Designing participatory on-farm experiments

Resources for training

Designing participatory on-farm experiments

Resources for trainers

Richard Coe, Steven Franzel, Jan Beniest – World Agroforestry Centre

Carlos Barahona – Statistical Services Centre, University of Reading, UK

World Agroforestry Centre

TRANSFORMING LIVES AND LANDSCAPES

The World Agroforestry Centre (ICRAF) is the international leader in agroforestry - the science and practice of integrating 'working trees' on smallholder farms and in rural landscapes. Agroforestry is an effective and innovative means to reduce poverty, create food security, and improve the environment. The Centre and its many partners provide improved, high quality tree seeds and seedlings, and the knowledge needed to use them effectively. We combine excellence in scientific research and development to address poverty, hunger and environmental needs through collaborative programmes and partnerships that transform lives and landscapes, both locally and globally.

ISBN 92 9059 152 8
Photos: World Agroforestry Centre
World Agroforestry Centre
United Nations Avenue
PO Box 30677, GPO 00100
Nairobi, Kenya
Tel: +254 (0)20 524 000, via USA +1 650 833 6645
Fax: +254 (0)20 524 001, via USA +1 650 833 6646
E-mail: icraf@cgiar.org
Internet: www.worldagroforestrycentre.org
Printed by: KUL GRAPHICS Ltd, Nairobi, Kenya

STATISTICAL
SERVICES CENTRE

Founded in 1983, the Statistical Services Centre (SSC) is a not-for-profit body within the School of Applied Statistics at The University of Reading, UK. The SSC provides training and consultancy in both statistics and data management in the international arena. It aims to encourage good statistical practice, and the use of modern statistical methods in applied research. The SSC currently has nine statisticians, plus computing professionals and administrative staff.

Statistical Services Centre
The University of Reading
Harry Pitt Building Whiteknights Road
PO Box 240
Reading RG6 6FN, UK
Tel: +44 (0) 118 378 8025
Fax: +44 (0) 118 975 3169
E-mail: statistics@rdg.ac.uk
Internet: www.rdg.ac.uk/ssc/

CONTENTS

Acknowledgements

The development of these training materials on 'Designing participatory on-farm experiments' is a collaborative activity between the World Agroforestry Centre and the Statistical Services Centre of the University of Reading.

The training materials presented here resulted from a series of four training workshops on participatory on-farm experiments organized by the Centre between 1995 and 2000 for the benefit of scientists and technicians working under its collaborative research and development programmes and projects. The organization and implementation of these workshops was funded through several donor agencies whose financial support is herewith acknowledged (Netherlands' Government, European Commission, United Kingdom Department For International Development, Swedish International Development Agency, Canadian International Development Agency, Rockefeller Foundation and others).

The final development and production of this training publication was coordinated by Jan Beniest, Principal Training Officer at the World Agroforestry Centre.

The publication of these training materials was made possible thanks to a generous grant of the Netherlands' Government through its Programme for Cooperation with International Institutes (SII) of the Ministry of Foreign Affairs. Their continuing support to the Centre's training and education activities is greatly appreciated.

The rationale for participatory experimentation

Participatory research approaches offer great potential for increasing the effectiveness of research in developing new technologies for farmers. By enabling farmers to become partners with researchers in the design, testing, evaluation and modification of new practices, the time taken to introduce new practices to farmers can be reduced, adoption rates increased, and impact maximized.

In conventional approaches to technology generation, trials focus almost exclusively on biophysical variables, such as a new crop variety's potential to increase yield per hectare. Where technologies were fairly simple and biophysical circumstances fairly homogenous, as for rice varieties in the irrigated areas of Southeast Asia, the approach achieved considerable success. But in Africa, where farming systems are often more complex, more subsistence-oriented, and more unpredictable than in the irrigated areas of Southeast Asia, the biophysical approach was found inadequate. In the late 1970s and early 1980s, farming systems research emphasized the need to develop technologies based on the priorities and circumstances of farmers (Byerlee and Collinson 1980). Researchers emphasized the need for testing new practices under farmers' circumstances but research prototypes for on-farm trials still tended to be drawn up by researchers, following consultation with farmers (Zandstra et al. 1981). Participatory approaches in the late 1980s and 1990s highlighted empowering farmers to choose the technologies they wanted to test and to design and implement the research themselves (Lightfoot 1987; Chambers et al. 1989; Haverkort et al. 1991; Rocheleau 1991; Scherr 1991a). Researchers in international agricultural research centres highlighted the complementary nature of participatory research to biophysical research, that is, that research programs could adopt participatory approaches to improve their impact on farmers' livelihoods (Franzel et al. 2002).

In the 1980s, there was considerable experimentation with adapting participatory on-farm research methods to agroforestry (Scherr 1991b, 1991c). During the 1990's, The World Agroforestry Centre and other organizations devoted much effort to the participatory design and testing of methods for on-farm research for different types

of practices, and with an explicit view to understanding adoption potential. Technology development was observed to be multifaceted, requiring an understanding of biophysical performance under farmers' conditions, profitability from the farmers' perspective, and acceptability to farmers (in terms of both their assessment of a practice's value and their willingness and capacity to access the information and resources necessary to manage it well). Furthermore, it was realized that participatory research offers researchers, extensionists, policy makers and farmers an opportunity to learn important lessons about achieving effective dissemination of agroforestry practices, as well as feedback on further research priorities.

Participatory research is especially important in agroforestry technology development. This is due to the often poor understanding of farmers' agroforestry strategies, lack of empirical information about on-farm agroforestry practices, agroforestry system complexity and variability (in terms of objectives, components, management and ecological interactions), the longer technology cycle and period required for farmer and researcher assessment, and the lack of scientifically validated technologies (Scherr 1991a). To put it more simply, researchers cannot get the practices 'right' testing them at research stations, they not only have to involve farmers but have to give them a lead role in modifying the practices to suit their needs and circumstances.

References and recommended reading

Byerlee D and Collinson MP. 1980. *Planning Technologies Appropriate to Farmers.* Mexico, DF: CIMMYT.

Chambers R, Pacey A and Thrupp LA. 1989. *Farmer First: Farmer Innovation and Agricultural Research.* London: Intermediate Technology Publications.

Franzel S, Scherr SJ, Coe R, Cooper P and Place F. 2002. Methods for assessing adoption potential - feasibility, profitability, and acceptability. p. 11-35. *In*: Franzel S and Scherr SJ eds. *Trees on the Farm: Assessing the Adoption Potential of Agroforestry Practices in Africa.* Wallingford, UK: CABI.

Haverkort B, van der Kamp J, Waters-Bayer A eds. 1991. *Joining Farmers' Experiments: Experiences in Participatory Technology Development.* London: Intermediate Technology Publications.

Lightfoot C. 1987. Indigenous research and on-farm trials. *Agricultural Administration* 24:1-11.

Okali C, Sumberg J and Farrington J. 1994. *Farmer Participatory Research. Rhetoric and Reality.* London: Intermediate Technology Publications.

Rocheleau DE. 1991. Participatory research in agroforestry: learning from experience and expanding our repertoire. *Agroforestry Systems* 15, 111-138.

Scherr SJ ed. 1991a. On-farm agroforestry research. *Agroforestry Systems*. 15 (1-2):2-3.

Scherr SJ. 1991b. On-farm research: the challenges of agroforestry. *Agroforestry Systems* 15 (1-2): 95-110.

Scherr SJ. 1991c. *Methods for participatory on-farm agroforestry research: Summary proceedings of an international workshop.* Nairobi: International Centre for Research in Agroforestry.

Zandstra HG, Price EC, Litsinger JA and Morris RA. 1981. *A Methodology for On-Farm Cropping Systems Research.* Los Banõs, Philippines: International Rice Research Institute.

Training guidelines

As a result of the interest in, and the need for training in, on-farm participatory research in agroforestry, the World Agroforestry Centre (ICRAF) has been conducting a series of training workshops on the subject. More information on these activities can be found in workshop reports such as 'Proceedings of a Training Workshop on Designing Participatory On-Farm Experiments' (compiled by Richard Coe and Steve Franzel, ICRAF, Zambia, 1999) or 'Proceedings of a Training Course on Participatory On-Farm Experimentation and Integrated Approaches to Land Management' (compiled by Per Rudebjer, ICRAF, Indonesia, 2001).

Over the last decade, training at the Centre has focused on 'training-of-trainers' since this is the only way to address the ever increasing need for capacity building and strengthening, and to reach audiences well beyond the training events the Centre is capable of handling directly. This approach necessitates the development of supporting learning materials and resources and therefore the main workshop resource persons have decided to compile and publish the materials to support training on the subject of on-farm participatory research. Apart from serving as self-learning materials and references, the training materials will also allow others to provide, or contribute to this type of training as resource persons.

This section gives some ideas on how a short training workshop on the subject can be organized and implemented, highlighting some important aspects and steps that need to be considered when organizing, implementing and following up on short training workshops on participatory on-farm research. For more general information on the subject of training, consult 'Training in agro-forestry – a toolkit for trainers' by Peter Taylor and Jan Beniest (World Agroforestry Centre, 2003).

Before the training

Identifying training participants

Trainees for this type of training workshop can be:

- people with expertise and experience in dissemination and extension, or facilitating development projects, who want to get more systematic learning through research into their work but have had no formal training in appropriate research methods,
- people with a science and research background but with little experience or training in the use of participatory methods, who want to realize the benefits of participatory research,
- people with experience in participatory research who can benefit from an exchange of ideas and experiences.

These three groups will have rather different requirements, so it is important that you recognize the participants for your course. Having all of them together in the same group will certainly lead to interesting exchanges of views, but will require skillful facilitation if all groups are to meet their learning objectives. Capable facilitators will ensure that participants learn from each other as well as from the resource persons.

The most important thing is to realize that these will be adult and experienced learners who will contribute as much as they will learn and thus the training event must be tailored to address their specific needs and those of their employing institution, using appropriate training content and methods.

Training needs

Training needs assessment and analysis (TNA) is the logical first step in the organization and implementation of any training event. Effective training has to be based on demand rather than supply and the trainers need to know what knowledge, skills and attitudes the trainees possess and what the required levels of these are so that the training can focus on bringing the trainees to the desired levels of on-the-job performance.

TNA however is part of a wider process of situation analysis that requires the analysis of key actors (stakeholders) with an interest in the training event. It also involves the analysis of all the factors, which may or will affect the learning process and outcome of the training. Not all identified needs can be addressed through training. Some problems can only be resolved by other kinds of change within an organization, such as new systems or structures, policy changes or other reforms or strategies. Methods required for such situation analysis include the collection of primary and secondary data and a range of participatory research methods. Training needs analysis leads to the identification of the needs for knowledge, skills and attitudes at the levels of the organization, the job and the individual.

Training aims and objectives

The outcomes of the identification of training participants and the TNA process will allow the trainers to develop a specific training curriculum framework that provides the shape, direction and overall approach for the training event and that takes needs, opportunities and constraints into consideration. The curriculum framework also clarifies learning outcomes, describes learning processes, guides trainers and learners and informs other stakeholders.

The aim(s) of a training programme is a general statement of purpose, less specific and usually longer term than objectives, and written in terms of what the trainers hope to achieve through the activity.

Objectives and learning outcomes are very specific and written in terms of what the learner will achieve within a given period of time. They are based on a cognitive approach, relate to a measurable change in behaviour and should include criteria and conditions. Objectives should be SMART (Specific, Measurable, Attainable or Achievable, Relevant or Realistic, and Time-bound).

In the case of some of the training workshops on participatory on-farm research, the aims and objectives were as follows:

- To provide training and exchange information on experiences related to the planning, implementation and evaluation of participatory on-farm experiments, including both researcher- and farmer-designed trials.

- To assess the importance of gender, risk and labour requirements in designing on-farm experiments and develop appropriate methods and tools to include them in the design.

- For specific research sites, to review on-farm research activities, assess gaps and develop new on-farm experimental protocols.

Content and methods

Once the course framework has been developed, the trainers will need to consider the related content, methods and materials, which are needed to facilitate learning and to achieve the identified objectives or learning outcomes. The choice and use of content, methods and materials will depend on the course framework and training events should not be designed based on the sole identification of course content. When selecting the content, it is necessary to keep in mind the knowledge, skills and attitudes that are desired and referred to in the objectives and learning outcomes. Content can be divided into 'must', 'should' or what is 'nice to' know, with a focus on what participants 'must' and 'should' know leaving the not essential 'nice to' know only if time is available. For an optimal result, it is important to give enough attention to a proper sequencing of the content; move from the simple to the complex, from the known to the unknown, use an existing logical organization and cover the content in the order of job performance.

The CD-ROM that accompanies this document contains some suggested training activities that you can use or adapt to your specific needs.

Resource persons

Resource persons with experience and expertise are essential. No amount of training material removes the need for people! We have found that having two or three experienced resource persons is very much preferable to having one;

- They can complement each other's strengths and weaknesses.
- They give participants a change in style and ways of explaining.
- They get less tired (and less boring!).
- They can better stimulate participant discussion, for example by presenting alternative views.
- Participants can learn from debate and disagreement between resource persons.

However, the resource persons do have to be comfortable working with each other. The whole area of research for development, and the role of participation, can generate among 'experts' very strongly held positions that are mutually incompatible. Debate between two resource persons

who disagree on fundamentals, and who refuse to concede a single point to an alternative view is not helpful to trainees who are trying to understand practical solutions to their real problems. Academic debate on epistemology is unlikely to meet participants' objectives.

A good facilitator who is a training professional is also needed. Not every subject-matter specialist who makes a good resource person can orchestrate an effective training event.

Needless to say that the training participants themselves will be key resource persons for such training since they will share their own experiences and problems and actively participate in all learning activities.

The training event

Characteristics

In our experience, effective training workshops on the subject have the following main characteristics:

- They are based on a good understanding of the trainees' backgrounds, experiences, interests and needs.
- They use a problem solving approach based on examples from the participants' work and allow participants to plan their future participatory on-farm research work.
- They are adaptable and flexible in terms of content and instruction with only few and relatively broad fixed points in the programme or schedule for general orientation.
- They focus on discussions, group work, exercises and other participatory methods rather than classroom lecturing.

Venue

Ideally, such training workshops need to be organized away from the place of work of the participants or the resource persons as to prevent possible interruptions and optimize the time available for discussion, learning and interaction between participants and resource persons.

Programme

A typical training workshop organized along these training guidelines and using the training materials and references proposed here takes about four days to implement using the following programme and learning methods:

Timing	Session	Content
Day 1	Introductions Expectations Objectives	Getting to know each other and making sure all participants and trainers understand each other's needs and abilities
	Introduction to participatory on-farm trials Critical concepts in study design	Short presentations, discussions and exercises on the basics of participatory on-farm trails
	Preparing for a field trip	Plan the activities which will be carried out during a field visit
Day 2	Field trip	A structured visit to ongoing on-farm experiments, with specific objectives
Day 3	Follow-up to field trip	Discussion of findings and observations
	Using designs for specific problems	Short presentations, discussions and exercises on design of experiments which are relevant to trainees' needs
Day 4	Using specific tools	Addressing other requirements of trainees, such as use of particular measurement tools
	Follow-up	Planning suitable follow-up activities and participants personal action plans
	Evaluation	Participatory evaluation of the workshop

Equally useful workshops can be longer or shorter than this example. At one extreme is a seminar of no more than one hour, perhaps taking its content from one of the theme papers contained in these resource materials. Maybe this should not be seen as a 'training event' as such since you cannot expect anyone's knowledge, skills or attitudes to have realistically changed after a one hour seminar, but this can be useful for alerting people to new possibilities and provoking discussion on the subject.

At the other extreme are training events that include a considerable amount of field work and practice. A programme that includes planning, implementing and assessing an on-farm trial is likely to take months, though certain topics or steps could be contrived that are quicker to organize and implement.

There is no doubt that practical work on real problems rather than just exercises helps greatly in the training. If more time is available, then this could be built in, focusing on the needs of participants. For example, they may take part in meetings with farmers at which trials are designed or evaluated, or take part in data collection and monitoring activities of real studies.

Field visits

One or more field trips to ongoing on-farm trials can be a very effective part of a training workshop. However, if they are simply visits to look around they will achieve little. Any field trip must be an integral part of the training schedule and properly prepared with clear objectives, planning, facilitation and follow-up.

Visits to two farms are ideal, preferably farms with different types of trials (e.g. one researcher-designed and farmer-managed, another farmer-designed and managed). It is essential that the farmer and other household members are present to discuss the trial with the participants. Following introductions and explaining the objective of the visit, the farmer should explain what his/her objective is in the trial, how (s)he got involved, and what has been learned thus far.

Other formats for visit are possible. Make sure that whatever format you use does not fall into one of several traps such as:

- Concentrating on farmers' problems and solutions, rather than on how research is carried out.

- Trainees acting as critical reviewers of the field work, rather than using it to learn from.

- Ignoring basic rules of courtesy and communication when with farmers.

In order to avoid the latter problem, participants can perform a 'good and bad' interviewing skit the previous day or evening. The script for this training skit, as well as some dos and don'ts as identified by visitors, are included under the 'suggested training activities' of the CD-ROM.

The database on the CD-ROM also contains a case study of a real workshop field visit as a suggested training activity. The case study includes preparation for the visit (including the development of a list of key concepts of participatory experimentation and the questions they will ask farmers and researchers in order to find out how these concepts have been used), group reports following the visit and feedback from 'communication monitors' who were monitoring communication between farmers and participants. After the visit, findings are discussed, differences resolved and summaries made.

Evaluating and assessing training

Training evaluation is an essential and continuous process and should be an integral part of the entire curriculum development process. Evaluation considers what the curriculum is worth to those who are involved in its development, how well the curriculum is working, and how it can be improved, for present learners and future ones. Evaluation should be participatory as well, and all relevant stakeholders should be involved in the evaluation of the curriculum. The methods, criteria and indicators for evaluation need to be formulated very early in the process of curriculum development. Information needs to be collected and analysed and conclusions drawn.

As part of the overall evaluation process, we need specifically to find out if the learners are actually learning or changing their behaviour as a result of the training. This will show both the learners and resource persons whether the training has been effective. Assessment is a means of finding out what learning is taking place. There is a wide range of assessment methods used in teaching and learning. Some are oriented towards quantitative measurement and behaviour of learners and can be applied formally (e.g. tests, examinations). Others are more empowering of the learners who may negotiate the type of assessment and be responsible for much of it. Self-assessment and peer-assessment are important approaches and may include reflective journals and diaries, visualized responses (scales, charts, posters), questionnaires, case studies, etc.

Linking training and application

Planning future work

One of the most effective training strategies we have used is to organize a training event which combines learning about participatory on-farm research with project planning and research design.

Using this approach, participants working on one or more research projects attend a workshop, which has the following dual purpose:

- To increase capacity and enhance knowledge, skills and attitudes related to participatory on-farm research and experiments.

