring by the project has detected the marked tendency for few women to attend these meetings, and those who do attend often propose research problems which are not prioritized In order to address this need, the project established a separate fund for communities to set up a women's CIAL if a group of 10 or more women requested to do so However, only two women's groups formed CIALs, and four others added women to the committees Women still only represent 7 percent of committee members The main reason for this appears to be the difficulty women have in devoting time to regular meetings that take them out of the home For special interest groups like women, or the semi-landless laboring poor, the research committee may not be an appropriate instrument for addressing their special research agenda Several options have yet to be explored for example, separate diagnosis with special interest groups to identify priorities which then are included as treatments in trials carried out by CIAL members This raises the question however, of the degree of motivation of CIAL members to carry out trials on topics of secondary importance to them, and the more powerful members of the community Another option is to have special interest groups evaluate the trials so that their criteria for what is a desirable innovation are included in the analysis and recommendations drawn from CIALs' research It may be however, that increasing the equity of coverage by adaptive research has to be achieved by targeting the very poor, with the "slack" research/extension capacity of intermediary organisations created by devolving part of the research agenda to CIALs These issues are topics for further empirical research, now starting in the project

CONCLUSIONS

Forming and monitoring the evolution of the CIALs is an ongoing experiment to assess the feasibility, and the implications of devolving the responsibilities for adaptive agricultural research to farmers The CIALs were formed to investigate to what extent the methods for participatory diagnosis and problem definition, planning and evaluation, and ultimately monitoring of adaptive technology testing, could be handed over to community-level organizations, to generate "demand-pull" on formal research and extension systems, and to improve the access of resource-poor farmers to an adaptive technology testing service, at a reasonable cost Our experience so far, suggests that it is possible to institutionalize this responsibility with farmers, that it is not unrealistic to expect "hard-data" from farmer-managed adaptive research, and that this demonstration of farmers' capability wins respect for farmers which is catalyzing a gradual reorientation of bureaucratic institutions' priorities Results show that current costs and coverage compare quite favorably with some state or private sector systems, although the basis for comparison is very limited A favorable cost structure is clearly related to the demonstrated effectiveness of paraprofessionals like support farmers for scaling up, and for achieving devolution

The project is entering a new phase with an international training program and monitoring of new CIALs, which are disseminating in widely-contrasting socio-cultural environments as distant as Brazil and Honduras Many questions remain about the long-run viability of the CIALs as an approach to institutionalizing farmer participation in agricultural research But there are already some signals -- like CIAL Miske in Bolivia which is reaching out to serve 22 communities, or the CIALs (rechristened CALITS) in Peru which organized as a group to campaign for support from their regional state experiment station -- that a quiet revolution may be underway, to bring the capacity of farmers as researchers to fuller recognition

Table 1 Activities carried out by a CIAL in a crop-related experiment, and institutional support required

Type of activity	Number of activities	Training & assistance by agronomist	Para-professional	Monitoring by para-professional farmer
Group Diagnosis	1	--	--	(1)*
Planning	1	1	--	--
Plot selection	1	--	1	--
Land preparation	1	--	--	--
Obtain inputs	1	--	--	--
Establish experiment	2	--	--	--
Check germination	2	--	--	--
Crop management	Variable	--	--	--
Mid-term evaluation	2	--	1	--
Harvest evaluation	1	--	--	--
Analysis of results	1	1	--	--
Community report	2	--	--	1
Total	15	2	2	2

* Infrequent

Table 2 Rate of increase in independence of CIALs from institutional support 1991-1994

Phase of CIAL formation	No of CIALs	Mean number of visits per training cycle				
		Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
Phase I (pilot)	5	17	10	4	2	2
Phase II	13	12	7	3	3	
Phase III	30	10	4	4	3	

Table 3 Quality of on farm trials conducted by farmers' Committees (CIAL) January 1991 - August 1994

Phase of CIAL formation	No of plots	Percent of plots statistically analyzable and interpretable by farmers	Statistically unanalysable but interpretable by farmers	Lost to analysis
Phase I (Pilot)	42	84	7	9
Phase II	85	62	27	11
Phase III	146	78	12	10
Total	273	75	15	10

