Manual
for Collaborative Research with Smallholder Coffee Farmers

What we learned from the CFC/IPM coffee project (ICO/02)

Jeffery W. Bentley
Peter S. Baker

With
Luis Fernando Aristizábal, Oscar Campos,
William Chilán, Armando García, Raúl Muñoz,
Ramón Jarquín, Alberto Larco, Carlos Gonzalo Mejía, Mauricio Salazar.

CABI *Commodities*
Egham, Surrey
TW20 9TY
UK

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CREDITS

EDITORIAL COORDINATION
Héctor Fabio Ospina O.

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Carmenza Bacca Ramírez

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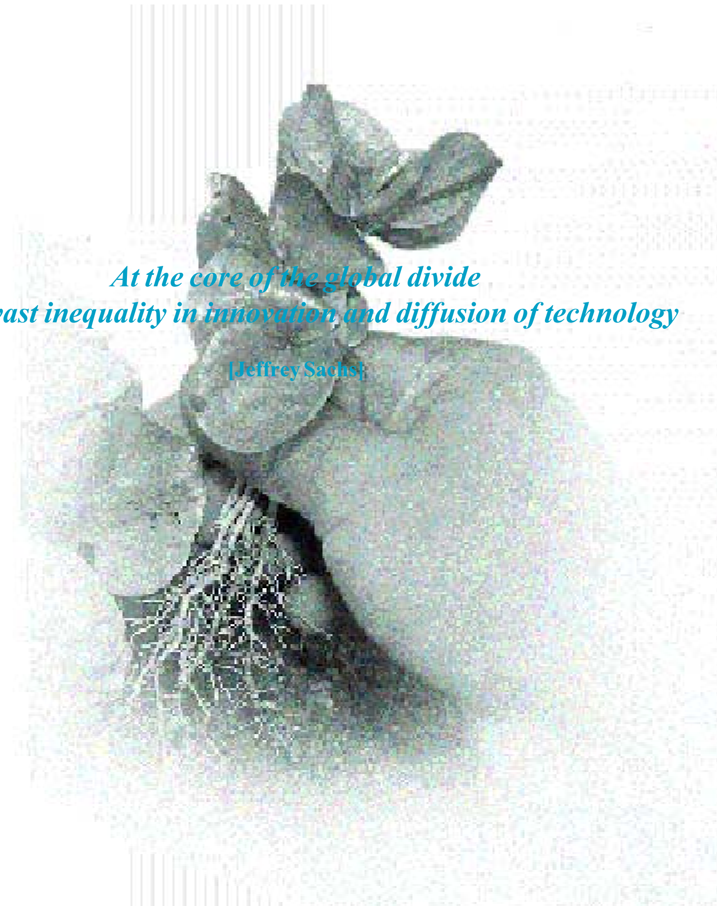

At the core of the global divide
is the vast inequality in innovation and diffusion of technology

[Jeffrey Sachs]

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FOREWORD

"…key ingredients in a successful development strategy are *ownership* and *participation*. We have seen again and again that ownership is essential for successful transformation: policies that are imposed from outside may be grudgingly accepted on a superficial basis, but will rarely be implemented as intended. But to achieve the desired ownership and transformation, the process that leads to that strategy must be participatory."

Joseph E. Stiglitz, *Towards a New Paradigm for Development: Strategies, Policies, and Processes* [The Prebisch Lecture, 1998]

This manual stemmed from the CFC-funded Integrated Management of Coffee Berry Borer project, ICO/02 (1998-2002). The aim of the project was to develop cost-effective and environmentally friendly ways of controlling the world's most serious pest of coffee, which would be useful to smallholder farmers, who supply the majority of the world's coffee.

But new methods, however well intentioned, are no use if they are not adopted. Over the last part of the 20th century, scientists and development experts became increasingly worried that much technology was not being adopted by the rural poor, and came to the conclusion that a principal reason was lack of understanding of the farmer's perspective, his problems and his capabilities. From this sprang new ways of working with farmers to ensure enhanced uptake; these methods can be broadly referred to as "participatory".

It is our contention that these developments have largely by-passed the coffee industry and because of the secular, global change that has struck it in recent years, this approach must now be more widely understood and assayed.

It is the purpose of this manual therefore, to explain some of the principles and practices to those who are interested in improving the situation of smallholder coffee farmers. We warmly thank the Common Fund for Commodities for allowing us to use their funds to produce this volume.

Jeffery Bentley & Peter Baker, April 2002

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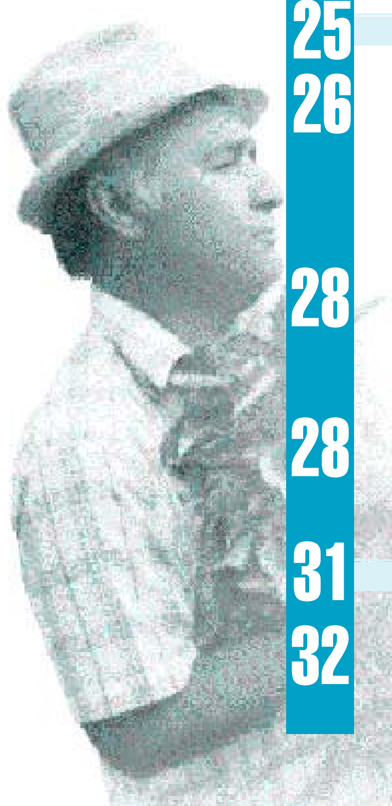

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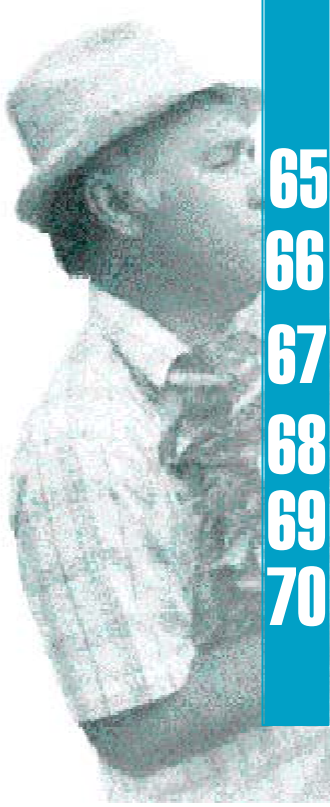

Chapter 1

PART I

An Introduction

"Less obvious than the economic and political significance of the industry is its impact on scholarship. Intellectual traditions have been born from the study of coffee; some have been overturned by it. The industry has shaped fields of learning."

Robert Bates
[World Coffee Conference, London 2001]

Farmers like to participate

1.1 WHY THIS BOOK?

This is a practical field guide to what is a relatively new discipline, especially for coffee.

Coffee, at the producer end at least, is in deep trouble for a number of reasons, including technology-driven oversupply. Historically, agricultural research has worked to improve production. But its adoption has been patchy and tended to benefit wealthier farmers. The tendency in developed countries in all crops has been for small farmers to be replaced by large mechanised estates and the migration of farm youth to city factories and services. Life has not always been easy for those who stayed on farm, as we have seen recently in developed countries such as the UK. We think this technological process is now underway in earnest for coffee.

1.2 WHY COFFEE, WHY NOW?

Coffee is important. Over 50 countries export coffee, together worth five to 10 billion dollars per year (according to fluctuating market prices—more than 100 million bags of 60 kg each). The number of coffee farmers that produce the crop is regrettably not known, but must be over 20 million. If we count dependent families and the many other actors down the coffee chain, at least 100 million people depend on coffee for their livelihood.

Coffee used to be the world's second most traded commodity. It is now down to fifth place, behind oil, aluminium, wheat and coal (Ponte 2001). But it is still the world's most important perennial crop and by its very nature, requires farmers to invest more than many other crops. In the case of coffee this has led to it becoming a culture in some countries, a way of life.

Hence farmers know a lot about coffee and its immediate environment but we have rarely consulted them in any formalised way about their knowledge.

The project from which this book sprung[1] was one of the first to do this in a systematic fashion. It turns out, when we do ask them, (e.g. Baker 1999, Bentley 2000a) that they have very interesting things to say, sometimes profound, sometimes completely erroneous but frequently unexpected and thought-provoking. For example, in Nicaragua recently we spoke with a farmer about CBB[2] incidence. She said that it had been low before, but that next year there could be much more, she explained that it was because:

"The price of coffee was low last year. This year the (quality of) the harvest was not too bad, and before that we only used chemicals." (*El precio del café el año pasado fue bajo. Este año se recogió más o menos y antes solo usamos el químico.*)

It was a perceptive observation. The logic goes like this:

1. In the year 2000 and earlier there was little CBB, because people used insecticides.
2. In the year 2000 the price of coffee was higher than in 2001.

[1] The CFC - ICO Integrated management of the CBB ICO/02 1998 – 2002
[2] The coffee berry borer (*Hypothenemus hampei*)

3. Therefore people harvested thoroughly and gleaned.
4. Thus they eliminated much of the CBBs' habitat.
5. So in the year 2001 there was little CBB.
6. But now that prices are lower, people are not harvesting as carefully and in following years CBB could be a problem.

The central problem we now all confront is that for a number of reasons, smallholder farmers are finding coffee-growing increasingly unprofitable and we, as so-called coffee experts, have not even told them about the great changes taking place. Neither have we documented what they think about what is happening to them. A way of life may be passing forever and what will we have learned from it?

It is ironic that whilst coffee farming has caused increasing losses for most smallholders, there is increasing interest in sustainable coffee farming and a growing number of ways that farmers can add value to their produce. And remarkably, at the top of the market, the gourmet sector, there is a shortage of high quality coffee.

Many small farmers could profit from these developments if they only knew how. To help small farmers is always a challenge, but the main contention of this book is that if we set about the task logically and methodically we can do it and that we can best succeed through soliciting their active participation. This is particularly the case now with the global reduction in government-backed extension services.

1.3 COFFEE IS SPECIAL

Maize, rice, potatoes and other smallholder crops are all annuals that farm families can eat at home, even when prices are low. Compared to these "daily bread crops," coffee is unique in several ways.

Coffee provides cash to resource-poor farmers and their labourers. It is labour-intensive; in most countries where coffee is grown, poor rural families pick coffee to earn some of the money they need. And they need more of it than previously since neo-liberal policies have reduced state-run social security, health and education services.

Coffee is a perennial crop. This has environmental benefits (biodiversity and soil preservation), but it also means that farmers cannot adjust rapidly to rising or falling prices.

Coffee is not a food. Smallholder farmers who grow staple foods can eat the crop if prices are low. But low coffee prices are a disaster. If the people have paid cash for fertilisers, labour etc., they risk going into debt.

Coffee has appeal, almost a mystique. The Colombians recognised this in the 1920s and specialised in meeting the demand for high quality coffee. Niche markets now include organic, bird friendly and fair trade coffee.

1.4 THE PROBLEMS OF WORKING ON COFFEE

Large variations in farm size. In some countries, many farms are large enough for the farmer to have his own brand name and be his own exporter. But coffee is also grown by many smallholders, who apply much higher levels of management per hectare than do estate owners. This means that smallholders can produce better quality coffee than large plantations because they are more likely to be able to organise the labour to harvest at the optimum moment. A smallholder picks coffee alongside her workers, while an estate owner hires overseers. But often smallholder coffee ends up being lower in quality; they dry it badly and sell to intermediaries who mix it with other coffees. Through lack of resources and training, the family farmers fail to realise the full potential of their crop. So large and small farms have different research needs; but unfortunately, many research institutes do not fully recognise this.

Coffee has been one of the few legal crops that can help smallholders escape poverty. Few farmers earn a middle income by hand-farming staple food crops. In Colombia some families make a decent living[3] by specialising in three hectares of coffee (Bentley & Baker 2000). In many countries, smallholders are more

[3] Or at least they used to, until the recent crash in coffee prices.

diversified. They grow food crops to eat, and they grow some coffee for the cash they need for clothes, medicine and children's school supplies.

***Coffee is an export crop**,* and so governments pay attention to it. Many coffee-growing smallholders have been visited for years by extension agents, and have learned more scientific information (and occasionally dis-information) than say, grain growers.

***Integrated Pest Management**:* IPM is a difficult, information-intensive and location-sensitive topic, and needs to be participatory to avoid producing irrelevant technologies.

But because coffee has long been an important export commodity, much of the research and extension in coffee has been top down, driven by political needs. Much of the current thought on farmer participation in research has bypassed coffee. For all these reasons, and the massive changes in socio-economic thinking, environment and trade factors, globalisation of markets, technology and agribusiness, and evolving consumer tastes, we need to rethink how to help small coffee farmers.

From the disaster that we discover to be 21st century coffee-growing, new thinking and actions will have to come. We coffee experts have failed the farmers; neither having listened to them nor told them what is happening.

This book is a small step towards trying to redress this inequity. It is addressed to researchers and others who design and carry out projects on behalf of coffee growers.

This manual is the direct product of the Project: Integrated Management of the CBB, supported from 1998 to 2002 by the Common Fund for the Commodities and co-ordinated by Peter Baker, of CABI Commodities in the UK. The project was implemented by specialists in coffee institutes in the following countries:

Colombia (CENICAFÉ)

Ecuador (ANECAFÉ)

Mexico (ECOSUR)

Guatemala (ANACAFÉ)

Honduras (IHCAFÉ)

India (Coffee Board of India)

Jamaica (Coffee Board of Jamaica)

This manual reflects what the project did, and what we would do differently, if we could do it over again.

GLOSSARY

◆ **ANACAFE,** Asociación Nacional del Café, the Guatemalan coffee institute

◆ **ANECAFE,** Asociación Nacional de Exportadores de Café, the coffee exporters association of Ecuador

◆ **Biological Control** Using nature to control pests. All organisms have predators, but some manage to escape them by migrating. The coffee berry borer is one of them, its co-evolved natural enemies stayed in Africa. This project helped them catch up with their prey.

◆ **CABI,** CAB International is a not-for-profit treaty level intergovernmental organisation with 41 member countries including several major coffee-producing countries. It consists of two divisions CABI Bioscience and CABI Publishing. Its main goals are generation and brokering of scientific knowledge for developing countries. CABI Commodities is an initiative of CABI Bioscience.

◆ **CATIE/NORAD,** *Centro Agronómico Tropical de Investigación y Enseñanza*. A project of this Costa Rican Institute in Nicaragua, funded by NORAD the Norwegian foreign aid agency.

◆ **CBB,** coffee berry borer (*Hypothenemus hampei* (Ferrari 1867)) a 2 mm long black beetle that is the most significant pest of the world's most important tropical agricultural commodity.

◆ **CBI,** The Coffee Board of India

◆ **CENICAFE,** Centro Nacional de Investigaciones del Café, the Colombian coffee research institute, a division of the Federation of Colombian Coffee Growers.

◆ **CFC,** Common Fund for Commodities is an intergovernmental financial institution, funding commodity development projects globally. The Agreement establishing the Common Fund for Commodities was negotiated in the United Nations Conference on Trade and Development (UNCTAD) in the 1970s, concluded in 1980 and came into force in 1989. Currently the Common Fund has 104 Member Countries plus the European Community, the Organisation of African Unity/African Economic Community (OAU/AEC) and the Common Market for Eastern and Southern Africa (COMESA).

◆ **CIAL,** Local Agricultural Research Committee, a farmer participatory research validation committee.

◆ **CIAT,** Centre for Agricultural Research in the Tropics, Cali, Colombia

◆ **CIB,** Coffee Industry Board of Jamaica

◆ **Cultural control,** a broad term involving mostly manual control that includes hand picking of infested berries.

◆ **ECOSUR,** El Colegio de la Frontera Sur, Chiapas, Mexico

◆ **Gleaning,** the term for cultural control used in India, chiefly for cleaning up after the main harvest.

◆ **ICO,** The International Coffee Organization (ICO) is an intergovernmental body whose Members are coffee exporting and importing countries. Established in 1963 it administers the International Coffee Agreement from its Headquarters in London, and is committed to improving conditions in the world coffee economy through international co-operation, helping price equilibrium by developing demand for coffee in emerging markets and through projects to reduce damage from pests and improve marketing and quality, enhancing coffee growers' long-term competitiveness and contributing to the fight against poverty.

◆ **IHCAFE,** Instituto Hondureño del Café

◆ **IICA,** Instituto Interamericano de Cooperación para la Agricultura

◆ **IPM,** Integrated Pest Management, a knowledge-intensive strategy for controlling pests where the farmer estimates current and future damage to his crop and picks from a range of techniques to optimise profit. The basic principal is that control measures should cost less than the losses incurred by inaction. It requires knowledge of pest biology, continual monitoring of the crop, the worth of control methods, simple maths and an understanding of commodity price dynamics.

◆ **Parasitoid,** A specialised predator that lays its eggs on or (as in the case of *Phymastichus coffea*,) *in* the insect. The egg hatches out and kills its host by consuming it. Parasitoids differ from parasites in that the former always kill their host to complete their life-cycle.

◆ **PROMECAFE,** Programa Cooperativo Regional para el Desarrollo Technológico y Modernización de la Caficultura, a Central American coffee technology network formed under the auspices of IICA.

Chapter 2

Participatory research, a people-centred approach

"Farmer participation in agricultural research is more than talking to six farmers or putting ten experiments in their fields. Above all, it is a systematic dialogue between farmers and scientists to solve problems and ultimately increase the impact of agricultural research."

[Mauricio Bellon 2001, Participatory Research Methods for Technology Evaluation]

2.1 BASIC ISSUES

A brief account of types of participation, extension and research and their inter-relations is needed because we have found considerable confusion about the terminology.

The fundamental point is to decide whether your project is about:

a) new knowledge generation and collaborating directly with farmers to help you do this, or
b) adapting and extending to farmers an existing menu of possible answers to a pressing problem, e.g. low yields.

New knowledge is needed. For instance with the CBB, we simply do not have an adequate method of easily assessing damage caused by the insect in the field, in order to judge if or when to apply some control method. We have sampling methods that we as researchers use, but they are time-consuming and we know, from previous experience, that few farmers will use them. So we could devise a number of experiments to see what ideas farmers have about the amount of CBB in their groves, and how accurate farmers' notions are, and whether this might be the basis of a new method (see the Mexico Case Study for one example). By consulting with farmers, we could develop new methods with them that we might have confidence to believe would be generally acceptable to other farmers.

Adapting ideas. For example, some researchers are working on new types of CBB traps, and want farmers to adopt them. They might ask farmers to try prototypes. This could be truly participatory research if the researcher evaluates farmer responses and makes adaptations based on their comments. On the other hand it could be an exercise in extension if one merely shows farmers how to use the traps and documents the rate of adoption.

Farmer Participatory Research (FPR) is research, not extension. Like other types of agricultural research, the goal of FPR is to contribute new knowledge, to find things out. FPR is not planting an agronomic trial as a demonstration plot. It is not teaching quantitative sampling methods to farmers as a way of encouraging them to sample.

2.2 FARMER PARTICIPATORY RESEARCH (FPR): A GUIDE TO SOME OF THE TYPES

We want to give a taste of some different types of farmer participatory research (FPR). The idea is not to get obsessed on methodology, but to realise that there are different types of FPR, for different purposes. Be creative, and adapt them to your own circumstances. Here are four different approaches: CIAL, Back-&-Forth, FFS[4] and Zamorano.

A coffee farmer tasting his own coffee for the first time

[4] Strictly speaking, FFS is participatory extension, not research (Kevin Gallagher, personal communication). Nevertheless, even some of its main supporters stress how FFS teach farmers to experiment (Dilts 2001). See Vos (2001) for one of many examples which could be given where FFS is part of a participatory research programme.

CIAL (Local Agricultural Research Committee): technology validation

CIALs were pioneered in the 1980s at CIAT (International Centre for Tropical Agriculture) near Cali, Colombia. The CIAL is a method for validating technologies, especially new varieties of annual crops (Ashby 1991). The CIAL is now becoming institutionalised, with booklets on how to organise communities to conduct formal experiments. In 1993, CIAT published 13 "Cartillas para CIAL," large-print, step-by-step guides on how to establish and lead a CIAL (Ashy *et al.* 1993). Like the name suggests, the CIAL is based on a committee of farmers, chosen by other community members. The CIAL method involves a great deal of effort to organise people into a formal structure (president, vice-president, treasurer etc.). Researchers give the CIAL a small fund, which they use to finance their research. For example, the CIAL gets several new varieties of beans, and rears them out on their farms, and evaluates them. The CIALs work so well for judging varieties of annual crops that many of them have evolved into small seed companies (Ashby *et al.* 2000). (See the Honduras and Guatemala Case Studies, this volume, for experiences that were somewhat similar to CIALs).

Back-&-Forth: adaptive research

Unlike the CIAL, this is not a widely known method, which is the point: there are a lot of unsung, workable methods. Back-&-Forth *"Ir-y-Venir"* was developed in Bolivia in the 1990s to design ox-drawn implements. The context was PROMETA, a DFID-funded Draught Animal Traction Project at a public university, Universidad Mayor de San Simón. Back-&-Forth begins with a diagnostic survey in the communities, to learn what type of animal-drawn tools middle income campesinos need. Then a mechanical engineer designs a tool (typically a plough, but harrows, weeders and planters have also been developed). Researchers test the tool in laboratory and on-station. Then they return to communities for farmer comment, followed by redesign, lab and station testing and then, after several visits Back and Forth until the farmers are entirely satisfied. Finally it is manufactured (Leonardo Zambrana & Brian Sims, personal communication).

Unlike agronomic trials, which usually take a whole crop cycle, research with machinery is quicker, and Back-&-Forth is well suited to rapid R&D of farm tools. One day we watched Mr Zambrana drive his pick-up truck, with a new plough prototype to a village near Cochabamba, Bolivia. With some students, he unloaded the plough, borrowed a donkey from a local farmer and cut a few furrows in another farmer's field. Farmers who were harvesting carrots in nearby fields gathered around. The researchers knelt in the dirt with farmers, who showed them what size and shape of furrows they needed, adding "It's a nice plough, but to make the furrows we need for carrots, these metal wings have to be a little narrower, but at a higher angle." (See the experience with *beneficio ecológico* in the Ecuadorian Case Study, for a near example of Back-and-Forth.)

FFS (Farmer Field School): participatory extension

FFS are now going through a period of rapid expansion and change. The original idea was to allow farmers to discover the concept of the ecosystem (including the idea of natural enemies), through field observations, and to decrease the use of insecticides to control brown planthopper in rice (Winarto 1996, Vayda & Setyawati 1995). Farmers met for half a day every week, to observe insects and rice plants, while an extensionist facilitated a discussion of whether or not they needed to spray insecticides, e.g. that the damage from insects was not so much real as apparent. Later, FFS resource persons began to notice that some farmers conducted experiments and invented things on their own, following FFS. For example, some farmers in Indonesia learned through FFS that dragonflies prey on insect pests. The farmers responded by inventing perches: sticks in rice paddies where dragonflies could rest (Ooi 1998). FFS can also be used to explain the background information that will encourage farmers to adopt researcher-derived innovations (see the Mexico Case Study).

However, there are criticisms that FFS is too slow and expensive to be cost-effective for extension (Quizon, *et al* 2000). Also, the quality of FFS may deteriorate rapidly when it is "up-scaled" out of the hands of master trainers (Matteson, *et al* 1994). Another problem is that there is little spontaneous farmer-to-farmer communication of the FFS message, so the new ideas are slow to spread from trained farmers to their neighbours (Winarto 1996, Quizon, *et al.* 2000).

Can FFS be adapted to research? We suggest that FFS should be formally adapted as FPR: retool it from an extension device to an R&D method. Besides Peter Ooi's dragonfly example cited above, Yunita Winarto reports farmers in Java who blended ideas from FFS with existing knowledge to generate new technology. She gives several examples; in one, farmers learned from FFS the life cycle of the white rice stem (WRSB) and learned to notice the adults and the egg clusters. Previously, the farmers had only recognised the larva of the insect. After training, the farmers observed adults and eggs of WRSB in rice stubble, and invented a new practice: ploughing rice fields immediately after harvest (instead of just before planting) to kill the moths and their eggs (Winarto 1996). This invention would have had much more of an impact if FFS extension agents had been trained to report it to researchers, who could have seen it in the field, validated it, and told other extensionists about it. In another case, the CABI IPM participatory research with FFSs in Kenya had some positive results[5]. Mostly testing neo-traditional, non-chemical controls (spraying milk to control virus, burning organic matter on soil, hot water, chilli etc.) with chemical pesticides (Kimani *et al.* 2000).

In the CFC CBB project, researchers and extensionists in Ecuador, Mexico and Colombia used a version of FFS adapted as research, visiting farm communities periodically, to share information with them and introduce new ideas to test. (See the Ecuadorian, Mexican and Colombian Case Studies for examples of field schools adapted for research. See also Vietnam case history (Vos 2001) to be included in a CD of the project, available from CABI *Commodities*.

The Zamorano method: encouraging farmer inventions

The Zamorano method is based on the simple, factual observation that farmers experiment on their own, and on a hypothesis that farmer experiments could be further stimulated by filling in the gaps in farmer knowledge, with short courses on insect bioecology.

The Zamorano method is like FFS in some ways; both stress training in biology and ecology. A major difference is that FFS trainers return every week: the sessions follow the growth (phenological) cycle of the crop. The Zamorano method is based on a short course (about three days) to teach general principles, and teach farmers to observe for themselves. This lowers costs and raises excitement. We borrowed the idea from the late Elías Sánchez, who used five-day courses to show soil conservation to tens of thousands of Honduran farmers. Zamorano researchers in Honduras taught farmers about insect reproduction, predators, parasitism, and entomopathogens. After training, farmers invented many techniques, most of which related to the conservation and manipulation of large, native predatory insects. Many farmers independently invented the idea of spraying sugar water on crops, to attract ants and wasps to control fall armyworm.

The idea was based on farmers' existing knowledge that ants like sugar, combined with the new knowledge from the course about the ants and wasps that are insect predators (Bentley 2000b).

Farmers also learned that parasitic wasps drink the nectar of flowers. One farmer actually experimented with flowers of different colours, concluding that yellow attracted more parasitic hymenoptera to fields than did flowers of other colours (Meir 2000). Meir found that of 100 farmers who had received Zamorano training, 25 had invented something significant (Meir 1999). For a critical review see Bentley (2000).

There is some evidence that encouraging farmers to experiment can be part of a successful, long-term project (see Boxes 1 and 2). However, our experience has been that farmer experiments are easier to find than to follow up. Many farmers experiment, but their greatest limitation is that few researchers or extensionists take them seriously enough to validate them and pass the ideas on to other farmers.

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[5] Actually, the combination of simple field trials with FFS suggests a kind of CIAL-FFS hybrid: just the kind of creative adaptation we should look for.

Box 1 *Sugar water, 10 years later*

In October 2001, Jeff Bentley and Falguni Guharay visited Pedro Julio Bustos, Juan Carlos Alemán and Carolina Cruz (manager and two master trainers of ESTECA a small agricultural extension company in Niquiohomo, central Nicaragua). They had no idea that Bentley had a previous association with the sugar-water technique when they said that they were teaching farmers to use sugar to attract predatory insects to kill pests. Extensionists from Zamorano had taught the technique to extensionists in Nicaragua, who still found it useful 10 years after Hubalda Castro and other Honduran farmers invented it. By way of comparison, extensionists in Central America have quietly abandoned most of the other techniques that were in vogue in the early 1990s (like velvet beans as a cover crop, and making compost). Sugar to attract beneficial insects is still acceptable to farmers, because a farmer invented it, and it has farmers' concerns built into it.

Farmers in Honduras are also still (2002) enthusiastically reporting the use of sugar water to control fall armyworm (Robert O'Neil, personal communication).

2.3 DISCUSSION OF FPR

By their promoters' admission, the CIALs are best suited to adaptive research, especially crop varieties, rather than for inventing new technologies (Ashby *et al*. 2000). Back-&-Forth also adapts technology with farmers, but does so in short, one-off sessions; it is especially well suited to testing new machinery. The FFS (adapted for research) and Zamorano method both stimulate farmers to invent on their own, but in both cases the greatest limitation has been that researchers are not careful enough to document and follow up on those inventions. If all we do is teach farmers, then we are doing extension, which is worthwhile, but it is not what this manual is about (Box 3). In FPR, farmers are our colleagues, and we exchange information with them as a way of working together to generate new information, of which there are three main kinds: diagnosis, bioecological and control tactics. (See Section 6.3).

Summary of Chapter 2. We have reviewed above a variety of approaches to the subject and we believe in diversity. But like any good scientist, one needs a simple taxonomy to categorize what you are working on (see Tables 1 and 2 for a summary).

You have to define not only the nature of the problem you are studying, but your *modus operandi*. FPR researchers must also be interested in the "human" aspect of their research topic, as well as having the capacity to be a facilitator, rather than a teacher.

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Box 2 *Getting slugs drunk*

In the mid-1980s, entomologists at Zamorano, Honduras, designed traps to capture bean slugs. The traps were piles of cut weeds, which farmers had to turn over every two or three days to kill the slugs that had taken refuge there. Farmers found the trap tedious and adoption was low (Bentley & Andrews 1991). But extensionists taught the idea, and farmers began experimenting with other designs of traps. One design, attributed to Nicaraguan smallholder Francisco Vásquez Gómez of Somoto involves burying clay pots up to their necks in the bean field, and pouring some traditional chicha (homemade maize "beer") into them. In three days, 18 pots captured 289 slugs. Farmers like the pot traps, because they are highly attractive to slugs, and farmers do not have to check the traps every day. The slugs either drown in the chicha, or get too drunk to take cover from the sun, and die of exposure. Extensionists are now promoting the idea in Central America (López 1997).

Table 1 *Comparison of five participatory methods*

PLATFORM	FOCUS	DISADVANTAGES	REQUIRES MUCH STAFF TIME PER FARMER?
CIAL	Validating technology with farmers.	Farmers are unlikely to continue them on their own, unless they can transform the CIAL into a seed-growing business.	Yes
Back -&-Forth	Designing machinery.	Difficult to adapt to biological topics.	No
FFS	Teaching bioecology to farmers.	Not traditionally seen as a research method.	Yes
FFS adapted for research	Teaching bioecology to farmers to stimulate farmer experiments.	Researchers are not always good at following up on farmer experiments.	Yes
Zamorano	Teaching bioecology to farmers to stimulate farmer experiments.	Researchers are not always good at following up on farmer experiments.	No

Table 2 *Levels of farmer participation, and their characteristics*

LEVEL OF FARMER PARTICIPATION	BRIEF DESCRIPTION	TYPES	USE OF NUMBERS AND STATISTICS	FUNCTIONS
1 contractual	The scientist hires the farmer's labour and land. Researchers work with several individual farmers.	Strategic, on-farm research.	Quantitative. Scientist controls and manages numbers almost as on-station.	To write a quantitative description of the results of many independent variables.
2/3 consultative/ collaborative	Researchers work with committees of farmers, and communities.	Adaptive research, e.g. CIALs, back-&-forth.	Some numerical data is taken and analysed with farmers.	To adapt a nearly finished technology to local conditions.
4 collegial	Farmers do original research, supported by scientists.	Zamorano method, FFS adapted for research.	Little quantification, or some simple statistics.	Farmers invent novel technology.