- To apply this through the development of proposals, protocols and work plans for projects that will actually be implemented after the training.

A typical workshop along these lines might involve the following steps:

1. Participants present the stage they have reached in their ongoing research projects and propose the next steps that will need to be planned and implemented.

2. The basic concepts of participatory experiments are reviewed and discussed, preferably using participants' examples and possibly involving a field trip to these.

3. A structured development of proposals, protocols and work plans, interspersed with appropriate learning activities.

The last part involves, for example:

- A training session (presentation and discussion) on setting objectives for a trial.

- A working group session setting objectives for the actual trials that participants want to implement.

- Joint review and refinement of the proposed trial objectives.

- Writing up the agreed objectives.

- Repeating for the next steps (choosing a trial type and approach, selecting farmers, measurement, etc).

At the end of such a workshop participants not only have enhanced knowledge and skills, backed up with training materials and references, but they also have written-up work plans ready for review by project managers, and implementation.

Some advantages of this approach are:

- It meets the dual objectives of training and work plan preparation.

- It helps to keep training focused on the real problem areas.

- It gives participants practice in solving real problems they face, not just contrived examples.

- It gives trainers insights into participants' work and their real needs.

- It forms the basis of effective follow-up.

Follow-up and impact assessment

It is easy to organize training events that leave participants feeling that they have learnt something useful. It is much harder to ensure that this actually leads to changes in research and development. Researchers return to their institution or project and find:

- They are unable to change the views or approaches of managers and colleagues with whom they have to work.

- They try to implement things learnt, but quickly get stuck and have no one to help them out.

- They realize their particular problems were not addressed during the training and cannot see the relevance of the ideas and skills acquired.

For these reasons, effective training events will be embedded in a longer-term process of capacity building or strengthening. Simply inviting researchers to training for a week or two and then having no further contact is unlikely to lead to much impact. Options for follow-up and continued support for trainees include:

- Each participant writing a 'personal action plan' (a description of what they intend to do differently, and actions they will take as a result of the training). Training resource persons monitoring progress during the following months.

- Organizing follow-up workshops (perhaps 'virtual' workshops online) for participants to discuss experiences and emerging problems.

- Resource persons formally becoming part of participants' project teams and continuing to be involved in the project (only likely to work when trainees and resource persons are from organizations that work together anyway).

- Establishing a 'community of practice' for people who have attended the workshop.

- Incorporating in the budget the possibility of small follow-up grants to allow participants to pursue the ideas presented in the training.

Training materials

The training materials developed in support of on-farm participatory research consist of this written document and a CD-ROM with additional electronic resources.

This written document introduces the need for on-farm participatory research and provides some guidelines for training and supporting materials and references. It also contains a series of 'theme papers' and 'toolkit papers' as well as a recommended reading list.

The resources on the CD-ROM are the electronic files of this text document (in Microsoft Word and Portable Document File – PDF formats) plus a series of case studies, suggested training activities, examples of timetables and some other useful materials and links. The case studies and suggested training activities have been compiled in a database that can be searched using keywords to help learners use these for learning in groups or as individuals. The database can be modified by users as to add new case studies and experiences. This approach will allow you to adapt all the resources to suit your own training and learning needs. For an update on the contents and structure of the CD-ROM, consult the 'read me' file on it.

It must be noted that most of these materials are but good examples of what can be used to develop a training event on participatory on-farm research. As suggested in the training guidelines, competent and committed resource persons will adapt this type of training and its supporting materials and references to suit the practical needs of their learners and also develop new and additional ones. Going through these materials and references and the various recommended readings will facilitate this.

Printed materials

Theme papers

Theme papers deal with issues that are critical to the understanding of how to design participatory on-farm trials. They can be used by workshop resource persons to prepare a brief presentation on the key issues. The following theme papers are included in these materials:

Theme paper 1: Partnerships and joint learning

In participatory trials, researchers and farmers join in a learning exercise to develop, assess and modify new practices. Researchers have traditionally dominated these processes in the past; the challenge of participatory technology development is to develop partnerships with farmers in which they play a lead role in design, testing, and evaluation. The researchers' main role is to facilitate this process.

Theme paper 2: The research-development continuum

The traditional model of researchers developing technologies and extension disseminating them is outmoded, because the model fails to involve the farmer in research and extension, and fails to recognize the blending of research and extension roles. An innovative, alternative model is the adaptive research and dissemination network in which researchers, extensionists and farmers plan, implement, and evaluate on-farm research, as well as training and dissemination activities.

Theme paper 3: Conventional versus option-oriented approaches to problem-solving

The objective of conventional research is usually to come up with recommendations involving specific optimum solutions such as the quantity of fertilizer to use, how and when to apply it, etc. In contrast, an option-oriented strategy recognizes


CONVERSE
NBA

that farmers differ in resources, preferences and objectives, and can benefit more from obtaining information on a wide range of options rather than specific recommendations. The difference in approach has important implications for the design of the trial.

Theme paper 4: The balance between researcher and farmer involvement in technology testing

This paper presents a typology for classifying on-farm trials, focusing on how different types of trials may be used to meet different objectives. Trials to assess biophysical performance need a high degree of researcher control in both design and implementation. In contrast, where the objective is to assess feasibility and acceptability, farmers need to control the experimental process with little researcher involvement. This paper also examines some main issues in the management of different types of trials.

Theme paper 5: Designs that allow inference

Designing experiments and surveys is complex; design does not involve choosing among alternative types of surveys or experiments but rather defining a set of field activities to address the particular objectives of the research. This paper explores critical concepts in designing field research to ensure that the results can be generalized to as great a degree as is possible. These concepts include objectives, design hierarchy, comparison, uncertainty, bias, and confounding.

Theme paper 6: Collecting the data

Data collection is often taken for granted; all that appears to be required is to follow standard procedures. But collection of data requires careful attention to the research objectives and careful planning of how each bit of data will be used. This paper examines the choice of variables to measure, where, at what scale, how much to collect and what tools to use.

Toolkit papers

Toolkit papers are practical guidelines that describe methods that can be used to design, implement and monitor participatory on-farm trials. They can be used as stand-alone references to accomplish specific tasks. This is not an exhaustive list of toolkit papers and resource persons are encouraged to identify and use new and additional ones as research on this topic evolves.

Toolkit paper 1: Checklist for preparing protocols

This paper describes the rationale to develop detailed and complete trial protocols and provides a checklist of important points to remember when preparing these. Most useful protocols will cover these important points even though the format for protocols may be different from one institution to another. The checklist specifically focuses on planning experiments that involve farmers.

Toolkit paper 2: Monitoring on-farm trials

This paper is a compilation of tools described in several papers that can be used to elicit farmers' assessments and to help farmers assess and exchange opinions and experiences in on-farm trials. It contains references and summaries of a number of papers, included on the CD-ROM as full-text papers, dealing with interviewing, questionnaires for monitoring, surveys, tools for evaluation, assessment methods, group meetings and village workshops.

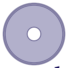
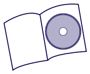
Toolkit paper 3: Collecting data on labour use

The paper describes four methods for collecting data on labour use in on-farm trials. Each method is explained with advantages and disadvantages listed. It ends with a summary of important points, common to all methods and also gives some further reading references and data collection forms that can be used. The methods are monitoring work rates through observation, farmer recall, farmer 'norms' and periodic visits.

Toolkit paper 4: Assessing risk in on-farm trials

Farmers face risk and uncertainty when they make farming decisions and this paper looks at the assessment of some risks so that researchers can take this into account when designing on-farm experiments. Climatic, economic, pest and disease risks are the more important ones for agricultural enterprises. Messages based on data obtained from on-farm experiments need to consider this.

Recommended reading

This is a structured list of key references with brief summaries on designing participatory on-farm experiments compiled by training workshop resource persons with the view of providing useful additional materials to support this type of training. The full text of articles marked with a  can be found on the CD-ROM complementing this document, articles marked with a  are also included on the CD-ROM and are further mentioned as 'toolkit papers' in this document as well. Instructions are given to obtain the other non-marked articles in this recommended reading list.

Electronic resources

As mentioned before, all the electronic files of the text in this document (training guidelines, theme papers, toolkit papers, recommended reading list and selected full text papers) have been included on the CD-ROM accompanying this document, either as Microsoft Word files or Portable Document Files (PDF). PDF files can be read using Adobe Acrobat [Reader] which is freely downloadable over the internet and has also been included on the CD-ROM. This will allow future resource persons and learners to edit or adapt these materials, or print out selected parts for copying and distribution to workshop participants. You are free to use all of these materials but we will appreciate if you acknowledge the source and the authors.

In addition to this, the CD-ROM contains a series of case studies, suggested training or learning activities and some sample timetables used for this type of training workshops. Case studies and suggested training activities have been cross-referenced and compiled in a searchable database using keywords that will allow you to find relevant materials easily. Search results can be printed out, exported to a word processor such as Microsoft Word or browsed for further information like web pages with clickable links that open relevant documents. The database also allows users to add new case studies and training activities so that you can start developing your own library. If you want to do this, you will need to copy the database to a writable medium (hard disk, other disks) since the CD-ROM is 'read only'.

The CD-ROM content has been developed as a browsable website using webpages and hyperlinks for easy navigation to the different resources. The 'home page' of the materials on the CD-ROM should load automatically as soon as it is inserted into the CD drive. If this is not the case, use Windows Explorer to identify the file 'home.htm' on the CD-ROM and double click it to open this page using your web browser (Explorer, Netscape,…). From this 'home page' you can start navigating to the different materials as you would when searching or navigating on the internet.

Please read the 'read me' text file on the CD-ROM carefully for further content updates, information and instructions on its use.

Case studies

These are a collection of experiences describing participatory on-farm experimental research. They support suggested training activities and therefore are best accessed using the database since this links these case studies to the proposed activities. They provide the basic information needed to implement the suggested activity and in some cases give a more detailed and complete description of a participatory on-farm experience.

Suggested training activities

These are a series of activities or assignments suggested by workshop resource persons aimed at using the information contained in the case studies for training purposes. In each case, participants, either as individuals or in groups, are requested to read all or part of a specific case study and to address a series of questions related to participatory on-farm research and experimentation.

Suggested timetables for training events

These are some examples of training workshop programmes or timetables that have been used by resource persons based on previous experiences, available relevant materials and suggested training activities. Their main aim is to show that these training workshops can be extremely flexible even if all of them address a common purpose and learning objectives. You are encouraged to study these examples and their supporting materials and use this to develop your own programme or timetable for a training event on on-farm participatory research.

Using the materials

The main purpose of these 'references for trainers' is to give future resource persons for this type of training as much relevant information and materials on the subject of participatory on-farm experiments as possible so that they can develop adapted training activities using these, or their own materials.

The materials can be used for individual learning and application or for short group training events involving one or several resource persons and a group of trainees.

Individuals can use the various documents for self-study in order to get a better understanding of the key concepts and principles of participatory on-farm experimentation.

Researchers actively involved in participatory on-farm experimentation can use the information and references in direct support of their research activities.

For short workshops, organizers and resource persons must have a good idea about the needs of the workshop participants and their employing institutions in the area of participatory on-farm research. This will allow them to develop an adapted training event (purpose, objectives, duration, programme, etc.) and to identify references and materials that address these specific needs. The database on the CD-ROM will help linking training activities to suitable case studies, either the available or newly added ones. It is strongly recommended that you add new learning experiences and case studies to this database and also update the references contained in these materials.

THEME PAPERS

Partnerships and joint learning

By Steven Franzel

The principle of partnership between researchers and farmers is a key component of participatory research. The foundation of the partnership is that each actor, the researcher and the farmer, has unique information and skills to contribute and that each can benefit from working together.

The relationship between researchers and farmers has changed considerably over the past several decades. In the 1950s and 1960s, researchers often thought the farmers' main problem was ignorance of improved practices and the role of change agents was to teach farmers correct practices. In the 1970s and 1980s, farming systems researchers focused on identifying the constraints farmers faced and supplying inputs and advice to remove the constraints. Farming systems researchers noted the importance of learning from farmers, but the emphasis was on learning from farmers in order to solve their problems. The advent of participatory research in the late 1980s marked a change in the relationship between researchers and farmers. The role of the researcher was that of a facilitator, to share knowledge with farmers and help them enhance their capacity to solve their problems. Indigenous knowledge and scientific knowledge each had a role to play in the process and the most progress would be made by merging the two knowledge sets. Implicit was the imperative that researchers and farmers join in a learning process to ensure that innovations made the most of indigenous and scientific knowledge. Indeed, farmers and scientists both conduct research. The idea of 'adaptive management' emerged, farmers continuously modifying the management of their resources to meet changing priorities and learn what works well. But this is best done in a structured and systematic way, making sure each change generates information to help in future decisions. Researchers have skills to facilitate this.

The following table illustrates some of the contributions that researchers and farmers can each make to the research process:

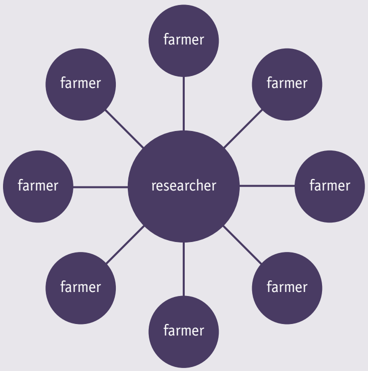
Stage	Researchers	Farmers
Vision	National policies	Own aspirations
Problem identification	The national perspective	Detailed local knowledge + understanding of different user groups
Setting priorities	Hypotheses on magnitude of benefits	Understand own constraints
Selection of technologies	World literature	Indigenous technical knowledge + feasibility screening
Experiment design	Statistical procedures	Own methods of evaluation and comparison
Implementing experiments	High degree of control	Low cost
Evaluating experiments	Quantify against checks	Include non-design criteria
Drawing wider conclusions	Geographical information system techniques	Knowledge of others' situations

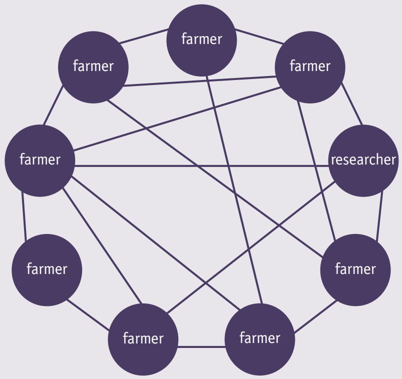
Researchers are often strong in involving farmers in participatory rapid appraisals to identify problems and define ways to solve them. However, the strong partnership in Participatory Rural Appraisals (PRAs) is often not replicated in on-farm trials. Too often, a 'partnership' in on-farm trials means 'researchers design the trials and farmers do the work'. For trials in which the objective is to identify solutions to farmers' problems, farmers need to be involved in selecting which possible practices they want to try out (see theme paper 4). This means, they are involved in actually designing trials, selecting treatments in trials and deciding the levels of non-experimental variables. For example, in Burundi, farmers visited a screening trial at a research station to decide which upper-storey tree species, indigenous and exotic, they wanted to test in on-farm trials. They were given information about each species and then three methods were used to decide which species to plant: voting in plenary, individual interviews and group interviews. The farmers chose four species and researchers also suggested two that they felt farmers would like. Interestingly, female farmers also chose one species that male farmers were not interested in. Females preferred it because its leaves were used for curing diarrhoea in babies. Farmers were encouraged to try all of the proposed species in order to facilitate systematic comparison, but were free to exclude trees that they were not interested in planting (Franzel et al. 1995).

The evaluation of the results of a trial is also a time when researchers' talk about partnerships is often not reflected in their actions. A farmer may know how an experiment performed on his/her own fields, but have little information on how it performed on others' fields. Field days and exchange visits may give them some impressions, but often they are not presented with the results of the trial across sites or even the data from their own farm. The joint learning process has failed; the researcher has all the data and does not share it.

In conventional on-farm research, the researcher is the hub and there is little or no interaction among farmers participating in on-farm trials. In the participatory model, in addition to the researcher, each farmer is a hub (see drawing). The sharing of knowledge takes place among all members of the network, not simply from the researcher to each farmer or through feedback from each farmer to the researcher.

A key element of the partnership paradigm is the need to work with farmer groups in participatory technology development rather than solely





with individuals. Whereas individual experimentation is relatively ad hoc, group experimentation can be more focused, synergistic and contribute to building self-help institutions for agricultural development. Experimenter groups facilitate the exchange of results and innovations, replications across farms and increase the range of practices that can be tested. But certainly, working with groups, as compared to individuals, has advantages as well as disadvantages, as noted by participants at a recent participatory research workshop.

Reference:

Franzel S, Hitimana L and Akyeampong E. 1995. Farmer participation in on-station tree species selection for agroforestry: a case study from Burundi. *Experimental Agriculture*, 31:27-38.

Box 1: Advantages and disadvantages of working with groups

Advantages:

- Groups empower people, give them confidence, influence, courage.
- Groups give more ideas and feedback.
- Groups can be more sustainable than working with individuals.
- Working with groups is more cost-effective.
- More contact with more farmers, thus faster adoption.

Disadvantages:

- One person may dominate.
- Groups may have deep internal conflicts and may collapse.
- The group may not be representative.
- Groups need organization, rules (you may be better off working with existing groups that are already known to be effective).
- Facilitators need more skills to work with groups.
- Is it really more time-efficient to work with groups than with individuals? Transaction costs may be high!
- The most innovative farmers in the community may not be interested in working in groups.

Theme paper 2

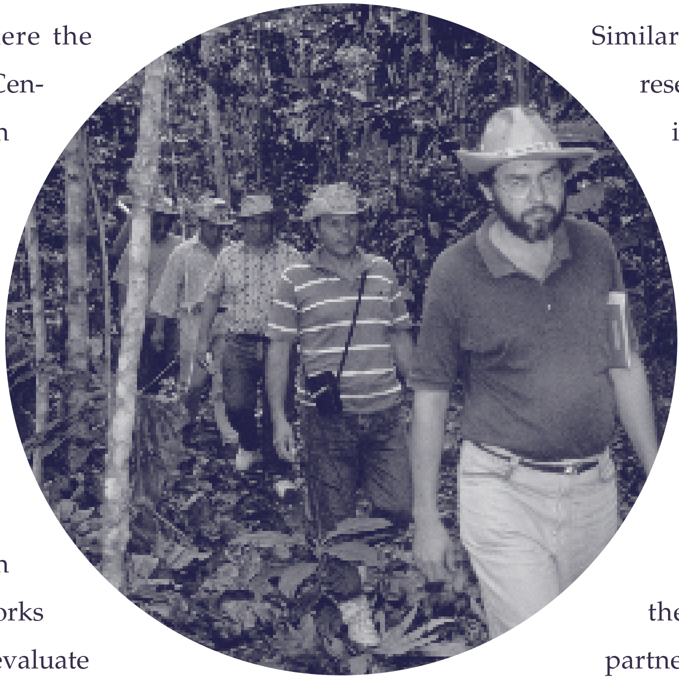
The research-development continuum

By Steven Franzel

Participatory research has demonstrated that there are multiple sources of innovation in agroforestry: formal sector researchers, farming tradition, farmer-innovators, extensionist-innovators. Through shared experiences in on-farm research studies, their complementary strengths can be effectively exploited and integrated at reasonable cost. Instead of a linear sequence whereby technology is developed by researchers, then passed to extensionists, and finally to farmers, in the on-farm research centred model, there is continuous interaction among these groups throughout the process. Input from farmers and extensionists is provided early on; opportunities for early extensionist and farmer innovation and adaptation are encouraged. Also, implementation on farmers' fields, and hence potential for farmer-to-farmer diffusion begins much earlier in time (see theme paper 4). Moreover, building a coalition of organizations to conduct on-farm research and dissemination together is vastly more effective and efficient than leaving each to work independently on only one element.