Table 4 Experiments of Local Agricultural Research Committees

TOPIC	NUMBER OF EXPERIMENTS[1]		
	Phase I	Phase II	Phase III
Peas and related cultural practices	1	3	5
Potato	6	5	3
Maize and related practices	7	8	7
Peanut	1	3	4
Fruits and related fertilizer dosages, pest control	3	6	11
Beans	6	4	0
Snap-beans	0	1	1
Tomato	1	1	1
Soya bean	1	2	1
Sugar cane	1	1	1
Vegetables	4	7	6
Chicken feed mixes	1	1	0
Forage grasses	1	1	1
Cover crops (green manure)	0	0	1
Guinea pigs	0	0	1
TOTAL	32	42	43

[1] Sums to less than the number of CIALs because not all CIALs are establishing new experiments

Table 5 Seed production by six CIALs and its estimated impact over one planting season

Crop	No CIALs	Total seed production (Kg)	Estimated area planted (ha)	Estimated production (tons)	Farm gate price (US$/ton)	Gross value (US$000)	[illegible])%
Beans	2	147,080	3064	3064	683	2,093	[illegible]
Maize	2	8430	281	1124	488	549	[illegible]
Peas	2	136	7	3 5	2439	8	[illegible]
Total	6	155,646	3352	4191 5	--	2650	3

Table 6 Comparison of manpower requirements of an on-farm managed by CIAL and by extension

TRIAL MANAGEMENT	MANDAYS REQUIRED[1] (N)	TOTAL COST OF SALARIED MANPOWER[2]
BY EXTENSION RESEARCH	8	62
NEW CIAL (CYCLE 1)	11	46
FULLY TRAINED CIAL	5	23

Notes

1 Excludes crop management after trial establishment which is variable depending on the crop, and initial diagnosis

2 Support farmer's time costed at minimum wage, extension agent costed at 2 x minimum wage, agronomist time costed at average salary current in the pilot area

Table 7 Annual operating costs of the CIAL corporation for 55 CIAL

ANNUAL COSTS	US $
Personnel costs per CIAL[1]	290 0
Cost of experiments per CIAL[2]	90 0
Other operational costs per CIAL[3]	122 0
TOTAL COST PER CIAL	502 0
Cost per capita	*$ per capita per year*
Total population (50,000)	0 55
CIAL communities (12,900)	2 1
33% of CIAL communities (4260)	6 5
Seed purchasers (10,500)	2 6
CIAL Committee members (220)	125 5

Notes

1 Includes Agronomist (0 33), farmer coordinator (1 0), support farmers (2 0)
2 Average of costs per CIAL charged against CIAL funds in 1994
3 Average of transportation, supplies, and capital depreciation on 4 motorcycles

APPENDIX 1

IPRA PROJECT TRAINING MATERIALS **

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Roa, J I , L Hernandez and J A Ashby, *Evaluaciones de tecnologia con productores Analisis de informacion Unidad de Instruccion No 3* (in press) English forthcoming

THE IPRA METHOD (video), available in English and Spanish

CIAL HANDBOOKS

IPRA, CIAT, *El Ensayo* (The Experiment*), Cartilla No 1, 1993, 43 pages

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IPRA, CIAT, *La Planeacion del Ensayo* (Planning the Experiment*), Cartilla No 5, 1993, 44 pages

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IPRA, CIAT, *Las experiencias tambien cuentan* (We Learn from our Experiences), Cartilla No 11, in press

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* English translations without illustrations available

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END NOTES

1 This however, places heavier requirements on the paraprofessionals' skills, particularly with respect to the training linked to reinforcing the CIALs management capacities At present, the most effective paraprofessionals in this respect are two young farmers with prior experience in community committees, who have the self-confidence to speak in front of a group, and who have taught in the rural schools although they have no training as teachers, they have completed secondary school