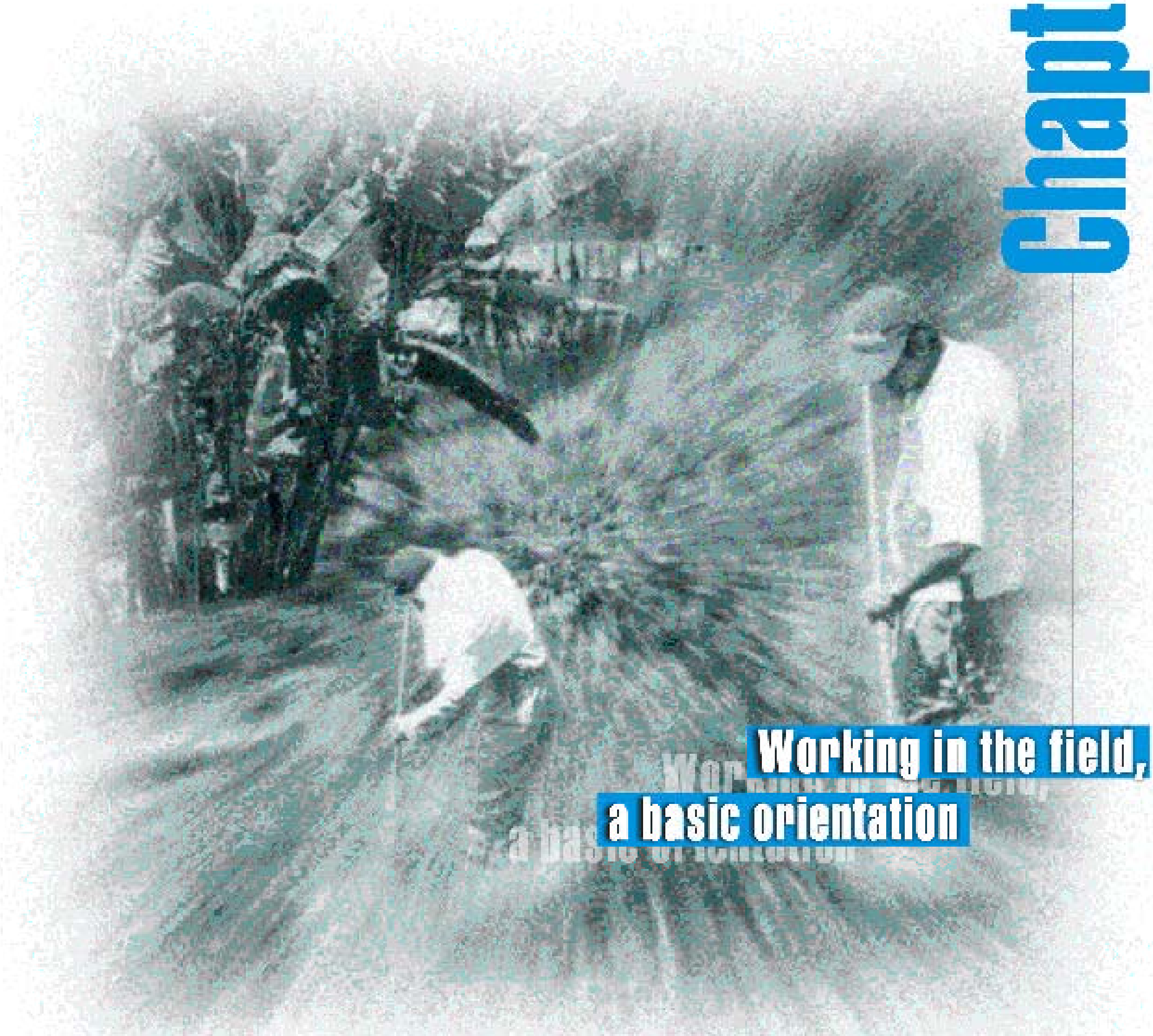
Notes: "1" is the least participatory and "4" is the most. Adapted from Biggs (1989); see Section 5.1.

Box 3 *How to tell if an experience is participatory research*

If researchers and farmers work together on an experience in which:

- **Only researchers learn**: *it is conventional research, not participatory*
- **Only farmers learn**: *it is extension, not research*
- **Farmers and researchers learn something**: *it is participatory research*
- **Neither farmers nor researchers learn anything**: *it is just goofing around*

Chapter 3



Working in the field, a basic orientation

"The secret of getting ahead is getting started. The secret of getting started is breaking your complex overwhelming tasks into small manageable tasks, and then starting on the first one."

Mark Twain

The players. The three main players in FPR are **the farmer**, **the extensionist**, and **the researcher**. Each group has its own agenda and background. At the risk of stereotyping each of these groups, they are, regardless of their country of origin, adapted to a similar set of circumstances, to which they have responded in similar and rational ways, which we describe in the following sections.

It is probably obvious to most readers that researchers and smallholder farmers are from different class backgrounds. What is perhaps less obvious is that there are social differences between researchers and extensionists as well. Most researchers have middle class backgrounds, may have advanced degrees (Ph.D., M.Sc.) and have gone to elite secondary schools. Many have international experience and speak English. Extensionists may come from middle income families, but some are also the children of smallholder farmers or of small town shopkeepers, and have struggled to attend a public university in their own country. Most have a lively command of local and national languages, although not necessarily of English (Boa, *et al.* 2001).

3.1 THE FARMER

The farmer's mind-set. Smallholder farmers value hard work and private property. They are eminently pragmatic, with little romanticism (they will not hesitate to build a cement-block wall onto a 200 -year-old granite barn). They value money and are reluctant to spend it, preferring to save it to buy seed, or used trucks or other useful property. They are busy, and time is precious to them. They are moderately hospitable, but often suspicious of outsiders. They treat outside knowledge with a touch of scepticism, the way a scientist treats a hypothesis. They have often not had proper medical care, and illness and early deaths have struck many families, leaving them with

Initial contact with farmers can be difficult

a permanent sadness. One of the things they like most about their lives is being their own boss, not having to punch a time clock. Yet, they don't especially enjoy their work, because it is backbreaking, tedious and dirty; they are happy if they can afford an education and a better future for their children. Most have had just a few years of schooling, and some cannot read. A few are avid readers. They appreciate the value of their own practical experience.

Four kinds of farmer knowledge: deep, shallow, missing and mistaken. There are four basic types of local knowledge, depending on whether the things in the natural world are important to people or not, and if they are easy or difficult to observe (Table 3).

Farmers' worries. Farmers worry about going hungry, about not being able to feed and clothe their children. In some countries where land title is insecure, they fear having their land confiscated by lawyers and rich people. They worry about thieves (or marauding armies) stealing from them. They worry about the rising prices of the inputs they buy, and the falling prices of the goods they sell. Contrary to naïve opinion, traditional smallholder farmers are not in the least afraid of new technology. They are eager to adopt changes that will improve production, but they are worried that the extensionist or other outsider may not know what he is talking about, and may make exaggerated claims for the new idea, or that the new technique will increase risk (to which farmers are averse). They worry about insects and diseases; they believe that all insects are pests and that any insect or leaf spot can be dangerous to their harvest. Pesticide companies profit on such misperceptions.

Table 3 *A classification of farmers' knowledge*

	NOT OF PERCEIVED IMPORTANCE TO LOCAL PEOPLE	*OF PERCEIVED IMPORTANCE TO LOCAL PEOPLE*
Easy to observe	***Shallow knowledge*** *People do not pay much attention to some things that they can observe, because they do not consider them worth looking at.* *Example*: Farmers have observed web-building spiders in coffee groves, but may not have appreciated their role as natural enemies of pests.	***Deep knowledge*** *Farmers know in detail the things that they can observe, and that their work forces them to look at.* *Example*: Coffee growers know that bored berries harbour beetles and whether or not this might affect the sale price.
Difficult to observe	***Missing knowledge*** *Local people are unaware that some things exist, because they are small, nocturnal, camouflaged, and because necessity has not forced the people to notice them.* *Example:* nematodes, parasitic wasps, microscopic fungi.	***Mistaken knowledge*** *Smallholders know the thing exists, because it is so important to them, but misunderstand it because it is difficult to observe.* *Example:* farmers do not understand how the CBB spreads. Some conclude that the insect comes from their neighbour's plot, when it may actually be reproducing within the grove.

Source: Adapted from Bentley & Rodríguez 2001

Farmers' constraints. Farmers are limited by the obvious: capital. Some farmers are constrained by labour, but have plenty of land (extensive farming), while others are constrained by land, and lavish their labour on it (intensive farming). In most countries they are constrained by a near total lack of political power. Many farm communities are unorganised. Their children attend bad public schools, which offer basic literacy, nationalism and disdain for their own cultural and class heritage. Rural schools teach a nagging sense of inferiority, but not enough scientific concepts to make sense of pests and disease.

Above all, smallholders are smart. They may lack in formal education but they have skills and experiences that we researchers do not. For example, farmers in Honduras, Mexico and Colombia could identify "hot-spots" (high concentrations) of CBB populations that researchers thought could only be detected by sampling. In Mexico, when researchers told farmers they wanted to create IPM plots to control CBB, the farmers quietly took them to the largest hot-spots in the community. The villagers chose the hot-spots as the places that would most clearly show the success or failure of the new ideas. The scientists didn't realise that they had set up their trials in the most infested areas until villagers told them (see Mexico Case Study).

What farmers think of you, the researcher. They think you know everything, until they get to know you. Then they are surprised to realise how many basic things you do not know[1]. You cannot train an ox team, or prepare lunch for 20 hungry workers. Many

[1] Our apologies to the scientists who are also farmers, those who grew up on farms and have not lost their roots. This is much more common in coffee than in other crops. It is especially common in some countries like Colombia, that are proud of their coffee culture, where researchers spend the weekend growing coffee on their family farm. This is an important distinction between participatory research with coffee and with other crops.

of you even have trouble just walking on the steep muddy paths of a farm. You call the simplest things by mysterious words, yet you often cannot recognise the most basic crops and weeds on a farm. And once they get to know you better, it gets worse. They realise that you only know your one specialty: you may know the bugs, but not know how to fertilise coffee. Or you know the diseases, but cannot repair a pulping machine. Or you are the anthropologist who knows how to ask a lot of questions, but does not recognise robusta coffee when he sees it. In spite of all that, the farmers still value you, because they know that you know things they do not know. They want you to keep visiting them, and they crave your respect. They want you to talk to them like adults.

3.2 THE EXTENSIONIST

The extensionist's mind-set. Most extensionists are men, or young single women. Extension work often requires one to be away from home for long days at a time. Most extensionists are kind and easy to talk to; they like people. Most were motivated to go into extension by a desire to help people. If left alone in a community, they tend to spend their free time playing cards or football with farmers. Yet they don't mind being treated with a touch of deference; in Latin America most extensionists like farmers to call them by a university title (ingeniero). Few extensionists say to farmers "just call me Juan". Extensionists have been to university, or at least to technical secondary school. They read, some more than others. They all can write, but few enjoy it, and so extensionists are not entering the historical record as much as they could. They identify more or less with the middle class, but their material aspirations (car, house) are frustrated by their low salaries. They value education, but few can afford to send their children to elite schools. Many of them have traditional religious values, as well as a basic scientific education.

The extensionist's worries. They are afraid of losing their job (except in some remarkable institutions with solid job tenure for extensionists). Their biggest fear is losing "credibility" in front of farmers, of making a recommendation which later does not live up to its promise.

The extensionist's constraints. Few extensionists have the logistical support they need. It is a rare extensionist who has a car or a motorbike. We have met extensionists who sleep in schoolhouses, without plumbing or electricity, eating tinned sardines. Conditions are usually a little more comfortable in coffee-growing areas, because people and money (used to be) more plentiful around coffee, but most extensionists have had to rough it at least sometimes. Their travel and expense money is frequently insufficient. They rarely have enough well-written, well-illustrated, pertinent technical literature to help them teach farmers. They are usually unable to buy any extra tools or supplies. Many have poor access to computers and e-mail; even though there may be both in the local office, the extensionist either does not have the time or the information to make full use of them.

What extensionists think of you, the researcher. In general he respects you, for your education and your standing in the institution. Most extensionists would like to be listened to a little more, to be taken just a bit more seriously by researchers. Extensionists can come to resent researchers who "release" technologies that worked on-station. When those techniques don't work on-farm, the extensionist doesn't like being blamed by the researcher ("It would work if the extensionists would just teach it right" is a common researcher complaint which extensionists resent).

3.3 THE RESEARCHER

The researcher's mind-set. Why are you thinking of doing this sort of research? Participatory research can be rewarding for scientists who like going into the field and talking to people. Some people are naturally good at this, and most researchers have the basic people skills. We can all learn to improve; the following chapters provide some pointers.

The researcher's worries. Some researchers are worried about whether they can publish the results. In many institutes pay rises are based on publications, so anything that is not considered publishable in their target journals is not interesting to them. Others are concerned about what their colleagues may say ("It's not science"). If you are one of these, just remind sceptics that one of the most important crop protection technologies for a perennial crop was invented by participatory research. Bordeaux mix was first concocted by a French farmer in the late 19th century. He wanted to spray something obnoxious on grapes that would repulse passers-by, so they would stop plucking bunches from his vines that hung over a path. A plant pathologist noticed that the grapes were free of fungal disease, and he validated the mix as a fungicide (Lang & Clutterbuck 1991). You may be the researcher who works with farmers to invent the next Bordeaux mix.

The researcher's constraints. Lack of time, especially when administrators can invent paperwork and meetings faster than researchers can avoid them. One of the main failings of participatory research so far is that there has been a real shortage of senior scientists in the field, working with farmers. Agricultural scientists have delegated so much of the farmer participatory research to technicians, extensionists and social scientists that FPR has not had enough serious field testing to become a standard method.

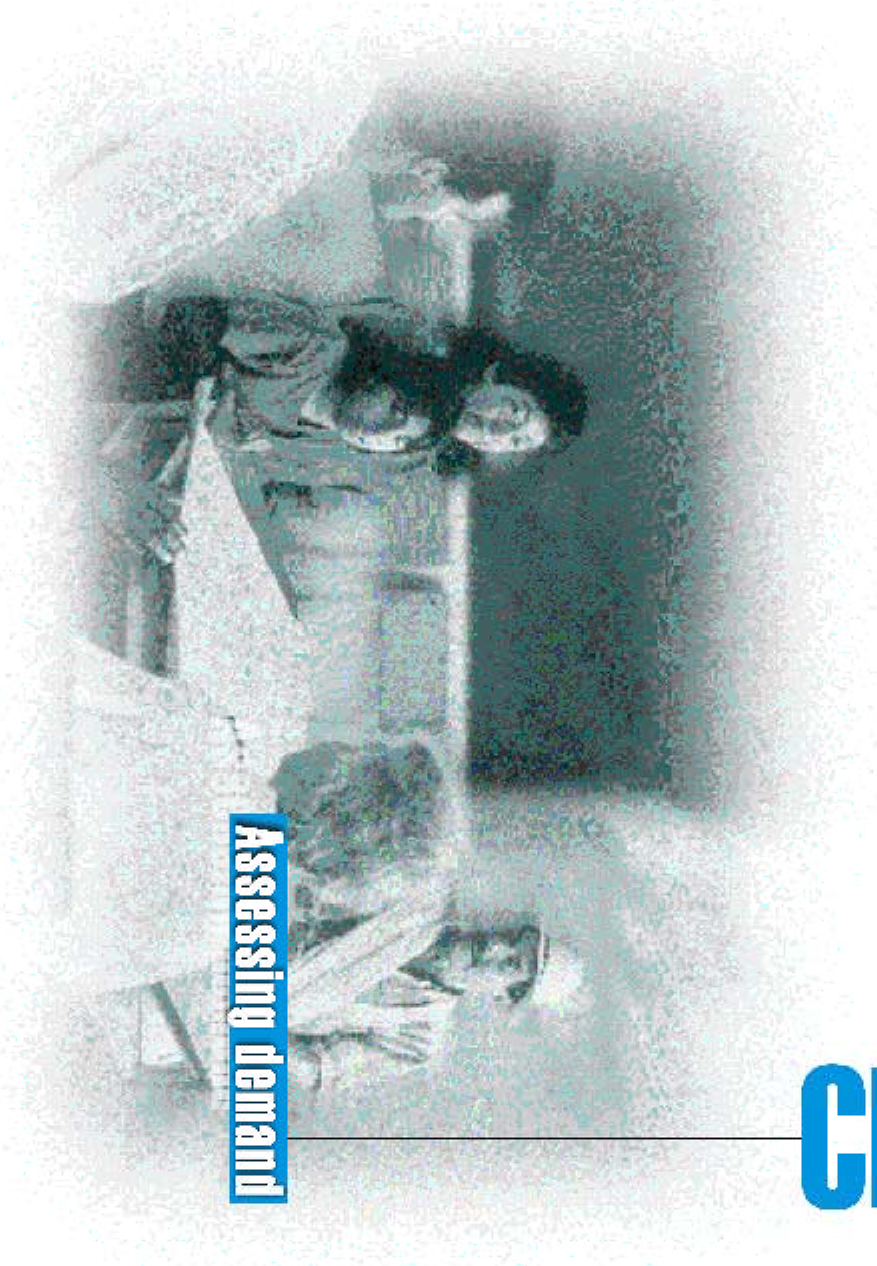
Researchers are constrained by a certain conceit that their ideas must be adopted by farmers ("How can we get these farmers to adopt our ideas?") The answer is: invent the things that farmers want to adopt. Participatory research helps you to do that.

And in all fairness to agricultural scientists, a word must be said about social scientists. Most know too little about agriculture to be of much help in research. Most are from the city and have little biological training.

The academic ones have been afflicted with romanticism, Marxism and post-modernism to the degree that they are simply irrelevant, at odds with the agricultural scientists' basic project. Even anthropologists who have studied agrarian communities tend to know only the farmers' point of view, and so have difficulty relating it to the scientists' perspective. It takes time and patience for "aggies" and "anthros" to learn to work together.

Chapter 4

Assessing demand



> *"Successful innovation requires supporting institutions. There are 48 countries with more than a million people (in 1995) and with at least half of these living in tropical areas: with a total population of 750m, they took out just 47 of the 51,000 American patents issued to foreign inventors in 1997."*
>
> ***Jeffrey Sachs***
>
> *"To see things in the seed, that is genius."*
>
> ***Lao-tzu***

In the previous chapter, we dealt with some fundamental characteristics of farmers, extensionists and researchers. Now we are going to discuss interactions with farmers and extensionists in order to achieve the goals of research. And the logical place to start is working with extensionists and farmers to choose the right research topics.

4.1 BASIC FIELD SKILLS

An excellent way to learn about farmers and their problems is to go live in a village for a year, working, eating and talking with people the whole time. It is such a useful, bedrock experience that it should be mandatory for agricultural scholars. Few mature researchers have the time, but fortunately there are quicker methods (see especially Section 4.2, below).

Attitude. More important than the method you use, is the background education and goodwill you take to the field. As part of a previous project, we once brought scientists from Cornell to meet farmers in Honduras, to listen to talks and to go to farmers' fields to see pests. The researchers complained that they had been invited to "a growers' meeting", so of course they got little out of the experience. Whatever you do, get into the field and talk to farmers. The PROINPA Foundation in Bolivia occasionally closes the office and takes everyone, even the secretaries and the accountants, to the field to meet farmers and to climb up to their fields to see the test plots they have planned with researchers.

4.2 LEARN FROM EXTENSION AGENTS

Time is always short and most researchers do not know many farmers, so they use extension agents to help contact the farmers. In most countries it is essential to approach extensionists first to introduce you to farming communities; it ensures that the farmers receive you with less suspicion and it helps avoid later "turf wars" between research and extension staff. It has some drawbacks, e.g. the farmers naturally associate the visitor with the people who take him or her to the village, but given time, the villagers and the researcher can get to know each other in their own right. Unfortunately some extensionists are ill-suited to the role of agrarian tour guide, and react by interrupting farmers and trying to explain the farmers' business to the researcher. On the other hand the extension agent has much valuable experience, which can help the researcher get to the point quicker with farmers. For example, researchers in India tried to convince extension agents to tell farmers to pluck early blossoms from robusta coffee, as a way of eliminating habitat for the CBB. One senior extensionist later took one of the authors to a coffee grove, grasped a coffee branch and picked off a few flowers, showing how this was not only time-consuming, but also damaged the blossoms that would produce the main crop.

Tips for working with extensionists. Extensionists are professional information brokers, who are used to relating outside information to farmers. With some preparation, most extensionists can also broker information in the other direction: from farmers to scientists (Boa *et al.* 2001, Bentley *et al.*, in press). In general:

Extensionists know the area better than you do. They can help to characterise an area based on agro-ecological principles, ("These are the areas we call the high-country, and this is the low country." Or "These are the valley bottoms used for commercial cattle, and these are the hillside areas for smallholder coffee"). Work out areas to visit with extension agents, rather than just turning the agenda over to them, this helps to see a representative cross-section and allows you to start to see their perspective on the area. When left to their own devices, extensionists often drive visiting researchers to the most far-flung areas, on the well-meaning assumption that one needs to "see" the most different areas.

This can make for nine hours of looking out the windshield and one hour talking to farmers. Try to make sure beforehand that most of your time in the field will be spent on-farm rather than in-car. If an extension agent wants to take you to very far places, ask if you can stay overnight there, to spend more time with farmers.

Extensionists know the farmers better. They know how to greet people, whether or not one needs to ask permission before walking onto a farm, and the right choice of words. Extensionists know which days are devoted to festivals and other events, when people will not be working, and may not want visitors. In some areas, farmers are suspicious of outsiders and a trusted extension agent provides the introduction you need to start the interview. The down-side to this is that extension agents also have a bias towards wealthier or at least middle income male farmers who tend to be early adopters of new technology. Extensionists may call them "progressive" farmers, and assume that they adopt innovations because they are clever.

The extensionists almost always miss the fact that, besides being smart, the progressive farmers are also usually people with land and with a large, healthy family so that the chores get done, even while the farmer is taking short courses or entertaining visitors. Other farmers struggling with illness or large dependency burdens may be just as eager to learn, but don't have as much time to go to meetings. Extension agents also work in a few communities, not in the whole area. Work this out beforehand and try to visit some women, poorer households, and other villages. All extensionists have their favourite farmers who may be some of the friendliest or most compliant individuals. They are easy to talk to, and it can be tempting to meet one "progressive" farmer after the other, but beware of thereby selecting an unrepresentative group to work with.

Extensionists know a lot about local problems . For example, they know the common names for the area's pests, and can describe most of them in scientific terms (Bentley *et al*., in press). Extensionists can also tell you when the coffee harvest is, how long it lasts, if local people prune shade trees themselves or hire specialists to do it. A good extensionist can help you to ask good questions like "Would you rather grow coffee or maize, and why?" (This is an example of a question Ecuadorian extensionists asked, based on their understanding that people in the Jipi Japa province were switching from coffee to maize, but debating it among themselves as they went along).

Be aware that the extensionists have their own agenda, featuring the (usually narrow) range of concerns dealt with by their own institution. Don't let an extensionist distract you by directing the conversation repeatedly to, say, organic fertiliser, or certified seed, or the introduction of pine trees, unless you have broader interests. NGO extensionists tend to have an anti-chemical bias, and so farmers may downplay their real use of agrochemicals in front of NGO staff. Extensionists may have certain unselfconscious social agendas, for example, our extensionist colleagues in India identified with full-time family farmers, and tended to avoid landless labourers and part-time smallholders, as well as plantation estates.

The period of stupidity: credit schemes. Although it is not as common as it was in the pre-liberalisation era of the 1980s, some extensionists still work as credit agents. Indonesian anthropologist Yunita Winarto describes a classic credit scheme in Central Lampung, on Sumatra, from the 1970s and 80s, which farmers in retrospect now call "the period of stupidity" because the credit scheme obliged them to buy packages of seed, fertiliser and insecticides. Farmers were organised to buy the package, and government agents were assigned to oversee its adoption as a whole. Farmers were allowed little creativity for adopting parts of the package (Winarto, in press).

The Indonesian scheme is not unlike credit packages for maize that Bentley saw in 1987 in Honduras. Obviously, extension agents working in credit schemes are biased to see if farmers are adopting the whole technology package in an uncreative way, as well as making their payments. Credit agents may have access to communities, but approach them with caution.

Some extensionists will have good ideas . And they will all have something to say. Some extension agents tend to interrupt farmers during interviews. Asking extension agents' opinion *before* going to the field can help them to feel that they have already had their say, so they will be less likely to interrupt farmers. You may want to assign extension agents the role of asking the questions during the interviews with farmers. This gives the extension agents a meaningful role, one they play well, and helps them resist the temptation to contradict farmers.

Some will resent you. Because you are a foreigner, or are from the capital city, or because you make more money than they do, or because you are interrupting their busy schedule to do something they may not instantly identify with. This is not usually as big a problem as it seems, just something to be aware of at the start of the day, if the extensionist seems cold. If you treat them with respect and courtesy they usually respond in kind. Always try to work with several extensionists, to get a balanced picture and avoid spending too much time with someone who may be atypical.

The entourage. When you are just starting out, and if you are collaborating with an institution that does not quite trust you yet, you may think that you are going to the field with one extensionist, only to find yourself with two or three extensionists, their supervisor, his supervisor, someone from research, a driver, a student, even a photographer. By the time you realise you have an entourage it's usually too late to do anything about it. If the farmer is not nervous around such a crowd, the host extensionist will be. Ask the farmer to show you her farm. Most of the entourage will then break into small conversation circles and you can talk with the farmer and the extension agent. Hopefully you will keep working with the institution and the community until they relax with you, and you can work with smaller groups of people.

Extensionists are sometimes wrong. We have heard extensionists say that the three main nutrients for plants are "potassium, phosphorus and sulphur" (instead of nitrogen). And while most can tell a coleopteran from an orthopteran, many can spout off scientific names of insects without being able to tell you which family they belong to. Take it in your stride and don't play know-it-all with them.

Most are glad to receive some attention. Some extensionists are posted to remote locations, and may spend most of their time alone in communities. Many are lucky to even have a motorcycle to get to their worksite. Showing some appreciation for their work usually goes a long way to overcoming the resentment they may feel about the intrusion into their routine, when a carload of people bursts into the village. Before going to the field with extension agents, spend a few hours discussing the topic and the community. This can be done with individual extensionists or with a group. It helps to:

- Generate hypotheses about farmers.
- Give the researcher insight into the local extensionist's attitudes about farmers.
- Let the extensionists feel that they have been listened to, so they can relax during the interview with farmers.

ACTIVITY 1

Talk to an extensionist or a group of extensionists about the local farming system and about farmer knowledge. Ask them key questions about coffee growing, farmer knowledge and coffee pest problems in the community.

Form one or more hypotheses and identify topics to ask farmers later. Start by identifying topics that extension agents are not clear on. For example, in Sucre, Bolivia, extensionists listed several popular terms used by farmers to describe fruit tree diseases. The extensionists disagreed among themselves over whether *polvillo* meant the same as *ceniza*, and what were the exact symptoms of each one. They agreed to ask farmers about this in the field.

Avoid formal meetings at first

An informal setting can be best (spot the extensionist)

4.3 APPROACHING THE FARMERS

Selecting farmers to interview. Bellon identifies four ways of choosing people to talk to: incidental, key, randomly selected and self-selected (Bellon 2001).

- *Incidental informants* are those people that researchers happen to meet, including shop keepers, or farmers asking for a lift by the side of the road. They are usually easy to meet and talk to, but be careful to re-confirm anything they say with other people. Incidental informants may be biased, and researchers do not usually know their role in the community.

- *Key informants* are people with specific, important roles in the communities, and include healers, leaders, master farmers, rural school teachers. They are not always representative of the community, but usually are articulate and are respected for having certain kinds of specialist knowledge.

- *Randomly selected informants* are chosen at random off a list of the population (the sociologist's "universe"). They may be representative, but in rural areas of Latin America, Africa and elsewhere there is often no list of local households, so researchers have to make do with an opportunistic sample of people they can manage to meet. But keep in mind that the ideal is to talk to many different kinds of people, who represent the different groups in the community. Be sure to talk to women, elderly, ethnic minorities, people far from the road, the landless, labourers, smallholder farmers, and not just the "progressive" farmers the extensionist will try to steer you towards.

- *Self-selected informant*s are people who approach the research team. They are invariably articulate and may be farmer experimenters, or people who are eager to learn about new technology. They may also be looking for political connections, employment or a ride to the city (adapted from Bellon 2001).

Recomendations.

- *Identify objectives* or hypotheses before going to the field. Sit down with extensionists or other colleagues beforehand and agree on what are the specific things to discuss with farmers.

- *Work in two-person teams* of an interviewer and a note taker. Designate one person to conduct the interview. This person may be an extensionist or another person who is fluent in the local dialect. The interviewer will not take many notes, since he or she needs to maintain eye contact with the person being interviewed. Designate another person to take notes in a blank notebook. This person may say something from time to time, but does not speak nearly as often as the designated interviewer. If there are three or four people on the interview team, still designate just one person as the interviewer. The rest should listen. The more people there are on the interview team, the more unwieldy it is, and the more difficult it is for the farmers to relax.

- *Avoid town meetings, at first.* At early stages of research, e.g. when learning about farmer demand, talk to individuals or small groups of rural people. Do not meet with the whole community until you are ready to plan research with a community (see Chapter 5). Extensionists are often eager to call the whole village together, when the team really just needs to talk to a few people. Town meetings are frustrating for everyone because they waste a lot of the community's time and energy, and because out of 30 people, only two or three local people do most of the talking. Interviews with individuals and small groups give marginalised and shy people the chance to talk.