Research and extension are thus two points along a continuum; certainly, farmers recognize the blending of the two roles. After all, when farmers participate in on-farm trials some degree of technology dissemination always takes place. Similarly, when a new technology is disseminated, each farmer trying the technology for the first time can be said to be experimenting with it to see if it works on her/his farm.

At many sites where the World Agroforestry Centre conducts research and development activities, extension, research, NGOs and farmer groups have established partnerships or consortiums called 'adaptive research and dissemination networks' These networks plan, implement, and evaluate on-farm research, as well as training and dissemination activities. Extension and NGO staff have much to offer and can benefit greatly from participating in on-farm research. Their involvement reduces the costs of the research and their knowledge of local circumstances improves the design and quality of the research. They also benefit from greater interaction with researchers and are likely to be more knowledgeable about a practice if they are involved in its development in on-farm trials along with the farmers.



Similarly, it is important for researchers to be involved in disseminating practices in order to assess adoption and impact, to obtain feedback from farmers and to identify issues for further research. One of the most important impacts of the networks is that all partners develop a sense of involvement, enthusiasm and ownership of promising innovations. A critical task of the network is to clearly define the roles and responsibilities of the different actors in on-farm research and dissemination.

One of the most advanced examples of an adaptive research and dissemination network is in eastern Zambia. Seventy-five representatives of research, extension, NGOs and farmer groups meet 1-2 times per year to review progress and to plan activities for testing, training, and disseminating improved fallows and other soil fertility measures. The mechanisms in place for disseminating the practice and for providing feedback on performance have greatly contributed to the impact that improved fallows achieve in Zambia and elsewhere. The network in Zambia has already had important impacts:

- Reduced cost of conducting on-farm research, as field-based extensionists and NGOs establish and monitor on-farm trials.
- Enhanced breadth of input into and relevance of the research.
- Expanded range of sites under experimentation with relatively little additional cost.
- Partners are increasingly well informed on key aspects of technology options and better placed to disseminate technologies and respond to farmer feedback.

- Partners have developed a sense of involvement, enthusiasm and ownership of promising innovations.

With this new approach, research organizations accept joint responsibility and accountability for ensuring the greater adoption and impact of innovations. By proactively engaging in the development process, research organizations can see four distinct benefits in institutional effectiveness (Denning 2001):

- Faster and greater impact: by adopting a proactive rather than a passive approach to knowledge and technology dissemination, agroforestry innovations would reach more farmers, more quickly.

- Innovation and learning: by working directly and collaboratively with development partners in the field with farmers, opportunities would be greater for innovation and learning that would strengthen the knowledge and experience base of scientists and thus share that asset with others.

- A more relevant, demand-driven research agenda: the innovation and learning associated with direct engagement in development would provide feedback to research on how innovations performed and generate hypotheses for future research.

- Institutional credibility: by demonstrating a clear commitment to greater impact of development, research organizations can become more credible partners in development and therefore could attract support from a broader group of stakeholders than would be the case if they assumed a strict 'research only' mandate.

References:

Denning GL. 2001. Realizing the potential of Agroforestry. *Development in Practice* 11:4 pp. 407-416.

Conventional versus option-oriented approaches to problem-solving

By Richard Coe

The problem

The research process starts with identification of opportunities, problems and possible solutions. This can, and should, be done with the clients or stakeholders, the most important being the farmers themselves. At some stage in the process, some specific problems emerge that can be addressed through on-farm trials. For example:

Problem	Possible solutions
Low maize yields because of nitrogen deficiency in maize plots	Use of fertilizers, tree fallows or a combination of the two
Shortage of quality animal fodder during the dry season	Fodder banks of woody species planted in suitable niches
Disappearance of fruit trees from the wild	Planting of fruit trees on-farm

Note that until the problem is well specified, it is not appropriate to consider any on-farm trials. A solution to the problem of 'low maize yield' cannot be investigated by experimentation because the problem has not been defined in enough detail. In contrast, it is possible to investigate the range of solutions to the problem of 'low maize yield because of nitrogen deficiency in maize plots' because the problem is more specifically defined.

Conventional approach

Each of the possible solutions involves some unknowns, which give rise to research questions. These unknowns relate to best or optimum practices. For example:

- What is the best rate of fertilizer to use? What is the best fallow species to use? What is the best set of agronomic practices for the tree fallow? How can fallows and inorganic fertilizer best be combined?

- Which is the best species to use? What is the best location on a farm? Should it be mixed with fodder grasses or grown by itself? What is the optimal management package (spacing, cutting interval, cutting height, etc)?

- Which species are best for farm production? What are the best niches, methods of raising seedling and managing the trees?

In each case the aim is to come up with a recommended optimum practice. Researchers aim through experiments to compare the various possibilities and identify 'the best' alternatives.

It often turns out that the optimum practice involves a 'package' of practices (for example: use fallow species X, planted at spacing Y at time Z, followed by W fertilizer applied at time V...). Farmers are expected to adopt this optimal 'package'. The assumption is that farmers have uniform requirements and resources. However, when it is recognized that not all farmers live and work under the same conditions, researchers try to find a 'recommendation domain', or group of farmers for which the recommendation is optimal. Researchers would also attempt to develop different 'packages' for other recommendation domains. The packages are then handed over to dissemination professionals who are expected to tell and train farmers to use the recommended practices. Success is judged by the number of farmers who follow the recommendations and the extent to which the problems are overcome.

The option-based approach

The conventional approach described above frequently fails. Farmers do not adopt the package, or adopt only some components of it, and the problems are not reduced to the extent researchers anticipated. When researchers trouble to find out why, the answer often comes down to the fact that farmers are different and do not all have the characteristics of the 'typical' farmer assumed in the definition of the recommendation domain. Farmers differ in their resources (both 'hard' resources such as land and capital and 'soft' resources such as education and contacts). Farmers differ in their objectives. Their farms have differing pests, soils and weed problems. They also differ in their attitude to new ideas and risk. If the farmers could be fully characterized we would end up with recommendation domains of size one! That suggests that each farmer has to find their own solutions - do their own research for their own situation. So what is the role of the researcher?

The researcher can aim to provide information about a range of options. For the examples above this might include:

- Information of the suitability of different fallow species for different soils. Advantages and disadvantages of each species. The crop cycles with which they are compatible and not compatible, the alternative uses of fertilizer for extending a cropping cycle or use of other land.

- What are the characteristics of different species? How do they behave in different farm niches? What is the effect of managing them in different ways? Under what conditions (bio-physical, such as soil, or social, such as labour available) will different management options be suitable?

- Which species are suitable for raising on-farm? What are the characteristics of the different varieties available? How can common pests and diseases be controlled? How do the trees interact with neighbouring crops? What is the effect of different pruning regimes?

The aim is to come up with information about a wide range of options and to make this information available to farmers. Farmers then choose options to try out, basing their decisions on knowledge of their own situation and the new information provided by the researcher and the process of experimentation. Success can be measured as the extent to which the problem has been reduced, but it may not be possible to attribute this directly to 'research' as farmers are not adopting a single package, but using information to take better decisions.

The options proposed by the researcher should not just be an arbitrary collection of possibilities, but alternatives that appear to be consistent with the understanding of relevant principles, such as soil management or economics and the farmers' conditions, preferences and resource constraints.

Another role of the researcher is to help farmers understand some of the basic principles of sound resource management, so that they may start developing their own options that are consistent with them. For example, we know that in some environments, minimizing soil erosion requires maintaining 60% land cover, the practices used to achieve this being unimportant. Once farmers understand this, they can explore options that are consistent with this principle, but also meet their other objectives.

Implications for the research process

Moving from the conventional to the options approach requires modification of the research process. Take the example of evaluating alternative fallow species. The conventional approach typically involves a trial with the following characteristics:

- Six species compared.
- Carried out at a few locations chosen to be 'typical'. The trial may be established in farmers' fields.
- Assessed by measurement of yield and perhaps farmers' assessment.
- Analysed by finding the species with the highest mean yield and most popular with farmers, with variation from the optimum designated as 'error'.

- Report the optimum as the recommended species.

The option-based approach involves a trial with the following contrasting characteristics:

- Six species compared, but not necessarily all compared on every site or farm.

- Carried out at a range of sites chosen deliberately for their varying conditions. Sites may be the farms of people who want to try some of the species.

- Assessment by:

  - measurement of yield, measurement of factors that seem to be related to yield.

  - farmers using their criteria and reasons for farmers' assessment.

- Analysed by:

  - looking at variation in yield across farms and which factors explain it.

  - looking at why farmers choose some species and not others and why different types of farmers (e.g., males and females) prefer different species.

  - bearing in mind that variation is important as it increases the range of information.

- Report information about all species; where they do (and do not) do well, why they are (or are not) liked by farmers.

Two examples of the output of this type of research are shown on the following pages.

The option approach requires considerable involvement of farmers to ensure that a wide range of options are tested under a wide range of conditions, and that the assessments include those made by farmers. However, the process must be more than farmers researching to find their own solutions. Three reasons researchers should be involved are:

- To make sure options tested are consistent with, and contribute to, knowledge of basic principles.

- To make sure that options are tested in a suitably wide range of conditions.

- To collect, interpret and compile the information generated by the farmers, so that the process does not have to be repeated everywhere.

Table 1 Example: Options for soil fertility management

	Technologies						
Criteria	Natural fallow < 5 years	Mechanical soil conservation	Manure use	Rotation	Inorganic fertilizers	Green manure	Improved fallow
	Requirements						
Land requirements	very high	medium	none	none	none	high	high
Labour Input	none	very high	medium	no extra	low	medium	high
Capital input	none	low	medium - transport	none	very high	low	low
Draught power needs	none	helpful	high	helpful	none	medium	low
Period foregone	< 5 years	none	none	none	none	1 season	2-3 seasons
Associated risks	land tenure	breakage	weeds	low value for some crops	capital loss	pests	pests, livestock, fire
Skills required	low	high	medium	medium	medium	medium	high
	Effects						
Production increase	none	low	high	low-high (dep. on crops)	very high	high	very high
Lasting effects	low-none	increasing	1-3 seasons	continuous	1-2 seasons	1 season	2-3 seasons
Short term benefit	low (pasture)	low-medium	high	medium	very high	medium fodder, food	low
By-products	pasture	water retention	none	diversified output	none	fodder-food, fibre	firewood
Side effects	weeds ⇒ labour	need for maintenance	weeds⇒ labour	improved food security	nutrient imbalances	weed suppression ⇒ less labour	weed suppression ⇒less labour

Source: Raussen (1997). Integrated soil fertility management on small scale farms in Eastern Province of Zambia. RSCU, Nairobi.

Table 2 Guidelines to the use of four green manure species in central and eastern Uganda

If you want to	**plant ....**	**Do not plant ....**
produce in sole crop	mucuna or lablab	canavalia
intercrop with maize	canavalia, or lablab at very low density	mucuna
intecrop with newly planted banana or coffee	canavalia	mucuna or lablab
intecrop with established banana or coffee	canavalia or mucuna at low plant density	crotalaria
intercrop between sweet potato mounds	crotalaria or canavalia	mucuna or lablab
intecrop with newly planted cassava	canavalia or mucuna at low density	crotalaria
produce fodder	lablab or mucuna	canavalia or crotalaria
suppress weeds	mucuna or lablab	canavalia or crotalaria
reduce nematodes	crotalaria	canavalia
produce durable mulch	crotalaria and canavalia (allow to mature)	lablab or mucuna

Source: Fischler M. and Wortmann CS. 1999. Green manure research in E. Uganda - a particpatory approach. Agroforestry Systems 47 123-138.

The balance between researcher and farmer involvement in technology testing

By Steven Franzel and Richard Coe

Introduction

In participatory on-farm evaluation, farmers take a lead role in the design, implementation and evaluation of technology. This paper outlines objectives for conducting on-farm trials and presents a typology for classifying on-farm trials, focusing on how different types of trials may be used to meet different objectives. Some main issues in the management of different types of trials are also discussed. This paper draws on Franzel et al. (2002a).

Objectives of on-farm experimentation

On-farm experimentation has several different objectives:

First, it permits farmers and researchers to work as partners in the technology development process. The more and earlier that farmers are involved in the technology development process, the greater the probability that the practice will be adopted. On-farm trials are important for getting farmers' assessment of a practice, their ideas on how it may be modified and for observing their innovations. Assessments are likely to vary and may be associated with particular biophysical (e.g. soil type) or socio-economic (e.g. wealth status) circumstances. Farmers' innovations often serve as a basis for new research or for modifying recommendations (Stroud 1993; van Veldhuizen et al. 1997).

Second, on-farm testing is useful for evaluating the biophysical performance of a practice under a wider range of conditions than is available on station. This is especially important because soil type, flora and fauna on research stations are often not representative of those found on farms in the surrounding community.

Third, on-farm trials are important for obtaining realistic input-output data for financial analysis. Financial analyses conducted on on-station experiments differ from those on farms because:

- yield response is often biased upward,
- estimates of labour-use by station labourers on small plots are unrepresentative of the farming community,
- operations often differ, as when tractors instead of oxen or hoes are used for preparing land.

Fourth, on-farm testing provides important diagnostic information about farmers' problems. Even if diagnostic surveys and appraisals have already been conducted, researchers can still learn a great deal about farmers' problems, preferences and livelihood strategies from interacting with them in on-farm trials. Trials have the advantage over surveys in that they are based on what farmers do rather than on what they say.

Types of on-farm trials

On-farm trials can thus provide critical information for determining the biophysical performance, profitability and acceptability of agroforestry (i.e. adoption potential). However, the design of a trial depends on its specific objectives.

Assessment of biophysical performance requires biophysical data on the products and services that the technology is planned to produce. These are likely to change with different adaptations of the technology as might occur if farmers were asked to manage them. To prevent such possible variation, trials designed to assess biophysical performance should be controlled in order to replicate specific technology designs. The trials should also be implemented in a way that farmers' willingness and ability to establish and maintain the trials does not affect the outcome. Thus trials to assess biophysical performance need a high degree of researcher control in both design and implementation.

The assessment of profitability requires biophysical data (to estimate returns) that must be generated from standardized experiments. However, the financial analysis also requires realistic input estimates, of which labour poses most difficulties. Realistic data can only be obtained if farmers manage the trials to their own standards. Thus profitability objectives require trials in which researchers have considerable input into the design, but farmers are responsible for implementation. The objectives of assessing feasibility and acceptability require data on farmers' assessments and adaptations of the technology. These can only be assessed if farmers are left to experiment with little researcher involvement.

There are many different ways of classifying on-farm trials (Okali et al. 1994). The differing requirements of the objectives of biophysical performance, profitability and acceptability mean it is helpful to classify trials according to the balance of researcher and farmer involvement in their design and implementation. The classification used in this volume involves three types of trials and draws upon Biggs (1989).

Type 1: Trials designed and managed by researchers

These trials are simply on-station trials transferred to farmers' fields. They are useful for evaluating biophysical performance under farmers' conditions and require the same design rigour as on-station research with regard to treatment and control choice, plot size, replication and other aspects of statistical design. In the design stage, researchers need to consult the farmer on the site's homogeneity and history. If possible, they should observe a crop on the field before establishing a trial.

Because type 1 trials take place on farmers' fields, trial results are generally more representative of farmers' biophysical conditions than are on-station trials. More accurate information may be obtained on interactions between the biophysical environment and management, for example, how different species in an improved fallow trial perform on different soil types.

Type 1 trials are usually more expensive and more difficult to manage than on-station trials; they often involve renting land from farmers and bringing labourers from the station to implement them. Farmers' assessments are an important objective of type 1 trials. As with on-station trials, it is useful to get farmers' feedback on the different treatments (Sperling et al. 1993; Franzel et al. 1995).

Type 2: Trials designed by researchers but managed by farmers

Here, farmers and researchers collaborate in the design and implementation of the trial. The trial is labelled 'researcher-designed', because it follows the conventional scientific approach to conducting an experiment: one or more test treat-

Farmer group comparing different nursery methods in western Kenya.

ments are laid out in adjacent plots and compared to one or more control treatments. Researchers consult farmers on the design of the trial and each farmer agrees to follow the same prototype (or chooses one of several possible prototypes), so that results may be compared across farms. Farmers are responsible for conducting all of the operations in the trial.

In type 2 trials, reliable biophysical data over a broad range of farm types and circumstances are sought. The trials also facilitate the analysis of costs and returns; inputs, such as labour and outputs, such as crop yields, are relatively easy to measure (see toolkit paper 3) because plot size is uniform and known. The trials are also useful for assessing farmers' reaction to a specific practice and its suitability to their circumstances. Farmers are encouraged to visit each other's trials and to conduct group field days to assess the practice at different stages of growth.

Type 3: Trials designed and managed by farmers

In type 3 trials, farmers are briefed about new practices through visits to field stations, on-farm trials, or innovative farmers. They then plant and experiment with the new practices as they wish. They are not obliged to plant in plots of fixed size or to include control plots. Researchers monitor the farmers' experiments, or a sub-sample of them, focusing in particular on their assessment of the new practice and their innovations. In addition farmer-to-farmer visits and meetings are useful so that farmers can compare their experiences, assessments and innovations with others. Any farmer experimenting with a new practice could be said to have a type 3 trial, regardless of whether they obtained planting material and information from researchers, other facilitators, or other farmers. This 'hands-off' approach, which assumes that farmers know best how to test a new practice on their own farms, is supported by some in the literature (Lightfoot 1987). Others emphasize training farmers to conduct trials following scientific principles, such as replication and non-confounding of treatments (Ashby et al. 1995).

Next page: A farmer in western Kenya testing his own innovation: planting seedlings in banana stem casing to improve their growth through moisture conservation.