2 The following example illustrates how CIALs work together In 1991, Loma Corta prioritized field peas in their community diagnosis, with the objective of finding a short-season crop, easy to cultivate and with a stable price, useful for consumption as well as for sale, and easy to market Field peas were a completely new crop in the CIAL experiments This region is considered marginal for field peas and so the crop is not recommended officially Loma Corta planted a varietal trial with four varieties, obtained from an experiment station in another department by the paraprofessional In another experiment Loma Corta compared three systems of support for field peas posts with string, the technical recommendation, bamboo stakes collected from the local groves, bamboo stakes with one-third of the amount of string recommended CIAL Loma Corta discarded the technical recommendation with posts and string (this costs $5 for the string and the other systems use only local materials, or 60% less string with the bamboo-stake/string support) Their budget analysis showed that the local support systems require more labor but less cash outlay

At the annual meeting of CIALs (the "*Encuentro CIAL*"), CIAL Betania learned about the results of Loma Corta with peas, then in its second cycle (*parcela de comprobacion*) As a result CIAL Betania planted the two varieties and the support system selected by CIAL Loma Corta

CIAL Esperanza, a colder climate community, repeated the varietal trial with the two varieties selected by CIAL Loma Corta to see if they were adapted, with two planting systems (line planting and "cajuela" ie their traditional system of planting holes) After determining that line planting was preferred, because of the higher plant density obtained in a small plot close to the home garden, CIAL Esperanza planted a second experiment to test the two support systems with bamboo stakes

Loma Corta lost one year (2 cycles) waiting for an agronomist who had promised to obtain more field pea varieties which never materialized Notwithstanding this demoralizing experience, Loma Corta then went back to experimenting with the two varieties, after observing the progress CIAL Betania was making with peas

CIAL Betania, having learned from Loma Corta that the support system of bamboo stakes with string was preferred, had selected one variety which had the best commercial quality and which the women selected for its large size (Piquinegra) They planted a production plot, and began to sell the produce They decided to sell part fresh, and another part as seed (worth 120% more than the fresh peas) to other farmers in Betania and in the region

On the basis of Betania's experience, Loma Corta planted Piquinegra with the bamboo stakes and string, and went immediately to production plot and seed multiplication Esperanza, having tested variety, planting system and support to its satisfaction, scaled up to production plot and seed multiplication, buying seed from Betania Now field peas are beginning to appear in monocrop and in association with other crops in farmers' fields, after Betania took its seed for distribution to the "*Encuentro CIAL*"

3 An analysis by Jansen et al , (1991 195-211) provides some data on the impact of on-farm research with beans carried out in Cajamarca, Peru, from 1982-89 the research carried out by on-farm researchers and extensionists involved 10 on-farm trials in 1982, 30 demonstration plots in 1983 and an unspecified member of demonstrations and on-farm variety trials in 7 regions in 1984, 363 interviews with farmers in 1985, and 51 experiments, subsequently 53 trials were planted in 1986 Estimation of the impact of this on-farm research determined that about 70% of the total impact was induced by the research program, resulting in additional bean production worth between US$130,000 - US$265,000 over an additional 5000 ha of beans

4 The 55 CIALs were not distributed geographically across this area on the basis of for example, the requirements of particular agroecological niches or client groups for location-specific adaptive testing The project's primary objective was methodology development, and secondarily to assess how different institutional linkages affect farmers' capacity to do participatory research in agriculture, so that CIALs were located geographically to facilitate comparison among institutional settings As a result, the existing CIALs are probably more highly concentrated than warranted by the degree of location-specific diversity in the region

5 Graf et al (1991 56-57) reporting an on-farm research program in Rwanda found that farmer participation in on-farm research, and a system of group meetings reduced the costs of on-farm varietal testing These were estimated at US$27,225 between 1986-90 for working with about 79 farmers in four communities, later reduced to about 40 farmers in two communities The research area covered about 31,500 ha and 20,000

families Our calculations based on the costs reported only for experimentation in this study (of which 80% were covered by the national program ISAR together with CIAT, and for which salaries of researchers were costed at the level of national program salaries) range from about $63 to $34 per farmer per year if we consider only the 40-79 farmers reported as actually involved in the trials Since this study, the climbing beans tested have difused dramatically, so that the per capita costs of the on-farm research based on the population covered must have gone down very significantly (Sperling et al , 1994)