- *Take notes,* at some time or another. Anthropologists routinely take notes during interviews, or record the interview. Extensionists and agricultural scientists are often reluctant to write in front of farmers; they think this puts the farmers off. Usually it doesn't. On the contrary, the farmer may feel pleased that someone is paying attention to what she has to say. But if the research team is uncomfortable taking notes, their body language will communicate that to the farmer, who may then feel ill at ease. Farmers are much more likely to feel threatened by a questionnaire form than by a blank notebook. Have your notebook in your hand or get it out soon after arriving. Open it without making a fuss about it and start jotting things down. If the farmer looks at you, you may say something like "I want to write down what you tell us, because it is important and I don't want to forget it." If you are honest, the interviewee may sense it, and trust you. If the farmer seems uncomfortable, stop taking notes, but you must sit down with the team immediately after the interview and write an account of it. But this takes a lot longer.

We do not recommend recording interviews, unless you really need a verbatim account. Recordings must be transcribed to be of much use, and that takes about eight hours per each hour of tape. If you do tape record, you must have the person's informed consent. Turn on the tape recorder and speak into it, ("It's the eighth of April, 2003, and we're interviewing Anselmo García in Santa Rita de los Imposibles. May we record you, Mr García?"). Unless he says "yes" on tape, you cannot show informed consent.

- *Tell farmers who you are and what you're studying, and who is paying* for the study. They have the right to know, and the honest information may help reduce their anxiety, and get them onto the topic. For example, "My name is Pat Smart, I'm a British consultant doing a study for some North American coffee buyers. We are interested in knowing more about how family farmers in Latin America grow coffee."

- *Be respectful.* Address them as you would a senior colleague, especially if the farmer is older than you.

- *The farmer has the right to refuse the interview.* If the farmer is eager to be interviewed, she will ask you to come onto the porch, will offer you something to eat or drink, or in some other way show a willingness to be interviewed. Do not plead with farmers to talk to you. If farmers resist being interviewed just say good-bye. In some parts of the world, you may need to be introduced before people will talk to you.

- *Be a sympathetic listener.* Saying "mm, hmm" from time to time, and use the right body language to show that you are interested in what the interviewee is saying. Phrases like "tell us more about that" often encourage a person to open up.

- *Be flexible, and open to new ideas.* Even though you have outlined some topics of interest beforehand, allow yourself to be surprised and interested in new twists.

For example, in Ecuador in 1999, while discussing shade and cacao, farmers surprised us by pointing out different ways in which cacao was occasionally the shade for coffee (Bentley *et al.* in press). If the interviewee gets way off your mandated topic, let him speak for a while and bring him gently back by saying something like "What you're saying about the water-users' association is really interesting, but getting back to the subject of coffee farming…. Can you tell us a little more about what you said earlier, about the first time you realised that you could do without insecticides?"

- *Don't interrupt a farmer who is speaking.* Do not mistake a short pause as a chance to leap in. Wait for a few seconds, and if they have really stopped talking, ask a question (Alexiades 1996).

- *Introduce the theme in broad terms,* to avoid introducing too much bias. For example if we ask farmers about the berry borer, they tend to concentrate on it, exaggerating its importance. A better tactic is to start talking about coffee, or about farming in general, and work into the more specific themes, like individual pests, or shade trees. This gives you a chance to see how important the specific ideas are in the farmers' broader context.

- *Don't interrogate.* Ask as few questions as possible. Especially in the beginning. People like to be listened to. Each question costs you rapport. Not asking questions allows farmers to feel that we have listened to them. They are then more likely to relax and answer a few questions later in the interview. Listen to the story they want to tell before breaking up their train of thought with questions.

- *Do not put the words in farmers' mouths*. Follow the thread of the conversation. If you do ask questions, ask clarifications ("What do you mean?" Or, "Why did you do that?") Or ask questions that follow on the topic ("You were telling us about pruning shade trees, how do you do that?"). Do not ask questions that can by answered by "yes" or "no." E.g. point to some diseased leaves and ask the farmer about them. This is a better way of getting onto the topic of diseases than saying "Do you have *koleroga*?"

- *Avoid jumping in*. One problem with large interview teams is that one colleague may wander off, looking at plants and pests on the farm, then comes back blurting out exciting questions about what he has seen. This often knocks the farmer off track, just as she was getting to the interesting part of some other topic. If a colleague has been interviewing a farmer, don't come in and start asking questions. Those topics may have already been covered. Your question will probably be, at best, a *non sequitur*. Listen for a while and wait until the farmer gets onto your topic, or until there is a long pause, and people are willing to have a new topic introduced.

- *Timing of questions.* Once you have developed some rapport with the farmers, and they relax, you can ask them a few questions in the second half of the interview.

- *Avoid asking farmers their land size, income* and other economic details. These questions are about as personal as their sex-life. We maintain rapport and learn a lot from the farmers by avoiding certain pointed questions, but we have to sacrifice some quantitative information in order to do so. If you really must have economic details, ask about them later in the interview, and be sensitive to farmers' discomfort about discussing them.

- *Don't preach.* This is especially important when extensionists or social "promoters" help conduct the interview. They often cannot resist breaking in with lectures on their favourite topics. This biases the farmer, who quickly learns to say what he thinks you want to hear.

Do not sacrifice the objectivity of the interview by wearing your heart on your sleeve. For example, a farmer in Nicaragua once asked us if we would like to see his macaw. He proudly showed us a dead, juvenile macaw, which he had killed on the farm. It had been amateurishly dried into a grizzly wad of feathers, and nailed to the living room wall. We avoided criticising him for killing wild birds, but went on with the interview. There will be plenty of time later in the project to address dead birds and other issues that come up in interviews.

- *Do not become exasperated with people.* A Colombian colleague once wanted to know why some farmers still planted the caturra variety of coffee instead of the Colombia variety. We met a farmer and her mother, who graciously invited us into their two-room plank house to talk about coffee growing. But when she said that "caturra is a good variety" our colleague actually took off his cap and threw it on the floor in exasperation. Of course, the farmer immediately stopped talking about the variety and we never did learn what she liked about it.

- *Take an hour or less for the interview.* Leave before people start to yawn and look at their watch. If you need to talk more, come back later, or go to another farm.

Don't interrogate. Farmers find questionnaires more threatening than a blank notebook. With questionnaires, less is usually more.

- *Ask the host family if they have any questions for you.* This is a nice way to break any tension caused by the questions the team has asked, and it starts to end the interview. The farmers may smile and say no, or ask again who you are and who you work for, or they may want to know how to control a pest.

- *Ask people's name.* It is often polite to be able to address people by their names during the interview. The extensionist usually knows the interviewee's name beforehand, but male extensionists may not know the names of the women. If you have to interview people without being introduced, some interviewees may be nervous about telling you their name until the end of the interview. If you do not know the person's name, ask before you leave.

- *Thank them* for their time and say good-bye.

- *Later, review your notes together as a team.* This may be done in narrative form ("he said this, then he said that"). Extension agents may not have enough time to help you analyse the interview, or their only free time may be in the car. After several days of interviews, the team may start to feel overwhelmed with the new information from interviews, or they may wonder if they are learning all the key ideas. It helps to take an inventory every few days, as a team. Draw up a table on large sheets of paper (the kind used for discussions at "workshops"), to compare the major points that have emerged from various interviews.

ACTIVITY 2

Go to the field with the extension agents. Ask farmers about growing coffee. Have a small set (4-7) of pre-designed questions, based on topics that emerge from Activity 1. For example, the first activity is likely to indicate that some farmers perform some cultural controls (e.g. gleaning) while others do not. You may want to ask the farmers to describe their activities, paying attention to which cultural controls they mention, and asking them why they perform those tasks.

Agree beforehand who will ask the questions. (It may be one of the extension agents.) The important thing is not who asks the questions, but listening to the answers.

Don't ask them leading questions. For example, don't say "How do you control CBB?" The question suggests that the farmer should be using some active control, and he may exaggerate the importance of insecticides in his reply. Better questions include "What are the important tasks in coffee growing?" And if he does not mention borer control, a more specific question that is still not too leading is "What do you do when you have CBB in your grove?"

4.4 LEARN FROM FARMERS

Everybody knows something, but nobody knows everything[7]. Farmers do know a lot, especially about things they regard as important, and which they have the tools to observe. For example, Quechua farmers in Bolivia can pick up a handful of moist, black soil and squeeze it between their fingertips to show the tiny, black seeds of weeds[8]. These farmers know which weed seeds are more likely to survive the trip through a sheep's guts, and end up in the manure spread on next year's potato crop. But farmers don't know everything. They tend not to understand how the market sets commodity prices, the structure of chromosomes, the existence of insects that are natural enemies of pests etc.

Ethnoscience. Interest in local knowledge goes back a long way, but not in development circles. Anthropologists have studied local knowledge since the 1960s, with a set of formal techniques and theory called ethnoscience (for example, Berlin 1992, Conklin 1962, among many others that could be cited).

The American anthropologist Eugene Hunn's thoughtful book *The Big River* describes how Indians along the Columbia River still rely on and know a great deal about wild plants (Hunn 1990).

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7 This was a favourite saying of the late Elías Sánchez ("todos sabemos algo, pero nadie lo sabe todo"), though we are not sure who said it first.

8 Especially of the invasive species *Spergula arvensis.*

9 For example, anthropologists working with the Kofyar on the Jos Plateau of Nigeria found that the agricultural calendar was essentially full. New crops had been fitted into the system until there was no slack time left (Stone, Netting & Stone 1990).

ACTIVITY 3

Visit a community and participate in or observe people perform a task related to coffee growing.

For example, watch people harvest, weed, glean, or plant coffee. Participate if you feel it is appropriate. Be able to describe the task:

- ***Amount of labour required***
- ***Tools needed***
- ***Productivity***

(See the Ecuadorian case study)

A Place Against Time by the British anthropologist Paul Sillitoe is an encyclopaedic description of environmental knowledge of a traditional people in New Guinea. Sillitoe shows that for some subjects (e.g. sweet potato varieties), local knowledge is astoundingly complex. For other topics, traditional knowledge is fragmentary or incomplete (e.g. pests and diseases and geology) while for others (like soils) local knowledge is deep and detailed, yet bears little resemblance to modern scientific accounts of the same subject (Sillitoe 1996). The gist of ethnoscience is learning local categories for things (insects, plants, diseases, people etc.), and the meanings of those categories. (See Annex, an outline of ethnoscience).

During initial interviews with farmers, we can elicit their terms for social categories (e.g. wealthy farmers, poor farmers, labourers, cattle owners etc.). Farmers can tell us which local families belong to which categories, which may help to ensure that all groups are represented in the research. Farmers may be asked to draw calendars of their activities (including off-farm labour), which will allow researchers to identify labour bottlenecks[9]. Local classifications of soil, climate, crops etc. will give scientists a starting place for studying local knowledge (for filling in gaps in farmer knowledge, learning new information, designing collaborative research; see Bellon 2001).

4.5 OBSERVE FARMERS' BEHAVIOUR

Social study of behaviour. For example, coffee berries dropped onto the ground are a habitat for CBB, so in every country we need to know what percentage of farmers pick coffee off the ground (or allow others to do so). In Ecuador, we know that during the harvest, some labourers cut open two sacks and sew them together, and then carefully gather all the berries that fall on them. But we do not know how common this practice is. These are just some of the agronomic practices that influence CBB populations. Some of them may seem trivial, but they are not and we need to know about them. Researchers could either validate this information or use it as the basis for a new technology.

Visit coffee groves to see what the production looks like. Look around to see if the groves are weedy, if there are coffee berries on the ground, or coffee seedlings sprouting from fallen berries from previous harvests.

4.6 LEARN FARMERS' RESEARCH NEEDS

Appraisals. Early in a project's life, the staff needs a formal learning experience with farmers, in order to refine ideas about what the existing farming system is and what the real research demands are. We give a few examples of method below. The main idea is to give the reader a flavour for the wide range of methods that exist. There is no orthodox method, and new ones can be created and old ones can be combined. A creative research team designs a practical study that is consistent with the topic at hand.

Questionnaires. Long questionnaires are the most abused and over-used social science tool in existence. As Robert Chambers pointed out years ago, they tend to be too long, they ask the wrong questions, and most projects do not budget enough time to analyse the numbers or write the results (Chambers 1983). Better questionnaires are shorter, and more to the point, based on a qualitative understanding of local people. This project started with a questionnaire in most countries, and they were fairly well done, largely because the staff already had a sophisticated idea of what to ask the farmers. The questionnaires suggested that most of the farm families had under five hectares in coffee, and most also had some other crops. Most hire labour, used insecticide and had had problems with CBB.

The Honduran questionnaire reported that 36% of farmers claimed to apply insecticides only on hot-spots. Qualitative interviews (and formal studies, see Mexico and Colombia Case Studies) later supported the idea that farmers can identify hot-spots, and apply a control measure just where it is needed. When interpreting questionnaire data one must always bear in mind that the reliability is low. For example, in Ecuador, 77% of farmers denied stripping the coffee berries from the trees. The extensionists said in fact stripping coffee was much more common, and the study of post-harvest machinery (Ecuador Case Study) reconfirmed the extensionists' notion.

Short questionnaire plus sampling. We have been working on a hybrid research method combining a one-page questionnaire with direct observations. In Mexico, researchers asked farmers if CBB were distributed uniformly or not. Most farmers said the CBB lived in *manchones* (large spots). Researchers asked what caused the large spots of CBB, and visited the spots with the farmers. The researchers confirmed that the spots were indeed infested with CBB, and took data on shade, proximity to roads and other data, to verify local knowledge of why the CBB are more common in some parts of the grove. (See Section 3 of the Mexico Case Study).

PRA. The Participatory Rural Appraisal (originally called "Rapid Rural Appraisal") has been used extensively to assess the demands of rural people for development projects. It was developed in the late 1970s in India and Nepal, and was championed by Robert Chambers. There are already several good manuals on how to do a PRA, including one in English by McCracken and colleagues (1988) and one in Spanish by Katrin Linzer (1995). There are many shorter articles on PRA, especially in the journal devoted to it (*PLA Notes*).

One of the strong points about PRAs is that researchers go to a village and stay there, for four days and nights, or longer, giving them contact with rural people that may otherwise not be part of their experience. The PRA stresses listening to villagers, rather than lecturing them. Another valuable lesson from the PRA is the reliance on a set of tools (interviews, transects, agricultural calendars, local oral history and others). A religion didn't quite spring up around PRA, but it was a refreshing change from the questionnaire, and for a few years doing a PRA was a required start for any donor-funded project. Since 1995, Stephen Biggs (1995, Biggs & Smith 1997), Paul Richards (1995), Robert Rhoades (1998) and others have severely criticised the PRA: arguing that it is simply a new orthodoxy, that it can be manipulated to back up the agenda of the facilitators, that it is paternalistic and that it treats rural people like schoolchildren. Village leaders can manipulate PRAs so that ethnic minorities, the poor and other groups are excluded from discussions.

PRAs take up a lot of rural people's precious time. Another problem with the PRA is its emphasis on drawing pictures and charts. Rural people are expert speakers, not expert artists, and their drawings can look naïve, which may, at a subliminal level, reinforce some researchers' stereotypes of *campesinos* as simple and unsophisticated. PRA facilitators also tend to leave all the drawings in the community, and to document little of the experience later in writing. On the other hand, Nazarea-Sandoval (1995) skilfully analysed farmers' drawings to learn about their attitudes about IPM and farming in the Philippines.

PRAs are now being rapidly dropped from the agenda of formal development, and have not been replaced by any other social science research method. The lack of yet another new orthodoxy is a positive step. But it also means that development professionals, many of whom have no social science background, are now left without a model of how to interact with communities. While the PRA was due for some well-deserved criticism, it is disconcerting that the development community is throwing the method out like last Sunday's newspaper, without incorporating its better ideas into an improved method.

Three legs: local extensionists can outline a lot of information for you in a hour or two

The PRA was valuable because it induced many senior researchers to talk to farmers. It was relaxed (Chambers 1992). Researchers actually slept in a village for three or four nights, while now we seem to be returning to drive-by visits. PRA's toolbox of various methods was flexible enough that social scientists were just starting to use it for empirical studies reported in academic journals (e.g. a study of villages in Eritrea: Tesfai & de Graaf 2000).

Sondeo. The sondeo is a sensible, practical method, developed in Guatemala (Hildebrand 1981). It was eclipsed by the PRA, but it is worth considering again. An ideal sondeo is carried out by 3 social scientists and 3 agricultural scientists. Finding enough social scientists was often a limitation, but the idea was that every day one social scientist would team up with an agricultural scientist to walk around in the countryside and chat with farmers.

The team would sleep in a provincial town and visit a different village every day. The sondeo involves some nice touches, like buying a watermelon in a local market, slicing it up under a shade tree and inviting passing farmers to sit and eat some and chat about their work for a few minutes (Peter Hildebrand, personal communication). The sondeo starts on Monday, with a final write-up by Saturday. It is a quick, interdisciplinary way to get a description of a province's agriculture.

Three legs. During a previous CABI project with coffee in Colombia in 1996, Jeff Bentley and John Stonehouse began experimenting with short PRA-type workshops with extensionists, who enjoyed drawing maps and charts about the adoption of IPM technologies.

The extensionists were pleased to have someone ask their opinion about farming systems in their area. Along with other colleagues we later found that extensionists or other grassroots technical people could provide a quick overview of an area. Talking with extensionists is no substitute for interviewing farmers, but a two to four hour session can be a productive start to formal social research. The extensionist's perspective allows triangulation (hence the three legs) between the scientists' and farmers' ideas. See Bentley *et al.* (in press) for a more complete description and a case study of a survey of farmer knowledge in Peru.

Semi-structured interview. The interviewer has some topics in mind, but is open to other ideas as well. The semi-structured interview is one of the most versatile methods, and can be adapted to almost any topic. It also forms the basis of the sondeo, participant observation and many other methods. Speaking has a "natural" feel to it, because language is innately human. Farmers have large vocabularies, highly abstract grammar and can develop as complex a conversation as anyone. Asking farmers to draw something during a PRA does not always elicit the kinds of wise, perceptive statements that are common in their speech. See some of the farmer quotes in the Colombia Case Study for examples. The hardest part of an interview is not asking the questions, but listening and writing up the answers. See also the tips for interviewing farmers in Section 4.3.

Participant observation. This is the most powerful, versatile and objective way of getting a qualitative view of another people. It involves living in a community for a year or two, going with people as they go about their business and then describing it. Participant observation is an old method.

The classic account based on participant observation is the description of inter-island ritual trading in Melanesia by the British-trained, Polish anthropologist Bronislaw Malinowski (1922), whose fieldwork was conducted during the First World War. Twenty years earlier, the American anthropologist Frank Cushing wrote of his 7 years among the Zuni of New Mexico, from pottery (Cushing 1886) to creation myths (Cushing 1926)[10]. Participant observation is well suited to studying smallholder agriculture, because the researcher can work alongside the farmers and see what they actually do, and it continues to be the preferred research tool of anthropologists. Paul Sillitoe's (1996) beautiful account of local knowledge of agriculture (including pests) among the Wola of New Guinea is based on many years of participant observation. Yunita Winarto's description of a farmer field school in Java is the most meaningful account available of the impact of an IPM program, because

[10] Nothing is sacred. See Hughte (1995) for a cartoon parody by a Zuni artist (published in *American Anthropologist*).

she lived in the village long enough to "get" the farmers' perspective (Winarto 1996).

Few senior agricultural researchers can spend a year or two in a village, but most of them can sponsor students to do so. Students have the time, and their stipends are well within the budgets of most projects. The senior researcher must visit the student occasionally, read her thesis and otherwise provide leadership, but participant observation can be an effective way for an agronomy student to learn social science skills, or for an anthropology student to learn about agriculture. This cross-disciplinary experience will pay dividends to agricultural development for the rest of the student's later career. Participant observation as student projects are of uneven quality. Some people are more insightful observers than others, and some students find it difficult to express what they have learned. They are affordable, so sponsor two or three students to do participant observation, and at least one should return good results, especially if you:

- Give them clear objectives.
- Demand occasional reports or ask to see their field notes, to make sure they are on the right track.
- Visit them in the field once in a while.

Avoid getting a naïve collection of obvious problems: be aware that all people in the community may not have the same needs. Wealthier people, men and members of the dominant ethnic group may take the floor to exclude or manipulate others. Even assuming that the researchers have talked to people representing the various groups of the farming community, as we see in the following section, people may not be able to articulate all their research demands.

Explicit and implicit demands. Explicit demands, the things people tell researchers they need, are not always very useful. A small town mayor in Bolivia once told Bentley that their greatest need was to learn to use highly toxic chemicals. Many rural people are highly in favour of insecticides, or may want to kill beneficial insects. A common demand is for price supports for agricultural products or subsidies for seeds and fertiliser. Researchers still have to learn farmers' explicit demands, but must also dig deeper. For example, coffee growers have explicitly demanded control of the CBB. But few if any smallholders in Latin America demanded that entomologists bring parasitic hymenoptera from Africa, because farmers did not know that the wasps existed. Still, entomologists correctly perceived that if the releases were successful, they would satisfy the farmers' demands for pest control. Likewise, people cannot demand nematode control if they do not know the worms exist. Similarly they cannot ask for help setting up inspections for bird-friendly coffee if they do not know about such programmes.

Of course, there's a fine line between intuiting people's implicit demands and paternalistically imposing your own agenda. At conferences one may run into "participatory extremists" who think that a project should only do what farmers specifically mention. But few of these people are running projects. One of the most serious efforts to incorporate farmer demand has been the Swiss-funded ATICA project in Cochabamba and Chuquisaca, Bolivia. Beginning in 1999, they gathered community demands in meetings in about 100 villages in six municipalities. Even so, project leaders realise that these demands (mostly for pest control and soil-&-water conservation, it turns out) must be refined with technical help to ensure that the resulting projects are sensitive to social, technical, financial, natural resources and gender issues (ATICA 2001). See the Ecuador Case Study for an example of how researchers responded to an implicit demand for a study of the relationship between coffee varieties and CBB incidence.

Problem vs. demand[11]. Farmers' problems usually boil down to a limitation to profitable farming, e.g. a pest or marketing problem. A demand is a functional solution to that problem. For example, the CBB is a problem. But so is the high cost of labour.

The demand is for an insect control that either saves labour or costs little money. That is one reason farmers like insecticides; they are affordable, time-saving and they kill insects, at least in the short-term. Insecticides may not be a lasting response to the demand, because they often cause resistance in pest populations and kill beneficial insects, although farmers don't know that when they start using them.

[11] This idea was first suggested by Andre Devaux, a CIP researcher in Lima, Peru.

Let the farmer have his say

In an example from India, farmers wanted control of a lepidopteran pest (*Helicoverpa sp.*) of pigeon pea. A project promoted two technologies: crushed neem kernel extract and NPV virus. Both had to be prepared by farmers, who did not like grinding the unsavoury neem kernels on their food preparation stones; nor did they like mixing and spraying 500 dead caterpillars to get the NPV. Farmers would use these alternative insecticides only if NGO staff prepared them, but rarely mixed them themselves (Tripp & Ali 2001). The innovations were not spreading spontaneously, because they were directed at a problem, but did not satisfy the demand.

How to ask farmers about their research needs. If 6 people from the city drive their car into a village and blurt out "what are your problems?" farmers will have high hopes that the researchers will then solve all these problems (e.g. building bridges and roads, creating and staffing schools and health care centres). Avoid raising expectations that you cannot fulfill. Even after carefully explaining that the researchers are in the community to help with agricultural research, villagers may have unrealistic expectations. Some rural people think that scientists already know the answers to all the health problems with crops and animals, and may become disillusioned when researchers explain the need to do more research to learn the answers. Farmers may exaggerate the importance of insect pests, naming every large, herbivorous insect in the ecosystem, believing that the project will donate insecticides.

Learn researchable topics. It is important to know the right format for asking questions (what anthropologists call eliciting frames). We have already discussed avoiding leading questions, like "do you perform sanitary harvests?" Or "what kind of insecticide do you use?".

Avoid asking "what are your problems?". Such a question induces farmers to exaggerate their problems. It also raises expectations. In many parts of Central America, the lack of enough clean water at harvest time is a real problem that keeps farmers from washing their coffee. Unless the team includes hydrologists, and is prepared to work on water supplies, it may be best not to raise local people's expectations that the project will work on water.

ACTIVITY 4

Rank research demands on a scale of 1 to 10.

Based on your experiences with the previous exercises, decide which are the most important research demands from farmers. Include explicit and implicit demands. Visit farmers and discuss the researchable topics with them. It may be helpful to ask farmers to rank them. When ranking, the order is not so important as which ones farmers regard as indispensable. For example, while testing new forage plants in Bolivia (on another project), we saw that farmers accepted the ones that survived local conditions, and rejected the ones that died. Asking them to rank seven or eight dead species of grass seemed silly to the farmers. A new species could either survive local conditions or it could not. The meaningful question was: which new plants would they sow again? Likewise with research demands, try to determine which ones are essential and which ones are not.

Modify the demands according to farmers' suggestions.

Example of a researchable topic. Sampling is key to Integrated Pest Management, yet in most projects, farmers are reluctant to sample. Initial social science research on our CFC CBB project suggests that farmers need sampling techniques that are less mathematical and use less labour. This is where things get tricky: farmers are not going to just come out and say "we need a new sampling method." You have to figure it out, based on what they say and do.

"What this village needs is more mango varieties". When gauging implicit farmer demand be careful not just to impose your own biases. For example, there was a mango breeder who met with farmers in various communities of a certain South Asian country, and after each meeting concluded that farmers' main research demand was for more improved mango varieties. Be more open to new ideas.

Chapter 5

Planning research with farmers

"We trained hard, but it seemed that whenever we were beginning to form up into teams we would be re-organised. I was to learn later in life that we tend to meet any new situation by re-organising, and a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency and demoralisation."

Author unknown, commonly but wrongly attributed to Gaius Petronius

"Three key decisions for a scientist using a participatory approach are deciding where to work (in other words, selecting a site), who to work with (who participates?), and how to work with them."

[Mauricio Bellon 2001 Participatory Research Methods for Technology Evaluation]

5.1 DECIDING THE APPROPRIATE LEVEL OF FARMER-SCIENTIST COLLABORATION

Farmers and scientists know different things. Depending on the research topic each will have a greater or lesser contribution to make. Researchers may have to chose early in the study whether to delegate more of the research to farmers, or to conduct most of a given trial themselves (for example, see the experiment with traps, Ecuador Case Study). The decision depends on whether scientists or farmers have the greatest comparative advantage for that topic.

Farmers' comparative advantage. They know their own labour and capital constraints. This is especially important for research on cultural controls. For example, the farmers know when they have time to perform the cleansing harvests and gleanings that help lower CBB populations. Farmers have the ability to extrapolate qualitatively. Farmers also know the details of their own environment (things like, "this is the shadiest part of the grove; this is the part that yields the most; these are the CBB hot-spots").

Scientists' comparative advantage. Scientists understand numbers, not just high-powered statistics, but also more prosaic concepts like percentages and probability.

Scientific concepts—like genetics, organic evolution, insect ecology, sexual reproduction, geological time, price-setting through supply and demand—may seem obvious to many researchers, but can be revolutionary topics to farmers.

The different levels of farmer involvement.
In 1989, Stephen Biggs proposed the following four levels of farmer participation in research.

1. Contractual (farmers participate the least)
2. Consultative
3. Collaborative
4. Collegiate (farmers participate the most)

◆ *Level 1, "contractual",- the least participatory.*
For a while, agricultural development experts almost lost sight of the fact that on-station research is still important. The Colombian beneficio ecológico ("Becolsub" ecological coffee processor) is one example of a successful technology recently developed on-station, with little input from farmers. In another case, British scientists in Bolivia recently brought about 20 legume crops to the country for local testing. They needed a quick, quantitative evaluation of each species' response to local conditions, and decided to do the first round on-station, which minimised travel time, costs and allowed easier control over the crop. Later trials of the more promising legumes will later be conducted with farmers (Sims & Bentley, in press).

In Ecuador, researchers on this project tested CBB traps, and worked with different designs and baits. They needed some simple, numerical data (e.g. how many CBB fell into which kind of alcohol). Rather

Farmers can help with experiments

than trying to involve farmers very much with this particular experiment, the researchers decided to carry it out themselves, on-farm, but with most of the decisions taken by researchers (see Ecuador case study).

- *Levels 2-3, "consultative & collaborative", -more participatory.* This is the kind of research most often thought of as participatory. It involves more or less equal collaboration between scientists and farmers. It takes place on-farm. Farmers not only provide land and labour, but make an intellectual contribution to the research. The trials have some of the format of on-station research. The example in Box 4 shows that researchers in India invented a new harvest technology based on traditional farmer picking mats. In Box 5, some of the treatments for an experiment in Ecuador were farmers' existing practices. In both cases farmers contributed intellectually to the research.

- *Level 4, collegiate: "the most participatory".* - This is potentially the most important and rewarding level, where farmers conduct their own research, and researchers support them as colleagues. Because the farmer leads the research, the method is more open-

Box 4 *Consultative research (scientist discusses research with farmers).*

Example: Inventing picking mats with farmers in India

In 1990, the CBB came to Kerala. Coffee Board entomologist C. B. Prakasan is from Kerala, but was working in Coorg, Karnataka from 1992 to 1996. In Kerala he had seen people tying a mat or tarp onto the tree at harvest, which is a traditional practice, to keep the berries from rolling down steep slopes. Prakasan thought that the same idea could be used for CBB control. Prakasan asked Thammaiah, an extension inspector, to make some bags. Thammaiah told some labourers to cut open some gunny bags and stitch them together. With the active involvement of Mr. H. K. Dhruvkumar, the then Junior Liaison Officer of Siddapur, Coorg, Karnataka, they demonstrated the picking mats in a video film on CBB in 1994. Then without any trials, but as a hypothesis, the researchers took the mats to the field. The extension service started teaching the mats to growers in the village of Ammathi, Kodagu, and the mats were adopted by the Coffee Board for CBB management.

Box 5 *Collaborative research (scientist and farmer work together)*

Example: participatory research with planting styles in Ecuador

Researchers and farmers evaluated two types of seedbed and two types of transplant, for a total of four treatments. The experiment was conducted on five farms, each of which was a replicate. The seedbed treatments were 1) the seedbed and 2) direct planting.

From the seedbed, the coffee was transplanted to either standard, black-plastic bags, or to a raised platform that is 30 cm tall and composed of three parts black earth, two parts decomposed livestock manure and one part sand. Coffee was planted 15 cm apart.

Afterwards, the agronomists weighed some of the coffee plants in the laboratory. They also evaluated the treatments with the farmers. Now they are studying the adaptation of the seedlings to the coffee grove.