Suitability of trial types for meeting objectives

The suitability of the different trial types for differing objectives is summarized in Table 1. Suitability involves both the appropriateness of the trial for collecting the information and the ease with which it can be collected. Different types of trials are suited to different types of analyses. Biophysical measurements are most meaningful in type 1 and 2 trials; they are less useful in type 3 trials because each farmer may manage the practice in a different manner. Type 2 trials are well suited for collecting parameters (e.g., labour use) for financial analysis; such data are difficult to collect in type 3 trials because plot size and management vary. The data can be collected in type 1 trials but will be less relevant to farmer circumstances; yield response to new practices tends to be biased upward and labour use, measured using labourers hired by researchers and working on small plots, is unrepresentative of farmers' labour use.

Farmers' assessments are more accurate in type 3 trials for several reasons. Because farmers control the experimental process, they are likely to have more interest and information about the practice. Furthermore, because farmers in type 3 trials usually have less contact with researchers than farmers in other types of trials, their views of a technology are less influenced by researchers' views. Finally, whereas it is often necessary to provide inputs to farmers in type 2 trials to ensure that results are comparable across farmers, no inputs, with the possible exception of planting material, are provided in type 3 trials. Thus farmers' views in type 3 trials are more likely to be sincere than in type 2 trials, where positive assessments may simply reflect the farmers' interest and satisfaction in obtaining free inputs. For example, in a hedgerow intercropping trial in western Kenya (Swinkels and Franzel 1997), 50% of the farmers claimed that hedges increased crop yields whereas technicians noted yield increases on only 30% of the farms; the technicians claimed that the difference was due to farmers trying to please researchers.

*Table 1 The suitability of type 1, 2 and 3 trials for meeting specific objectives**

Information types	Type 1	Type 2	Type 3
Biophysical response	H	M	L
Profitability	L	H	L
Acceptability			
Feasibility	L	M	H
Farmers assessment of a particular prototype†	L	H	M
Farmers assessment of a practice	L	M	H
Other			
Identifying farmer innovations	0	L	H
Determining boundary conditions	H	H	H

*H=high, M=medium or variable, L=low, 0=none
The suitability involves both the appropriateness of the trial for collecting the information and the ease with which the information can be collected.

† By particular prototype, we mean a practice which is carefully defined. For example, a prototype of improved fallows would include specific management options such as species, time of planting, spacing, etc.

Finally, all three types of trials play a potentially important role in defining the boundary conditions for the technology, that is, the biophysical and socio-economic conditions under which the practice is likely to be adopted by farmers. Which type of trial is best depends on the participants' objectives (facilitators' and farmers') and the particular circumstances.

Continuum and sequencing of trial types

The different types are not strictly defined; rather they are best seen as points along a continuum. For example, it is common for a trial to fit somewhere between type 2 and type 3, as in the case where farmers agree to test a specific protocol (type 2) but over time, individuals modify their management of the trial (type 3). For example, in the hedgerow intercropping trial in western Kenya mentioned above, farmers planted trials in a similar manner but most farmers later modified such variables as the intercrop, pruning height and pruning frequency.

The types of trials are not necessarily undertaken sequentially; researchers and farmers may decide to begin with a type 3 trial, or to simultaneously conduct two types of trials. For example, in the case of upper-storey tree trials in western Kenya (Franzel et al. 2002b), no type 1 or type 2 trials were needed, because much was already known about the growth of the trees in the area. Rather, farmers planted type 3 trials, in order to assess the performance of the species on their farms. In Zambia, many farmers planted type 2 and type 3 improved fallow trials in the same year (Kwesiga et al. 1999). They tested a particular set of practices in their type 2 trials and used type 3 trials either to extend their plantings or to test a modification of the practice. Researchers wished to assess biophysical response in the type 2 trials and to monitor farmers' innovations in the type 3 trials. Type 2 and 3 trials often generate questions or sharpen hypotheses about biophysical factors which can then be best evaluated through type 1 on-farm or on-station trials. In western Kenya, several researcher-managed trials to explore specific aspects of improved fallow function and design were set up following farmer-managed trials (Swinkels et al. 1997).

Handling complexity

The more complex the trial or technology, the less effective a type 2 approach is likely to be for both biophysical and socio-economic assessments. 'Complexity' involves:

- the number and diversity of components (intercropping trees and crops, as opposed to trees or crops in pure stand),
- the length of the cycle of the technology (3+ seasons as opposed to single-season cycles), and
- the size of the trial (whether it takes up more than 10% of a farmers' cultivated area).

In a trial comparing annual crop varieties, it is often possible to combine biophysical and socio-economic objectives because, according to the above definition, the trial is not complex. However, most agroforestry trials are complex and thus different trial types are needed to meet the differing objectives. For example, where technologies are complex, researchers and farmers could conduct type 1 trials for biophysical data and type 3 trials for socio-economic data, instead of trying to collect both sets of data in a single type 2 trial.

Promoting farmer innovation

Promoting farmer innovation is an often-mentioned objective of on-farm trials, yet little is written on how to do this. Type 2 trials require the standardizing of practices across farms and thus actually reduce farmers' motivation to innovate. Only in type 3 trials, where farmers completely control the experimental process, are farmer innovations likely to emerge and be captured. In type 3 trials on improved tree fallows in eastern Zambia, two of the main technological components being extended to farmers emerged from farmer innovations in type 3 trials (Kwesiga et al. 1999; Franzel et al. 2002c). In the first example, farmers were given potted seedlings, raised at farmer training centres, for planting improved fallows on their farms. In order to reduce the cost of transporting them to their farms, a farmer removed the seedlings from the pots and carried them 'bare-rooted' in basins. When farmers' plantings of these seedlings proved successful, researchers conducted type 1 trials to compare the performance of bare-rooted seedlings, grown in raised seedbeds, with potted seedlings. They found no important difference in performance and as potted seedlings were much more costly to produce, they were phased out.

Farmers' second main innovation, intercropping trees with maize during the year of tree establishment, was also later tested in on-farm trials. The trials found that intercropping reduces maize yields and tree growth during the year of establishment, but most farmers prefer it because it economizes on land and labour use relative to planting in pure stands.

Conclusions

The type 1-2-3 classification system is useful for highlighting the different objectives for conducting on-farm trials and for illustrating that different types of trials are suitable for particular types of assessments (Table 1). It is tempting for researchers to use the same on-farm trial to collect information on biophysical responses and farmer assessment. However, these objectives are often conflicting. A high degree of control is needed to collect accurate biophysical data whereas farmer assessment is most valid when individual farmers are allowed to use the practice in the manner they see fit. Researchers and farmers interested in biophysical and socio-economic data may be better off conducting type 1 trials for biophysical data and type 3 trials for socio-economic assessment rather than a single type 2 trial that tries to do both. The more complex the trial or technology, the less effective a type 2 approach is likely to be for both biophysical and socio-economic assessments.

References:

Ashby J, Gracia T, Guerrero M, Quiros C, Roa J and Beltran J. 1995. *Institutionalizing Farmer Participation In Adaptive Technology Testing.* London: The 'CIAL.' Overseas Development Institute Network Paper 57.

Biggs S. 1989. *Resource-poor farmer participation in research.* The Hague, Netherlands: ISNAR.

Franzel S, Hitimana L and Akyeampong E. 1995. Farmer participation in on-station tree species selection for agroforestry: a case study from Burundi. *Experimental Agriculture*, 31:27-38.

Franzel S, Coe R, Cooper P, Place F and Scherr SJ. 2002a. Methods for assessing agroforestry adoption potential. *In*: Franzel S and Scherr SJ. *Trees on the Farm: Assessing the Adoption Potential of Agroforestry in Africa*. Wallingford UK: CAB International.

Franzel S, Ndufa JK, Obonyo CO, Bekele T and Coe R. 2002b. Farmer-designed agroforestry tree trials: Farmers' experiences in Western Kenya. *In:* Franzel S and Scherr SJ eds. *Trees on the farm: Assessing the adoption potential of agroforestry practices in Africa.* Wallingford UK: CAB International.

Franzel S, Phiri D and Kwesiga FR. 2002c. Assessing the adoption potential of improved tree fallows in Eastern Zambia *In:* Franzel S and Scherr SJ eds. *Trees on the Farm: Assessing the Adoption Potential of Agroforestry Practices in Africa.* Wallingford, UK: CAB International.

Kwesiga FR, Franzel S, Place F, Phiri D and Simwanza CP. 1999. Sesbania sesban improved fallows in eastern Zambia: their inception, development, and farmer enthusiasm. *Agroforestry Systems* 47, 49-66.

Lightfoot C. 1987. Indigenous research and on-farm trials. Agricultural Administration 24: 1-11.

Okali C, Sumberg J and Farrington J. 1994. *Farmer participatory research. Rhetoric and reality.* London: Intermediate Technology Publications.

Sperling L, Loevinsohn ME and Ntabomvura B. 1993. Rethinking the farmers' role in plant breeding: Local bean experts and on-station selection in Rwanda. *Experimental Agriculture* 29:4: 509-518.

Swinkels R and Franzel S. 1997. Adoption potential of hedgerow intercropping in the maize-based cropping systems in the highlands of Western Kenya. Part II: Economic and farmers'evaluation. *Experimental Agriculture* 33: 211-223

Stroud A. 1993. *Conducting on-farm experiments.* Cali, Columbia: CIAT. 118 pp.

Swinkels R, Franzel S, Shepherd K, Ohlsson E and Ndufa J. (1997) The economics of short rotation improved fallows: evidence from areas of high population density in western Kenya. *Agricultural Systems* 55: 99-121.

van Veldhuizen L, Waters-Bayer A and de Zeeuw H. 1997. *Developing technologies with farmers: A trainer's guide for participatory learning*. London: Zed Books. 230 pp.

Designs that allow inference

By Richard Coe

Introduction

Descriptions of methods for designing field research studies seem to suggest that there is a range of well-defined types of design: the on-station experiment, the informal survey, the on-farm trial and so on. Each of these designs has some well-defined variants, for example for the on-station research you can choose, among others: a randomized block design, a split plot design or any other textbook experimental design. It is further suggested that designing the study means choosing from this set of methods and then 'following the recipe'. This approach is not appropriate for two reasons:

1. There is an infinite variety of study objectives. Since the design of a study is dependent entirely on the objectives, we might expect as great a variety in the details of the appropriate design.

2. The study design also depends on the practical constraints and opportunities. It is therefore not usually possible to pick a standard design from a book and apply it.

However, there are some basic principles or concepts relevant to any study. Understanding these will help you come up with a sound design for your problem. These basic principles are much the same whatever the context of the experiment, in particular whether it is participatory and on-farm.

Objectives

Every aspect of the design depends on the objectives. What exactly are you trying to find out? Well-defined objectives for an experiment will be:

- Clear
- Complete
- Relevant
- Achievable through experimentation.

Objectives are 'relevant' if they are clearly related to solving the problem being studied. It should be clear to you, before you establish the experiment, what you would be able to do towards solving the problem once the trial is completed that you could not have done without carrying it out.

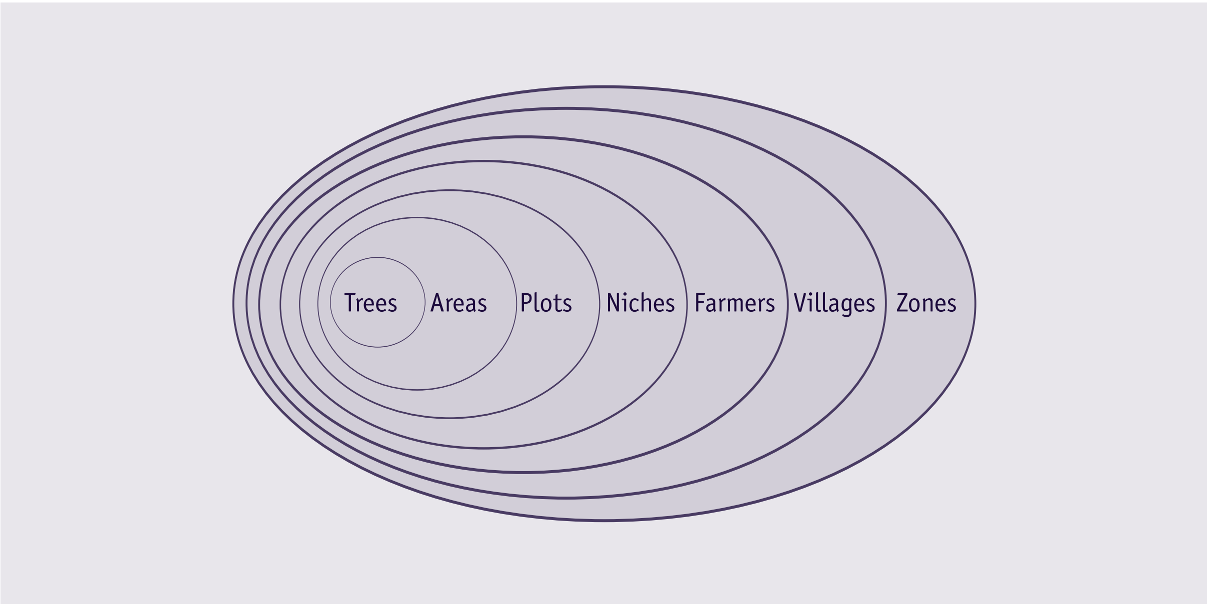
You need to remember that not all research problems need an experiment. Surveys, literature reviews, case studies and modelling exercises are examples of alternative types of research. Look out for problems which require experimentation, but for which a single experiment will not be feasible. Be aware that multiple objectives might require multiple trials.

Different stakeholders in a study may have different objectives. For example, a farmer might be looking for suitable options for her/his own farm while the researcher is trying to understand variation in performance across a range of environments. We tend to think of the research design being important for the researchers objectives, with the farmers learning from any experiences offered. However, attention to design may also help farmers meet their objectives. For example, if several farmers test similar options in a range of conditions and share the results, farmer learning will be faster than if each farmer is only using her/his own information. Attention to the variety of conditions from which we learn is important.

The objectives for a trial will often include testing hypotheses. A useful hypothesis is a statement we have good reason to believe is true and confirmation of this by the trial will allow progress in solving the farming problem.

The design hierarchy

Think of a simple on-farm trial comparing 3 different improved fallow species. Each farmer has plots with the treatments they are comparing. The plots occur in niches on the farm. The farmers are arranged in villages and villages in land use zones. Within each plot there are areas from which we sample, within each area there are a number of trees that are part of the study. There is a hierarchy of components or layers to the design. For example:



When planning a trial we have to think about these layers. Taking the 'farmers' layer as an example, we have to work out:

- How many farmers will be involved?
- Which farmers will be involved?
- Who decides on the farmers to be involved?
- Which species will each farmer compare and who decides this?
- What information will be collected about each farmer?
- Etc.

There will be a similar set of questions for each layer in the hierarchy.

Comparison

Experiments are designed to compare things. The primary comparisons are often called the 'treatments', for example different species, technologies, management options and so on. We are also interested in comparing these under different conditions, for example different soil types, different farm sizes, different farmer gender, etc. We compare them in terms of responses, which may be a physical measurement, an observation made by a researcher or an assessment made by a farmer.

We have to ensure that the conditions to be compared really occur in the study and that the comparison is as clear as possible. For example, if we want to compare the acceptability of two different technologies to farmers at different distances from the main road, we have to design the study with farmers at a range of distances from the road. Furthermore, we will see the effects most clearly if we make sure there are plenty of farmers both close and far from the road. Some methods for selecting farmers will not achieve this with most observations ending up middle distance from the road.

If we want to compare the growth rate of two species, the comparison will be clearest if environmental and management variations are minimized in the conditions where the two species are grown. This is going to be easiest to achieve if the comparison is made between neighbouring plots within the same farm. Note that such a comparison is not possible with the design for the study of the acceptability of two different technologies to farmers at different distances from the main road. This is an example of the importance of understanding the design hierarchy since the comparison of species is better achieved within the farm level while for the comparison involving distances from the road multiple farms will be needed.

If the main objective is not comparison but estimation of a quantity such as survival rate, the adoption rate, etc, a survey may be more appropriate than an experiment. In contrast to an experiment, a survey measures what is going on with minimal interference.

Uncertainty

If all trees, farmers and environments were the same, research would be easy. We could give one tree to one farmer, watch what happens and reach conclusions. The variability in everything we deal with makes research harder and makes uncertain all inferences drawn from data. If we observe one farmer who lives near the road preferring fruit trees to trees for fuel wood we cannot conclude anything. However, if we see this repeated across many farmers then we become increasingly certain that it is a general rule. It is the replication of farmers that allows us to make this inference.

Replication achieves two things:

1. It decreases the uncertainty. For example, when 40 out of 50 farmers (80%) prefer fruit trees the information is more certain than when 4 out of 5 (80%) prefer fruit trees.

2. It allows us to quantify the uncertainty of our findings. If we observe 40 out of 50 farmers preferring fruit trees (80%), with the help of statistical methods it is possible to say that the real proportion, i.e. the proportion that would be found by asking all farmers, is somewhere between 67% and 93%.

The replication has to be at the appropriate layer in the design hierarchy. Asking one farmer about preferences for each of 50 fruit and fuel wood trees is not the same as asking 50 farmers. If we wish to make inferences about something which varies between villages (say, ethnic group or presence of an extension officer) then we have to make sure there are several villages of each type in the study.

Bias

The study is biased if the measured differences, for example differences between treatments or between farmers, consistently underestimate or overestimate the real differences. Bias may be a problem of experimental layout or measurement.

Suppose we want to assess the yield benefit of an improved fallow compared with continuous cropping. If we consistently put the improved fallow on less fertile plots then the comparison will be biased. This form of bias can be avoided by randomization, i.e. by determining which of two plots gets the improved fallow by random allocation. If farmers are designing the trial themselves and choosing where to plant the two treatments, then we have to check whether a biased allocation has been used, for example by asking farmers why they put each treatment where they did. We can also find out from farmers if the comparison they intended to make is the same as the one the researcher thought of making. For example, they might be interested in determining whether the improved fallow can improve an infertile spot until it is as good as the other. A design, which is biased for one objective, may be appropriate for another.

Another source of bias may be in the selection of farmers (villages, zones etc). For example, we might end up with only the wealthier farmers in the study. This bias can be checked for by comparing the farmers in our study with the farmers in the target population. The problem can be avoided either by random selection, often not feasible, or careful targeting. In some research strategies, there is a deliberate decision to use a biased set of farmers, for example when working with 'innovators'. This may be a sound approach, but it must be remembered that results only apply to such farmers.

Measurement can be biased, for example by poor interview techniques. This form of bias can be avoided by using a sound measuring tool. Its existence can sometimes be assessed by triangulation: measuring the same thing in several different ways.

Confounding

Confounding means 'confusing'. Suppose farmers using an improved fallow also use an improved maize variety, and farmers using

Woman in western Kenya testing improved fallows using Crotolaria grahamiana.

continuous cropping use a local variety. Then, if we compare crop yield from improved fallow and from continuous cropping, we are also comparing improved with local maize. The two variables 'cropping system' and 'variety' are confused or confounded.

In experiments we aim to avoid confounding by keeping everything the same except the treatments to be compared and randomly allocating treatments to plots. This means that the only consistent differences between the treatments being compared are the treatments themselves. In an experiment with farmers this may not be possible - farmers may choose to confound variety and system (for example, see theme paper 4). However, we can arrange for additional plots of improved fallow with local variety and continuous cropping with improved variety, to be included to 'break' the confounding.

Using the concepts

How can you use these concepts and principles in the design of an on-farm trial? This is where the art comes into research! Here there are some hints to help you in the design process:

- First, look at the 'standard' experimental design such as the randomized block design at one or a few locations. Make sure you can identify where each concept enters into such designs.

- Then start with a potential plan for the trial you wish to organize. Such a potential plan might be based on your previous experiences or understanding what others have done in similar situations. Look carefully at each of the concepts and think through how it applies and whether, in the light of the principle, a modification is needed.

- The process of designing the trial will be iterative, as you look at each aspect in turn, make modifications and then look at earlier ones again. You may well find yourself going back to objectives and modifying these, once you realize the original objectives were either ambiguous or unattainable.

- It will probably be necessary to make compromises. For example, you might like to randomly allocate treatments to farmers' plots, but that could conflict with other requirements of farmer control. A compromise might be to find out why farmers used the allocation they chose, and to record some indicators that will allow you to confirm that there are no systematic differences between plots allocated to different treatments.

- There are some 'technical' ideas that might help in some of the decisions. For example, guidelines on sample size based on statistical theory may be useful for checking that the replication you intend to use at different levels in the hierarchy is appropriate. The ideas of factorial structure and quantitative levels may be useful both for selecting treatments and for selecting environments to compare.

Many researchers ask for a name of the design they use, such as 'split plot design', so that they can report this or include it in a protocol. The variety of designs is so great that they have no names. You just have to be able to describe what you did and why.

The process of experimental design is an interesting challenge. The concepts described in this paper should help you face this challenge in such a way that your design would be useful for making inferences.

Collecting the data

By Richard Coe

Introduction

While 'generation of data' is clearly central to the idea of experimentation, often researchers pay less attention to planning the actual collection of data from a trial than to other aspects of trial design. Maybe there is a feeling that collecting data 'is obvious'. After all, in many situations the researcher's interest has been centred on indicators of output such as a crop yield and these indicators have been used for assessing experiments for a long time. However, careful consideration of the detailed objectives, together with the practicalities of measurement, will often reveal the complexities and measurement decisions that have to be made.

As with the rest of design, choosing what to measure and how to measure it, depends exactly on the objectives. The researcher may well want to assess performance of alternative options in terms of crop yields in tonnes per hectare or tree growth rates, but may also be interested in why yields vary, so he/she will have to collect data on potential sources of variation as well as yield.

It is important to remember that different stakeholders in a trial might have different objectives.

A farmer may be more interested in comparing performance between options than in measuring actual yields, and may prefer to make comparisons with the usual or expected performance rather than directly between observed yields. Furthermore, their assessment of options will integrate many objectives, and if the researcher is interested in understanding specific aspects of the farmers' assessment, there will be a need to collect appropriate data.

It has been suggested that the purpose of participatory trials is the farmer's own experiential learning. If researchers also try to meet their objectives, they are somehow corrupting this paradigm. We believe there are few situations in which a researcher can afford to be involved simply to facilitate farmers' own learning, and the expense of involving a researcher can only be justified if some general results are obtained. This requires attention to data collection as well as to all other aspects of the design. There is also a belief that collecting and analysing quantitative data somehow contradicts a participatory principle. Yet quantitative analysis is often of interest to farmers and can:

- Provide useful, easy to understand summaries of results.
- Allow description of uncertainty and variation.
- Reveal complex interactions.
- Give insights and suggest new hypotheses.

Collecting data suitable for quantitative analysis does not mean that we have to use traditional quantitative measures only, such as crop yield measured in tonnes per hectare using a balance. We could, for example, use participatory tools to elicit both farmers' criteria for assessing options and scores on these criteria and still perform a quantitative analysis (see toolkit paper 2).

Choosing variables to measure

There are various ways of categorizing the variables that should be measured, so that planning can proceed in an organized way. The first is before-during-after.

Before the trial starts there are three classes of quantities we need to measure:

- First, some sort of baseline may be needed: the current density of Striga, the visible signs of soil erosion or the percentage of fuel wood produced on farm.

- Secondly, you need data that are used to characterize the plot/farm/etc. along the various gradients that you need to sample as part of the experiment. For example, if the objectives require comparing acceptability of options to farmers of different wealth categories, the wealth category has to be determined.

- Thirdly, you need to be able to place the farms and farmers involved in the trial within the general population, for example, to confirm that trial farmers are not much richer than other farmers.

During the trial you will want to collect data on 'interim' responses. For example, how well did trees survive the first dry season? Why did some farmers drop out of the experiment? Remember that experimentation is a dynamic process. During any trial you will probably learn and discover new information that will lead you to start taking new measurements that will allow you to explain the results of your trial or test new hypotheses.

After the trial there may be follow up measurements that can help in completing the picture or are important for assessing non-immediate outcomes, for example, did farmers repeat it the following year?

Another way to think about what data to collect is in terms of primary responses and variables that help explain them. The primary responses are those variables that are central to the objective of the trial, for example yield, farmer's assessment of change in soil quality or labour reduction. In most trials these primary responses are very variable, with variation at every level in the hierarchy: within plots, between plots, between farmers, between locations, etc. Often the most important insights generated by a trial are reasons for this variation. For example, a study comparing the growth of two tree species reveals that on average A is faster than B, but there is a lot of variation, and on 40% of farms B actually grows faster. A simplistic analysis would report that on average A grows faster.

However, investigation of the variation shows that there are differences in growth rate in different soil types and an interaction with weeding (Table 1). The richness of the information in such data compared with the simple species comparison is obvious, but if this kind of analysis is to be done, soil type and weeding have to be recorded along with the growth rates.

Table 1 Rate of growth of species A and B under different soil and husbandry conditions

Weeding	Soil type	Species A	Species B
Weeded	Sandy	+	+++
	Clay	+++	++
	Water logged	+	-
Not weeded	Sandy	+	+
	Clay	++	-
	Water logged	+	-
Overall		+++	+

- Extremely low   + Low   ++ Intermediate   +++ High

Often the need for such additional measurements becomes apparent during the experiment. Researchers should be monitoring a trial by regular field visits. If large variation is noted, identify potential explanations and then collect the data to confirm it. These represent new hypotheses not in the original plan. The advantage of participatory experimentation is that the search for explanations would also involve the farmers themselves trying to explain the possible causes for the variability encountered.

In farmer-designed trials (see theme paper 4) farmers choose which treatments to plant and where to plant them. This makes it necessary to ask 'Why' the design is the way it is, yet this is often forgotten. Think of this example. A trial is established to compare a soil-improving fallow technology with the farmers' usual cropping. The researcher imagines a simple design with two treatments, the new fallow and the current

Malawian woman comparing maize cob (at right) following an improved tree fallow with a maize cob (at left) from her other plots.

practice. The farmer chooses the location and management of the plots. At the end of the trial, the difference in performance of the two treatments is minimal. Not only is this disappointing, but it also contradicts results of earlier trials. Then someone thinks to ask the farmers about the design. It turns out that some of them have put the fallow on a plot known to be infertile and the 'control' on a fertile site. This is logical; they know the fallow is supposed to improve fertility, so it is sensible to test it on somewhere that needs improving. In addition, as they still have to eat at the end of the year, it is natural to put the control on a plot that is expected to perform adequately. With this knowledge the interpretation of the results is very different, yet it would not be possible if the 'Why?' question had not been asked. Of course, in the above example, researchers and farmers should have agreed from the start on the role of the control and the treatment plots. For example, farmers could have divided themselves into two groups, those that wanted to plant the improved fallow and control on plots of similar fertility and those that wanted to test the improved fallow on a plot of lower fertility than the control plot.

Where and how many?

The concept of the design hierarchy is relevant to decisions on measurement. Different quantities have to be measured at different levels in the hierarchy, for example the wealth of a farmer is usually measured at the household level, the crop yield may be assessed for a plot and tree height has to be measured on individual trees. Other variables may be measured at higher levels, for example the presence of an extension worker or effectiveness of the farmer group may be village-level variables.

In a researcher-designed and -managed trial the researcher should take measurements in all the plots or farms that are part of the trial; why include them if they will not be measured? This may not be the case in farmer-designed and -managed trials. It may be sensible for the researcher to measure some quantities on all farms and others on a selection. For example, the researcher may have objectives that require crop yields to be measured. It may be judged that there is little point in measuring crop yield on farms which have had very low quality management; that would mainly show that weeds reduce yields, which we know already. So yield measurements may be limited to the subset of well-managed farms, with the corresponding condition applying to any conclusions. The reasons for varying management input, however, could be recorded on all the farms and may be very revealing. Perhaps the farmers found the technology so disappointing that they gave up. That might make the yields from the few well-weeded plots rather irrelevant.

Cost and practical considerations will have a major bearing on measurement decisions. 'Crop yield' is often suggested as a primary response, but think carefully through what this means in a participatory on-farm trial. If it is to be measured by the researcher then the research team has to be present on the farm at harvest time. Just communicating to the researcher when this will be may be impossible and it may not be feasible for a measurement team to get to all farms harvesting on the same day. Add to this the problem of who does the work. Should the research team actually do the harvesting to ensure a consistent method is used (including sensible researcher decisions about avoiding edges, dealing with gaps and damaged plots and so on)? Or will this bias farmer's assessments? It may affect them positively because of the labour provided in harvesting, or may affect them negatively due to the disturbance or restrictions on when harvesting can occur. Few crops actually have a single harvest day, for many crops farmers remove product from the field as it matures or as need arises.

Alternatives to measuring crop yield in tonnes per hectare at harvest time include pre-harvest measurement of a proxy, for example cob count, or stand density and height, farmers' reported yield, a farmers' score or rating. There are many options for the last of these: scoring on a 'poor' to 'excellent' scale, scoring relative to a control (worse, same, better) or relative to expectation or historical values.

Many of the concepts and methods from formal research design will be useful in selecting sampling schemes and patterns of measurement. You need to understand the difference between measuring 100 trees on one farm, 10 trees on each of 10 farms and 1 tree on each of 100 farms. There will certainly be differences in the cost of these, but more importantly these three different samples each of 100 tree measurements contain very different information. Make sure the information your sample contains, both on comparisons and on variation, is the information needed to meet the objectives.

Tools

The tools available for measurement are varied and, or course, must fit the objectives and the practicalities of the trial. Standard tools such as balances and tapes are useful, but with much of the data being collected from farmers, other tools will also be needed. Formal questionnaires have a role, but so do a range of methods taken from Participatory Rural Appraisal (PRA) and other types of social enquiry. For example eliciting information on crop yield from a farmer may be done by simply asking and recording on a form, or by using a more visual technique. Many are possible, for example representing yields (and other criteria) of different options by piles of stones. Such techniques can have advantages over the questionnaires.

PRA practitioners find group discussions and recording of data useful. There may be advantages in use of group methods when collecting data from on-farm trials. However, remember that recording a single consensus measure from a group is not at all the same as recording opinions of each participant. Information on variation and its possible causes is lost. You should also be aware that when using some PRA tools, it is possible to have group discussions and still record information on an individual basis, but this might require adaptations of the standard PRA tool (Barahona and Levy, 2002).

There will be decisions to take over the balance between understanding detail on a few plots, farms or villages and collecting more limited information from the whole trial. Again the key is to understand the requirements of the objectives. A mixed strategy may well be appropriate. Detailed understanding of a few plots may be used to identify new hypotheses and indicators. This could be done in some cases through direct measurement, for example soil analyses to pick up causes of small-scale variation, or in other cases through in-depth discussion and consultations with farmers. The resulting indicators can then be measured on a larger number of farms to provide the breadth required to make reliable inferences about the whole population.

There is also a data quality consideration. In most situations spreading the data collection over many plots, farms and locations will lead to a decrease in quality. If more enumerators are needed, it will be harder to ensure they are using common methods, harder to monitor their performance and follow up on difficulties and questionable data. This point is explained further in toolkit paper 3 'measuring labour'.

One tool that should be used in all on-farm trials is the GPS (Global Positioning System) receiver. It is now simple and cheap to record the exact location of every measurement. Doing this allows revisiting the same spot for checking of data or for follow-up measurements in the future. It also allows information to be properly integrated with other data sources, and is a key element in mapping and scaling up or extrapolating results.

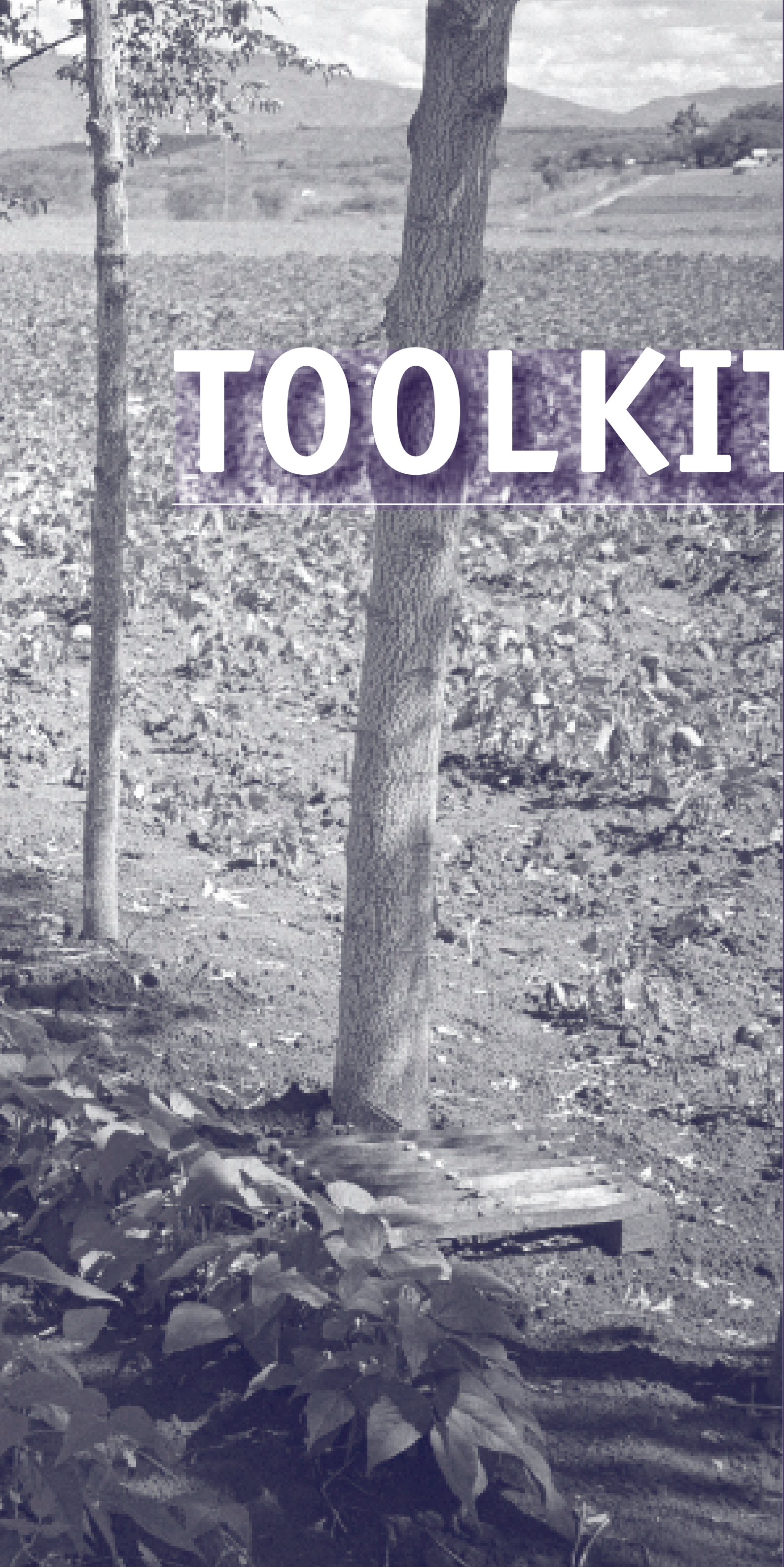
Conclusions

The key message in this paper is that the data collection in an on-farm trial may not be straightforward or routine, nor simply a matter of following standard practices. It needs careful planning. The objectives drive all data collection decisions. A useful technique for planning data collection is to work out in detail exactly how every bit of data collected will be used. Some researchers find it helpful to go as far as sketching the tables and graphs that they will use to analyse and present the information. In this way they can judge exactly what data is needed. This practice should be encouraged. Any data that does not have a clear purpose in analysis and interpretation should not be collected.

As with the rest of the design, details of the data collection planned should be recorded in the written protocol, for sharing with others before the trial, as a guide to action during the trial and as part of the archive after the trial (see toolkit paper 1).

References

Barahona C, Levy S. 2002. *How to generate statistics and influence policy using participatory methods in research.* Reading: Statistical Services Centre.



TOOLKIT PAPERS

1 Checklist for preparing protocols

2 Monitoring on-farm trials

3 Collecting data on labour use in on-farm trials

4 Assessing risk in on-farm trials

Checklist for preparing protocols

By Richard Coe

1 Trial protocols

A protocol for a trial is a detailed and complete description of what happens in the trial. It is first produced during planning of the trial and is revised as necessary as the activity progresses.

There are three reasons for producing a written protocol for any trial:

1. Before starting the trial, the protocol can be shared with anyone who might be able to comment on it and improve the effectiveness of the research. Consider eliciting comments on the protocol from:

   - People who know the farmers and farming systems in the area where you are working.
   - People who understand the subject area (soil fertility, animal feed, etc).
   - People with experience of the methods you plan to use.
   - Farmers! Even if they cannot read the protocol, you can get useful comments from discussing the trial with them.

Ask anyone who might have something to offer. The worst that can happen is that you get no response! Remember that people working outside your immediate location may well have valuable experience that may benefit your research.

2. Success of the trial cannot depend on the continued presence of any single person. If a detailed protocol is written up, then it will be possible for the trial to continue to a successful conclusion even if the principal investigator leaves.

3. After the trial is completed, the protocol is a record of what was done, to be referred to in any reporting and to be archived with the data.

2 The checklist[1]

A checklist is a list of points to remember when preparing a protocol. To use it, consider each point in the list and make sure you have addressed it in the protocol. Different institutions require protocols prepared in different formats, but any useful protocol will have to cover most of the points in this checklist. The checklist does not give you the answers, nor does it tell you how to carry out the trial. It is just a reminder of the points to decide on.