The scientific recommendation had been to use plastic bags. But the best results were obtained with coffee that was not germinated in a seedbed, but planted directly into a raised platform, and not into a black-plastic bag. The extensionist/researcher (Evaristo Calle) concluded, "we learned that the farmers' practice might be best".

Box 6 *Farmer invention stimulated by learning about a technology*

Staff of the CFC CBB project taught Colombian farmers to use boxes (tolvas) with greased plastic covers for storing freshly harvested coffee berries. One of the farmers (Wálker Cano) made a radical modification of the technology. He invented a greased plastic drum with backpack straps, for holding and hauling coffee berries in the grove during harvest. Colombian researchers then helped Mr Cano and other community members to validate the invention, and invited them to a farmer-experimenter workshop where other farmers could learn about it (see Colombia Case Study).

ended. Perhaps for this reason researchers are generally slow to recognise opportunities to work this way. The scientist has four main contributions to make to farmer-experimenters.

- Share scientific concepts with them that may inspire them to see the world in a different way.
- Show them new techniques, which the farmers may later modify.
- Validate. Reconfirm the functionality of the farmers' invention.
- Moral support. Recognise their efforts, and help other farmers to learn about their inventions.

One example is from Zamorano, where agronomists taught Honduran farmers that wasps and ants were natural enemies of insect pests. Several farmers then began spraying sugar water and fruit extracts on maize to attract predatory Hymenoptera to attack fall armyworm. Luis Cañas later wrote a Ph.D. thesis in entomology at Purdue University, validating the innovation (Cañas & O'Neil1998). See also the Honduran Case Study for an example of a large, commercial farmer who invented a novel method of strip applications of insecticide, based on new information he learned from the Project.

Conclusion: deciding on the level of farmer involvement. For a project trying to achieve an impact at community-level, level 2-3 (see above) is probably the most appropriate. They are methods for working with groups of people, adapting not-very-novel new technologies for local conditions. If you need a rapid, quantified response to research questions (e.g. response to fertiliser), level 1 (the least participatory) is best. Level 4 (farmer's own research, supported by researchers) is best done with individual farmers. It is well suited to developing (some kinds) of technology, but not for spreading it to other farmers.

5.2 CONTACTING COMMUNITIES

Picking communities. Communities can be chosen at random, purposefully, or self-interestedly. Samples may be *ad hoc* or stratified. However, "in many cases this decision (of where to work) is pre-ordained for administrative, political or logistical reasons" (Bellon 2001:16).

- *Random selection.* In theory this should be simple. Take a map of the area, or a basic geography. Write the community names on slips of paper and pull some out of a hat. Few projects start this way. Researchers almost always have some characteristics in mind and are not particularly interested in working in random villages.

- *Purposeful selection.* One strategy is to choose the communities that suffer in the most extreme way from a given problem. This ensures that the problem is of interest to the community. One of the best examples of this was the case of the Mexican project (see Mexico Case Study), where researchers carefully selected the communities that had the most concerns about CBB, in order to ensure local interest in the participatory research. Other forms of purposeful sampling might include electing the communities:

  - closest to a national park, with coffee grown under natural forest trees, in order to work with shade management and biological conservation.

  - that produce the highest quality of coffee, to make sure that the project result is socially and environmentally sound coffee, that can also be sold on a premium market.

- *Selection through self-interest.* No one will admit to having chosen their project sites this way, but development projects are occasionally chosen with the comfort of project staff in mind. Latin American smallholders live in some remote areas, and projects tend to avoid the most distant ones, working with villages near the main highways, around the nicer cities, in the least violent countries. In part this is because project leaders want to live in cities where there are school and job opportunities for their own families, and field sites are chosen near those cities. Coffee programs have not always had this luxury, because of the importance of coffee in the nations' macro-economy. Coffee programs have made more of an effort to reach a broad range of coffee growers.

- *Ad hoc selection.* The course of least resistance is to simply keep working in the community where one has always worked, or where ones friends have worked. This is not quite as cynical as it seems. If the researchers already have rapport with a community, it may be easier for them to work there than if they have to start all over again, getting to know a different group of farmers, all of which takes time. The problem may be that such communities are not necessarily representative (usually being on the highway, near the research centre and have already been visited by many extension agents and researchers). It is usually a good idea to avoid the most difficult or distant localities, at least to start with, until you can fully appreciate the problems of your chosen topic. You have to get a result to your project in a finite time and you should allow for that which you cannot foresee.

- *Stratified selection.* Researchers may chose sites based on two, or at most three contrasting variables. For example, communities in an area could be classified into four groups, using a simple matrix, according to two variables, altitude and degree of crop diversity (Table 4).

Whichever method the project uses to choose communities, also bear in mind that most areas have agro-ecozones, with different pest problems, and different coffee qualities in each one. An area typically has 1) a high zone of high quality and low pest problems, 2) a medium zone of acceptable coffee quality and more pest problems, and 3) a low or marginal zone of poor coffee and lots of pests. Choosing communities with these zones in mind does not mean choosing villages in each one. E.g., a project interested in gourmet coffee and cloud forests would only work in the highest zone. In the year 2010 if a major increase in world coffee drinking has boosted prices of even mediocre grades, a project with a pest bias would choose to work in zone 3. A project with a social mandate might choose to work in zone 2 if the area was home to a large constituency of coffee-growing smallholders, with an agronomic problem that could be solved by research, thus increasing coffee quality.

Table 4 *Example of matrix for selecting four types of communities, with two variables*

	Coffee monocrop	*Coffee and other crops*
High altitude		
Low altitude		

- *Post-FFS FPR.* Another option is to conduct one or more FFSs, and build on them for FPR in later years. The experience reported in Kimani *et al.* (2000) is one example. If you decide to do this before establishing the field schools, you will still need to take into account all of the information in this section on choosing communities. Setting up FPR with existing or earlier field schools is possible, and is a kind of ad hoc selection.

- *How many communities?* The number of communities to work with depends partly on the project's human and financial resources. Our CFC CBB project in Colombia worked with nine communities, because each of the three researchers could cover three (each researcher also had two assistants). Three or four communities per researcher is about a maximum load, allowing a visit per week to each, and time for preparation, writing and administration. This could be doubled, by going once every two weeks to each site.

Another consideration: how much of a direct impact does the project intend to have? If the project is designed to invent a better beetle trap, and then disseminate it by mass media and conventional extension to a large area, then one or two communities in each major agro-ecozone is probably enough. If a project wants to have an immediate impact in a certain area (e.g. if environmental activists want to stem illegal clearing of forests in a national park), then researchers may want to work directly with all or most of the relevant communities.

Social structure. Local leaders . Some rural villages are highly organised and others have a structure as loose as a bag of marbles. In some countries, like Bolivia or Mexico there is a formal, political structure at the village level, with local leaders who can help call community meetings. In some countries, e.g. Honduras, each household must be individually invited to meetings. Each country is different, and local extension agents can explain ways of approaching a community to start a research project with them.

In our CFC CBB project, we used a wide range of ways to contact local leaders. In Mexico, project staff contacted leaders of the *ejido* (land reform community) organisation, who helped get in touch with local leaders. Likewise, in Colombia, researchers contacted extensionists from the Coffee Growers' Federation, who introduced them to local leaders. In that case, the biggest problem was "turf," the extensionists had to be constantly reassured that the researchers were not "doing extension." In Ecuador when our project started, the village level organisations were weak. Old self-help groups had been established, but were inactive. Still, project extension agents went to villages, asked who were the former leaders of the self-help groups, and simply introduced themselves and asked the former leaders if they would help the extensionists invite their neighbours to a community meeting. In Honduras and Guatemala, the project simply continued working with communities where researchers had long-standing relationships.

- *Farmer committees.* Local research committees are useful. When working on level 2-3 research, with several replicates of the treatments, in several farms, the best way to work with the farmers is in small groups, or committees. Take care to choose the committee *with the community*. If an extension agent picks the committee, he will probably choose "progressive" farmers, men that he gets along with, but not necessarily people that the community would choose. Researchers should meet on a regular basis with the committee, taking data and discussing the trial's progress with the farmers. The whole community need not necessarily meet again until near the end of the season, when the committee can explain the results to their neighbours.

5.3 AROUSING COMMUNITY INTEREST

It takes time to develop these skills – we all make mistakes - don't get discouraged, keep trying, try a range of things. Local people do not expect the project staff to be perfect. As long as researchers and extension agents keep their appointments with the community, and observe the following protocols, odds are good that the people will collaborate with the project until the end.

Identifying the problem you are going to work on. Chapter 4 discussed how to identify researchable problems with farmers. These still need to be formally presented to the communities, for their approval. It is important that the whole community gives an opinion of the research agenda. Go to the community with a research agenda (based on interviews, *sondeos* etc. with farmers in the area) and present it to them to ratify, modify and reject, item by item. Take a team of four or five facilitators. After an initial meeting, divide the community into interest groups (e.g. men, women, farmers, other occupation groups, elders, youth). Many rural communities have ethnic minorities who should be consulted. It is common for communities to have ethnic, religious or political factions. Indians (native Americans) are disenfranchised in much of Latin America, as are "tribal" peoples in India. After the civil wars in Central America there was bad feeling between people who had fought on opposite sides. If local social relations are strained it will take skill and local understanding to create a space where all the groups can be consulted. For example, researchers may want to contact influential members of the minority community, and hold a smaller meeting in a private home, to ensure that their concerns are met.

At the first meeting it is important to go beyond just presenting farmers' problems back to them. They may become bored and frustrated. Also, present an outline research agenda, to show community members that the project team has started to think of possible solutions. By dividing community members into four or five groups, even if the groups are random or chosen *ad hoc* by the people themselves, it will give a chance for more people to talk. The facilitators can help them write their concerns on paper, and express them in a closing session with the whole community. If you really did learn the demands for research in the first phase of the project, at the close of the first meeting with the community, you will be able to say something like, "We learned by talking to you earlier that your problems are X, Y and Z. This afternoon we proposed A, B, C and D. Your comments in the work groups have helped us to see that we need to take the following into account…"

Agreeing on priorities. In theory, the researchers choose the research agenda with the community. In actual practice, even the projects with the most politically correct rhetoric start with an agenda and look for communities that will accept it. The reason is simple. Any community can have a complex agenda, much of it involving large capital expenses. Virtually all rural communities want an access road, electricity, drinking water, school, health care etc. Some communities in special circumstances demand irrigation, more land, secure land title, paid jobs, protection from other settlers, etc.

Agricultural research is rarely as important to a community as any of the above, although the current problem with low coffee prices has now become a major problem in communities that specialize in coffee. This is not to say that agricultural research and training is unimportant to communities, because it *is* important. Even so, farmers may be concerned about several topics, e.g. soil conservation, soil fertility management, water management, livestock health, crop management (usually for one to four commercial crops and 20 to 30 subsistence ones), seeds, pests (arthropods, weeds and diseases), for several crops.

Few institutions can keep up with farmers' potential demand for research, let alone with a rural community's demands for roads, schools and other capital-intensive development. Institutions have a smaller agenda, determined by their interests and their competence. Thus an institution and the communities must negotiate their joint agenda in good faith, what is called *concertación* in Spanish. They must do a kind of categorisation:

a. An important part of the community's agenda, but not of interest to the institution. ("We don't build roads.").

b. Part of the institution's competence, but of little use to the community. (E.g.: researchers may know a lot about CBB, but is not a pest in some communities):

c. Of interest to both. (E.g. a technology to lower coffee production costs and increase quality).

The community and the project team agree on topics of the last category. Try to understand the communities' explicit demands and design a research agenda that they will buy into. Avoid "snowing" the community by forcing them to accept the project's agenda. On other projects, we have heard farmers mouthing back the extensionist's environmental rhetoric ("We never use chemicals; that would damage the environment") but later discussing the use of insecticides in the extension agent's absence.

Maize scientists in Oaxaca, Mexico, asked a group of farmers to prioritize their problems. Of eight major problems, the top three were all with coffee (low prices, shortage of labour, lack of washing and drying facilities). The maize researchers opted to work with problem #5—small maize harvest (Bellon 2001). This example shows two things: 1) None of the demands were for pest research. This is often the case with coffee, and researchers who have been trained as entomologists or agronomists are currently obliged to deal with marketing and processing problems, 2) Farmers are generalists, growing maize, coffee, pepper, bananas and 20 other crops, and livestock as well. Scientists are specialists of one crop, or one aspect of a crop.

Setting an agenda. During one of the first community meetings, agree with local people on the topic(s) for participatory research (see Section 6.1). We suggest:

- Setting regular dates for return visits, for example, every two or four weeks, on the same day of the week and the same time of day.

- Starting preparing for the research after coffee harvest, before they have started their tasks for the following year (e.g. pruning, weeding, fertilisation).

- Working out an agenda with the community based on their interests (e.g. pest and disease control, improving quality), adding other topics that they may not realise are also important.

The greatest limitation on the agenda is scientists' creativity. Farmers will test nearly all of the ideas that are presented to them. Present new ideas (diagnosis, bioecology and control) just before the time of year when they must be implemented. For example, discuss the importance of a first fruits harvest a week or two before the first berries are ripe, to give farmers time to decide to try the technique, but not time to forget about it.

- *Set a large agenda and allow farmers to choose from it.* A consistent problem in participatory research is scientists who set a small agenda of pet ideas, and who refuse to accept the fact that the farmers consistently reject these ideas, and for good reason.

For example, before the CFC CBB project started, researchers in Colombia insisted that extensionists teach farmers to culture an entomopathogenic fungus (*Beauveria bassiana*, Bb) at home. In theory it was a nice idea: farmers would boil rice, put it in old rum bottles and grow fungus on the rice, later to spray on the coffee groves, controlling CBB with non-toxic fungus. In practice, it was complicated, farmers did not have enough room at home to cook and store the fungus, contamination of the fungus-on-rice culture was common and it was not always easy to come up with enough empty rum bottles. In the end, thousands of farmers adopted, then abandoned, *Bb* culture. The extensionists were upset at having lost credibility among farmers, and the researchers were also embarrassed. The whole sad event could have been avoided by discussing and fine-tuning the research agenda with farmer colleagues, by setting up some farmer groups to try the technology on a pilot scale before launching a regional effort.

- *Only promise what you will fulfil.* Community members do not expect project staff to know everything or to solve all their problems. They just expect people who are honest and follow through. Some people think they need to promise a lot of things to ensure community participation. This is not true and in the long run is counter-productive. If local people ask for something you know you cannot fulfill, do not tell them that you will look into it. Just tell that that you cannot do it.

Getting and keeping extensionist collaboration. Some projects use extensionists as the foot soldiers of participatory research, - conducting community meetings. The results are not always very rewarding. Extensionists think like extensionists, not like researchers: extensionists like to show farmers new things to try. Extensionists tend to be poor at documenting their work. They also tend to give little importance to farmer inventions. For example, in India a farmer unrolled two large picking mats, and showed us how he had modified them, by slitting them to the middle on one side. This allowed pickers to pull the mat right around the tree. The farmer also said he was thinking of experimenting with a rope and a set of holes, "like a shoelace" that would allow labourers to tie the slit shut. The shoelace would take more time, but would keep more coffee off the ground. The farmer suggested that the mats should come already cut with a slit. The extensionist could have reacted by saying:

a) "What a great idea, I'll tell other farmers about it." Or -

b) "That's interesting. Let's try to validate it and see how much time it takes and how much coffee it saves." Or even -

c) "Yes, I've seen other farmers do similar things." But no, he said -

d) "We have enough trouble as it is getting our manufacturer to make the mats. We can't get them to add another specification."

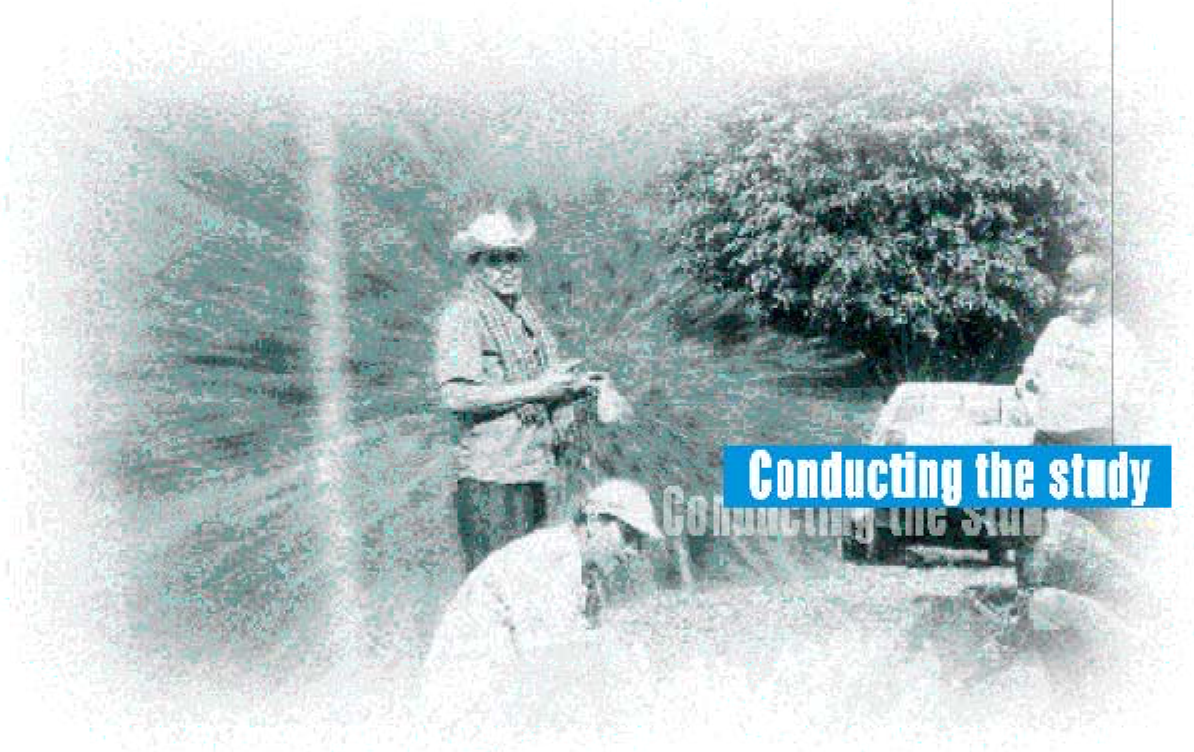
In spite of such wasted opportunities to support farmer research, extensionists are often skilled at dealing with communities, and are more willing to go to a community every week than most researchers are (the average scientist has classes to teach, a department to run, committees to sit on….). The best solution is for ambitious young researchers to accept the challenge of collaborating with communities (as was the case with our Mexico and Colombia projects). Another solution is for researchers to work closely with extensionists, going with them to the field on some of the visits (as in our Ecuador project).

If the project hires and supervises extensionists directly, the secret to keeping them is paying a premium salary and attending to basic good management. Our experience in Latin America has been that extensionists quit low-paying programs and gravitate towards higher-paying ones; some have even emigrated. If extensionists are paid a decent wage and given adequate moral and logistical support, they will probably stay. If they feel that their boss won't listen to them, that they cannot get access to a car or a motorbike when they need to go to communities, or if they cannot get advances for subsistence expenses, then they will look for work elsewhere.

Working with extensionists on someone else's project is not as easy. A research program frequently signs an agreement with another institution to carry its ideas to farmers. It can work well, but the grassroots personnel are sometimes caught in the bind of being asked to do additional work with no additional reward. On our Ecuador project, researchers offered the extensionists in another institution a modest, US $20 bonus per month to collaborate with us. More than the money, the extensionists appreciated the gesture of good will, and many of them actively supported the Project until it was completed.

Most agreements for extension services involve paying for them. Success depends in part on the attitude of the extensionists' supervisor. If he or she feels that the services are reasonable, and communicates this idea to the extensionists, they will be likely to carry out the tasks responsibly. It is useful for the institution that contracts the services to host a training event for the extensionists. Good training will impress the extensionists with the intellectual authority of the contracting institution, and create loyalty, while bad training will create cynicism. Continue working with extensionists and their supervisors in the field. Make payments to the extension service based on completion of certain milestones (so many agronomic trials established in so many communities, data taken, report written etc.) rather than on a strict calendar basis.

Chapter 6



Conducting the study

When the only tool you own is a hammer, every problem begins to resemble a nail.

Abraham Maslow

In previous chapters we have discussed how to identify researchable problems, about the need to distinguish problem from demand, and how to select research sites. We have also stressed that there are different levels of FPR (either farmers or scientists may take the lead, or they may collaborate equally). Once you have defined the research demand, the level of farmer involvement depends on the type of solutions available. In Figure 1 we see that there are four main types of solutions:

- The solution exists but needs training (Section 6.1)
- A range of options exists, but needs statistical screening (Section 6.2)

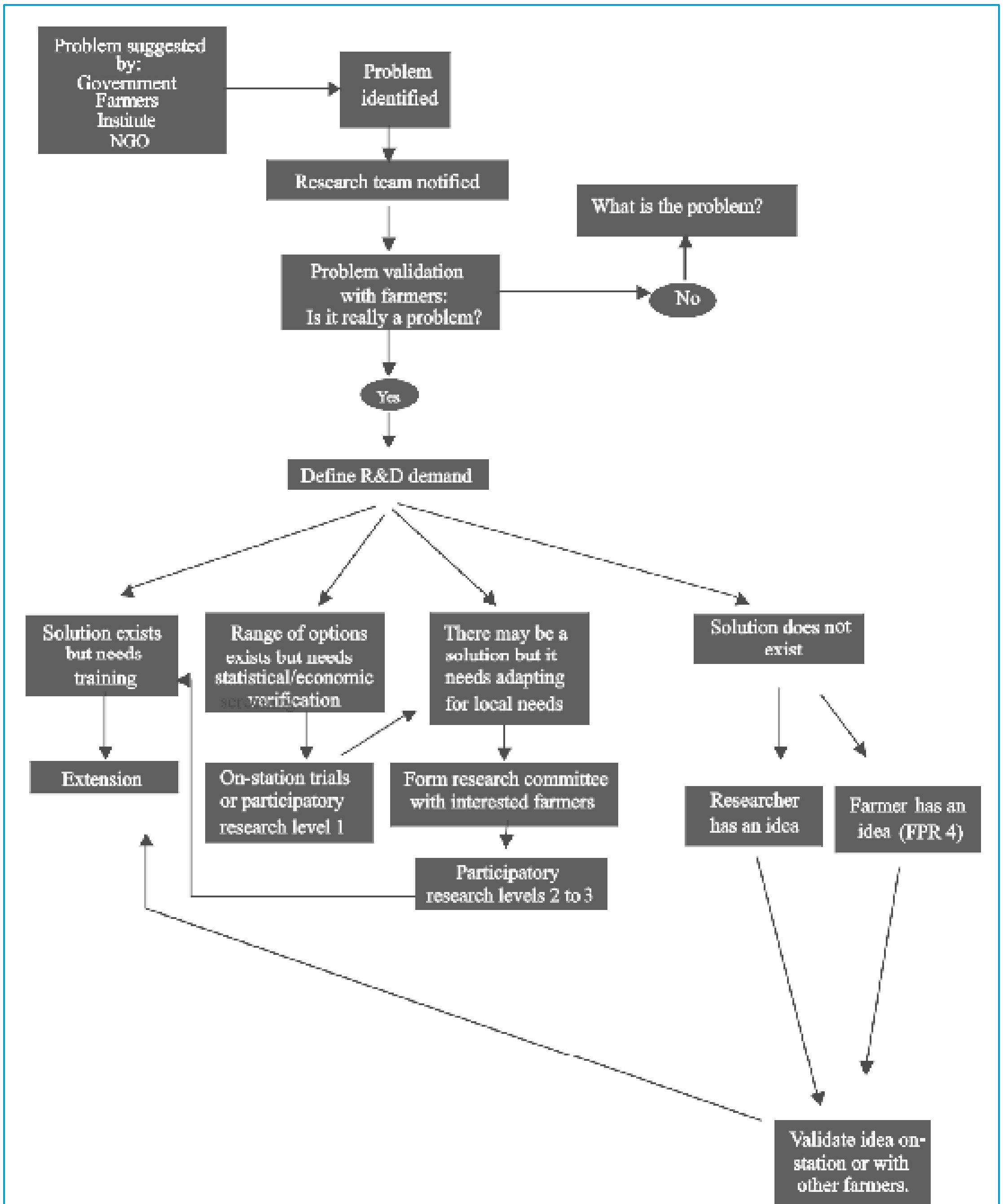


Figure 1. Knowing where you are and what your are doing

- There may be a solution, but it needs adapting for local needs (Sections 6.3 to 6.6)
- The solution does not exist (at least not yet) (Chapter 7)

Each of these situations requires a different tactic.

6.1 THE SOLUTION EXISTS BUT NEEDS TRAINING

The solution may come from scientists, farmers, from another country, but sooner or later a technology should be developed that is ready to be taught to farmers on a mass scale (see Section 8.2). The most important thing is that a technology is not ready to extend simply because it works in the lab or on the station.

Paul Starkey reports that the wheeled tool carrier worked for 30 years on experimental stations in India. It was like a cross between an ox-cart and a Swiss army knife. Ploughs, harrows and other tools could be bolted onto the cart. But farmers would never adopt it, because it was not practical on farms. It was too heavy, so it tended to tip over, and it was too difficult for one person working alone to change the tools (Starkey 1988). In the history of CBB control there have been similar experiences with Bb, sampling and other techniques that work just fine when used by agronomists, but are not practical for farmers. If you have a half-baked idea, finish it with a group of farmers (Section 6.3) before taking it to mass extension.

Certain coffee varieties, the effects of shade trees (e.g. *Inga* spp.) and clean harvest are some of the ideas in coffee IPM that are ready to extend to farmers (at least in some places).

6.2 A RANGE OF OPTIONS EXISTS, BUT NEEDS STATISTICAL SCREENING

We have slightly modified Stephen Biggs' classic idea of four types of FPR to suggest that there are three levels of farmer involvement in research: contractual, collaborative and collegial.

Recall that contractual level 1 participation, with a greater role for the researcher, is more appropriate for data-intensive research. Less participation from farmers means that the trials are more uniform, more replicable.

In level 2/3 collaborative participation, if the farmers really participate, they will begin changing the treatment design, so that each replicate begins to diverge from the others. Soon each replicate is its own treatment. (This is what happened in our Honduran case). In this case, statistical and numerical analyses are difficult (unless you have many replicates).

However, in many cases the researcher needs a rapid, quantitative evaluation of a spread of variables, before designing the technology. For example, we might need to know the amount of weed suppression by 10 different cover crops, or the biomass of 20 new legumes, or the yield range of eight new coffee varieties. There are many treatments, each of which must be standardised and replicated. The research could be done on-station, but doing it on farms gives you a certain reality check from the beginning. In the case of the CBB, in earlier projects our colleagues did several experiments on-farm, with cultural control, to understand the arithmetic relationship between the number of berries left on the ground and CBB populations (see Baker 1999, Chapter 6).

Such statistical research can be done as level 1, contractual FPR, where several farmers each agree to manage one set of replicates. (See Section 6.5 below; it is difficult for one farmer to manage more than one replicate). The participating farmers may be organised into a committee, although this is not strictly necessary. The main point here is that the researcher is providing almost all of the intellectual contribution (the design of treatments), but wants to test the treatments under "real" conditions.

The researcher contracts the farmer for land and labour. Be sure that the farmer understands the importance of not modifying the treatments as he goes along (see the Honduran case, where one farmer stumped half of one of the treatments). It is usually best for the researcher (or students, or assistants) to collect the numerical data, not the farmer. Provide an incentive for the farmer not to harvest the crop before you have collected your data ("I will pay you X amount to leave the berries on the trees until I come on a specified date to count the borers …").

It is always a good idea, when designing a project, to request some funds to pay for such contingencies as compensation to the farmer for any losses occasioned by trials and experiments.

Once the team has screened a large number of options, the best ones can be presented to farmers to validate under their conditions (Section 6.3). On the other hand, if you do not have a large number of options to screen, but need a straightforward qualitative judgment of a *few* options, it makes more sense to skip level 1 research, and go directly to level 2/3 collaborative research (Section 6.3) (e.g. see our Ecuadorian case on coffee varieties).

6.3 ADAPTING A SOLUTION FOR LOCAL CONDITIONS: GETTING STARTED

This is the bread and butter of FPR. It involves collaborative (level 2/3) research with one or more communities to validate and adapt new ideas. Unlike contractual field trials (level 1), which may be done with several individual farmers, collaborative research should be done with groups, because you are looking to bounce the idea off the farmers. A group of farmers will be more likely than an individual to think of and voice changes in the idea. The technology may be a new kind of coffee pulper, a pest sampling strategy, or a comparison between *Inga* and bananas as shade[12] .

During the first meeting with the community, researchers and farmers should have agreed on research demand and possible solutions (Section 5.3). During a second meeting with the community, begin to establish a committee of the individual farmers, who will collaborate with the research. By this point, you should already have your topic (at least a rough sketch of it), which will determine the times of year for the research (e.g. a technology for processing coffee can only be tried at harvest time). The committee can be largely self-selected, which at least ensures having the more enthusiastic people to work with. Or the community can nominate farmer-researchers. The most important thing is to select the committee in a public meeting, so that other community members know who is selected. It also helps the local farmer-researchers to take ownership of the trials, so that later they don't say, "this is the agronomists' experiment; I don't know what they're doing here."

Practical hints. With annual crops, several topics must be introduced about the same time, when the crop is planted. One advantage of participatory research with coffee is that topics can be introduced at a more comfortable, less confusing, pace: e.g. at pruning time, at weeding, when making seedbeds, at flowering, when fruit is set, at harvest.

Thus, introduce each research topic with the sequence:

1) problem diagnosis
2) background knowledge upgrade
3) action (management, control)

- *Problem diagnosis* includes information on how farmers can distinguish the problem from other phenomena. For example, how to detect CBB, how to distinguish CBB from other small beetles.

- *Background knowledge* is the biological and ecological (or other real world) knowledge that the audience needs to know in order to understand what may be (for them) a counter-intuitive action.

- *Background knowledge* makes the proposed action intuitive. For example, farmers may think that insecticide is the only solution, if they believe that insects have no natural enemies and that pests never die unless poisoned. Explaining that the CBB is a living organism, with a specific life cycle and that its only habitat is the coffee berry will help farmers understand and support a cultural control method.

- *Action* includes new ideas about *how* to manage or control a pest. Be sure to explain how each control idea is linked to the background knowledge (*why* the action works).

[12] Which takes the longest to grow? Which provides the best shade? Which requires the least labour to manage? Which provides the most food and other products?