The checklist is designed to help develop protocols for single trials or experiments. It does not help in designing projects, which will consist of several linked activities (for example, planning and training activities, surveys, experiments, etc). It is designed for planning experiments that involve farmers. Other types of research activities require protocols with different information.

[1]Prepared by members of the African Highlands Initiative (AHI) Workshop 'Participatory Experimentation', Nairobi, 28 June-3 July 1999. Compiled by: Richard Coe, ICRAF, Nairobi, Kenya.

2.1 The key headings of a checklist

1 Abstract

A summary of the trial is useful. Note that the format of the whole protocol may have to conform to institutional requirements.

2 Reference or number

Use a unique reference or number for this study. This is needed to keep track of the experiment and not confuse it with other related studies.

3 Title

Choose a short, memorable title that people quickly learn and that relates to your study.

4 Location

Part of the identification of the study is where it takes place. Other details such as exactly which villages take part in the experiment come later.

5 Investigators

5.1 Team leader or principal investigator and his/her institution

Remember that he/she is the person responsible for the design and implementation of the work. Independently of how the 'team' operates, there has to be one person who takes overall responsibility.

5.2 Team members and their institutions

It may be useful to list their professional area.

6 Background and justification

You have to justify the spending of money and time on this work. In each of the following sections you must clarify:

- What the farming problem is that you are trying to find solutions for.
- How your work will help solve the problem.
- What the next step will be when this experiment is finished.
- What the target group is and why it has been chosen.
- On who the work will make an impact.

The information given must be specific to the location you are working in and the problem you are working on.

6.1 Summary of literature

Review of what is known about the problem and possible solutions. This will often come from other locations within the country and elsewhere.

6.2 Past research by you and others in this area

Results from PRAs, surveys, other experiments, etc.

6.3 Links to other parts of the same project

Describe how this trial links to other activities of the same or related projects, such as, other trials, farmer training activities or planning meetings. Describe existing institutional linkages and relationships with farmers and farmer groups.

6.4 Hypotheses

Even initial and exploratory studies have hypotheses! Hypotheses are statements which you believe to be true and, when this is confirmed by the study, allow the work to progress. They may concern biophysical, social or economic processes, or the links between them.

6.5 Potential impact

If the work goes as planned and hypotheses are confirmed (or not) what will the effect be? Who will the beneficiaries be (both on and off the farm)? How will they benefit and by how much? Will any people suffer a negative impact? How sustainable will the impact be?

7 Objectives

The whole of the rest of the design (and hence the protocol) depends on the objectives. List them clearly, completely and in sufficient detail to leave no doubts about any aspect of the study. Include a description of who the resulting information is aimed at.

The objectives must be consistent with each other and capable of being met with a single trial. Farmers should be involved in deciding the objectives. If that has not yet been done it is probably too early to write a detailed protocol.

8 Methods

Give enough detail to allow the protocol to be:

- Useful for anyone to see what you plan to do, so that suggestions for improvement can be made.
- A permanent record of what should be done, to be referred to during implementation. It should be good enough for this even if the principal investigator leaves.

Farmers will be involved in deciding many of the details of the protocol. In each section described how that was done (if it is completed) or how it will be done.

8.1 Trial type

There are several ways of summarizing the type of trial. The World Agroforestry Centre has used Type 1, 2 and 3 (see theme paper 4). The Contractual-Consultative-Collaborative-Collegial description is useful. Try to find a simple description that summarizes the approach used.

8.2 Duration

Be realistic! The start date must be far enough in advance to make proper preparations. The trial must be long enough to get outputs, for example to allow farmers to realize benefits, but short enough to keep everyone interested. The appropriate length will depend on the objectives.

8.3 Location

Describe how and why locations are selected. Methods may be random, stratified, selected to follow a known gradient, etc. Description of locations may well be hierarchical, for example, districts chosen because of the mandate area, locations chosen randomly, sub-locations chosen to cover a range of distances from the main road. Describe sampling schemes and sample sizes.

8.4 Farmers

Describe how farmers (or households, fields, etc) are selected to be in the study. Examples are: volunteers at a village meeting, introductions made by extension staff, contact farmers from a previous study, farms chosen during a mapping exercise, etc. Section 8.10 points out it is important to describe the farmers themselves, for example in terms of gender, household type, wealth category, and how they compare to the general population. You should state how many farmers will be involved.

8.5 Treatments

Describe what the treatments to be compared are and the method for arriving at these. Define clearly what is to be determined by farmers and what by researchers. If the farmer makes the decision, find out what they are comparing. Remember that the comparison might not be with the results from a physically adjacent plot (see theme paper 5) and that the point of reference might come from another season. If 'farmer's practice' is included as a treatment record exactly how this is defined and if it varies between farmers.

8.6 Layout

Describe where the treatments will be applied and the process for reaching the decision. Describe plot location within a farm, their sizes and the method for allocation of treatments to plots. Define clearly what is to be determined by farmers and what by researchers.

8.7 Inputs

Describe what inputs (e.g. seeds) are needed, how and on what terms these will be supplied.

8.8 Management

Who is responsible for deciding on management activities (for example, planting, weeding, spraying, harvesting) ? Who is responsible for carrying them out? Describe each management decision and who is making it. Do not generalize. Distinguish decisions about management (e.g. how many times to weed), from decisions about carrying out the work (e.g. doing the weeding).

8.9 Non-experimental variables

Describe key variables and if they are fixed (if so, at what level and by who). How are farmers involved in deciding the level to fix non-experimental variables?

8.10 Data collection (see theme paper 6)

Data may be collected on 'response variables' such as:

- Agronomic performance.
- Economic performance.

- Farmers assessment.
- Ecological impact.

It is also necessary to record 'design variables'. These are such things as:

- Location of participants (measured by GPS).
- Household and farmer characteristics.
- Layout details (what treatments selected by farmers and why, what plots or niches used and why).
- Levels of non-experimental variables.

For each describe:

- What variables or indicators will be used?
- Who decides on them and how farmers were involved?
- The weights they should be given in data analysis (perhaps also elicited from farmers).
- The measurement tool (e.g. survival by researcher count, farmer's assessment by questionnaire).
- The measurement unit (plant, plot, farm, village, or other) and sampling scheme.

Describe the monitoring process (e.g. visits to the farmers that do not involve any planned data collection).

8.11 Data management

Describe who will be collecting data. If farmers are doing data collection explain how this will be organized and the training necessary. Describe how and where data will be looked after. How will it be computerized? Who will have access to it? How and where will it be archived?

8.12 Data analysis, reporting and feedback

Describe methods to be used for analysing, interpreting and reporting the data. Describe farmer involvement (including how results will be reported to farmer-collaborators) and when they will visit each others' fields.

9 Implementation plan

9.1 Outputs

List 'hard' outputs (e.g. reports or training manual)

9.2 List of tasks

Include such activities as monitoring and evaluation, reporting and reviewing, things which take time but get forgotten when planning.

9.3 Timing

When are you doing what? A tool that helps managing the list of activities and that combines it with their timing is a Gantt chart . It is useful to prepare a Gantt chart as part of the planning process as well as an aid to the implementation of the trial.

9.4 List of partners/team members

9.5 Roles of all partners

Make it clear exactly who is responsible for what.

9.6 Budget

10 References

11 Version

Keep the protocol up to date, both while it is being revised during planning and when details change during implementation.

Monitoring on-farm trials

By Steven Franzel

Who should take the lead in monitoring on-farm trials, researchers or farmers? We believe that both researcher- and farmer-led on-farm trials are useful and that the issue is not 'which is better' but rather, how the two types of trials could complement each other (see theme paper 4). Certainly, the same argument is true for monitoring on-farm trials. Certain exercises should be led by researchers and others by farmers. We present below a set of possible tools for monitoring on-farm trials, focusing on farmers' assessments since much is already available on biophysical assessments and these may not differ much from on-station trials. The monitoring tools may be divided into two groups: tools which researchers use to elicit farmers' assessments and tools which help farmers to assess and exchange opinions and experiences in on-farm trials. Note that in the latter type of exercise, researchers can also learn a great deal about farmers' assessments. Note also that there is not a strict boundary between the two groups, the 'bao' game, for example, can be usefully used by both researchers and farmers to elicit and exchange information. (Franzel 2001)

The full text of these papers is available on the CD that accompanies this document

Women farmers evaluating trees for firewood using the bao game. Branches of each tree are placed next to a different pocket on the board and the women place 1-5 beads in each pocket (1 = poor and 5 = excellent).

Tools for researchers to elicit farmers' assessments

Ashby JA. 1990. The evaluation interview. p. 47-62. *In*: Ashby JA. *Evaluating Technologies with Farmers: A Handbook*. Cali, Columbia: CIAT publication no. 187. CIAT.

Planning, tools to use, and analyzing data from interviews to elicit individual farmers' assessments of new practices.

Franzel S. Monitoring questionnaire for farmers in a type 2 trial (researcher-designed, farmer-managed). Nairobi: ICRAF.

A simple, brief farmer questionnaire for an on-farm trial to assess farmers' perceptions of the technology they are testing, its management, problems, and related questions.

Franzel S. 2001. Use of an indigenous board game, 'bao', for assessing farmers' preferences among alternative agricultural technologies. pp. 416-424. In: Peters GH and Prabhu Pingali eds. *Tomorrow's Agriculture: Incentives, Institutions, Infrastructure and Innovations.* Proceedings of the 24th International Conference of Agricultural Economists. 13-18 Aug. 2000,Berlin. Ashgate, Aldershot.

Explains the use of an indigenous African board game for getting farmers' evaluations of different alternatives (e.g., crop varieties) across different criteria.

Franzel S. *Monitoring farmers assessments and uptake of a technology following an on-farm trial: the case of Calliandra calothyrsus, a fodder tree in central Kenya.* Nairobi: ICRAF

A case study of assessment methods and results including an informal survey checklist and results, formal survey objectives and questionnaire, and a summary of survey results.

Tools to help farmers assess and exchange opinions

Ashby JA. 1990. Group evaluations. P. 63-77. *In*: Ashby JA. *Evaluating Technologies with Farmers: A Handbook*. Cali, Columbia: CIAT publication no. 187.

Topics covered include advantages and disadvantages of group evaluations, how to set them up, how to moderate them, and recording and reporting group evaluations.

Obonyo OC. 1995. *Report of the group meetings held with farmers in farmer-designed agroforestry tree trials farms of Kisumu, Vihiga, and Siaya Districts.* Maseno: National Agroforestry Research Centre.

This paper reports on farmer meetings held to evaluate the tree species included in on-farm agroforestry trials.

Place F. 1997. *A methodology for a participatory approach to impact assessment: implications from village workshops in Eastern Province, Zambia.* Nairobi: ICRAF.

Describes two village workshops in which farmers expressed their views on the likely impacts of improved fallows, which they were testing, on their farms, in households, and villages, and how these impacts might be monitored.

Toolkit paper 3

Collecting data on labour use in on-farm trials

By Steven Franzel

This note describes four methods for collecting data on labour use in on-farm trials. First each method is described and advantages and disadvantages are listed. Next, some important points common to all the methods are given. Finally, references and data collection forms are listed.

1 Monitoring work rates through observation

This method involves being at the farm and recording the amount of work done, who participated, and the time it took. Alternatively, the farmer or another household member may be asked to record the time taken. The advantage of this method is that the exact time taken to complete the task is known. The disadvantages of this method are that:

- The people generally know their work rate is being measured and they work differently (faster!) than they normally would. If the enumerator records the time the farmers started working and then leaves and comes back later, he/she may be able to reduce the bias involved.

- If the time monitored is less than a normal working day, this method may underestimate the amount of time normally required. For example, if one is monitoring the amount of time taken to weed a 5m x 5m plot in an on-farm trial, farmers would probably work at a faster rate than if they were spending a day or longer weeding a 50m x 50m field.

- The task may have taken much longer or shorter this year than in other years for some reason (e.g. climatic factors: more rainfall meant more weeds, or personal factors: the farmer was ill while doing the task so did not perform effectively). Note that climatic factors will likely affect all respondents; thus data across more than one season may be needed. Personal factors can often be ignored in a large sample because individual cases will not have a great effect on sample distributions.

- The method requires a lot of time unless researchers or technicians need to be at the farm anyway (e.g. to weigh the biomass harvested in a hedgerow intercropping trial). Alternatively, the farmer or another household member may be asked to record labour data.

For an example of the form used in this method, see Annex 1 - Form for monitoring work rates on farmers' fields, Maseno (by S. Franzel and R. Swinkels).

2 Monitoring work rates after each major activity

This method involves asking farmers to remember how much labour was used to complete a specific task. This is best done standing in the field just after the task was completed and asking exactly what was done, who participated, and how long each person was present each day.

This method does not require measuring labour use; therefore much time is saved and the problems noted above concerning measurement bias are not relevant. However, the problems noted above in points 2 and 3 are still problems: the work rate may not be representative because of the size of the plot or because of climatic or personal factors. Also, there are additional problems in using farmer recall; many farmers simply cannot remember how much time they spent on a task. Others may give incorrect answers, biased upward (trying to show you how long they work) or biased downwards (trying to show you how quickly they work).

An example of the form used in this method is Annex 2: Form for monitoring work rates, Chipata, Zambia (by S. Franzel and D. Phiri). The forms used in monitoring work rates through observation and through farmer recall are interchangeable, thus this form could be used in monitoring through observation and the forms presented there could be used when monitoring through farmer recall.

3 Monitoring work rates by visiting the farmer periodically throughout the season

In this method, an enumerator visits the farmer weekly or twice weekly and asks about the time spent working since his/her last visit. We would advise against using this method for collecting labour data. It is extremely labour intensive, requiring much interviewing and analysis time. And besides, two new sources of error are introduced:

1. Enumerator errors. It is likely that you have to hire enumerators in this method whereas researchers or technicians may conduct the work required in the other three methods described here.

2. For any given interview, the farmer may include activities that were already recorded during the previous interview, or forget some activities done since the previous interview.

4 Monitoring work rates using farmers' 'norms'

Farmers may know how long it normally takes to complete a task for a specific unit of area, either a locally used area measure or a field on their own farm. Thus, this method is similar to the recall method above. Instead of asking the respondent to state the amount of time spent conducting the operation, one asks how long it takes to normally conduct the operation, on this field or for a standard measurement of area (e.g. weeding) or quantity (e.g. to thresh a bag of maize). Using farmer norms can reduce the problems mentioned in points 1, 2, and 3 above, of farmers being aware that they are being monitored, of small plot size, and of personal and climatic factors. The disadvantages of this method are that the norm may not reflect reality: that is, farmers may say it normally takes five hours to weed a standard area when it actually takes much longer or shorter. As with monitoring through farmer recall, the farmer may bias his response upward or downward. The same forms presented above can be used here.

Table 1 Comparison of methods for estimating labour use

Method		Effort required	Precision	Bias	Seasonality	Notes
1	Observing farmers	High if researchers observe, and medium if farmer records	High	May be high as farmer is aware (s)he is being monitored	Only relevant for season in question	Observation period should be a normal working day
2	Farmer recall after each major activity	Medium	Medium	Farmer may over- or under-estimate or may not know	Only relevant for season in question	Interview in field after each major activity (e.g. land preperation/ planting, weeding, harvesting) Purposive* sample best
3	Farmer recall periodically during season	Very High	High, but farmer may confuse periods	Farmer may over- or under-estimate or may not know	Only relevant for season in question	Enumerators necessary, so training is needed and they represent a new source of error and bias
4	Farmer norms	Medium	Medium	Same as above	Average across several season	Interview in field after each major activity Purposive* sample best

* A purposive sample is a sample of a farmer

We have used methods 1, 2, and 4 and found that each was a good 'consistency check' on the other.

Table 1 summarizes the advantages and disadvantages of each method. Periodic visits and observation have the highest cost in terms of effort required. As in any field research, researchers have to decide on what they can collect themselves, what their technicians can collect and what exercises require enumerators to be hired. The less researchers are involved, the more concerns of quality and consistency become important.

All methods have potential biases. By testing the various methods, the researchers can decide which method is most appropriate for the situation.

Some other important points for collecting labour data:

1. It is better to keep sample size small (say 10 to 20 farmers) and conduct the interviews yourself than to have a large sample size using an enumerator. Interviews on labour use are highly complex, they require considerable interviewing skills such as probing, performing arithmetic calculations quickly to confirm that responses are reasonable, checking that responses are consistent, and assessing whether the farmer actually remembers the time he/she spent working or is just trying to please you.

2. Use a purposive sample (that is, farmers who you think wil give accurate data) rather than a random sample or a sample of all farmers in the trial. Many farmers will be unable to answer questions about rates of work. It is better to collect data from farmers who you believe, based on your previous interaction with them. Collecting data on labour use from a small number of farmers selected purposively is far better than collecting data from a large number of randomly selected

farmers. The risk when using this method is that your sample of farmers might not be representative of the whole population. Gather information other than labour (e.g. socio-economic variables) about farmers you interview to try to assess whether you are introducing any bias by only interviewing farmers who appear to be able to better remember how much time they spent doing things. The assessment of bias can be done by comparing the characteristics of your sample of farmers with the characteristics of the population they are suppose to represent. For example, if they tend to be high-income, you may need to make an effort to include more low-income farmers in the sample. Notice that through using purposive sampling you will be making a trade-off between the opportunity of collecting good quality information and the risk of collecting that information from a sample that might not be representative.

3. Interview the farmer in the field. This will help him/her remember what was done there. If you are collecting labour data on two plots (e.g. a control plot and a treatment plot), it is better to complete the questions on one plot standing in that plot and then move to the next plot to begin asking questions about the work done there. If you mix questions about different plots you are likely to get confused and confuse the farmer. On the other hand, it is important that you compare labour inputs on control and treatment plots during the interview, in order to ask the farmer about the differences. It may be better to do this at the end of the interview. For example, if you note that less weeding is done on the treatment plot (e.g. a maize plot following an improved fallow) than on the control plot (a continuously cropped maize plot), it may be useful to discuss this with the farmer, both to confirm that it is so and to find out why.

4. Break down questions into the smallest bits possible. When using monitoring work rates using farmer recall, instead of asking how much time did you and your family spend weeding this field, first find out how many weedings were done and the type of labour used (e.g. family, hired, etc). For the first weeding, ask how many days were spent. Then ask about the first day of weeding: who was present on that day, for how long was each person present, and did they take breaks. Then go onto the second day. If hired labour was used, be sure to find out the method of payment (per day, per area worked, etc.). The more you can break down the question, the more accurate the data will be. When asking this type of questions the interviewer and the farmer need to deal with large amounts of information in their heads, the process can be facilitated by using drawings or symbols to help in remembering and visualizing how different bits of information fit together. Using visual aids also helps in the process of crosschecking or triangulating results.

5. Many farmers are unable to answer questions on labour use or give biased answers. During the interview, if you feel that this is the case, then politely end the interview and exclude the farmer from the sample.