Filling in gaps in knowledge. We have suggested above that there are four kinds of knowledge (see Section 3.1). Whether you decide there are four, three, or six kinds of knowledge is not quite as important as whether you make a serious effort to inventory farmer knowledge during the first phase of the project, as part of the assessment of research demand. Use that inventory now to prepare training sessions with the communities. During the demand assessment phase researchers learned from farmers, and now they return the favour, helping farmers to understand some key scientific concepts. Each researcher has to understand what farmers know, do not know, or misunderstand, and whether the available scientific knowledge is relevant or whether it needs fundamental research. It is no longer enough to develop techniques on-station and then blame extensionists when farmers reject the ideas. You as a researcher may be increasingly exhorted to not only develop new knowledge but also promote it and ensure that it is put to use. In order to do this you have to create a framework of the relevant knowledge and its use and place yourself the farmers and extensionists within that structure. Making a table or a diagram is probably the easiest way to clarify what each group of stakeholders knows. Once you have done this, you may find your work more satisfying and easier to defend against critics. We here offer you a few ideas; one is that there are basically four types of knowledge that you are trying to create and broker (Table 5). Another is that it is a process that can be codified in boxes and arrows (Figure 2). Maybe one or both of these will help you. But you might want to develop your own analysis.

Table 5 *Do's and don'ts for teaching ideas, by type of knowledge*

TYPE OF KNOWLEDGE	EXAMPLE	DON'T	DO
Deep	*How to harvest coffee*	*Bore farmers out of their minds by spending a whole afternoon telling them things they already know, e.g. that the ripe, red berries are the easiest to process.*	*Ask the farmers themselves to explain the topic. They can often do so quickly and effectively. Add any clarifications if they are necessary, and use their remarks as a bridge into related topics*
Shallow	*Coffee diseases*	*Confuse farmers by using scientific names for diseases they know by other names. Give them lots of irrelevant detail.*	*Use local names to discuss the diseases. Discuss why the trees become diseased and show them improved control strategies.*
Missing	*Parasitic Hymenoptera, nematodes etc.*	*Make people feel like idiots for not knowing that these things exist.*	*Use microscopes, rearing chambers and other devises to help farmers see these creatures. Explain their ecological roles.*
Mistaken	*Dumping coffee pulp into bodies of water.*	*Lecture community members like they were school children. Use lots of rhetoric from deep ecology.*	*Show the people that you understand why they do what they do. Convince them that it is in their own best interest to save the pulp for fertiliser.*

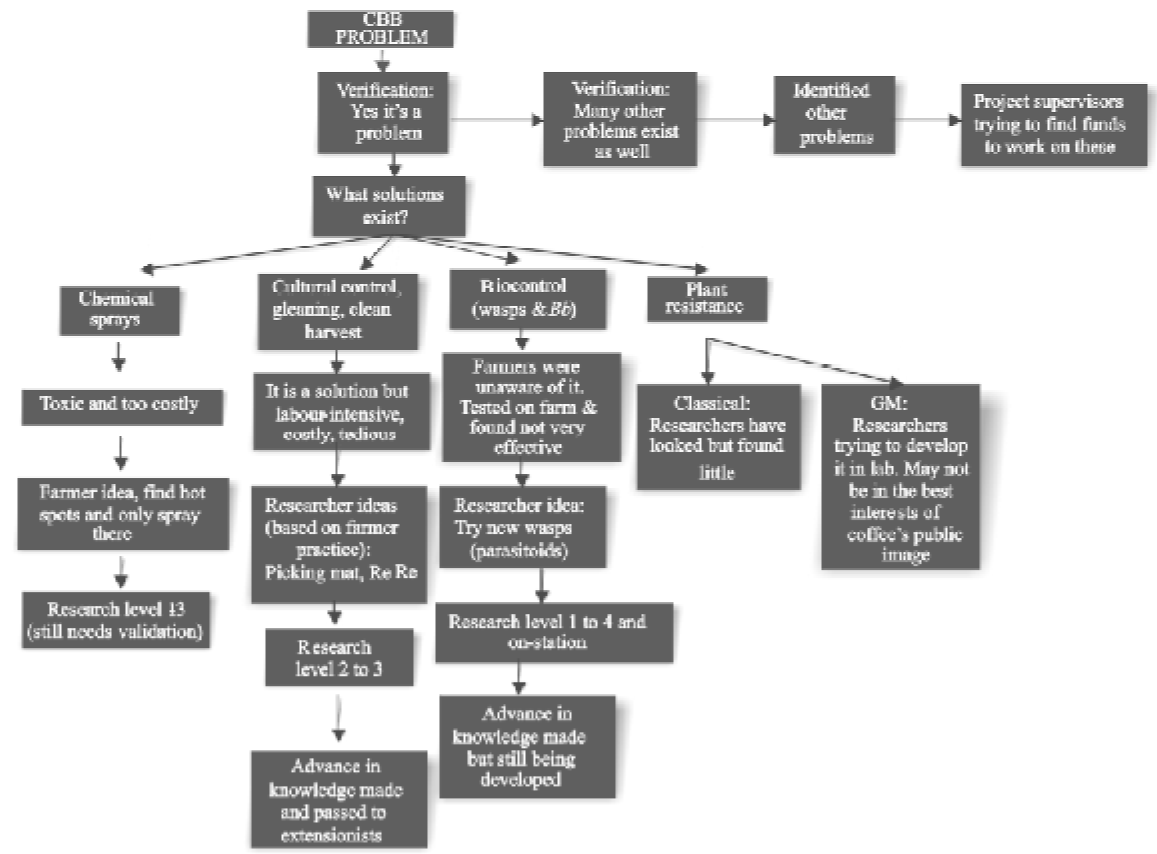


Figure 2. Identifying problems and solutions, a simplified schematic of the coffee berry borer problem and attempts to solve it

The style of teaching must take its cue from the type of knowledge, for example:

Keeping notes (Farmer statements as data for evaluating technology). Keeping a written record of what farmers say is important, especially their observations about the technologies (e.g. "How much does this machine cost?"; "Where would we get replacement parts?"; "Who knows how to repair it?"). Unfortunately, most agronomists have not been trained to take this kind of data. For example, if farmers say they are "too lazy" to use a new technique, they are saying that it is too labour-intensive to be attractive to them. Agronomists' training emphasizes making a neat, geometrical layout of a field trial, and taking mostly quantitative data. University agronomy training should include a course on introduction to journalism, with the *who, what, when, how, why* and where of a simple newspaper story. Fortunately, agronomists are usually friendly and sympathetic to other people, and have all the basic sensibilities and talent that it takes to pay attention to farmers' statements. A workshop can be helpful in teaching field agronomists to write some of this material. For example, we recently had an experience in Bolivia where an anthropologist observed an extension agent teach farmers to use a microscope at a small-town fair. The anthropologist (Bentley) wrote up a simple, seven-page narrative describing what the extensionist said, and the farmers' reaction. Bentley sent the file by e-mail to extensionists. The example was clear enough that six of them wrote similar, straightforward accounts.

6.4 ADAPTING A SOLUTION FOR LOCAL CONDITIONS (Continued): EXPERIMENTAL DESIGN, STATISTICS, THE SCIENCE DEBATE

Field trials versus one-off experiments. Normal, agronomic research can take years: setting up the checkerboard field trials with stakes and string, and taking data on them from planting to harvest, and then repeating it several times more to compensate for annual climatic variation. This style of research is usually born of necessity, but bear in mind that in some cases, a one-off trial can be done instead. This is especially true with tests of machinery (see Section 2.2 on "Back-&-Forth", FPR). The new water-saving pulper, mentioned above, can be tried in one session with farmers. Another way to test it (after showing the community how to use it) is to leave it with them for a week or two and come back and discuss it with them.

Experimental design. Researchers who have invested years in an idea regard it as a kind of brain-child. The scientist comes to love the idea like a child, and cannot bear to see it be criticised. "It's not a bad technology; it's just misunderstood." In coffee, researchers continue to promote ideas like *Beauveria bassiana* and mass release of *Cephalonomia* wasps, in part because researchers have invested so much in them in the past that some scientists become unscientific and cannot accept the technical problems with these concepts.

Set up field trials with the idea that the treatments represent hypotheses that can be rejected, not brain-children that need to be proven to the community. A field trial in a community is an experiment, not a demonstration plot.

Statistics. Numbers are like food. Don't put more on your plate than you can deal with. Collect basic data on cost, plant health, harvest, etc. Enter it into an Excel spread sheet as you collect it. That way you enter the data when it is fresh in your mind and you can clean it more easily. If you cannot enter the data in the same day (or at least the next day) as you collect it, you may be collecting more data than you will be able to use anyway.

Don't make the statistics any more complicated than they have to be. Simple descriptive numbers are often more meaningful. (E.g. "The new technology cost us $100 per hectare, but it increased the value of harvest by $200").

The science debate. Agricultural science and social science both deal with very complex realities that are poorly modelled, with many independent variables. In that sense they have more in common than either has with a hard science like physics. Even entomology is natural history, not really a hard science. Research with production agriculture is not science either, but engineering. We are trying to figure out how to produce more, at higher quality, to earn more while not increasing costs, and also not increasing risks. This is more complicated than just testing a hypothesis. Unlike the civil engineer, trying to figure out how to design a specific bridge that will hold so many tons of four-door sedans, withstanding maximum velocities of wind and water, the agricultural engineer designs systems that must be implemented over and over again, by thousands of people. Agricultural systems are subject to:

- *user failure* "I was going to weed, but I got sick, and my son-in-law didn't have time to weed it for me until a month later."
- a very large set of different natural environments (based on interactions of soil, altitude, rainfall, slope, exposure to sun, previous crop, previous fertiliser and pesticide applications etc.) and huge annual variation in weather.
- *large annual variation in factor and output prices* "The coffee was worth so little last year, and we had no money; we tried offering it to harvesters on a 50:50 basis, but many of them wouldn't even harvest it for half the crop").

It is not so much that agriculture is unscientific *per se*. It is just that its outcome is determined by so many natural *and human* variables that in the end, the farmers' practiced, qualitative evaluation may be as important as the quantitative judgement derived from the scientists' incomplete set of numbers.

6.5 ADAPTING A SOLUTION FOR LOCAL CONDITIONS (Continued): RESEARCH PROTOCOLS

Start as soon as the community selects a committee of experimenting farmers (probably the second community meeting) to discuss with farmers the nuts and bolts of the test plots, including treatments (including size and shape) plus dates and data.

Choosing treatments. Form an idea before the community meeting regarding the treatments you want to try. Start by eliciting their ideas in a brainstorm ("What are some things we could try to eliminate more CBB while processing coffee?") Feel free to suggest some other ideas, and allow farmers to criticise them. Farmers may suggest the same things that the researchers would have suggested ("Now that we know that *mal de hilacha* is a fungus, let's try controlling it with a fungicide, like Bordeaux mix"). Even so, the fact that farmers suggest the idea helps them to own it, more than if the researcher simply presents it to them (Sherwood 1997). Each farmer will be comfortable with one or at most two treatments, plus a control.

Have one or two treatments per farm, with a control. This also saves the farmer labour, which helps ensure collaboration in following seasons. The parcel is split into two or three sub-plots, with one as the control and the other(s) as treatment(s). If you need to test more treatments, use more farms.

Number of replications. Three or four per community is often about as many as they and the field agronomist will enjoy working with. Any more than that and farmer-researchers and their facilitator cannot visit them all during each meeting.

Thus, each extensionist or field researcher may have about nine to twelve replicates in all the communities. This is merely suggestive, not a hard-and-fast rule, but it does begin to suggest the high cost of participatory research. More replicates can be added if participation is level 1 (less participatory—see Section 6.2): the agronomist goes to the community and instead of facilitating a meeting goes straight to the research plots and takes the data, with or without the collaborating farmer. Level 1 (contractual) FPR is a trade-off, less collaboration from community members, but more data and more replicates.

- *Some advice:* researchers usually make the mistake of doing too many treatments and too few replicates. They do this because they underestimate the amount of variation in the measured variable(s). It is usually better to do, say, three or four treatments and as many replicates as possible and then analyse the results to see how clear the results are and how well you can separate them with parametric or non-parametric statistics.

Each farm is a replicate. Farmers typically experiment with new varieties of crops by planting a few rows of the new variety. Farmers are usually enthusiastic about testing new varieties or other techniques, if the experiment does not cause them a lot of extra work. Having several replicates in a single plot adds to the farmer's time and management load. Avoid extra labour demands on the farmer by planting only one replicate per farm. This also maximises the number of farmers who can participate.

Their location. There is a trade off between replicability and access. Good coffee is grown in the mountains, and groves can be a good hike from the farmstead. Walking with a research committee from a typical coffee grove to three or four others can take two hours or longer. But if the experimental plots are placed in areas with the easiest access, the trial may have serious biases (towards flat land, near the homesteads) and be unrepresentative.

Size of replicates. Allow farmers to explain which are the easiest sizes for them to work with. Farmers tend to make sizes smaller for treatments they do not think will "work." Other than that, most groves are laid out in lanes of trees, and farmers will have an idea of the minimum number of lanes per treatment. Often farmers prefer rather large treatment sizes, as much as a hectare sometimes. Also, if each farm is a replicate, as it should be, then each farmer may prefer different treatment sizes. Agronomists, on the other hand, like to have each treatment and each replicate exactly the same size. But bear in mind that this is not necessary. A scientific comparison is based on a result per unit of input (e.g. coffee harvested per person/day, or per hectare). These results can be calculated, as long as the edge-factor is accounted for, and the replicates can be of different sizes.

Shape of replicates. Rectangular is usually the chosen shape for researchers, but irregular shapes are often easier for farmers to work with. Do not insist on rectangular treatment plots. Small fields are rarely rectangular, especially on mountainous, smallholder coffee farms and insisting on rectangular treatment plots, of a predetermined size, creates left-over corners and edges that are hard for the farmer to work. Talk to farmers about a shape and size of treatment plot that you are both happy with. Go easy on string and stakes.

Planting and harvest dates. This is according to normal farmer practice for each area. It places a strain on the field agronomists to meet commitments on many farms at about the same time of year, especially at harvest time. Farming is a no-nonsense business. A coffee-growing family is often short of cash, and so needs to start harvesting at a certain date, in order to make more money to hire labour to pick the rest of the crop before the harvest season ends and workers move on. Farmers may not be able to arbitrarily postpone a harvest until researchers have taken their data. Researchers must be in close contact with the farm to take the harvest data as soon as it is appropriate. If they delay even a few days, some farmers will harvest anyway, even though the data has not been taken. Others will keep from harvesting the plot, inconveniencing themselves and damaging rapport with the project.

What numerical data will be taken and who will take it. The farmers need little or no numerical data. They decide to use technology or not, based on an objective, qualitative evaluation ("Chemical fertiliser really helps coffee to grow and produce more, but I just did not have the money to buy it this year"). As described above in Section 6.4, limit the data taken to bare essentials. The more participatory the research is, the less replicable it will be, and less data should be taken. Take the data during the periodic meetings with the local research committee. Discuss the meaning of it with them. Document their feedback.

Be prepared to lose some farms. In our experience it is very common for farmers in some way to affect the course of an experiment, so you have to be prepared for this eventuality. E.g. some farmers will harvest the crop before you can measure the yield. Others may migrate, lose interest, die or for some other reason drop out of the experiment. Have 50% or more extra replicates than you need, to ensure completing enough of them. If it is vital that an experiment is not interfered with, you may have to go to great lengths to avoid this, e.g. by building up to the experiment through preliminary phases to make sure that the farmer understands his role.

6.6 ADAPTING A SOLUTION FOR LOCAL CONDITIONS (CONTINUED): COMMUNITY RELATIONS

Timing of visits. In most of the countries where our CFC CBB project worked, researchers set a calendar for visits with the community at one of the first meetings. It is important that everyone knows when you're coming back. Remind them at the end of each meeting when you will return. The biggest complaint of rural people (at least in Latin America) about agronomists is that they make appointments and don't show up. Honouring your commitments for meetings helps the villagers build trust in you. Do not schedule more meetings than is needed. Depending on the topic etc., you probably need to go at least once a month.

Use participatory research to validate and reject technology. In Colombia, researchers with this Project taught farmers in nine communities many techniques for controlling CBB. Farmers and researchers validated most of the technology, especially the use of sticky covers to trap CBB during post-harvest. Farmers rejected most forms of numerical sampling as being too tedious and time-consuming; those researchers who had worked in the field with farmers were sensitive enough to farm conditions to respect the farmers' rejection as reasonable.

Balance replicability with participation. The more farmers contribute to the design of individual trials, the less replicable the plots become. Researchers on a (very good) DFID-sponsored project in Bolivia worked hard to be participatory. Researchers and farmers planted 150 test plots of perennial cropping systems, including intercropping of trees with annual crops, and legumes to regenerate degraded pastures. The farmers decided what to plant and how to manage it. This led to two problems: first, farmers choose to work with more profitable systems, like citrus, so for some of the native trees there was only one replicate planted. Second, as each farmer changed the management style (over three years) to suit his or her conditions, the replicates became so different from each other that they essentially weren't replicates[13].

[13] For example, one treatment was forage groundnut between citrus, but the second year of those who had this treatment, some left it in, others pulled up the groundnuts. Others tried to get rid of the groundnuts, but they were too well rooted. Thus each year the "treatments" became more idiosyncratic.

The experiment was designed to be analysed statistically, but in the end, qualitative evaluation was perhaps more important. For example, researchers learned that farmers preferred citrus to peach palm (*Bactris gasipaes*), and that velvet bean (*Mucuna pruriens*) was better adapted than the forage groundnut (*Arachis pintoi*), and that over time, farmers tended to keep some inter-cropping, but to simplify some of the combinations (Pound *et al.* 1999).

Failure is part of success. A project that makes no mistakes is not doing anything interesting. Most conventional experiments fail. So we would expect failure in participatory research.

People who don't admit failure aren't learning from it, or allowing others to do so. For example, in our Ecuador Project, researchers tested alcohol-baited traps with farmers, to monitor CBB. During a community meeting after the research had been completed, we realised that farmers had made the spectacular error of assuming that a dozen small traps had somehow decimated the CBB population for the whole community. Researchers carefully explained why this was impossible (see Ecuador Case Study). It was an honest mistake, gracefully salvaged.

Keep the statistical design simple, because of the above mentioned problems with replicability. Have a few key variables to measure and be prepared to evaluate the results qualitatively. If you really need some numbers, sometimes you can get farmers or extensionists to rank the results of treatments and then you can work with these numbers. Another alternative is to have very large sample sizes, to filter out the statistical noise of large, individual variation in trial management.

One treatment at a time. In general, treat all of the experimental plots the same, except for the variable you are testing. Sometimes, however a treatment may be composed of two linked behaviours. For example a straw mulch on a seedbed may require less watering than an uncovered seedbed, otherwise the seedlings will rot.

Hold workshops with participating communities to evaluate the test plots at the end of the experiment. It is also important to record the observations of individual farmers during the growing season and at harvest.

ACTIVITY 5

Plan an experiment with farmers.

Chapter 7

Supporting Farmers' Original Research

(Level 4, Collegiate FPR)

> *If something fails, admit it frankly and try something else, but above all try something.*
>
> ***Franklin D. Roosevelt***
> ***(referring to efforts to end the Great Depression)***

We now come to perhaps the most fascinating and rewarding type of FPR, when the farmers suggest solutions to R&D demands. One way is for scientists to learn traditional and contemporary knowledge from farmers. This knowledge may be quite widespread in farm communities, but not necessarily known (or at least not taken advantage of) by researchers. During the CFC CBB project, Mexican scientists Juan Francisco Barrera and Ramón Jarquín noticed that farmers in Chiapas found numerical sampling difficult and tedious. Barrera and Jarquín also noticed that farmers seemed to know the location and size of the CBB hot spots in their coffee groves. In 2001, Jarquín and colleagues conducted research to confirm this hypothesis (see Mexico Case Study). Now that we realize that farmers know where the hot spots are, researchers in the future may be able to design lower cost control strategies aimed at only infested parts of the grove.

7.1 FARMER INVENTIONS

Agricultural scientists and anthropologists have both tended to see farmers as tradition-bound. For example Daryl Forde is often cited as one of the first "cultural ecologists" and one of the few British anthropologists to study North American Indians. In his book Habitat, Economy and Society, originally written in the 1930s, and still in its fifth edition in the 1960s, Forde wrote:

> "Adaptation proceeds by discoveries and inventions which are themselves in no sense inevitable and which are, in any individual community, nearly all of them acquisitions or impositions from without. The peoples of whole continents have failed to make discoveries that might at first blush seem obvious." (Forde 1963:463).

But in 1972, the American anthropologist Allen Johnson wrote about inventions by smallholders in Brazil (Johnson 1972). Few scientists were ready for the idea, and Johnson's paper was ignored for 15 years[14], until noticed by Paul Richards, Robert Rhoades and others who rediscovered farmer experiments in the 1980s. Advocates of farmer participation have parroted the idea. Yet in practice, most FPR is little more than demonstrating outside ideas to farmers (testing bean varieties, concocting garlic and chilli sprays, trying cover crops).

Farmers actually invented everything that was used on farms until formal research started about 1840 (Pretty 1991). And farmer inventions can still be a source of ideas for scientists. Many scientists find this hard to accept, but if you have reached this far in the book, then you are probably ready to explore the idea.

Box 7 gives one example of the sort of modest farmer invention that we commonly observe in communities. See also the "first fruits" invention in the Honduras Case Study.

One problem with farmer inventions is that the pace of change generated by them has been slow. Perhaps this has been because we have not had a formal programme to find, validate and promote farmer ideas. Farmer inventions are so common that many can be elicited by a sympathetic listener in just an hour (Box 8).

The idea of collecting a large number of farmer experiments is appealing, because it can be used to winnow a few highly productive ones from many prosaic ones.

If 100 farmers invent things, at least of few of those have to be worth the time it would take to learn about them. For example, the first experiment listed in Box

Box 7 *A farmer method for spraying hot spots*

In El Tigre, Honduras, Santiago Amaya is a medium farmer, with eight hectares of coffee. He applies insecticide only on CBB hot spots. Mr Amaya walks through his grove, with the backpack sprayer loaded. When he sees a tree with many perforated coffee berries, he sprays that tree.

[14] A notable exception was Brokensha *et al.* (1980).

Box 8 *Eliciting examples of farmer experiments*

In August, 2000, during a course on participatory research methods, Mexican coffee scientists Juan Francisco Barrera and Ramón Jarquín visited Honduran farmers at El Tigre to ask about farmer experiments. In about an hour, a group of five farmers revealed that they had done the following experiments:

1. A coffee-manioc-maize-bean intercrop, to take advantage of land after stumping coffee.

2. A coffee-manioc-banana intercrop for the same reason.

3. Comparison of shade of two kinds of *Inga* spp.

4. Trial of a new variety, IHCAFÉ-90.

5. Trial of the variety Pacamar.

6. Use of coffee pulp as fertiliser and to control the fungal disease *Rosellinia* sp.

7. Trial of new brand names of endosulfan.

8. Various activities to control *mal de hilacha* (Pellicularia koleroga), including shade management and fungicide.

9. Application of lime to control root rot.

ACTIVITY 6

Learn about farmers' research.

Visit farmers and ask about experiments they have done on their own. Identify a few experiments and plan some additional research that builds on them.

8 could improve the profitability of stumping coffee. It would be easy to validate the practice and recommend it to other farmers. Even assuming that individual scientists are able to innovate faster than growers, farmers have a great numerical advantage. Half a million experimenting farmers should be able to create useful techniques, which could be adapted and diffused.

7.2 NEW IDEAS ARE THE FATHERS OF INVENTION

If necessity is the mother of invention, its father is a new idea, a new piece of biological or ecological information. Use the social science research methods mentioned in Chapter 4 to study farmer knowledge and behaviour. This will prepare us to speak to our audience, to know:

- what topics they are interested in?
- what are the gaps in their knowledge?
- what are the topics that confuse them?

Farmers invented several technologies as a result of new ideas they learned through the CFC project. For example, Honduran farmers invented strip applications of insecticides near stumped groves and control of CBB in dry berries (see Honduras Case Study) and a Colombian farmer invented a new kind of barrel for harvesting, which would capture borers emerging from freshly picked berries (see Box 6 and Colombia Case Study).

Box 9 *Example of a farmer innovation, based on new ideas about fertiliser*

Hecbert Bowen has a mixed, lowland orchard of coffee, cacao and other species in the community of Ayacucho, near Santa Ana de la Vuelta Larga, in Manabí, Ecuador. Mr Bowen was worried about soil fertility problems, because his grove had previously been planted in sugar cane, and he thought the soil was largely depleted of nutrients, and that the structure was damaged. After learning about organic fertiliser from extension agents, Mr Bowen experimented on his own with mixes of cacao husks, chicken manure, cut weeds and sawdust, applied as aprons around the coffee trees. He noticed that the soil retained more moisture under the organic matter, which also suppressed weeds. This had the advantage that when labourers weeded his coffee, they were less likely to swing their machetes near the trees. This helped avoid mechanical damage, which leads to a "machete disease" (mal de machete, probably Ceratocystis fimbriata). Mr Bowen calls this fertilisation technique "la gata" (the jack), because it helps to raise coffee trees taller and faster.

7.3 FARMERS MODIFY TECHNOLOGY (WHICH IS ALSO INVENTION)

When presented with new technologies, 99% of the time or more, farmers adapt that technology, sometimes in subtle ways, at other times more boldly (see Box 10).

> **Box 10** *Farmers experiment with occlusion chambers*
>
> *In one major modification in Colombia, farmers noticed occlusion chambers for wasps, during a visit to the main Cenicafé campus. Some of the farmer-experimenters built their own chambers, so they could put CBB-infested coffee fruit there, in 1 kg batches, allowing the parasitic wasps to escape, but not the CBB. The farmers made the chambers for a cost of about $5 each, compared to $20 for the ones made at Cenicafé. The farmers substituted bamboo for much of the lumber, and bought only the cloth (muslin, available in the nearby small towns).*

So studying farmers' own innovation is initially more of a descriptive process, though requiring good analytical skills to determine what exactly they are trying to do and then to determine whether it is really having a desired effect. This is where you the researcher can make an impact, because you can take an idea and then develop it into a more formal experiment, either with the farmer or on a field station, where you can study it in detail in more controlled surroundings. You may even be able to see something significant that the farmer does not consider important, and you can encourage him to further develop his ideas, if you think he has the talent and inclination to do so.

Published studies of farmers' innovations are rare, but the ones that exist can be of considerable interest because they give insight into what could be a powerful tool for people-centred R&D. We have already cited several (Johnson 1972, Ooi 1998, Winarto 1996, Bentley 2000b, Meir 2000, and some of the case studies in this book: especially Colombia, Mexico and Honduras). Paul Van Mele (2000) has discussed farmer inventions in Vietnam using weaver ants to control pests in fruit orchards. Sherwood & Larrea (2001) observed that 59% of farmers who had contact with the World Neighbours Güinope Project in Honduras had modified or invented technologies after the project. Classic studies include Paul Richards´ account of traditional experimentation in Sierra Leone (Richards 1985, 1986, 1989), and Hugh Brammer's observation that smallholders in Bangladesh invented wheat transplanting systems (Brammer 1980). Robert Rhoades (1987) summarized much of what was known about farmer experimentation through the mid 1980s. Edited volumes include Brokensha, Warren & Werner 1980, Gamser, Appleton & Carter 1990, Haverkort, van der Kamp & Waters-Bayer 1991, Scoones & Thompson 1994, van Veldhuizen *et al.* 1997. Last but not least, the journal *Honey Bee*, published in English and various languages of India, is dedicated to describing farmer experiments.

Chapter 8

Producing Results and Sharing them with the Community

It is better to teach one idea to hundreds of people rather than hundreds of ideas to one person.

Roland Bunch (Two Ears of Corn, 1982)

8.1 RESULTS OF ADAPTIVE RESEARCH

Your written results will be the only permanent record of your work so you need to think carefully about this. But unlike normal scientific work, where your responsibility ends after you have written up and published, you have an additional responsibility to inform the farmers with whom you have been collaborating. They need to understand what you have done together, its significance and what lies ahead and why you may no longer be visiting them when the study is over. You need to make a graceful exit.

Data processing. As we have said above in Section 6.3, don't take more data than you can write up. Don't let it pile up; enter the data into the computer as you go along (the same day, or next). There are now many hand-held devices where you can enter data directly to a spreadsheet and then download to a computer, and these are increasingly cheap and reliable. It could save you literally months of effort so think hard about gathering, storing and analysing data effectively. Get advice from statisticians where available, but don't be ruled by them; through our own experience we have found that as in all professions, there are good ones and bad ones.

Analysing data. Analyse what you have soon; this will also help you to see which data is the most useful. Some measurements may prove unnecessary. A typical error of many projects is to take more numbers than they can later analyse. Don't waste farmers' time if they are reluctant to help take the data. They are probably busy. The main thing is to maintain good rapport with them until the end of the season, when you can discuss the results in a community workshop.

Don't over analyse the results. Nobody cares if the incidence of CBB was 1.51% or 1.59%. The difference is not significant. If several different treatments yielded similar, low pest or disease incidence, admit that the difference is insignificant and perhaps even that it has more to do with background noise (rain, drought, micro-environmental differences between plots, an especially clean harvest the year before etc.) than with the experimental design.

Graph everything out before writing, try to be visual. Or at least try to have a point. Even if you do not present a lot of graphs to the farmers, graphing helps to have things clear in your own mind and now with computer programmes, it's easy: in a few minutes you can graph every variable against every other. If you do this you will sometimes see unexpected things (see the Ecuador Case Study for examples of simple graphs). We learn to interpret graphs in school but farmers who have been to school less may have a difficult time reading graphs. However, natural language is hardwired into the human brain, and farmers have as sophisticated a grammar as researchers do. Try to convince them of research results by talk and by showing them things in the real world.

Presenting the data convincingly. What farmers find most convincing is another farmer. Even if they do not know the farmer, they can tell by his dress and speech that he is a farmer, and will identify with him. If another farmer says, "I tried pruning my coffee trees to control diseases, and I found that it only took a day to do, and my coffee was much healthier as a result," it will be more convincing than all the graphs and photographs an agronomist can show. If you are thinking ahead to a follow-up extension program, consider taking some videos of farmers, to show later to other farmers, possibly on television.

Collect farmers' authentic statements. Do not bowdlerize them or rewrite them into dead prose. For

A Colombian coffee farmer; don't only participate with stereotypes.

instance if the farmer says "vergón" don't write "bueno". If the farmers say "what is the medicine we can use to get rid of this nematode?" write that. Don't write "the villagers requested chemical control for eliminating certain soil pests."

Photograph them. In some parts of the world people need to be asked permission before taking their photograph. In other places people don't mind. Be sensitive to the differences. Many rural people have few or no photographs of themselves. If you tell them that you are going to send them a photograph, then do so. It is most probable that in your final presentation what the local people will most enjoy will be the photos of community members.

Give them copies of the research. They will appreciate the thought, even if everyone in the community does not read the report. They may show more interest in short statements about the people and the community, and statements in clear language about the most appropriate technical results of the project (e.g. "We found that many groves in the community had uneven shade, and that some shade trees need to be pruned and others planted in order to achieve an even, medium shade"). Most Latin American smallholder farmers do not understand the concept of percentages; they understand absolute values much more clearly.

Participatory evaluation. Hold participatory evaluations with the community to discuss the results with them. Before the meeting starts, arrange to have a community leader open the meeting, and then turn the time over to you. Do not simply call the meeting to order and start talking; it undermines local authority.

The event should not last more than two hours. Set a time to start, and if few people come, wait 20 minutes and start anyway.

Treat the event more as an open house. As other people drift in, present the results again to them. Explain to people that if they have already heard the results and want to leave, that you won't mind. The main thing is to collect their opinion about the research. Small, relaxed groups are better for this than a formal, town meeting where two or three dominant farmers do all the talking. Cover the following points:

- The treatments (the things we tested).
- The results (which treatments achieved the de sired results; modifications in the treatments, made by farmers).
- Recommendations for the future (technology ready-to-adopt, technology that needs more research).

Inviting local people to meetings. Each area has its own style. Tightly organised communities have people who can invite others to a meeting. Consider making a written invitation to the participatory evaluation. Most farmers can read, and even those who cannot, will ask another family member to read the paper to them.

Case histories from the project. A useful way of presenting results can be a case history, especially if the results are more qualitative than quantitative. It gives you a chance to present more of the issues and problems and it may be more acceptable to those that commissioned the work than to present the results as a scientific study. See specific case studies of FPR in the following countries in Part II:

Colombia, Ecuador, Mexico, Honduras.

8.2 EXTENSION

Successful participatory research generates technology that must still be extended over a broader impact area. Participatory research is not a substitute for extension, because it impacts relatively few farmers directly. This book is not about extension but in Table 6 we summarise some of the models for extension including direct, indirect, and mass media. In your report you may want to make recommendations about what next steps to take to transfer any useful results of your research.

Ultimately, participatory research has to be judged by the new technologies that it generates, but especially by the ones it succeeds in handing over to extensionists in a form that they can use. This will be a challenge: essentially you will have to assess the usefulness of the technology (including an estimate

Table 6 *Extension taxonomy*

TYPE OF EXTENSION	BRIEF DESCRIPTION	Advantages	Disadvantages
Direct	*Face-to-face community and individual meetings, led by an extension agent.*	*Can be of high quality, depending on the extension agent.*	*Can be expensive and of limited range (except in the case of certain mass programs, e.g. that of the Colombian Coffee Growers' Federation).*
Indirect	*Work through NGOs and others who have extension programmes in communities. Teach their extension agents and give them pamphlets and other support material.*	*Can allow the programme to have a large multiplier effect.*	*Quality of the message delivery may decrease. Unless you pay and supervise other institutions, they may not be motivated enough to transmit the message well.*
Goingpublic	*Demonstrations in fairs and other public places.*	*In an hour or 2 you can present an idea to several dozen people from several distant communities. You can also distribute seeds, literature, and other materials. Allows audience feeback.*	*The setting can get hectic. Works better with short messages and visual demonstrations. The extensionist must have a talent for showmanship to pull this off.*
FFS	*Weekly meetings and discovery learning.*	*Good for knowledge intensive technologies such as IPM.*	*Costly and slow, needs attitude change by extension and research.*
Mass media	*Television, radio, newspaper.*	*Can reach a large audience at low cost. Messages can be targeted to farmers, e.g. broadcast early in the morning. Quality of the message can be quite high (using professional communicators, clever scripts, local languages etc.)*	*Feedback from the audience is limited. Some "channels" of communication are limited, e.g. one cannot show things on the radio.*

of costs-&-benefits) and give the extensionists as much help as possible in how to transfer it.

If we take the CBB as an example, IPM is the suggested method, but this involves several techniques, so how should the extensionist organise the topics? Should he start by transferring the most important (e.g. good harvesting) or perhaps the easiest (e.g. pruning or chemical fertilisation) or the one the farmers would find most exciting and engaging (e.g. releasing parasitic wasps). A good participatory project with prolonged farmer interaction, might give you some ideas on how to help the extensionist.

8.3 KEEPING THE PROJECT GOING

Most projects are short, frequently they are only just starting to yield the most interesting results when funds run out. And in our experience, many of the advances of a project can rapidly dissipate once it is finished. So you should build this pessimistic (but realistic) assumption into the work. Beginning in the second year of the project, continue to document results, but also start to encourage farmers to innovate on their own, so that you stand the maximum chance that at least a few of them will feel permanently empowered by your study.

8.4 OTHER THINGS TO BEAR IN MIND

Monitor how farmers adapt, adopt, & reject technologies.One of the biggest shortcomings from the project from which this book was developed, was that researchers and agronomists tend to see farmer participatory research along the model of on-station research. They emphasise variables like yield and pest incidence rather than costs and feasibility problems. The Colombian part of the project did a better job than most at reporting on farmers' evaluations of technologies. For example, they described teaching formal sampling to farmers, who then rejected it because it was too time-consuming, and because the farmers already knew which parts of their groves had hot spots of CBB, and thus needed control measures (Colombia Case Study). Most of the country projects anxiously showed how many farmers had *adopted* technology as a result of contact with the staff. But few researchers were willing to report on how farmers *adapted* technology to fit their own conditions. This is the greatest intellectual stumbling block to FPR, researchers will not realise that a farmer can improve on a scientist's ideas.

Holding farmer experimenter workshops is a quick, inexpensive way of learning and reinforcing farmer experimenters. Invite farmers who have done experiments to meet together and explain and demonstrate their research to each other. Write a proceedings volume (Aristizábal & Salazar 2000, López 1997, Rodríguez & Bentley 1995 a&b).

Reward farmer experimenters . Researchers, writers, and artists can be motivated to be creative not only by the promise of more money, but by the hope of winning recognition. Pulitzer, Oscar and Nobel prizes, and admission into the National Academy of Science are just some of the rewards that inspire professional people to work harder. As the renowned anthropologist Bob Netting used to say, "People can never get enough prestige, yet it is so easy to make." Reward farmers who invent really useful items with things like:

- Their picture and name in the newspaper.
- A handsome presentation plaque.
- A special dinner in their honour.

Virtue that is praised, grows.

Technology evaluation. There has been a lot written on how to involve farmers in evaluating and validating research by scientists. The CIAL method is perhaps the best known (Ashby *et al.* 2000). Sperling & Scheidegger (1995) describe how farmers can be involved in evaluating pre-released varieties of beans. Mauricio Bellon discusses several techniques for evaluating technology with farmers. One of the more interesting new ideas is that researchers can show farmers new varieties of maize (in the field, at maturity) and then offer them for sale to farmers (at the cost of local maize grain) and use the sale information to quantify which varieties farmers prefer (Bellon 2001).

Chapter 9

Discussion & Conclusions

There is an almost gravitational pull toward putting out of mind unpleasant facts. And our collective ability to face painful facts is no greater than our personal one. We tune out, we turn away, we avoid. Finally we forget, and forget we have forgotten.

Daniel Goleman

9.1 REVIEW OF THE PROJECT CASE STUDIES: WHAT WORKED AND WHAT DIDN'T[15]

On the CFC CBB project, scientists and farmers seemed more comfortable working together on adaptive research, in more or less formal platforms (e.g. community research committees or with designated farmer-experimenters). Researchers were not as interested in trying to supporting farmers in collegiate, level 4 research, where the farmers proposed and managed the topics.

The adaptive research went smoothly. Researchers proposed ideas that were novel, at least to the farmers, like the use of coffee pulp as organic fertilizer, and forage groundnuts as cover crops (in Guatemala). In most Project countries, researchers either introduced or reinforced gleaning to control the CBB. The tendency for farmers was to adapt the recommendation, not necessarily collecting berries from the ground, but by performing an especially thorough harvest, which they found less tedious than ground gleaning, and which also gave them more marketable berries. In a nice piece of validation of this adaptation, Colombian researchers showed that the berries farmers collected during cleansing harvests paid for the labour needed in 98% of the cases (see Colombia Case Study).

Some farmers like to be photographed

The Colombian Project developed a functional, pragmatic structure for collaborating with farmers. It was based on the existing community groups, which were supported by municipal extension agents of the Colombian Coffee Grower's Federation, with ideas for research provided during weekly visits by scientists from the Federation's Cenicafé research centre. In other words, like much that happens in Colombia, the work was based on a *sui generis* model rather than on trendy concepts from the "development literature". The Colombians adapted half a dozen researcher ideas to farmer conditions and encouraged the further development of one of the farmers' own ideas. Farmer-researcher meetings were also successful in providing feedback to Colombian scientists at the station, who did not visit communities, an important but often neglected part of FPR.

Social research. Because of the importance of harvest techniques for managing the CBB, the anthropologist recommended studying harvest systems in Guatemala and Ecuador. The idea was to get a basic picture of how workers harvest coffee, e.g. how much time they spend per tree, if they work alone or in pairs,

Others are not so sure

[15] The reader may want to refer to the case studies at the end of the book before reading this chapter.

the tools used (baskets, mats etc.) and how many berries are dropped onto the ground and left on trees (to become CBB habitat). The anthropologist also suggested comparing the thoroughness of harvesting on small, family farms vs. on large estates. The national researchers showed interest in the topics, especially in Ecuador, where they did carry out a small study on harvesting. In both countries researchers lacked confidence in conducting the study. The anthropologist outlined a research protocol, but it may have seemed too unusual or too time-consuming for local researchers. It probably did not help that the anthropologist pointed out that the study of harvest technology was social research, but was not participatory. This seemed to discourage researchers, who were thinking of participatory research as a kind of holy grail. Longer or more frequent visits by the anthropologist may have helped to conduct this research, since the agronomists really were interested in the results, but needed a bit more advice on method.

Hot spots. Project entomologists (Baker and others) had been suggesting for several years that a functional, compromise technology would be the application of insecticide to hot spots: places in groves with high densities of coffee berry borers. It would control CBB without lots of tedious labour, and would leave large areas of the grove as un-sprayed refuges for beneficial insects. Then farmers in Mexico and Honduras told the anthropologist (Bentley) that they could already identify hot spots, and applied insecticide only on those spots. Bentley and national researchers discussed the idea of documenting farmer's innovations. Mexican researchers (Jarquín and Barrera) did conduct a study which supported the idea that farmers were able to accurately identify hot spots. Some more research is needed, and unfortunately the idea came to light so late in the Project's life that little could be done with it.

Scientists often relate well with farmers, when they meet them. In every case, when we observed scientists and farmers interacting, they had things to say to each other. Scientists did not talk down to farmers or patronise them. We feel that many researchers could work productively with farmers, if given the chance. The main barrier seems to be that senior research scientists find it difficult to take time away from teaching, administration and the laboratory bench to go to the field. Institutions need to make more of an effort to get scientists and farmers together. The Colombian approach, of bringing farmers to Cenicafé is promising. Any method would probably be worthwhile, as long as scientists and farmers interact. Don't rely on extension agents to do all the interaction with farmers.

Farmer inventions? Researchers and even extension agents have a hard time relating to the idea that a farmer might invent something. The staff tends to treat such observations as amusing, or as irrelevant or unimportant, not as something to pick up and work on. Even the formal, participatory research movement is much more comfortable with involving farmers in last-link, adaptive trials (Ashby *et al*. 2000). We have already mentioned how, in India, a farmer suggested making a slit in the picking mats, to make them easier to fit around trees, and to keep more fruit from being lost on the ground. In the case of the hot spots, (mentioned above) Mexican researchers obviously thought the idea was of some merit, but did not emphasise it in their presentation to other researchers at the final Project meeting in Costa Rica in October, 2001. We still have a long way to go; just getting the research community to recognise farmer's experiments and support them requires a major change in perception.

Looking for a method. From the beginning of the Project, national staff wanted the protocol for participatory research spelled out in great detail. They were more comfortable with experiments that resembled experiment station trials, in part because the method was easy to extrapolate from their university training. Experts brought in to teach participatory research (the senior authors included) were more interested in philosophical issues, which the national staff found frustrating. It took us a while to begin working on nuts-and-bolts recommendations for how-to-do participatory research. To their credit, the national Projects all did something worthwhile, and unique.

Old friends. Most projects have their "pet farmers", although "farmer buddies" might be more accurate. These are the people who are willing to receive lots of visits, who converse well with outsiders, and who have benefited enough from the project to say something nice about it. The farmer buddy is also willing to carry out the project's field trials. Some projects foster whole groups of buddies, in a safe, friendly village.

During this Project, the Guatemalan researchers worked with Chocolá, a community they have collaborated with for years. On the other hand, in Mexico, Ecuador and Colombia, the staff worked with communities that they contacted specifically for this Project, although in each case they used existing networks[16] to contact the villages. In Honduras, researchers seemed to use a mixed approach, working with El Tigre and Agua la Piedra, which have had a lot of previous contact, while also starting work with some new places. The advantages of working with the same friendly people year after year should include lower transaction costs (you don't have to explain who you are and what you want to do each time; you already know them and can get right to work). Another advantage is that after several years of training, the old, friendly villages should have received many fresh ideas from researchers, which should stimulate more creativity. However, we did not observe any major differences. Researchers rapidly gained rapport in the new communities and completed research with them.

Many farming communities are remote. Except for Chocolá in Guatemala, El Tigre and Babilonia in Honduras and some communities near Chinchiná, Colombia, most communities are several hours' drive away. One does not just drop in on them. It costs a lot of time and money to visit distant communities. It adds to the cost of participatory research and is another reason for organising one's calendar of visits carefully with local people.

If farmers really participate in trial design, then there are no replicates. This may seem counter-intuitive. But as we saw in the Honduran case, the experiment was designed to have one treatment (IPM), and a control (farmers' practices). Yet, in each case, farmers introduced changes (one applied insecticides, one gathered first fruits, one stumped part of the plot). On the one plot where farmers did not change the IPM treatment, researchers took advantage of the fact that (only on this one farm) the IPM plot was far away from the control, so the entomologist introduced parasitic wasps on the IPM plot. In other words, farmers are individuals, and when they have the freedom to change a variable, they will do so in individual ways. Each plot will be different. In the Honduran case instead of having a treatment plus a control on four replicates, we ended up with eight treatments and no replicates. One wonders about the statistical validity of the large amount of data taken on these plots. In such cases, we need to spend more time thinking about why the farmers made the changes they did, their opinion of them, and collect some basic data on costs, plant health, and harvest.

Gleaning. Picking up coffee berries from the ground does help control the CBB, and uses no insecticide. But it is so tedious that we are reluctant to recommend it highly, especially with the costs of labour rising and the cost of coffee falling. Some of the berries that are recovered can be sold, which pays for the gleaning, if the price is right, but if these gleanings are of poor coffee it only adds to the world's stock of 'triage' which some national and international bodies are now trying to destroy. Some countries (Mexico, Guatemala, Ecuador, India) have traditional gleaning practices. In most cases, it is the very poor who ask permission from neighbours to glean their groves, spending the day stooped over to collect two to three kilos of berries which can be sold for a dollar or less. In Ecuador, Project extensionists were encouraging farmers to pick berries up off the ground, but most team members in Latin America were not keen to reinforce gleaning. However, in Colombia it rains more often, so coffee flowers and bears fruit all year, and the berry CBB is a much greater problem there. Cenicafé in Colombia recommended Re-Re (regular pickings and gleanings). Farmers did not adopt gleaning, in part because of the high labour costs and the tedium, but they did start to harvest more frequently and more thoroughly as a result of Cenicafé recommendations (Castaño 1998).

Other cultural controls. Because of the above problems with gleaning, what farmers need are techniques that help keep berries off the ground and from being left on trees, but which need less labour. The picking mats in India are one of the few practices that seem to be labour saving, and help keep berries off the ground. Some Ecuadorian harvesters sew two fertiliser bags together and spread them on the ground to recover

[16] The Union of Ejidos in Mexico, the lapsed self-help groups in Ecuador, villages organised by extensionists of the Coffee Growers' Federation in Colombia.

berries. We hypothesise that this practice profitably manages the CBB, but our initial study of this system was incomplete.

In hindsight. The ethnographer (Bentley) had more of an impact on Project researchers by working with them in the field than through workshops. The project started in mid 1998, but the anthropologist did not start working with the researchers until the project held a workshop in Chinchiná, Colombia in May 1999, to design participatory research. But by then the country programmes had planned their research, and the workshop did not give them the guidelines in method that they expected, so interventions by the anthropologist and other FPR experts at that workshop were of little value. But Bentley's visits to each Project began to have an effect. Bentley, Jarquín, Barrera and others noticed that farmers perceive hot-spots in Mexico and in Honduras, and this made its way into the research, at least in Chiapas. In Guatemala, we planned the groundnut and pulp experiments during Bentley's visit (June 2000), and researchers presented the results in October 2001. In Ecuador, most of the research was planned during Bentley's trips there (May 2000 and June 2001). In retrospect, Bentley and Baker should have supported each country by visiting them in the field and planning their research on a case by case basis.

Sampling. An inordinately tedious sampling method cropped up in Ecuador, Honduras and India, although in different form in each one. In Ecuador, extensionists were using it in 2000, but by 2001 seemed to have abandoned it. In Honduras the project was paying farmers to do the sampling on the IPM plots under study (because the data was useful to researchers, but farmers would not have done it without payment). And in India, extensionists made numerical sampling a major part of their work in pilot FPR villages, although few farmers seem to have adopted sampling on their own.

Not wild and crazy. Project researchers proceeded cautiously, planning a few studies that they were confident would yield results. With the exception of the Colombians, who worked on over a dozen ideas, most countries studied two to four topics.

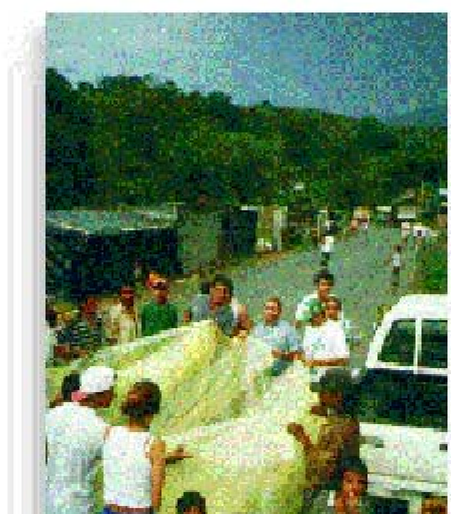
The Ecuadorians were especially open to new ideas, but Bentley encouraged them (perhaps mistakenly) to stick with five topics, arguing that it was better to do a more thorough job on a manageable number of ideas. As a result, we were aware of some promising techniques that we did not study. Cenicafé recommends stumping trees every five years, to maximize young woody growth, to increase yields and have smaller, more easily managed trees. This method may also help manage the CBB but a study on this would have taken too long for the present project.

A code for working with farmers? A code of conduct for working with farmers might evolve from this manual and similar efforts. In FPR we need a code of conduct that emphasises the positive things we need to do to facilitate productive research with farmers, more than a list of thou-shalt-nots.

What works with farmers? One thing that works is going to an organised community with a nearly finished technology for them to validate. The community often finds something useful in the idea. We had several examples of this during this Project.

- Control of CBB with sticky covers in Colombia
- The caturra coffee variety in Ecuador
- IPM techniques in Honduras
- Organic fertiliser in Guatemala

In India, Ecuador, and Colombia researchers are working on CBB traps with farmers. While a final trap has



Sometimes you have to stop and lend a hand. (Colombian project staff handing out plastic sheeting from an experiment, to earthquake victims).

not been developed, scientists in all three countries have worked side by side with farmers, hanging the traps in trees, pouring in the alcohol bait, evaluating the results. Because of this, the scientists realised that their traps are not ready. Had they tried the traps on-station, they might be under the impression that the technology was complete.

One-off trials with machinery are really worthwhile. The water-saving mechanical pulpers (*beneficio ecológico*) developed by Cenicafé, Colombia seemed like such a good idea for dry areas of Ecuador. Yet watching farmers and extension agents try to make the Colombian machines work in Ecuador immediately showed how we would have to either re-design the machinery to handle unripe berries, or work with Ecuadorian harvesters to pick only ripe berries (Ecuador Case Study).

What doesn't work?
Researchers rarely notice farmers' own innovations or even farmers' adaptations of new technologies. Studying farmer adaptations is important: it may help us to simplify or improve a technology.

In most cases, even formal experiences in communities do not provide enough feedback from farmers back to researchers.

Agricultural scientists and agronomists are uncomfortable writing qualitative results, for example, in the above case of the Ecuadorian trial of Colombian machinery, the researchers would not write up the results, because they could only be done in narrative, not in a table of numbers. This is not to criticise the Ecuadorians; few other researchers wrote narrative accounts of what actually happened in the field.

Compare with success stories from other crops. Success in other crops has been more modest than others like to admit. The FAO Asian Rice IPM Programme was successful because President Suharto outlawed a number of major pesticides. Even in this 'classic' case however, the long term effect of this is less than clear. As Oudejans (1999) puts it "It appears that after 1987, when the Minister of Finance withheld the subsidy for pesticides and the budget for procurement was lower, the large stocks which has been carried over from year to year were gradually marketed. When, by 1992, the stocks were exhausted, the purchases of pesticides went up again to meet the demand of government agencies and private parties."

Some final comments on FPR platforms. In Chapter 2 we discussed platforms for farmer participatory research. We have tried to incorporate the best of each in our approach, but some constructive criticisms may now be in order.

Some leaders of the FFS approach insist that FFS is extension, not research (Kevin Ghallager, personal communication). Others emphasize how FFS teaches farmers to experiment. Some of the informal experiments that farmers do after taking an FFS are truly geared to learning new insights; like farmers in Indonesia who cut rice plants, to mimic different kinds of insect damage, to then follow the life history of the plant (and see how much grain it yielded) (Yunita Winarto, personal communication). We recommend that FFS be used as a tool to stimulate farmer experiments.

The Zamorano method stimulated hundreds of farmers to experiment. Those of us who were involved with it over-emphasised the teaching program, and did not spend enough time documenting and following up on farmer experiments. The basic idea of teaching farmers background information (the fathers of invention) is still sound and deserves more replication and write up.

The CIAL actually has much in common with extension. In practice, CIALs and FFSs are converging (Braun, *et al.* 2000). In the field, many of the agronomists who use them, use both and are blending them (e.g. enriching field schools with CIAL-like trials).

The CIAL needs to learn more topics, and to work more with inventing and modifying technology, rather than just validating and teaching it. Back-&-Forth is still being used successfully by its home institution (CIFEMA in Cochabamba). It would be highly productive if such a practical, rapid method for inventing farm machinery could be adapted to IPM.

Is coffee different? When we started to write this manual, in November 2000, we thought it was. Now we're not so sure. But then the complex and interesting thing about IPM is how each crop and each pest IS different. The bit about hot spots was really interesting, and you don't see a phenomenon like that in every crop.

9.2 CONCLUSIONS

Participatory research is not easy, and unlike conventional research, an established protocol is only emerging now. Like all research, FPR takes time. This Project could have used another two years.

The notion of farmer participation has spawned lots of rhetoric and some modest results, especially in adaptive research, doing the final tweaking at the village level.

Few people are asking (yet) about issues like cost-effectiveness of staff time or of the technologies. From our experiences with the CBB project, we found that the researchers were much more heavily influenced by their previous experience in their own countries than by trends in development "literature."

Some of our colleagues had worked for years in conventional research with the CBB, and many of them had worked with farmers; those experiences formed the intellectual foundation for much of the project's planning.

We may have been too ambitious. Most projects only work in one country. We worked in six (not counting Jamaica). One thing that saved us is that in each country researchers were involved on some level; they never turned everything over completely to the extension agents. The researchers had met before, at CBB conferences, so they knew each other, and shared information with colleagues in other countries.

Pests can be maddening to research, because one year a species may almost disappear, only to return in force a few years later. Towards the middle of this Project, the target pest, the CBB, suffered a dramatic decline in many countries. We are still not sure whether this was due to the fact that farmers had adopted technical recommendations, or because of the stochastic fluctuation of the insect's population. But by the end of the Project, farmers no longer felt that the CBB was nearly as serious a problem as the serious erosion of the price of coffee.

Could we have done better? Yes. But we certainly didn't fail. Every country programme did some research, of value, and it was based on their own ideas. Each one was unique. This shows a high degree of freedom of thought. Having said that, we floundered around quite a bit at the start over the idea of "participation." A year into the project we were still asking:

- Which farmers would participate?
- What would they contribute?
- What research methods would we use?
- And even: Is FPR really research or is it just an extension tool?

By the end of the Project, much of this had been worked out, which is one reason we decided to write the project results as a manual. It is not so much a report of what we did, as much as guidelines about how we would do it next time.

Self-Criticism. We have raised criticisms of our project, in the interests of credibility and honesty. We had a good team of professionals, and any shortcomings reflect not so much personal failure as the difficulty of collaboration between scientists and farmers. By comparison, cover crops have been a favourite topic of participatory research and development in Latin America since the mid-980s. Yet a recent book on the subject suggested that, despite the fanfare from NGOs, researchers are only now starting to understand the limitations of these crops and that:

> "In most cases the methodologies used so far have not allowed researchers to engage with *campesino* community realities. This has led to extractive and inappropriate research. The Institutions acting as links between communities and research institutions have to increase their capacity to suggest research topics and their negotiation power to establish contacts between research institutions and communities, which would serve to define topics, products and cost/benefit distribution" (Anderson *et al.* 2001:117).

That's an amazing revelation: FPR in cover crops indulged in extractive research that did not engage with farmers' reality, even though some very good NGOs and research institutes and universities were involved, and in spite of how easy cover crops are to work with compared to coffee.

Our Project tried the more difficult task of researching a cryptic insect pest in a tree crop, in only three years, yet we still came up with some worthwhile results.

9.3 MAIN ACHIEVEMENTS

The Project produced a substantial list of R&D contributions:

Adaptive research:
Forage groundnut as a cover crop (Guatemala)
Coffee pulp as fertilizer (Guatemala)
Use of Caturra variety (Ecuador)
Observations on problems with beneficio ecológico (Ecuador)
Re-Re (economic validation, Colombia)

New technology, developed by scientist-farmer collaboration:
Manure slurry to control coffee diseases (Ecuador)[17]
Picking mats (India)
Strip applications near stumped groves (Honduras)
Picking dry berries in March, then spraying (Honduras)
Greased bin covers (Colombia)
Greased harvesting barrel (Colombia)
Trap trees in stumped groves (Colombia)

Validations by scientists of farmer technologies:
Traditional planting styles in Ecuador
Traditional harvesting in Honduras

Strategic on-farm research
With alcohol-bait traps (Ecuador, Colombia, India)
And with wasps (all countries)

Rejection by farmers of unworkable technologies:
Beaveria bassiana
Sampling

Researchers in all countries reconfirmed the importance of harvest systems for CBB control and the fact that new harvest and gleaning techniques must account for labour costs and the price of coffee.

Finally, and perhaps most importantly was the work with hot spots. Researchers in Honduras and Colombia observed that farmers identify them. The Project staff in Mexico conducted a detailed study of farmer knowledge of hot spots. This is a real breakthrough. It means that future researchers can recommend that farmers apply any given technology just to hot spots, and need not undertake cumbersome numerical sampling to find them. Though they still need to find out how farmers do it, so that it can be incorporated into future extension activities.

Did different approaches emerge? As seen in the previous section, there was a great deal of difference on the specific technologies studied by each of the country Projects. Many topics were only studied in one country.

Colombia and Mexico and to a lesser extent Ecuador paid formal attention to selecting communities and negotiating research with them. Honduras and Ecuador worked in places where they were already comfortable.

All of the country Projects based their work on extension. The senior authors heartily support the notion that participatory research involves bringing farmers up to speed on chosen concepts of diagnosis, bioecology and pest management as part of participatory research. But FPR is not just extension.

Farmers must build on what they learn to help researchers create new knowledge, otherwise the experience is not participatory research. In this Project, a weakness in all or most of the countries was a lack of researcher interest in farmer innovations and in the ways farmers modified techniques learned from programmes.

9.4 TOWARDS A PROTOCOL FOR WORKING WITH FARMERS

In a linear sequence, the life cycle of an FPR project should be something like this:

1. Pick a topic.
2. Pick a region.

[17] The manure slurry was invented elsewhere, probably in Nicaragua, but agronomists working with farmers on our project observed that the treatment was not just a foliar fertiliser, but also controlled disease.

3. Do a needs-analysis.
4. Determine implicit and explicit demand.
5. Don't just identify problems, identify demand.
6. Identify gaps in farmer knowledge (deep, shallow, missing, mistaken).
7. Document research by farmers.
8. Pick the communities.
9. Decide the appropriate levels of farmer collaboration.
10. Establish farmer-researcher committees; also identify individual farmers to work with.
11. Train farmers (fill in the gaps of knowledge).
12. Include diagnosis, biology and ecology, management.
13. Design experiments.
14. Conduct experiments with farmer committees and individuals.
15. Do community evaluations.
16. Document results: farmer improvements on the technology, farmer complaints (new evidence of demand).
17. Validate farmer inventions.
18. Link with extension (direct, indirect, mass media).

9.5 THE FUTURE, SOME RECOMMENDATIONS

If the participatory approach is to become part of mainstream research, as we believe it should, then this inevitably implies that it should be taught in universities. Indeed there is now a need to radically overhaul the curriculum for agriculture students to take fuller account of the problems that 21st century farmers face. Although the subject matter of this manual is new, there is now enough methodology and of sufficient rigour, to support an initiative of this approach.

Recommendations, specific to coffee IPM would include:

- Continue research on hot spots.

- Use hot spots as the basis for extension recommendations ("Apply technology X in the hot spots, instead of in the whole grove, to save on expenses")

- Continue to closely monitor the relationship between the price of labour and the cost of coffee (for cultural controls).

- Continue validating some of the new technologies (e.g. manure slurry for control of disease, forage groundnuts). Recommend some of the new technologies in extension programmes (e.g. greased covers on bins, picking mats).

- Work with alternative marketing programmes.

- Validate mass media as an alternative to face-to-face extension.