6. When reporting data on labour use, always report standard deviations or coefficients of variation in addition to the means (see toolkit paper 4).

7. Whenever possible, use local units of measure. For example, to collect information on labour used in threshing maize, it may be useful to find out the units farmers use (e.g. bags), how much labour is required to thresh a bag of maize, how much the bag weighs, and whether the time spent threshing a bag or weight of a bag varies and why. Similarly, for the norm method, farmers may be able to accurately

estimate the time spent to plough or weed the local unit of measure rather than an acre or a hectare. If you are working in different regions be aware that the same name may be used for units of different sizes in different regions!

8. A useful way to check your data on rates of work is to find out the local wage rate (rate per area covered and/or daily wage rate). If the farmer tells you that it takes three days to complete the task you can ask how much it would cost to hire labour to do it and then check that the amount of labour implied is roughly equivalent to what it would take him/her to do it.

Annex 1: Form for monitoring work rates on farmers' fields, Maseno.

ENUMERATOR:____

FARMER:____________________ GROUP:____________________ DATE:____________________

CROP(S)
- NONE 0
- MAIZE 1
- SORGHUM 2

HEDGE-ROWS
- YES 1
- NO 2

INTERCROPS
- NONE 0
- MAIZE 1
- BEANS 2
- SORGHUM 3

ACTIVITY
- LAND PREP (JEMBE) 1
- LAND PREP (PLOW) 2
- PLANTING CROPS 3
- PLANTING TREES 4
- WEEDING (1ST) 5
- WEEDING (2ND) 6
- WEEDING (3RD) 7
- HARVESTING 8
- CUTTING BACK 9
- OTHER____________________

DETAILS ABOUT ACTIVITY

____

____

____

____

____

____

____

____

PERSONS INVOLVED AND TIME SPENT

	PERSON 1	PERSON 2	PERSON 3	PERSON 4
Male farmer	1	1	1	1
Female farmer	2	2	2	2
Other male >14	3	3	3	3
Other female >14	4	4	4	4
Children <14	5	5	5	5
Hired labour male	6	6	6	6
Hired female	7	7	7	7
Other	8	8	8	8
Time started				
Time stopped for break				
Time work started again				
Time finished				
Total hours worked (fill later)				

AREA COVERED: (SKETCH AND SHOW NUMBER OF PACES FOR EACH SIDE OF FIELD)

WAS ENUMERATOR PRESENT AT START OF WORK?____________________

AT FINISH OF WORK?________________

IF ABSENT AT ONE OF THESE, EXPLAIN HOW YOU GOT THE DATA?

____

____

____

IF HIRED LABOR, HOW ARE THEY PAID?

QNA (Question not applicable)	0		
WAGE/DAY	1	RATE	____/DAY
CONTRACT	2	RATE	____/AREA (SKETCH AND SHOW NUMBER OF PACES)

TIME TAKEN PER AREA TODAY COMPARED TO AVERAGE FOR THIS ACTIVITY:

	ENUMERATOR'S VIEW	FARMER'S VIEW
NOT ANSWERED	0	0
HIGHER THAN AVERAGE	1	1
SAME AS AVERAGE	2	2
LESS THAN AVERAGE	3	3

REASON/COMMENTS____

____

Annex 2: Form for monitoring work rates, Chipata.

Enumerator:______________________ Date__________ Season_________

Farmer:________________ Camp:______________ Village __________

Sesbania	Tephrosia	Cajanus		Pure stand	Intercrop with maize		Seedling	Direct seed
1	2	3		1	2		1	2

Activity

Land prep (hoe)	1
Land prep (plow)	2
Planting maize	3
Planting trees	4
Weeding Maize (1st)	5
Weeding Maize (2nd)	6
Ridging	7
Weeding trees(1st)	8
Weeding trees(2nd)	9
Harvesting	10
Cutting trees	11
Other ________________	

Was time taken more or less than normal?

More than normal	1
Less than normal	2
About normal	3

Reason

____

____

____

Persons involved and time spent

	Person 1	Person 2	Person 3	Person 4	Person 5
Male adult > 14	1	1	1	1	1
Female adult >14	2	2	2	2	2
Children < 14	3	3	3	3	3
Hired labour	4	4	4	4	4
Day 1					
time started					
time on break					
time finished					
Subtotal					
Day 2					
time started					
time on break					
time finished					
Subtotal					
Day 3					
time started					
time on break					
time finished					
Subtotal					
Total (do later)					

If hired labour, how paid?__________________Plot size__________

Toolkit paper 4

Assessing risk in on-farm trials

By Richard Coe

Introduction

'Risk' refers to the uncertainty faced by farmers when they take a farming decision. For example, a farmer deciding to plant 1 ha of maize this season faces all sorts of uncertainties: (s)he does not know when the rains will start, does not know how large the weed problem will be, does not know if there will be an army worm outbreak, does not know if the rains will end at the appropriate time, does not know what the price for maize next harvest will be, does not know how that will change through the year, and so on.

It is often hoped that new technologies will reduce the risks faced by farmers. An aim of research is therefore to determine if this is actually the case.

On-farm trials may provide evidence about some risks, and choices made during design can determine what sort of evidence is available.

Assessing risk

The topic uses the following example. An on-farm trial in Malawi involved comparison of intercropping gliricidia and maize with maize monocropping. Nearly 40 farmers were involved. The results for 3 seasons are shown in the table below.

Season	95/6	96/7	97/8
mean yield increase (gliricidia - monocrop) t ha^{-1}	-0.1	0.0	1.0
standard error of mean increase	0.13	0.10	0.15

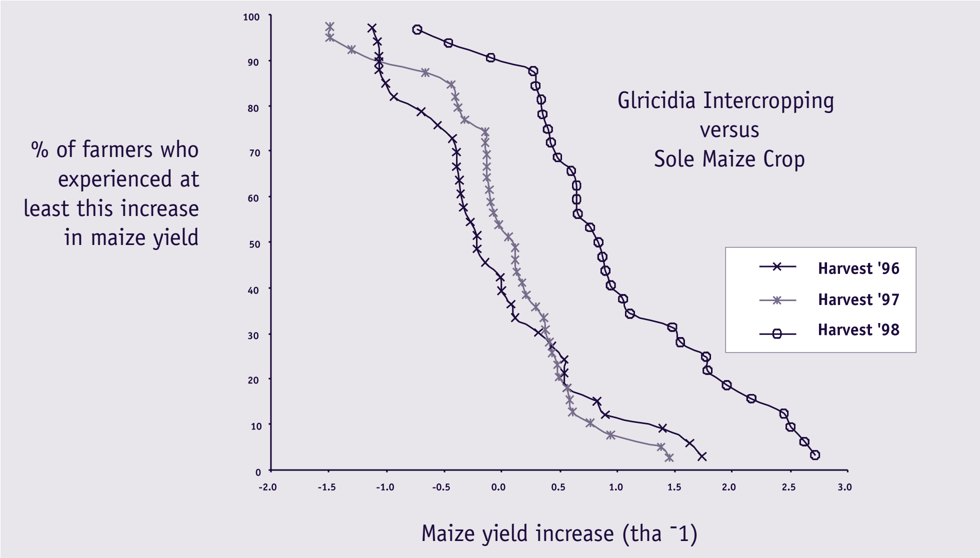
It is clear that there is no increase in yield, averaged across farmers, in the first two seasons, but there is in the third. This table is typical of the reporting of much of the research. It is used to illustrate two aspects of risk: the variation between individuals and climate-induced variation between years.

First, farmers are not averages! A farmer probably does not really care what the average increase across a large population is. Instead (s)he is concerned with the effect of changing system on his/her own production. The figure below illustrates the variation between individual farmers. In each season some farmers saw an increase, some higher than 1.5 t ha^{-1}, but, others saw a decrease.

This variability can be interpreted as a risk if we think of a farmer now deciding whether or not to use the new technology. Without further information the farmer does not know where (s)he will fall in this range of outcomes.

During the design of a trial, a larger sample size (number of farmers) will be needed when the aim is to look at variation than when the aim is just to compare means. The rarer the event we are looking for (such as the large positive or negative change in yield), the larger the sample needed to detect it.

On-farm trials around Makoka, Malawi



The analysis above assumes we know nothing more about the farmers. However, we may have some ideas of why some farmers see a larger increase than others. These might be ideas we have before the trial starts (e.g. the hypothesis that gliricidia will only benefit maize production in valley fields, not on hill sides) or become aware of during the trial (late weeding seems to reduce the benefits of the trees). In either case we can measure the quantity that might be important (slope or weed infestation level) and then determine the extent to which the variation is due to this.

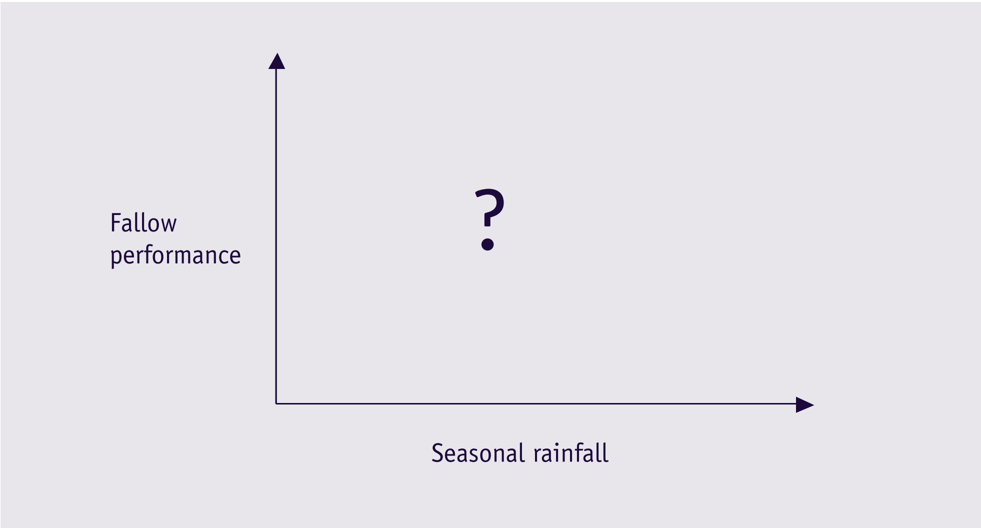
The result is potentially a reduction in the risk to farmers. Rather than saying 'This technology will give you a mean increase in yield of 1 tha^{-1} with a range of -0.5 to +2.5', we can say something like 'If on a hill side, this technology can give an increase between -0.5 and 1.5'. In the valley fields it can give an increase between 0.5 and 2.5 tha^{-1}.

Note that if, at the stage of designing the trial, there are factors we suspect are contributing to risk (such as valley/hillside) we can improve the trial by being sure to include plenty of farms of both types.

Climatic risk

The weather is one of the biggest sources of risk to farmers. Reducing this risk does not mean making the weather less variable from year to year, but making farming less sensitive to it.

It is easy to calculate the risk of various weather patterns. For example, we can simply find the risk of less than 600mm of rain in a growing season. Take the weather record for say the last 40 years. Count how many of those years had less than 600mm. Write this as a % of 40. The same method can be used for the chance of a long dry spell following planting, the chance of a late start to the rains, or any other weather event.



Now if we know the relationship between the weather event of interest and the technology performance, we can talk about risk or chances associated with it. Suppose we know the line to draw on the graph above. For any level of seasonal rainfall we can find the level of fallow performance. We can also find the chance of exceeding that rainfall, and hence the chance that fallow exceeds that level of performance.

The unknowns in the analysis are two: which weather events are important for the performance of a technology (e.g. seasonal rainfall in the graph above), and how the weather actually affects that technology (e.g. the line to draw on the graph above). We could try to take data as in the table, and look for a relationship between the yield increase each year and a weather event such as seasonal rainfall. The problem is that we have very few points from which to estimate a relationship, or determine exactly which weather event is critical. In the example there are only 3 such points. If the study area is large enough, so that sites experience very different weather, it may be possible to substitute different locations for different years and hence obtain more points in that way.

An alternative approach to climate risk involves modelling. If we can find a model that describes the relationship between weather and the performance of a technology it is again easy to estimate risks.

The minimum we can do is add both some weather data and associated risks to the table when reporting the data:

Season	95/6	96/7	97/8
mean yield increase (Gliricidia - monocrop) t ha^{-1}	-0.10	0.0	1.0
standard error of mean increase	0.13	0.10	0.15
Seasonal rainfall (mm)			
Chance of that rainfall being exceeded			

Economic risk

The situation is similar for economic risk. For example, the profitability of a practice depends on costs and prices which can change. There are again two steps to consider:

- the chance of a change (e.g. in fertilizer price) and

- the effect of the change.

The chance of a change is probably best estimated using expert opinion. A more sophisticated approach might link say maize production with rainfall, and hence link a rainfall risk to a price change risk. However, this type of analysis is beyond the scope of many researchers.

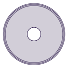
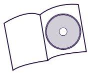
The effect of a change can be estimated simply through sensitivity analysis. Any of the figures in a profitability analysis can be changed and the effect on the overall profitability noted. For example, the effects of changes in discount rates, and prices of inputs and outputs can be tested in sensitivity analysis. Again there are more sophisticated approaches that involve modelling the various feedbacks and interrelationships between all the quantities. Note that the uncertainty in any of the inputs to a profitability analysis (e.g. the variation in labour use between farms) can be used in the sensitivity analysis (see toolkit paper 3).

Conclusions

The overall message is that variation should be highlighted, not hidden when reporting. The processes we are dealing with (biological, economic, social) are complex. While we try to draw simple general messages from the data, we also need to be explicit about the uncertainty and variation it displays.

Recommended reading

This structured list of key references on designing participatory on-farm experiments has been compiled by the authors and training workshop resource persons with the view of providing useful additional materials to support the training. A brief summary as well as information on how to obtain the publication has been included for all references of this list.

Documents marked with a  are available in electronic form on the CD-ROM with permission of the authors. Others, marked with a  are included in the CD-ROM and are also mentioned as 'toolkit papers' in this document.

General references on participatory technology development

Barahona C, Levy S. 2002. *How to generate statistics and influence policy using participatory methods in research.* Reading: Statistical Services Centre.

Can be obtained from www.reading.ac.uk/ssc

This paper describes how rigour can be added to participatory enquiries so that resulting data stand up to scrutiny and criticism.

Bellon MR and Reeves J eds. 2002. *Quantitative analysis of data from participatory methods in plant breeding.* Mexico, DF, Mexico. 143 pp.

Obtain from cimmyt@cgiar.org

Contains useful articles on quantifying farmer evaluations, 'mother-baby' trials, analysing ranking and rating data and identifying farmers' preferences.

Coe R. 1998. Participatory on-farm experimentation in agroforestry: experiences and the role of biometrics. Invited paper presented a the XIXth International Biometric Conference, Cape Town, South Africa, 14-18 December 1998. Nairobi: ICRAF.

This paper argues that in most cases, new methods for design and analysis in participatory agroforestry experimentation are not needed; rather, well established ideas and methods are available but are often not used.

Coe R. (compiler) 1999. Checklist for protocols for experiments with farmers. Prepared by participants of a workshop on participatory experimentation, African Highlands Initiative. Nairobi, 28 June - 3 July 1999. Nairobi: ICRAF.

Trials with farmers require considerable planning and available checklists of topics for on-station trials are not adequate for planning trials with farmers. This checklist provides details on what should be considered in background and justification, objectives, methods and implementation plan.

Coe R and Franzel S. 2000. Proceedings of the workshop, Designing Participatory On-Farm Experiments. Chipata, Zambia, 15-19 November, 1999. Nairobi: ICRAF. 70 pp.

The objectives of the workshop were to provide training and exchange of experiences in planning, implementing, and evaluating participatory on-farm experiments; to review on-farm research, assess gaps and develop proposals for four southern Africa sites; and to present methods for taking into account gender, risk and labor scarcity in designing on-farm experiments.

Franzel S, Coe R, Cooper P, Place F and Scherr SJ. 2001. Assessing the adoption potential of agroforestry practices in subsaharan Africa. *Agricultural Systems* Vol. 69: 37-62.

This paper outlines ICRAF's approach to assessing the feasibility, profitability, and acceptability of agroforestry practices. Includes discussion of types of on-farm trials and methods for assessing adoption potential and defining the boundary conditions of practices.

Franzel S and Scherr SJ eds. 2002. *Trees on the Farm: Assessing the Adoption Potential of Agroforestry Practices in Africa.* Wallingford, UK: CABI.

Can be obtained from www.amazon.com

Includes 5 case studies on participatory methods of assessing adoption potential of four practices: hedgerow intercropping, improved fallows, fodder trees, and boundary plantings of trees for timber. Also includes chapters on methods for assessing adoption potential and policy lessons from on-farm research.

Haverkort B, van der Kamp J and Waters-Bayer A. 1991. *Joining farmers' experiments. Experiences in participatory technology development.* London: Intermediate Technology Publications.

Order from www.itdgpublishing.org.uk

Includes many case studies of researchers and farmers experimenting together.

Hildebrand PE and Russell JT. 1996. *Adaptability analysis. A method for the design, analysis and interpretation of on-farm research-extension*. Ames, Iowa: Iowa State University Press. 188 pp.

Can be obtained from www.isupress.edu

Explains a method and case studies for evaluating performance of agricultural technologies under multiple biophysical and socio-economic circumstances and for identifying their adaptability to particular environments. Co-authored by an economist and an agronomist.

Okali C, Sumberg J and Farrington J. 1994. *Farmer Participatory Research: Rhetoric and reality.* London: Intermediate Technology Publications. 159 pp.

Obtain from www.itdgpublishing.org.uk

This book provides a useful overview of how farmer participatory research is being used in a broad range of research and development programs. Chapters include 'An Introduction to Farmer Participatory Research', 'Associated themes and concepts', 'Farmer participatory research in practice', 'Key implementation issues', 'Analysis of current trends and practice', 'Monitoring and evaluation', and 'Linking evaluation indicators to project design'.

Rudebjer PG. 2001. *Training course on participatory on-farm experimentation and integrated approaches to land management. Bandar Lampung and Kutabumi, Indonesia, 17-23 November 2000.* Bogor, Indonesia: ICRAF. 68 pp.

Describes a workshop to help participants to plan and implement participatory on-farm experiments to develop technology innovations, in the context of integrated approaches to land use change, including policy and institutional changes.

Stroud A. 1993. Conducting on-farm experiments. Cali, Columbia: CIAT. 118 pp.

Available from ciat@cgiar.org (CIAT, Apartado Aereo 6713 Cali, Columbia)

This manual focuses on researcher-designed, farmer-managed trials. Chapter headings include: planning an on-farm experiment program, designing on-farm experiments, trial management decisions, implementing experiments, and data collection. There are many practical examples of problems encountered in on-farm trials and how to solve them.

van Veldhuizen L, Waters-Bayer A and de Zeeuw H. 1997. Developing technologies with farmers: A trainer's guide for participatory learning. London: Zed Books. 230 pp.

Obtain from www.zedbooks.demon.co.uk

Chapters include basic orientation and skills, towards an agenda for action, farmers' experimentation, spreading the participatory technology development process, and references, resources and contacts.

Werner J. 1993. *Participatory development of agricultural innovations: Procedures and methods of on-farm research.* Eschborn, Germany: GTZ. 251 pp.

For copies write to TZ-Verlagsgesellschaft mbH Postfach 1164, 64373 Robdorf, Germany.

Chapters include: principles and procedures of on-farm research, communication with farmers, data collection, experimentation, and tools and methods for data analysis and presentation.

Methods and applications of methods

Farmer participation in selecting treatments for on-farm trials

Franzel S, Hitimana L and Akyeampong E. 1995. Farmer participation in on-station tree species selection for agroforestry: a case study from Burundi. *Experimental Agriculture*, 31:27-38.

An example of farmers using simple, quantitative methods to decide which trees, among trees in an on-station screening trial, they prefer to plant on their farms.

Roothaert R and Franzel S. 2001. Farmers' preferences and use of local fodder trees and shrubs in Kenya. *Agroforestry Systems* 52:3: 239-252.

This paper reports on a survey in which farmers explained their preferences among indigenous fodder trees, ranked them in importance and selected species that they wanted to test in on-farm trials.

Farmer and site selection

Gedeno Gemechu. 1986. Selecting representative farmers and sites for on-farm experiments. *Farming Systems Newsletter No. 27.* Nairobi: CIMMYT. 6 pp.

Discusses problems, their causes and possible solutions in selecting farmers and sites.

Guinand Y. 1996. *A method to help select farmers for on-farm agroforestry trials, based on wealth ranking*. AFRENA Report no. 102. Nairobi: ICRAF 32 pp.

A practical set of guidelines for defining the wealth categories (income groups) among farmers in an area. You can learn about the wealth status of farmers you are working with in on-farm trials and how representative they are of the community. The method is also useful for selecting farmers for on-farm trials from the categories you are interested in targeting.

Sutherland AJ. 1986. Managing bias: Farmer selection for on-farm research. *Farming Systems Newsletter No. 26.* Nairobi: CIMMYT. 18 pp.

Looks at farmer selection at various stages of the research sequence: surveys and trials.

Farmer assessment: guidelines and methods

Ashby JA. 1990. *Evaluating technology with farmers: A handbook.* CIAT Publication no. 187. Cali, Columbia: CIAT. 95 pp.

Available from ciat@cgiar.org CIAT, Apartado Aereo 6713, Cali, Columbia.

Chapters include: when to conduct farmer evaluations, social dynamics of farmer evaluations, establishing a collegiate working relationship with farmers, communication skills, farmer selection, setting up farmer evaluations, the evaluation interview, and group evaluations. Very useful guidelines on farmer assessment.

CIMMYT Economics Program. 1993.*The adoption of agricultural technology: A guide for survey design.* Mexico: CIMMYT.

Obtain from cimmyt@cgiar.org CIMMYT, Apdo. Postal 6-641, Mexico 6 DF, Mexico 88 pp.

A good source of information on collecting data on farmer assessment in on-farm trials. Presents many examples of how to present survey data. Chapters include: adoption studies, measuring adoption, understanding adoption, survey organization, and methods for analysing adoption patterns.

Franzel S and JK Ndufa. 1994. Guidelines for conducting farmer-designed multipurpose tree trials. Draft. Nairobi: ICRAF. 9 pp.

Discusses objectives, farmer and species selection, planting, monitoring and evaluation, and examples of results.

Franzel S. 1996. *Developing a questionnaire for a formal survey of rural households.* Nairobi: ICRAF 18 pp.

Explains the steps to take in developing a questionnaire. The last thing to do (not the first!) is to draw up questions to ask! Before this you need to clearly state your objectives, the hypotheses you want to test, and the information required to meet your objectives and test your hypotheses. Only then it is time to draw up your questions and show how each contributes directly to your objectives.

Franzel S. 2001. Use of an indigenous board game, 'bao', for assessing farmers' preferences among alternative agricultural technologies. p 416-424. *In:* Peters GH and Prabhu Pingali eds. *Tomorrow's Agriculture: Incentives, Institutions, Infrastructure and Innovations.* Proceedings of the 24th International Conference of Agricultural Economists. 13-18 Aug. 2000,Berlin. Ashgate, Aldershot.

Explains the use of an indigenous African board game for obtaining farmers' evaluations of different alternatives (e.g. tree species) across criteria selected by farmers. The method combines the strengths of matrix ranking/scoring from the participatory research literature and statistical analysis for improving the quality of research and drawing inferences.

Franzel S. Monitoring questionnaire for farmers in a type 2 trial (researcher-designed, farmer-managed). Nairobi: ICRAF.

A simple, brief farmer questionnaire in an on-farm trial to assess farmers' perceptions of the technology they are testing, management, problems, and questions.

Franzel S. Example of a survey to assess adoption following an on-farm trial: the case of Calliandra calothyrsus, a fodder tree in central Kenya. Nairobi: ICRAF.

A case study of assessment methods and results including informal survey checklist and results, formal survey objectives and questionnaire, and summary of survey results.

Gladwin CH. 1989. *Ethnographic decision tree modelling. Qualitative Research Methods Series 19*, Newbury Park, USA: Sage Publications. 90 pp.

Obtain from: Sage Publications, 2455 Teller Road, Newbury Park CA, USA.

Whereas econometric models explain how farm and household variables influence adoption, decision tree modeling examines the actual cognitive decision that farmers make in deciding whether to use a technology.

Guerrero MP, Ashby J and Gracia T. 1993. Farmer evaluations of technology: preference ranking. CIAT Publication no. 212. Cali, Columbia: CIAT. 129 pp.

Obtain from CIAT (ciat@cgiar.org) Apartado Aereo 6713, Cali, Columbia.

Discusses different methods for farmers to use in assessing alternatives. Includes discussion of matrix ranking.

Heinrich GM. 1992. *Strengthening farmer participation through groups: Experiences and lessons from Botswana.* On-Farm Client-Oriented Research Discussion Paper No. 3. ISNAR. 31 pp.

Available from isnar@cgiar.org

Examines the formation of farmer research groups for planning and conducting on-farm research. Chapters include group operations and outputs, benefits of the group approach, and management issues.

Quiros CA, Gracia T and Ashby J. 1991. *Farmer evaluations of technology: Methodology for open-ended evaluation*. Instructional Unit No. 1. Cali, Columbia: CIAT. 91 pp.

Obtain from CIAT (ciat@cgiar.org) Apartado Aereo 6713, Cali, Columbia.

Chapters include: the open-ended evaluation, formulating questions, establishing neutrality and clarifying expectations, compiling information, and planting farmer evaluations. Includes training exercises.

Walters BB, Cadelina A, Cardano A and Visitacion E. 1999. Community history and rural development: why some farmers participate more readily than others. *Agricultural Systems* 59 (1999) 193-214.

Most adoption studies focus on characteristics of individual farm households or farms; this study focuses on characteristics of villages in Philippines which influence why some villages participate in development activities more readily than others. Includes a useful checklist of general questions to guide investigation of a village's history and how that history may influence adoption.

Economic assessment: guidelines and methods

CIMMYT. 1988. *From agronomic data to farmer recommendations. An economics training manual.* El Batan, México: CIMMYT Economics Program.79 pp.

Obtain from cimmyt@cgiar.org CIMMYT, Apdo. Postal 6-641, Mexico 6 DF, Mexico.

Written especially for non-economists, this document has lots of practical advice for determining costs and valuing benefits in economic analyses of technology. Focuses on the partial budgeting approach.

Swinkels R, Franzel S & Shepherd K. 1994. *Economic analysis of on-farm improved fallows in western Kenya. ICRAF Training Note: Case study handout.* Nairobi: ICRAF. 13 pp.

Spells out in considerable detail how to do an economic analysis on improved fallows and where all the data come from.

Collecting labour data

Collinson MP. 1986. Collecting information on rates of work. *Farming Systems Newsletter No. 24 & 25.* Nairobi: CIMMYT.

Topics include productivity of seasonal labour, problems collecting labour data, farmer estimates of labour requirements, surveys, and work study on trial plots.

Franzel S. 1997. *Collecting data on labour use in on-farm trials.* Nairobi: ICRAF 8pp.

Evaluates different methods of collecting labour data and includes several data forms.

Spencer DSC. 1993. Collecting meaningful data on labour use in on-farm trials. *Experimental Agriculture* 29:39-46.

This article focuses on the effects of memory bias and the effects of plot size on the accuracy of data collected in labour use in on-farm trials.

Methodology notes (These are one-page descriptions of a particular method.)

- Degrande A. 1999.Assessing farmers' evaluations of agroforestry practices using coloured cards. Cameroon: ICRAF.

- Degrande A. 1999. Monitoring farmers' adaptation of technologies and options for using the information. Cameroon: ICRAF.

- Degrande A. 1999 What has gone wrong? Removing sites from analysis in on-farm trials. Cameroon: ICRAF.

- Phiri D and S Franzel. 1999. Where are your on-farm trials? Example of a chart showing biophysical and socioeconomic features of different areas where on-farm trials are located. Nairobi: ICRAF.

Reports on on-farm trials and on adoption and impact following the completion of the trial (B denotes biophysical analysis, E denotes economic analysis, F denotes farmer assessment, and G, gender analysis)

Darnhofer I. 1996. Ethnographic decision modelling of the adoption of Tagasaste, a fodder tree, and oats-vetch among farmers in the highlands of Ethiopia. Draft paper. 47 pp.

This paper provides an example of the use of decision trees in modelling the adoption process. F

David S and Soniia. 1995. What do farmers think? Farmer evaluations of hedgerow intercropping under semi-arid conditions. *Agroforestry Systems* 32: 15-28.

The author, a sociologist, examines farmers' perceptions of impact, management, and the potential for adoption of hedgerow intercropping in an area of Machakos District, Kenya. F

Degrande A. 1999. Farmer assessment and economic evaluation of shrub fallows in the humid lowlands of Cameroon. *Agroforestry Systems* 53: 11-19, 2001.

Assesses farmers' testing and expansion of improved fallows using *Cajanus cajan*. Economic analysis and farmers' assessment are very positive; wider dissemination requires a targeted extension approach and an effective strategy for seed supply. B,E,F,G

De Wolf J and Rommelse R. 2000. Improved fallow technology in western Kenya: Potential and reception by farmers.

Assesses the biophysical performance, feasibility, profitability and acceptability of improved fallows by farmers in western Kenya. Draws on data from on-farm trials and the monitoring of 2035 households in a pilot production project. B,E,F,G

Franzel S, Ndufa, JK and Obonyo C. 1996. Farmer-designed agroforestry tree trials: Farmers' experiences in Western Kenya. pp.111-24. *In:* Franzel S and Scherr SJ eds. *Trees on the Farm: Assessing the Adoption Potential of Agroforestry Practices in Africa.* Wallingford, UK: CABI.

This paper describes the results of a farmer-designed tree trial and has examples of the kinds of qualitative and quantitative analyses that can be conducted in type 3 trials. B,F,G

Franzel S, Arimi H and Murithi, F. 2002. *Calliandra calothyrsus*: Assessing the early stages of adoption of a fodder tree in the highlands of central Kenya. pp. 125-144. *In:* Franzel S and Scherr SJ eds. *Trees on the Farm: Assessing the Adoption Potential of Agroforestry Practices in Africa.* Wallingford, UK: CABI.

Assesses uptake of calliandra by farmers who had hosted calliandra on-farm trials. E, F

Franzel S, Phiri D and Kwesiga FR. 2002. Assessing the adoption potential of improved tree fallows in Eastern Zambia. pp. 37-64. *In:* Franzel S and Scherr SJ eds. *Trees on the Farm: Assessing the Adoption Potential of Agroforestry Practices in Africa.* Wallingford, UK: CABI.

Describes the different types of on-farm trials being conducted on improved fallows and assesses the practice's feasibility, profitability, and acceptability. The paper also includes a section on an adaptive research and dissemination network composed of researchers, NGOs, extension services and farmer groups. B,E,F,G

Fujisaka S. 1993. A case of farmer adaptation and adoption of contour hedgerows for soil conservation. *Experimental Agriculture* 29:97-105.

This case study from the Philippines includes biophysical assessments, analysis of labor use, and assessments from farmers who were familiar with the technology but did not adopt. B, F

Fujisaka S, Jayson E and Dapusala, A. 1994. Trees, grasses, and weeds: species choices in farmer-developed contour hedgerows. *Agroforestry Systems* 25:13-22.

A case study from the Philippines. Includes farmer evaluations and use of a decision tree. F

Guinand Y. 1996. Impact assessment study of Two Wings Agroforestry Groups, Kabale District, Uganda. Afrena Report No. 101. Nairobi. 33 pp.

Not an impact assessment per se but examines tree planting, niches, and management by different wealth groups, gender, and household types. F,G

Keil A. 2001. Improved Fallows using Leguminous Trees in Eastern Zambia: Do initial testers adopt the technology? MSc Thesis. Faculty of Agriculture, Institute of Rural Development, Goettingen, Germany: Georg-August University.

Examines the experiences of 100 early testers of improved fallows, 3-6 years after they started planting them. Topics examined include farmers' management practices, degree of expansion in use of improved fallows, factors affecting expansion, and the association between expansion, innovations and wealth group, F,G

Kwesiga FR, Franzel S, Place F, Phiri D and Simwanza, C.P. 1999. *Sesbania sesban* improved fallows in eastern Zambia: their inception, development, and farmer enthusiasm. *Agroforestry Systems* 47, 49-66.

Examines the development of improved fallow practices in eastern Zambia which are now being planted by over twenty-thousand farmers. B,E,F

Negassa A, Tolessa B, Franzel S, Gedeno G and Dadi L. 1991. The introduction of an early maturing maize variety to a mid-altitude farming system in Ethiopia, *Experimental Agriculture* 27: 4, 375-383.

Compares the results from researcher-designed and farmer-designed trials for the same technology.

Obonyo E. 2000. The adoption potential of biomass transfer technology in western Kenya. Draft MSc thesis. Kumasi, Ghana: University of Science and Technology.

Assesses farmers' experiences using biomass transfer, that is, application of leaves of *Tithonia diversifolia*, a common hedge species in western Kenya, to improve soil fertility. The thesis compares uptake of farmers working with researchers to those who learn about the technology from extension staff. Wealth ranking is also conducted to assess uptake by different wealth groups. F,G

Obonyo OC. 1995. Report of group meetings held with farmer designed agroforestry tree trial farmers of Kisumu, Vihiga, and Siaya Districts, Kenya. National Agroforestry Research Station, Maseno. 10 pp.

Reports on farmer meetings held to evaluate tree species included in the trials. F.

Peterson JS. 1999. Kubweletza Nthaka: *Decision trees and improved fallows in the Eastern Province of Zambia.* University of Florida/ICRAF.

This paper models and explains the decisions that male and female farmers make in deciding whether to plant improved tree fallows. While both males and females are actively planting improved fallows, their reasons for participating and not participating are somewhat different. F,G

Phiri D, Franzel S, Mafongoya P, Jere I, Katanga R and Phiri S. 2002. Who is using the new technology? A case study of the association of wealth status and gender with the planting of improved tree fallows in Eastern Province, Zambia. Agricultural Systems (in press).

Describes a wealth ranking exercise in which community members identify the different wealth groups in their communities and determine each household's wealth status. Both women and men were found to be planting improved fallows in similar proportions. There was a strong association between wealth and planting improved fallows but substantial numbers of poor households were planting them. F,G

Pisanelli A, Franzel S, De Wolf J, Rommelse R and Poole J. 2002. The adoption of improved tree fallows in western Kenya: farmer practices, knowledge, and perception. Submitted to Agroforestry Systems.

This paper traces the experiences and views of farmers who first tested improved fallows in 1997 over a three season period during 1998-1999. Farmers used the bao game, a form of matrix ranking, to assess preferences among different types of benefits and among different improved fallow species. Factors affecting adoption are also assessed. F,G

Place F. 1997. *A methodology for a participatory approach to impact assessment: implications from village workshops in Eastern Province, Zambia*. Nairobi: ICRAF.

Describes two village workshops in which farmers expressed their views on the likely impacts of improved fallows on their farms, households, and villages, and how these impacts might be monitored.

Ramadhani T, Otsyina R and Franzel S, 2002. Improving household incomes and reducing deforestation; the example of rotational woodlots in Tabora District, Tanzania. *Agriculture, Ecosystems, and the Environment*. 89/3 pp. 227-237.

Assesses the uptake of woodlots by tobacco farmers to meet their fuelwood needs and improve soil fertility. Estimates are made of the forest area saved by growing woodlots instead of purchasing wood from the forest. B,E,F

Swinkels R and Franzel S. 1997. Adoption potential of hedge-row intercropping in the maize-based cropping systems of the highlands of Western Kenya. Part II: Economic and farmers' evaluation. *Experimental Agriculture*, 33: 211-223. 1997.

Includes enterprise budget, decision tree, and assessment of feasibility, acceptability and profitability E,F,G

Swinkels R, Franzel S, Shepherd K, Ohlsson E and Ndufa J. 1997. The economics of short rotation improved fallows: evidence from areas of high population density in western Kenya. 21 pp. *Agricultural Systems*, 55: 99-121.

Includes results of a researcher/farmer-designed, farmer-managed improved fallow trial and enterprise budget. B,E

Tefera A, Rao MR, Mathuva MN and Atta-Krah K. 2001. Farmer-participatory evaluation of *Grevillea robusta* in boundary plantings in semi-arid Kenya. *Forests, Trees and Livelihoods Journal*, 2001, Vol. 11 13-27.

Good example of integration of biophysical, economic, and farmer assessment in an on-farm trial. Assesses a farmer-designed trial in the Machakos area including farmer expansion following the trial. B, E, F

Institutionalizing participatory on-farm trials

Ashby J, Gracia T, Guerrero M, Quiros C, Roa J and Beltran J. 1995. *Institutionalizing Farmer Participation in Adaptive Technology Testing* with the 'CIAL' Overseas Development Institute Network Paper No. 57, July 1995.

Obtain from ODI, their email is agren@odi.org.uk

Describes the participatory approach of the CIAT Hillsides Program. They assist farmer groups to conduct their own trials, so that the groups can then develop recommendations for their members and communities.

Ashby J and Sperling L. 1995. Institutionalizing participatory, client-driven research and technology development in agriculture. *Development and Change* 26:4: 753-770.

Main issues discussed include creating a client-driven agenda, decentralizing technology development, developing farmer capacity to lead adaptive research testing, and accountability sharing.

World Agroforestry Centre

TRANSFORMING LIVES AND LANDSCAPES