Chapter 10

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PART II

ANNEX

Outline of Ethnoscience and Farmer Participation in Agricultural Research*

* Based on a seminar given at El Cajón, Honduras, August 21-24, 2000, by Jeffery Bentley, funded by the CFC CBB Project. Many thanks to the participants: Valeriano Chay Méndez, Oscar Campos, Juan Francisco Hernández, Raúl Muñoz, Angel Trejo, Hugo Paz, Mario Williams, Rodney Santacreo, Juan Francisco Barrera, Ramón Jarquín.

FPR (Farmer Participatory Research)

Farmers can participate in research by contributing:

- Land
- Labour
- Ideas

Of which the ideas, or **knowledge**, are the most important.

Development scholars agree on this, but formal development efforts have made little progress on how to understand farmer knowledge. Yet the anthropological methods and concepts of **ethnoscience** have been widely used by academics for 30 years. Ethnoscience is not overly difficult to understand, and can be helpful for documenting farmer knowledge and incorporating it into agricultural research.[19]

ETHNOSCIENCE: INTRODUCTION

Folk categories of knowledge are formed by mental concepts attached to word labels.

These concepts are organised into taxonomies, which are usually hierarchical ("kinds of things," e.g. a dog is a kind of animal.) All languages use taxonomies, although there is a fair amount of leeway in how taxonomies are formed. E.g. Quechua may not classify the condor as a bird. Many languages spoken in the Amazon do not have specific words for "parrot."

This is especially true for insects, which traditional people often lump into broad categories which include arthropods, worms, even rodents and lizards (Brown 1984). These are actually minor differences in classification and do not mean that traditional peoples misunderstand the way the world is put together.

Brent Berlin (1992) has proposed 6 levels of folk taxonomies, which are repeated cross-culturally:

0. Kingdom
1. Life form
2. Intermediate
3. Generic
4. Specific
5. Varietal

Each of these levels has its own linguistic properties. Most striking is that folk taxonomies use generic and specific labels much like Linnaean names: e.g. "*hielo negro*" (where "*hielo*" is the generic term for most plant disease and "*negro*" is the specific name for severe disease).

Folk taxonomies make much use of **residual categories**, e.g. "just a bug" to label left-over, or under-classified organisms.

Some folk taxonomies are in the form of **partonomies**, or sets of categories that are "parts of" another, e.g. parts of an ox plough, or parts of a plant or of an insect.

The main **differences** between folk and scientific knowledge is that:

- Folk knowledge is **local**, with no pretence to describing the world in universal terms
- Folk taxonomies **do not** usually fill each of the 6 taxonomic **levels**; many are left blank
- Folk knowledge is (usually) **stored mentally**, which constrains memory. An entomologist can have many more names for insects because they can be stored in writing

Similarities between folk and scientific knowledge, they both:

- Have names for things (e.g. organisms) in the real world
- Use binomial labels, for some things
- Organise categories into taxonomies

Sometimes there is a 1:1 correspondence between folk and scientific categories, but often there is not. For example, the concept of *hielo* is applied to 30-40 dif-

[19] See Sillitoe (1998) for a similar idea.

ferent bean diseases in Honduras. It is a concept of real world phenomena, but does not have any simple analogue in scientific terms.
The structure of folk taxonomies is heavily influenced by whether the organisms that are being classified are easily observed and culturally important (see Bentley & Rodríguez 2001).

Eliciting frames (for fieldworkers) include a few simple questions like:

- What are the kinds of X?
- What are the parts of X?
- What is the difference between X and Y?

OTHER FORMAL PROPERTIES OF FOLK KNOWLEDGE

Emic and Etic. These are two concepts borrowed by anthropologists from the linguistic notions of phonemic and phonetic. Roughly, emic is local knowledge and etic is scientific knowledge. An emic concept cannot simply be described in terms of a scientific name. This is especially true of folk entomology. It is a poor definition to say that "*cogollero* (fall armyworm) is *Spodoptera frugiperda*).

EMIC LABEL	*ETIC DEFINITION*
Cogollero	*The larva of* Spodoptera frugiperda *(Lepidoptera, Noctuidae), especially in later instars, especially when in the whorl of the maize plant.*

Emic and etic descriptions can also be given for behaviour. For example, when a Honduran *campesino* uses magical rites to control grassloopers, an entomologist may give one (etic) analysis of why the magical rites seem to control the insects, while an anthropologist may provide another (etic) analysis of how the rite functions.

MEANING AND KNOWLEDGE

Scientific categories are based on semantic premises of necessary and sufficient conditions: an insect either is or is not a Coleoptera. It cannot be partially Coleoptera. As the above fall armyworm example suggests, folk definitions often make use of **prototypical semantics**. Categories are often defined in terms of best examples. E.g. in English folk biology, a robin is a good example of the category "bird", while a penguin is a poor example.

Lore. Defining a set of folk categories is a good start to describing folk knowledge, but traditional people have a deeper understanding for each of those concepts, which we also need to know if we are going to work with traditional people as colleagues in research.

The sociology of knowledge may be rather complex, with different people (women, elders, ritual specialists) knowing certain things. Games and drawings can be used to elicit some of these differences (see Nazarea-Sandoval 1995). However, much of folk knowledge is shared by the entire group of people (see Hayes 1983).

Memory load. There is some suggestion that people can hold about 500 names in their head. 500 personal names of people. 500 names for plants. 500 place names etc. This has obvious implications for folk entomology.

Chronologies. Some folk knowledge is organised into chronologies, e.g. the folk phenology of maize in Honduras.

Alternative classifications. Povinelli (1990) claims that the Emiyenggal and Batjemal peoples of Australia classify animals in 4 different kinds of taxonomy (habitat, morphology, function, food criteria) depending on context. In fact, agricultural scientists do the same thing, with alternate classifications by phylogeny (e.g. horse is a kind of equine) or by function (horse is a kind of livestock). IPM experts routinely classify diverse organisms into special categories like "pests of maize" or "pests of coffee" which are not at all phylogenetic.

Regional synonyms. Unlike scientific classifications, folk taxonomies may use different labels for similar categories, from one place to the next.

SHORT QUESTIONNAIRES

After a team has elicited farmer knowledge through interviews, if the research calls for quantified answers, these can be elicited through short questionnaires.

The short questionnaire is like a semi-structured interview, only with a larger sample:

- There are 4-7 pre-defined questions, set around a hypothesis
- The sample of respondents should be chosen randomly
- If this is not possible, try to minimise bias (do not just interview the wealthy male farmers near the highway)

Example, a study of maize ear rots in Honduras used short questionnaires to show that farmer knowledge was comparable to scientific knowledge, with little emphasis on magical or supernatural explanation. The only key idea the *campesinos* were missing was the notion of a fungus causal agent (Bentley 1990).

FARMER EXPERIMENTS

Farmers constantly experiment, but we often do not pay enough attention to them. Noticing farmer experiments is important for deciding how we can work with farmers as colleagues (Table 7).

SUMMARY

We have seen that traditional farmers have knowledge, and it is organised in ways that are not as strange as they seem. Farmers also conduct experiments. In other words, (many) farmers are knowledgeable and creative, which is something researchers look for in choosing colleagues. However, farmer experiments are organised in remarkably different ways from those of formal research (Table 8).

Farmers potentially have a lot to offer researchers, but their different styles make actual collaboration difficult.

Farmers participate more in research depending on whether they contribute:

1. Land and labour;
2. Ideas for research and validation;

Table 7 *Farmer participations by country*

COUNTRY	*FARMER EXPERIMENTS AND INVENTIONS*
Ecuador	◆ *Aprons of various mixes of organic fertiliser to improve soil fertility, control weeds and avoid mechanical damage to coffee trees.* ◆ *A fertilisation experiment with* Schizolobium *trees.* ◆ *A new metal tool for harvesting cacao.*
Honduras	◆ *First fruits: early hand picking of broca-damaged coffee berries.* ◆ *Fallen coffee fruit as a proxy for hot spots (with insecticide applied only on hot spots).* ◆ *Rapid identification of individual coffee trees with high levels of CBB infestation, and immediate application of insecticide, but only on those trees.*
Guatemala	◆ *No experiments documented, although in several communities the whole coffee system is so new it could be considered experimental.*
Mexico	◆ *Application of 0.25 litres of endosulfan to one* cuerda *of coffee, to see if it is effective.* ◆ *Varietal trial of caturra.*

Table 8 *Comparison of characteristics of experiments by farmers and scientists*

CHARACTERISTIC	*SCIENTIST*	*FARMER*
Shape	*Square or rectangular*	*Irregular*
Size	*The same for each treatment*	*Different for each treatment*
Repetitions	*A must*	*Not used*
Numbers (quantification)	*Important*	*Visual analysis, with few numbers*
Planning	*Absolutely essential*	*Sometimes used*
Serendipity	*Less often*	*More often*
Who is it for?	*Others*	*For that farmer*
Replicability	*Always important*	*Not always*
Capital cost	*More*	*Less*

3. Research methods, or if-
4. They actually conduct the research.

How and where to involve farmers depends on the nature of the research topic. Biggs has finally come to conclude that there has been too much emphasis on method, that the quality of the research staff and their work conditions are probably more important than method in determining the success of participatory research (Biggs & Smith 1998).

Researchers will have to design their own participatory methods, but some inspiration can be taken from the following:

- Participatory plant breeding uses a kind of open house, allowing farmers to see advanced lines of breeding material that are still not released. Farmers comment on the material and sometimes take some home to plant. The method allows researchers to see what characteristics farmers select for, and to save several years of breeding effort (Sperling & Scheidegger 1995).
- Most farmers can be encouraged to do varietal trials with the gift of some seed. Paul Richards (1985) gave rice seed to 50 farmers in Sierra Leone, and they all planted the seed and experimented with it.
- The Zamorano method.
- Back and Forth (*Ir y Venir*).
- Farmer-experimenter workshops.

SUGGESTED READINGS (ESPECIALLY IN SPANISH)

1. Bellon (1992) a case study of applied ethnoscience. Maize farmers in Chiapas have a detailed taxonomy for soil types and maize varieties. Farmers use these taxonomies productively in making decisions to retain certain native varieties, even after adopting high-yielding varieties.

2. Bentley, Rodríguez & González (1994), an idea for training courses for farmers that build on local knowledge to encourage farmer experiments.

3. Ramírez (1989), a review in Spanish of the classic literature in English on FPR.

4. Sims & Bentley (1999), a discussion of a soil conservation project in Bolivia which started with FPR rhetoric. Researchers were allowed leeway in defining their own work, and the project developed 3 participatory styles, plus on-station research, all of which were functional.

5. Sims, Walle & Ellis-Jones (1999), original title: *Guidelines for Research on Hillside Farms: Participatory Technology Development of Soil and Water Conservation Technologies*. Based on fieldwork in various countries, especially Honduras and Bolivia, this publication has detailed “how-to” sections.

6. Oltrogge (1975), an ethnoscience paper on wasps among a native group of Honduras. The early date on the paper reinforces the idea that ethnoscience has been around for a while: it is not a fad.

7. Bentley (1992), a model for explaining how traditional peoples (Honduran smallholders, in this case) classify pests and other organisms.

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Colombia case study

[20]Unless otherwise indicated, all information in this study is from Aristizábal & Salazar (2001).

1. INTRODUCTION

The Colombian Project was housed at a research centre, Cenicafé, which is owned by the Colombian Coffee Growers' Federation. Cenicafé's entomology department began participatory research in 1998 in 9 villages in the departments of Caldas, Quindío and Risaralda with 113 farmers, to develop technologies for integrated berry borer management under farmers' real conditions, taking into account the natural and human conditions of each community. Researchers took farmers', extensionists' and scientists' knowledge into account, to generate, validate, adapt, develop and transfer technology.

2. THE TEAM

NAME	*ROLE*
Luis Fdo. Aristizábal *Hugo M. Salazar*	*Agricultural engineers, department of entomology, Cenicafé, in charge of planning and carrying out the project.*
Carlos Gonzalo Mejía *Mauricio Jiménez* *Germán Tabares* *Arturo Gómez* *Andrés Trujillo* *Julio Cesar Patiño* *Carlos Alberto Marín*	*Collaborators from the department of entomology, who supported the whole process, in the field and in the office.*
Coffee growers of the Departments of Caldas, Quindío and Risaralda (Colombia's Central Coffee Belt)	*Voluntarily responded to the invitation to work on the Project. 113 farmers in the 3 areas.*
Extensionists from the Coffee Growers' Committees in each of the work areas.	*Invited to support the training events and to accompany the Project, in the areas where it was sited in their jurisdiction.*

Preparing the team for the FPR project. Before starting fieldwork, the Cenicafé team received training in all aspects of coffee growing, especially in berry borer IPM. Most have many years of university and on the job training. Training exercises also included the opportunity to get to know participatory research in Central America: Honduras (The Pan-American Agricultural School at Zamorano), and Nicaragua (CATIE's IPM/NORAD Programme), among others.

3. SELECTING COMMUNITIES

The team took the following criteria into account when choosing areas to work:

- Villages where CBB is a problem.
- Communities of smallholders (less than 5 hectares of coffee, each), living and working on their own land.
- Groups of growers interested in working to find alternative pest management.

The extension service helped locate nine villages in:

Caldas: Viterbo, Belalcázar, Riosucio.
Quindío: Montenegro, Quimbaya, Buenavista.
Risaralda: Balboa, Santa Rosa de Cabal, Santuario.

The team invited farmers to a presentation, where they described the Project, its objectives, and to gauge farmers' interest in participating; 113 farmers in 9 villages volunteered to collaborate with the Project.

4. PARTICIPATORY SURVEY

Describing the farmers

85% of the farmers linked to the Project are men.
15% are women, heads of household, who manage their own coffee farm.
96% of the farmers are over 30 years of age.
98% can read and write.
78% of the households have four members or more.

Identifying farmers' problems

41% said their main problem in producing coffee was the economic situation.
30% said it was the CBB.
12% said it was other plant health problems.
9% thought other problems were more important (such as law & order, environment) but an optimistic 8% said they didn't have any problems.
In the nine work groups (one per village), the team

carried out participatory surveys with the farmers, establishing their specific problems with CBB management, and seeking possible solutions:

The coffee growers met in work groups (they gave their groups up-beat names like: *Los Pilosos* (The Energetic Ones), *Los Terribles* (The Rascals), *Los Patarroyos* (possibly named after Prof. Manual Patarroyo, Colombian scientist and world expert on artificial vaccines for malaria), *Los Amigos Biológicos* (The Biological Friends), a play on the terms natural enemies and biological control. They used drawing to express their problems and to suggest solutions (Figure 3).

Figure 3. Drawing by Los Terribles of Santa Rosa, Risaralda, made during the survey. It shows a CBB and a farmer drinking coffee together. The CBB says "I am happy when I am with you" and the farmer replies "Let's learn to be friends." The group wanted to show the need to learn to live with the insect (instead of hoping they could make it disappear).

Filling in the gaps in farmer knowledge[21] . As they learned what farmers knew and did not know, the team began to fill in the gaps in farmer knowledge (see Table 9). The Cenicafé team worked with Federation

Table 9 *Method and topics that Cenicafé taught smallholder farmers*

TEACHING METHOD	*TOPIC*
Demonstrations	◆ *Cultural control (e.g. Re-Re)* ◆ *Evaluating harvest quality* ◆ *Home made entomopathogenic fungus* ◆ *Applying fungus*
Tours: groups of farmers visited the main Cenicafé campus in Chinchiná and Cenicafé's experimental sub-station at La Catalina.	◆ *Low-water coffee processing (*Beneficio ecológico*)* ◆ *Building seedbeds* ◆ *Renewing coffee* ◆ *Weed management, selecting the "noble" weeds, which conserve soil and do not compete with coffee* ◆ *Broca control in groves that have been stumped (*zoqueado*)* ◆ *Biology and rearing parasitoids* ◆ *Producing fungus* ◆ *Rearing earthworms* ◆ *Insect zoo: importance of natural enemies* ◆ *Coffee varieties*
Talks	◆ *Aspects of integrated broca management*
Participatory evaluations	◆ *Control in post-harvest (plastic cover on the* tolva *and on the pit;* marquesina *[a plastic & wood structure, shaped like a small Quonset hut, for trapping broca]).* ◆ *Making and using alcohol traps* ◆ *Sampling (EBEL)* ◆ *Techniques for releasing parasitoids (exclusion chambers)* ◆ *Evaluating trap trees*

[21] Much of the rest of Section 4 is adapted from Bentley (2000).

extensionists; relations were usually cordial, occasionally tense, especially when the Cenicafé staff began training farmers. The extensionists may have perceived the training events as a kind of territorial threat, as a suggestion that the extensionists had not done their job well. The Cenicafé team tried to explain that they were not trying to do the extension agent's job, but that they were "*nivelizando conocimientos*", creating a level playing field. Since the Cenicafé team had learned what the farmers knew, the team would then teach the farmers what the scientists knew, so that they could work together as colleagues.

Starting research trials with farmers. From the community diagnoses, the team learned that the communities' priority problems (with CBB) were:

1. Coffee groves are too old and not producing well.
2. Even if one controls the CBB, one's neighbour does not (and CBB travel)
3. The communities are disorganised
4. Control measures are expensive (but farmers do not know exactly how much they cost)
5. Too many coffee berries are left in the grove (*recolecciones ineficientes*)
6. Labour shortage
7. Generalised pesticide applicationsS

After March 1999, the farmers and scientists planned research trials on CBB control techniques to solve the above problems. Actually, some problems are more feasible to study than others, and the research described below deals with problems 1,4, 5 and indirectly 3. The research with sampling touches on number 7.

The techniques were overwhelmingly designed by scientists, especially Cenicafé researchers. This was because the farmers expected a toolkit from Cenicafé, a set of solutions they could try out and apply. But also because the scientists were comfortable with their role as experts. This is not necessarily wrong, but the Project anthropologist was concerned that farmers could have contributed more technical solutions.

Researchers, extensionists and farmers then prioritised the following list of research topics:

- Costs and efficiency of cultural control (Re-Re).
- Study of berry borer populations on farms.
- Follow-up studies of the fungus *Beauveria bassiana* on farms
- Monitor berry borer populations using alcohol-baited traps
- Effect of trapping on CBB populations
- Community workshops to evaluate *B. bassiana*
- Study of the positional dynamics of the berry borer
- Releasing parasitic wasps *Cephalonomia stephanoderis* & *Prorops nasuta* in the field.
- Inventory of insects (besides berry borer) captured in the alcohol trap
- Evaluation of *marquesinas* for drying coffee with defects (*pasillas*) for CBB control
- Control of CBB during processing
- Evaluation of collection containers to prevent escape of borers
- Participatory evaluation of the EBEL sampling format (devised by Cenicafé statistician Esther Cecilia Montoya) with farmers
- Changes in the adoption of IPM components

5. CONDUCTING THE RESEARCH CONTROLLING THE CBB DURING PROCES SING.

Researchers and farmers evaluated 45 greased covers for coffee collection bins, which represents 72% of

Figure 4 . Farmer's drawing of the plastic cover

the farms that have bins for holding cherry coffee. The average area of the lids was 3 m^2. Farmers conducted 903 evaluations, capturing (and counting) almost a million borers (949,723) with an average of 7,714 borers per square meter. The costs of making each cover, including materials and labour was an average of $ 10,269 (Colombian pesos, about $5 US). The group of farmers reconfirmed the importance of the greased covers during coffee harvesting. As one farmer said: “The plastic covers are very useful for trapping borers; they are very cheap and they prevent the CBB from returning to the coffee grove.” (“*Las tapas plásticas son muy útiles para atrapar broca; son muy baratas y evitan el regreso de la broca al cafetal”*).

Collection containers to prevent the escape of borers. The farmers adapted a plastic drum with a plastic lid, smeared with grease to trap borers during the harvest (Figure 5).

Figure 5. Farmer evaluating the capture of CBB on the greased lid of the cherry coffee bin

Figure 6. Drum with plastic cover, smeared with grease, for holding and carrying harvested coffee from the field, to prevent the insect from escaping. Walker Cano (Viterbo – Caldas, age 68), inventor of the idea

This tool was invented by farmers, once they had observed the results of the greased covers (described in the previous section). The purpose is to minimise the escape of borers during harvest. Researchers helped farmers design three treatments to compare different kinds of linings for the greased drum:

- The drum with the greased lid captured 4,208 adult borers in 2,306 kg. of cherry coffee (1.8 insects / kg of coffee)
- Using plastic bags, farmers captured 8,993 borers in 2,760 kg of cherry coffee (3 insects / kg)
- And in the control container (a fibre bag, tied shut, but with a greased plastic bag inside it—also a farmer invention) 5,839 adults were captured in 2.620 kg. of coffee (2 borers / kg.)

These groves had low rates of CBB infestation, less than 3%. Some of the farmers’ comments:

“It is not enough to tie the bags shut in the grove; the CBB keeps getting out.” (*“No basta con amarrar las bolsas en el lote, la broca sigue saliendo”*).

“The barrel and the plastic bag placed inside the traditional container are economical and simple solutions to keep the CBB from escaping.” (La caneca y la bolsa plástica ubicada dentro del empaque tradicional son soluciones económicas y sencillas para no dejar escapar la broca).

“At first it was a bit complicated to find the little borers, because there were so many and they are so tiny, besides taking data almost every day, while harvesting, is a lot of work, but since we wanted to show that it worked, there was no other way.” (Al principio fue un poquito complicado contar las broquitas, porque eran muchas y muy pequeñitas, además estar tomando datos casi diario y en cosecha es más trabajo, pero como queríamos demostrar que funcionaba, no había otro camino).

Managing CBB in groves that have been stumped. Farmers in Quindío evaluated the efficiency of trap trees and of applying the fungus *Beauveria bassiana* to the soil in groves that had been stumped (Figure 6).

On the farms Villa Holguín and La Palmita, the rate of CBB in trap trees was 51 and 16% in the control groups, compared with 34.5 and 10% in the lots where fungus had been applied. Neighbouring groves had average rates of less than 2.3%.

B. bassiana was found on the trap trees in the groves, with at a rate of 1.5 to 35%. The farmers confirmed the usefulness of trap trees as a physical barrier to prevent the spread of CBB to neighbouring groves. Some comments were:

"The trap trees are a good control measure for CBB in the groves renewed by stumping." (*Los árboles trampa son una buena medida de control de broca en los lotes renovados por zoca*).
"One sees a lot of CBB in the trap trees." (*"Es mucha la broca que se ve en los árboles trampa"*).

"Each time one chops down a coffee grove, one should leave some trap rows standing." (*"Cada vez que se tumbe un lote del cafetal hay que dejar los surcos trampas"*).

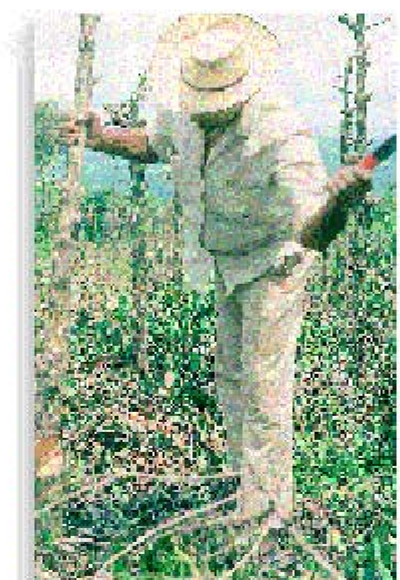

Figure 7. Renewing a coffee grove by stumping it

"The fungus helps to kill the CBB that comes out of the berries on the ground." (*"El hongo ayuda a matar la broca que sale de los frutos del suelo"*).

The "EBEL"[22] sampling plan for borers. 32 farmers participated, of whom 28% did more than five CBB evaluations in their groves, using the EBEL plan (Figure 8). In Risaralda, some farmers did 14 evaluations.

Farmers conducted 151 evaluations; in 123 (81.4%) they included data on percentage of the coffee beans which were damaged. 71% of the cases were below the upper limit for coffee bean infestation established by the EBEL plan. Farmers found the plan time-consuming and unhelpful, commenting:

"(The plan) requires technified[23] groves, which make it easier to move about and apply the plan." (*"Se requiere tener lotes tecnificados, lo cual facilita el recorrido y aplicación del plan"*).

"One does not need to count to know how much of one's coffee is sold with CBB (damage)." (*"No se necesita hacer cuentas para saber con cuanta broca vendemos el café"*).

"The CBB hot spots are easily identified (without sampling)." (*"Se identifican fácilmente los focos de broca"*).

"The table has too many columns; this makes you get confused." (*"La tabla tiene muchas columnas, esto hace que uno se confunda"*).

"Doing the evaluation wastes a lot of time and is tiring." (*"Se gasta mucho tiempo y se cansa mucho haciendo la evaluación"*).

This is an example of how participatory research can save time and money. The work on which the EBEL plan was based began more than five years previously and involved very detailed sampling of a plot, laborious entry of thousands of lines of data and months of computer analysis and report writing.

[22] EBEL stands for the initials of the Cenicafé scientists who invented the method, a clear example that researchers identify with their inventions personally. This is one reason researchers develop an irrational attachment to their technologies, and become frustrated when farmers do not adopt them, and may place unreasonable demands on extensionists to force adoption.

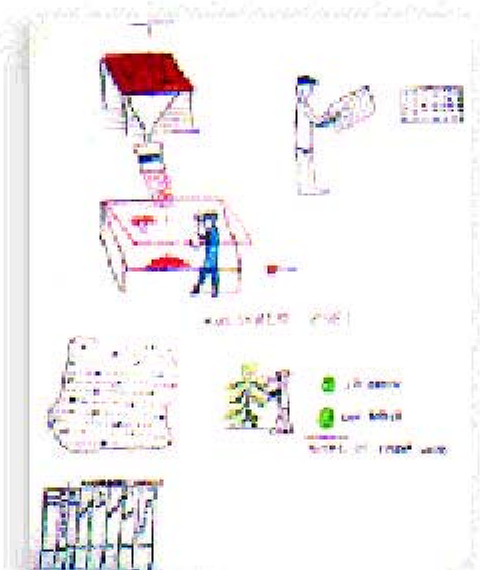

Figure 8. Diagram drawn by farmers to present their results of their test of the sampling plan

A preliminary exercise with farmers and extensionists, using a range of sample schemes, based on a simple and quickly-gathered data set, would have revealed the practical problems of sampling. This in turn might have occasioned a rethink which could have produced something more practical.

Biology of *Phymastichus coffea,* parasitoid of the coffee berry borer. Researchers in various countries are studying African parasitoids for the berry borer. The study presented here was designed to evaluate the lifecycle and levels of parasitism of *Phymastichus coffea* (Hymenoptera: Eulophidae) on three farms at different altitudes. Researchers conducted the evaluation on borers which were released and parasitized inside of insect sleeves. Farmers and extensionists collaborated in planning, conducting and discussing the results in each of the three areas (Figure 9).

The life cycles were as follows:

At 19.3^{o}C (elevation 1800 metres in Santa Rosa de Cabal, Risaralda): 60.0 days (egg: 11.9; larva: 16.6, pupa: 31.5)

At 21.5^{o}C (elevation 1400 metres in Quimbaya, Quindío): 37.3 days (egg: 5.5, larva: 17.7, pupa: 19.6)

At 22.8^{o}C (elevation 1200 metres in Viterbo, Caldas): 34.5 days (egg: 6.8, larva: 10.8, pupa: 16.9).

The average rates of parasitism were 96% for Santa Rosa, 67% for Quimbaya and 62% for Viterbo.The results show that *P. coffea* can complete its lifecycle in coffee between 1200 and 1800 metres above sea level. Mass release of *P. coffea* would probably reduce parasitism as much as by 50% when not done in insect sleeves. Even so, the percentages are greater than those achieved by other parasitoids released previously. *P. coffea* could be a viable control option.

Integrated management of the coffee berry borer, with emphasis on parasitoids. Farmers in Quindío showed interest in using the parasitoids *Cephalonomia stephanoderis* and *Prorops nasuta* (Hymenoptera: Bethylidae) on their farms. Researchers and farmers selected 36 groves in different agroecological areas, on 30 farms in Buenavista, Montenegro and Quimbaya. Borer control was based on frequent harvest of coffee and release of parasitoids. For two years, they studied the infestation rate of borers in the groves and in parchment coffee. The results were analysed as case studies, using descriptive statistics.

Borer infestation rates were low (Table 10).

83% of the farmers sold their coffee at rates of less than 2% CBB damage. All (100%) of the farmers said they observed parasitoids in their groves. The farmers concluded that frequent harvesting of coffee and releases of wasps could be used to control CBB.

Discussion. The Project anthropologist finds this a confusing study. It has a veneer of science, but it has no control group, and mixes two treatments at once. Be careful not to confuse farmers with spurious data.

Biological and economic analysis of cultural control of the coffee berry borer. The purpose of this study was to evaluate the efficiency of cultural control of the CBB, and determine the quality of dry parchment coffee obtained during one year on three farms in Caldas, Quindío and Risaralda. During the year 2000, collaborating farmers wrote down the number of kilos of coffee harvested, and the costs of harvest, processing and of hauling the coffee to sale. They

[23] That is, plots on which farmers have applied all the cutting-edge technology, as recommended by researchers.

also evaluated the level of infestation of the CBB in the field, the effectiveness of harvester labour and the level of infestation of the CBB in dry parchment coffee.

The results showed that in the three groves studied, the harvest labour was efficient, and that frequent, well-done harvests control CBB in the field, obtaining Federation grade parchment coffee. On all three farms, the cost of cultural control (Re-Re) was recouped in 98% of the cases by the coffee harvested during 2000. It was profitable for the growers to harvest ripe coffee every 15 to 22 days.

Farmer-experimenter workshop to evaluate *Beauveria bassiana* for the control of CBB. *Beauveria bassiana* is the natural enemy which causes the most mortality in CBB populations. Some farmers have produced it, and seen it in the field as a white dot on adult borers. The big question is, how many borers does *Bb* kill? Humidity favours the fungus, which may be one reason that farmers underestimate its role in CBB control. Project staff held a demonstration workshop with farmers from three villages Riosucio (Caldas), Balboa and Santa Rosa de Cabal (Risaralda) to evaluate the natural effect of the fungus in the field (i.e. the fungus naturally present in the field with no additional spraying). The team collected fruit with borers, at random, drew the borer's position and dissected the berries. Live and dead borers were isolated and placed in vials in a humidity chamber for 15 days. The farmers kept written records of the: number of holes, live and dead borers (with and without the fungus), absent borers and the position of the insect in the berry. The farmers detected the presence of *B. bassiana* on their farms after observing it during the evaluations. Live and dead borers without signs of fungus often developed it after being placed in the humidity chamber.

Figure 9. Drawing of the experiment, by one of the children. The researchers thought this drawing "emphasised the participation of the family". Actually, if you look carefully, each of the 4 human figures is labelled with a person's name and "Cenicafé". The child titled the drawing "Experiment by Cenicafé, CBB and wasps". The family seems not to have felt ownership of the experiment, although they were probably proud to be associated with researchers. Note the large amount of space devoted to the car and the road.

Table 10 *Borer infestation in three communities*

MUNICIPALITY	BORER INFESTATION IN GROVE	INFESTATION IN PARCHMENT COFFEE	ESTABLISHMENT RATE OF WASPS
Buenavista	2.0 ± 1.8 %	1.7 ± 0.5 %	28 %
Montenegro	3.5 ± 1.9 %	2.5 ± 1.3 %	90 %
Quimbaya	1.9 ± 1.7 %	1.3 ± 1 %	82 %

Discussion. The case of *Bb* is interesting because previous extension campaigns to transfer the use of this technology, failed. Additionally, the results of many field tests, in a previous project (Baker 1999) and one in this project, failed to show that the method causes sufficient mortality to be useful to farmers. But the farmers still wanted to try it. And even after they had tried it, they still made favourable comments about it, even though it was not effective. Were they picking up on a research agenda and giving the response they felt was required? Or did they genuinely think that the method still has some use? The results of the surveys (see below) suggest that the farmers did not know about *Bb*. But should the researchers simply have told them that this method needed further improvement before more field-trials? An interesting study might have been to determine what farmers use as criteria for a successful pest control method and then subsequently to get them to rank each method tried.

Study of borer population with traps. Cenicafé has studied alcohol traps to capture borer for some time. The participatory study was carried out in Caldas, Quindío and Risaralda. The objectives were:

1- Observe the degree of adoption of the technology,
2- Document the periods of most emergence of the borer
3- Study the borer population to help make decisions about IPM.

39 farmers participated in Riosucio and Viterbo (Caldas), Buenavista, Montenegro and Quimbaya (Quindío) and Balboa (Risaralda). They made the traps using material found on farm, and adapted the design.

The bait was medicinal alcohol, 90°, mixed with instant coffee. They placed 5 traps in each grove. Farmers and researchers made 551 counts of borer, an average of 14 per collaborating farmer.

Number of borers captured weekly: between 0 and 300 per trap,
Most captures: April 2000 (11.5(3.5).
Number of evaluations: 369, an average of nine per farmer.
Rate of infestations, between 0.2 and 15%, (2.9(2.2%).
No correlation was detected between number of borers captured, rate of infestation and rainfall.

Cost of materials: $1,185 (about 60 US cents) per trap and $625 (US 30 cents) for labour.

Cost of weekly evaluations: $250 (12 US cents) per trap.
Only two farmers (5.1%) continued the evaluations all year.

Discussion. The traps did allow researchers to conduct basic research on time of year when the most CBB emerge, although the experience apparently bored the farmers because nearly all gave up before the end of the study. The anthropologist wonders if the fact that each farmer designed his own traps damaged the replicability of the experiment.

Other studies, included a researcher-led study on one farm to determine the effect of trapping on CBB population, apparently there is little effect. There was also an esoteric study of the degree of penetration of borers in coffee berries in three municipalities.

Adoption. Researchers conducted another survey in the first half of 2000, to learn about technical change in the first 18 months of the Project.

- *Re–Re* was the item most adopted, 95% of farmers did it in 1998 and 99% in 2000, and they were doing it more thoroughly
- *Insecticides*. In 1998, 80% of the farmers made blanket applications, but by the year 2000, 58% of the farmers claimed not to use insecticides and the other 42% applied only on hot spots, and after evaluating the infestation in the grove
- *Knowledge of biological control* (fungus and parasitoids) went from 8% to 81%
- *Control in post harvest* and in processing was adopted by 82% of the group members, up from 7% in 1998
- *Records*, 47 % of the farmers kept records at first, vs. 72% by 2000

- *Field evaluations*, 15% did field evaluations in 1998, and 80% by 2000

Participating in research is linked with adoption. Farmers learn by doing, learn the reasons behind the technologies, increase their self-esteem, and generate new ideas of their own (Figure 10).

When researchers asked farmers about the problems, the story had changed. By the year 2000:

- For 34% of the farmers, their main problem in coffee was the economic situation
- Only 2% said it was coffee berry borer
- 10% said other plant health problems
- 25% said other things (like law & order, environment)
- And 29% said they did not have any problems with coffee

Compared with their answers in 1998, the farmers showed a lot more confidence in dealing with CBB (Figure 11)[24] .

6. VILLAGE EXCHANGES

The farmers of Riosucio visited the municipalities of Viterbo and Belalcázar; people from Balboa visited Montenegro and Quimbaya; those from Santa Rosa de Cabal and Santuario went to Balboa; growers from the village of Mesa Baja in Quimbaya visited the village of Morelia Alta, also in Quimbaya. Through the exchanges, farmers shared experiences and got to know the work of other collaborating farmers (Figure 11).

7. FARMER WORKSHOPS

The Project sponsored three workshops for farmer-experimenters (one per year), on the campuses of Cenicafé and the Manuel Mejía Foundation in Chinchiná, Caldas (Figure 12). A total of 72 farmers attended the three events. They were all chosen by their communities, in meetings, to represent their neighbours at the workshop. Nine extensionists, four agronomists from the Foundation and eight researchers also attended.

The attending farmers:

- Gave a general presentation on each village and the field trials they conducted.
- Reviewed the different IPM techniques.
- Made commitments as farmer-experimenters.
- Evaluated the participatory research.

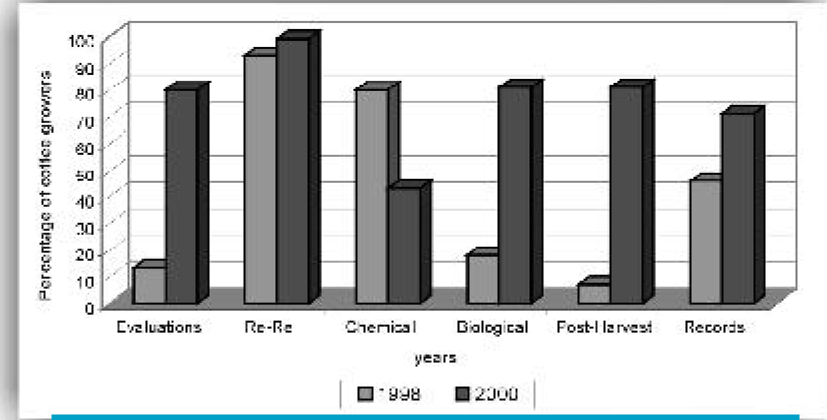

Figure 10. Use of IPM technologies by farmers who collaborated with the Project. Change from 1998 to 2000.

[24] Farmers are experts in telling survey-takers what they want to hear. While these numbers may be of some value, what is more important is that the researchers sense that the farmers are more optimistic and self-assured after their experience with the Project.

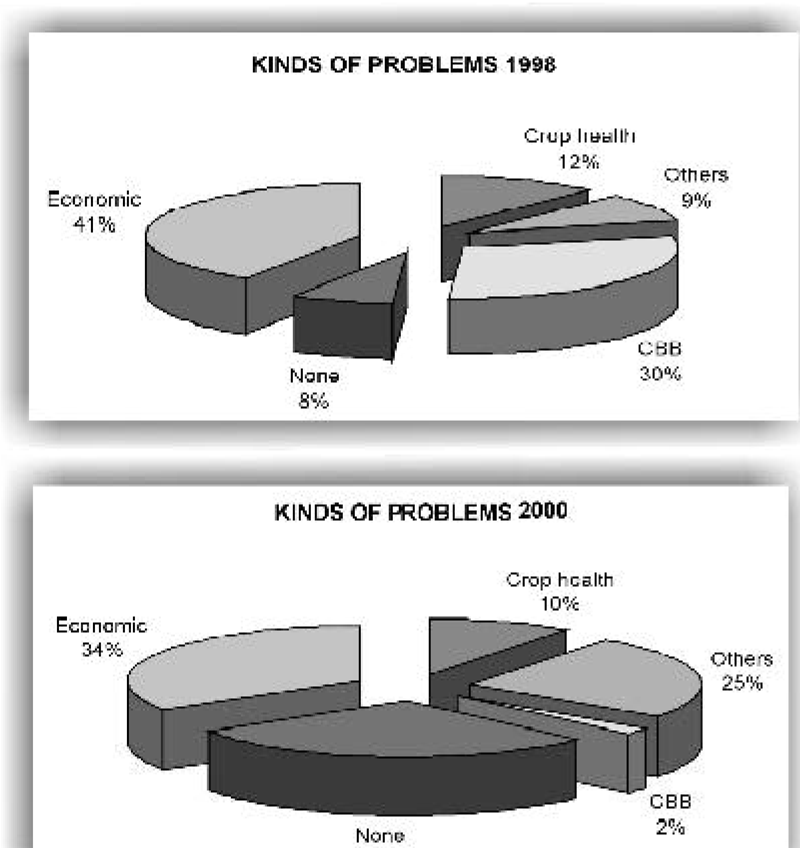

Figure 11. Change in the problems collaborating farmers reported in coffee growing, before and during the project.

Figure 12. Closing of the First Farmer-Experimenter Workshop held at Cenicafé, at the La Catalina experimental station, 3 November 1999.

The farmers who attended organised themselves into village committees for preparing their visual aids, the results of their research, and conclusions, which were submitted to a group discussion of achievements and weaknesses.

8. THE WAY FORWARD

The project staff have developed an original model for farmer-scientist collaboration. In summary, their method consists of:

1. First encounters: for the first four months they visited the areas with local extension agents, getting to know the areas, and gaining farmers' trust.

2. Individual visits with farmers, to learn what they know and the gaps in their knowledge. They conducted individual diagnoses of 113 farmers, to learn the farmers' concerns and knowledge. The method: the researchers had a written format to fill in, but did not administer it like a questionnaire.

They visited the farm household, walked with them over their land, chatted informally, and filled in the form later. They led Participatory Rural Appraisal diagnostic sessions in each of 9 communities, to identify problems, solutions and to brainstorm CBB control ideas to research. These formal, quantitative methods allowed them to assess farmer knowledge.

3. Training farmers, involving extension agents to filling in the gaps in farmers' knowledge thus creating a level playing field for collaboration. Evaluation of training is also carried out.

4. Establishing and carrying out tests on things that are likely to work. From the above steps things are agreed upon for further action. Some are farmer inventions, but most are scientist inventions. Farmers modify some of the techniques during the tests.

5. Farmers present results of the research in a farmer-scientist workshop. Three well-attended and comprehensive events were held.

6. Evaluate the cost-effectiveness of the process. A full economic analysis with an agricultural economist, e.g for CBB cultural control.

7. (Future step) train extension agents, using practical demonstrations (hammer and nails, not talk and chalk) of the most promising technologies. This might include the entry-level "most-likely-to-enthuse-farmers" technique (perhaps the sticky covers because they are cheap, easy to install and give quick visual results) and a series of subsequent steps leading up to more difficult concepts. There would also be some "don't-even-think-about-it" advice and ways to monitor achievement and encourage farmers (the regional events, prizes, etc.). Even this would be a pilot extension project, preferably with researchers monitoring it, followed by a full-scale roll out at a regional level of the validated techniques.

Step 7 is the most crucial because it is the link to a following project. Too many projects finish and no one takes them up because they do not have ownership of the original. This may well happen in the present case because the funding is finished and project staff will be laid off or reassigned.

Conclusions. The above project is not a panacea but is a useful attempt to assay new ideas in frequently testing circumstances. A general feeling we have is that top-down extension is nearing the end of its usefulness. It is not uncommon to find researchers who feel that extensionists are not making a good enough attempt to pass on their innovations, and likewise we encounter extensionists who accuse researchers of being arrogant and out of touch with farmers. Coffee producing countries simply cannot afford this state of affairs to continue.

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Ecuador case study

Ecuador case study

1. INFLUENCES

The Ecuadorian project is not housed in a national coffee institute, but in the headquarters of a National Coffee Exporters' Association (Anecafé); this gives the Ecuadorians a certain pragmatic perspective. For example, at the Project meeting in Colombia in May 1999, the Ecuadorians were the most willing to consider changing their research programme. When Bentley visited them in May 2000, Project leader[25] Alberto Larco frankly admitted that at the beginning of the Project they had confused participatory research with extension. Most of the others had also made the same mistake, but were not as ready to make a clear break with it. The Ecuadorian team rapidly got enthusiastic about involving farmers in research.

2. DOING PARTICIPATORY RESEARCH WITHOUT REALISING IT

One encouraging development was when Bentley and Larco realised that Project extensionist Evaristo Calle had already conducted a practical field trial with a community. Although it had not been appreciated as participatory research - it was.

Trial design. Mr Calle designed the trial to judge the value of four styles of planting coffee seedlings.

1) Direct planting in a raised bed.
2) Planted directly into a black plastic bag, filled with soil.
3) Planted first in a seedbed, and transplanted to a raised bed.
4) Planted first in a seedbed, and transplanted to a black plastic bag, filled with soil.

Data on plant growth suggested that the first treatment, which happened to be the farmers' traditional practice, was the most successful. The research was carried out from June to December 1999, with four collaborating farmers in the community of 10 de Agosto, in the canton 24 de Mayo, Manabí. Calle shared the results in a community meeting. While not earth-shattering research, farmers did participate, and it validated a traditional practice (Figure 13).

3. RESEARCH PLANNED FOR THE YEAR 2000

With Anecafé researchers, Alberto Larco and William Chilán, plus Project extensionists José Molina, Jorge Delgado, Evaristo Calle, Carlos García and the Project anthropologist (Bentley) we planned five studies in May 2000. The topics were:

- Varieties of coffee with supposed resistance to the coffee berry borer
- Alcohol-baited traps for capturing coffee berry borer
- The use of organic fertilisers: "*Biol*" and compost
- The relationship between harvest systems and coffee berries left in groves

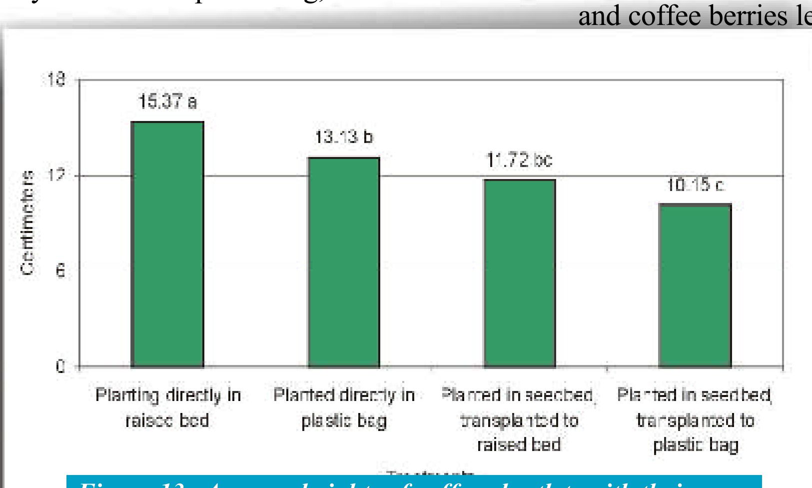

Figure 13. Average heights of coffee plantlets with their statistical significance for the four experimental treatments

[25] The head of Project for Ecuador is Pablo Delgado, who is the managing executive of Anecafé. While Mr Delgado provides active leadership to the project, most daily supervision is handled by Alberto Larco, an agricultural engineer.

◆A case study of coffee processing machinery. The team stayed with these topics, although each one evolved in its own way.

Varieties of coffee and coffee berry borer

This topic evolved quite a bit. Originally it was designed to test an observation farmers had made to researchers that the variety yellow caturra was resistant to berry borer. However, communication with researchers at Cenicafé and Peter Baker convinced us that the Colombians had already studied the topic exhaustively and that there was no varietal resistance to berry borer. But then, farmers in Pedro Pablo Gómez, Jipijapa, Manabí told the extensionist José Molina that they knew that (red) caturra yielded more than typica, but they were afraid to plant it, because they thought it was susceptible to CBB.

Ecuadorian researchers realised that this was an implicit demand for research, and helped the community set it up. They worked with a committee of farmers representing two organised groups (four farmers in the group Bajo Grande, and one in Santa Cruz). The selected farmers each had some caturra trees and some typica trees. The agronomists went with the farmers to the groves, where they collected the data. They showed that caturra is higher yielding, but is no more susceptible to CBB than typica is.

In June 2001, Bentley went with Ecuadorian researchers and extensionists to Pedro Pablo Gómez. It was one the most enthusiastic meetings he ever saw. The community was waiting for them in the small, brick house of the group leader. She opened the meeting and called on the extensionist to give a talk. José Molina spoke on one of the parasitic wasps. Then the community members explained the results of the experiment, how they had gone on the rounds from farm to farm, collecting the data from 10 caturra plants and 10 typica plants on each farm. And they saw that the incidence of CBB was about the same. "Sometimes there were seven in one and nothing in the other. There were only three little beans damaged in all three clusters that we evaluated at the end. And those three beans were typica"[26]. The farmers clearly caught the idea that caturra yields more and is not especially suscep-

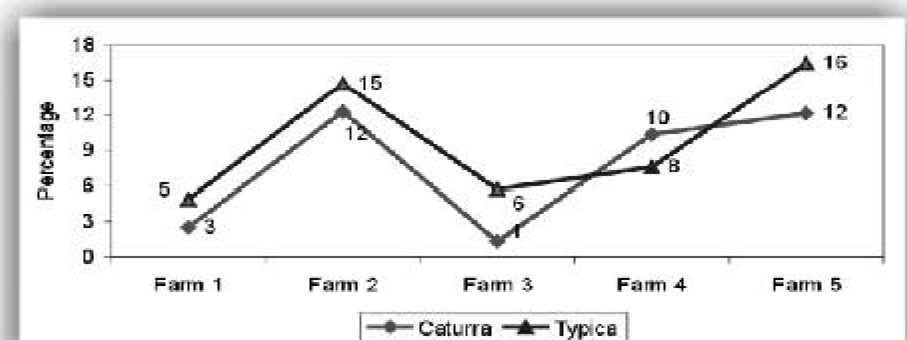

Figure 14. Percentage of CBB infestation on the tree- first evaluation

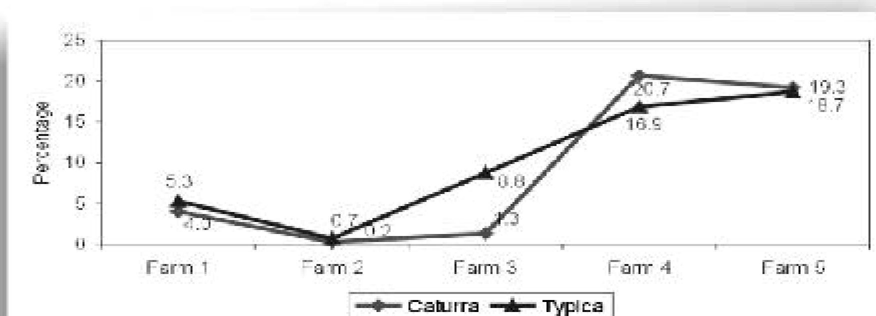

Figure 15. Percentage of CBB infestation on the tree- second evaluation

Source: Molina & Chilán 2001

[26] A veces era siete en uno, nada en el otro. Solo habían tres pepitas dañadas en todas las 30 gavillas que evaluamos al final. Y los tres granos eran typica.

tible to berry borer. In other words, the local people owned the data.

This may not be groundbreaking research agronomically, but it responds to an implicit community demand. It's probably an extension experience, because the farmers learned much more than the researchers, who already knew that Caturra was not more susceptible to CBB. But the experience can easily be used to benefit many others, by bringing farmers from other communities with the same concern, to visit P.P. Gómez, where local farmers will be able to explain the research, in the local vernacular, in no uncertain terms. An extension agency could even make a radio show, interviewing farmers from P.P. Gómez, and playing their remarks on the air, for the benefit of others who may also be asking themselves if they should plant caturra or typica.

Alcohol-baited traps for coffee berry borer. The goal of this study was to design a better CBB trap, so researchers could monitor CBB populations. William Chilán had already started testing three trap designs in farmers' fields by early 2000. As the farmers went with Chilán, they learned which traps caught the most CBB. In May 2000, Bentley cautioned that this might be counter-productive, if farmers began to make extra efforts to control CBB around the traps with the most captured insects, it might skew the data. Bentley (2000) suggested that there were several ways to approach the study of traps, as a:

- *Conventional, on-farm* agronomic trial (participatory level 1)

- *Qualitative experience*, with farmers suggesting some changes to make the traps cheaper or easier to make. For example, farmers were already suggesting using bamboo (locally abundant) instead of purchased wire, as the frame for the trap (participatory level 3/4)

- *Study of local knowledge*, to see if the traps could reconfirm what farmers were saying, that they already knew where the hot spots were in their groves (participatory level 4)

Ecuadorian researchers organised the study as a set of on-farm trials, with collaborating farmers, and a community evaluation. In June 2000, researchers took three trap designs to the communities of Entrada de Guarumo and Los Angeles, both in 24 de Mayo, Manabí. Chilán made the traps with local people. The three models of traps were made from:

1) A string of five plastic drinking cups
2) A string of five funnels, each funnel cut from the top of a large, plastic soft-drink bottle, and painted a silver colour
3) A large plastic soft-drink bottle, hung upside-down, with windows cut into it

Each model has two small, disposable plastic plates as a roof, a plastic film can filled with alcohol (a mix of ethanol and methanol) as bait for the CBB, and

The trap made from a soft-drink bottle

Photo courtesy of Anecafé

The funnel style trap

Photo courtesy of Anecafé

Johnny Sánchez hangs a trap made from 5 disposable drinking cups.

Photo courtesy of Anecafé

another film can filled with water, to capture the borers.

Chilán and collaborating farmers replenished the alcohol and collected data every 10 days, which Chilán analysed. Each community had a replicate of the 3 treatments, with 6 of each style of trap. The data clearly showed that the trap made from cups caught more borers. However, it also showed that far more borers were caught just after harvest, which suggested that if researchers were working on traps as a control device, they might concentrate on that time of year.

On 21 June 2001, Bentley attended a community evaluation, in Entrada de Guarumo, attended by Project researchers and extensionists, about 25 farmers and five extensionists from a collaborating NGO (OFIS). Chatting with farmers before the meeting, and again during the meeting, it became clear to us that the community members thought that the traps were controlling the CBB, not just on the participating farms, but in the whole community. This was a fantastic misperception.

Farmers said that the year before they had had 40% incidence of CBB, and that now there was much less. Alberto Larco led a long and sometimes noisy dis-

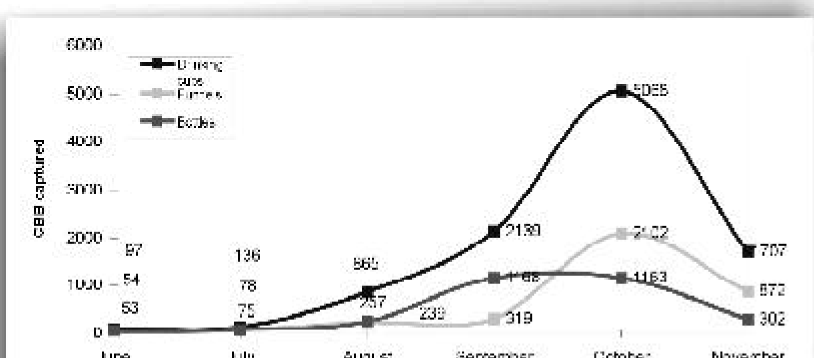

Figure 16. Capture of adult CBB by 3 kinds of traps in La Entrada de Guarumo, Portoviejo

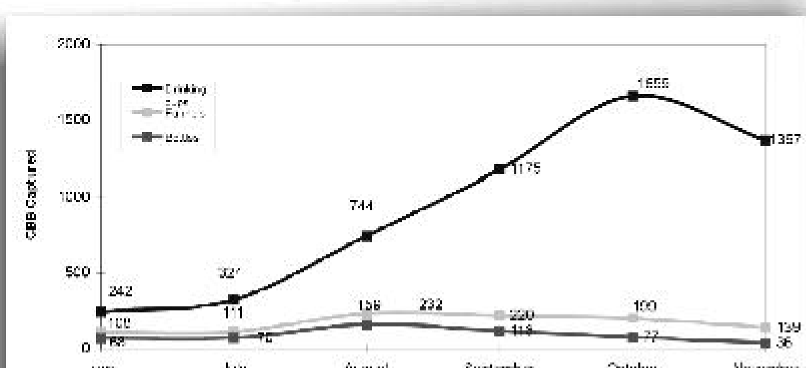

Figure 17. Capture of adult CBB by 3 kinds of traps in Los Angeles, 24 de Mayo

cussion, with community members providing much of the data. The logic of it went something like this:

- The traps killed a total of about 32,000 borers.
- A coffee tree can have about 900 berries.
- 2,500 plants per hectare would have 2,250,000 berries.
- 40% of which is 900,000.
- So if the traps killed 32,000, there are still 868,000 borers unaccounted for.

Larco then asked how many traps it would take to kill 900,000 borers.

We calculated 500 traps (though through the law of diminishing returns, it is most unlikely that this number would kill all the borers). The cost in labour of visiting these 500 would be $288 and the cost of materials would be $413, without taking into account the cost of getting the materials or of building the traps. It was courageous of Larco to take the time to clear up such a misunderstanding, especially in front of the surprised extensionists from the NGO. The farmers got very discouraged. It was clear that the local people had not realised that they were participating in research. One outspoken farmer, Johnny Sánchez, said that the researchers should bring things that were ready, and not things like this that they did not know would work or not.

Discussion. The experience was a shock at the time, but it shows how important it is to be clear with a community about the goals of research. We also see by the final meeting that the farmers had misunderstood what was going on, and formed some seriously wrong conclusions, that the traps were for controlling the CBB. The farmers' implicit demand was for a trap to control CBB, not just to monitor it (which was the researchers' idea). Perhaps Anecafé's business orientation led them to be so brutally honest with farmers' regarding the cost ineffectiveness of the traps. Certain other programmes tend to encourage farmers to adopt an innovation without bothering to count the costs.

Still, everyone learned something. The researchers learned when to trap and which model works best. The farmers learned how to make the traps, and how to count CBB. They got an idea of how many millions of borers they probably have in their groves. In other words, for all its flaws, it was participatory research, because farmers and researchers learned new information (see Box 3, Part I).

Compost. Project extensionist Evaristo Calle and other team members have been interested in organic fertiliser since at least 1999, specifically, in two types of organic fertiliser, both of which they learned from Nicaraguan NGOs.

Biol: a slurry of water, cow manure, cane syrup, milk and lime, fermented in a plastic barrel.
Bokashi: a Japanese-style potting soil, made of manure and half a dozen other ingredients, mixed 25 times and fermented indoors.

Bentley's first impression of these tedious technologies is that they were conceptually, as well as literally, bullshit. They use too much labour, too much purchased material and generate little organic fertiliser. The nutrient value of organic fertiliser is low, and to be very useful, a farmer or gardener must apply a lot of it.

But the Ecuadorians countered that Ecuadorian coffee farmers also usually had cattle, so the cost of the manure would be lower than in some other countries. They also observed that in previous experiences, they had noticed that Biol helped to control disease on coffee plants. That made Biol worth trying.

From July 2000 and for the next year, the extensionists Evaristo Calle, Jorge Delgado and Pedro Tulio Gómez tried Biol and compost in three villages. They only report on results of Biol, not on results of compost (Delgado *et al.* 2001). Their trials showed that *mal de hilacha* (Koleroga) was significantly lower on coffee that had been sprayed with Biol.

This was basically level 1 participatory research, on-farm. It remains to be seen if it is cost-effective or if farmers will adopt it, but the initial results are interesting and suggest that Biol can be adapted as a fungicide, which could make it much more profitable than if it is used as a fertiliser.

Harvest systems. In May 2000, Ecuadorian researchers told Bentley they wanted to study the effects of

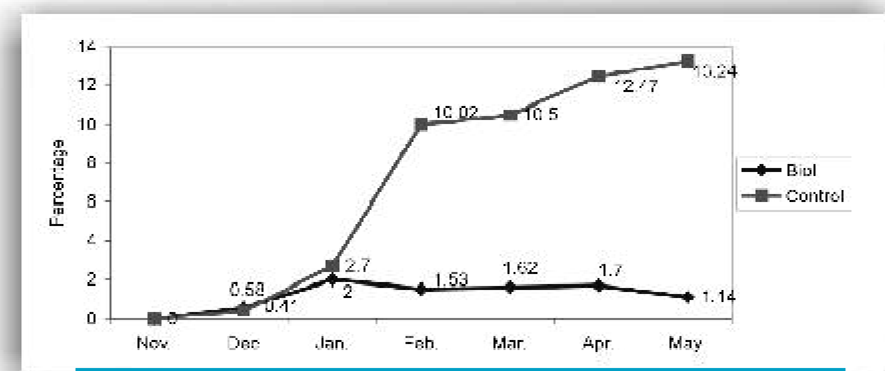

Figure 18. Incidence of mal de hilachas (Pellicularia koleroga) in Caña Brava, 24 de Mayo

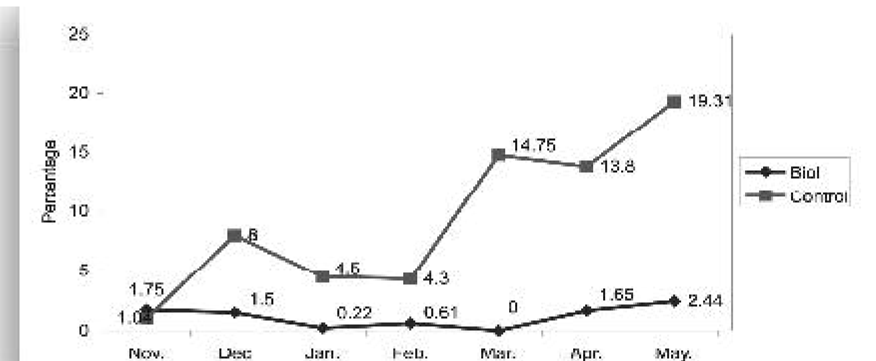

Figure 19. Incidence of mal de hilachas (Pellicularia koleroga) in Los Colorados, Portoviejo

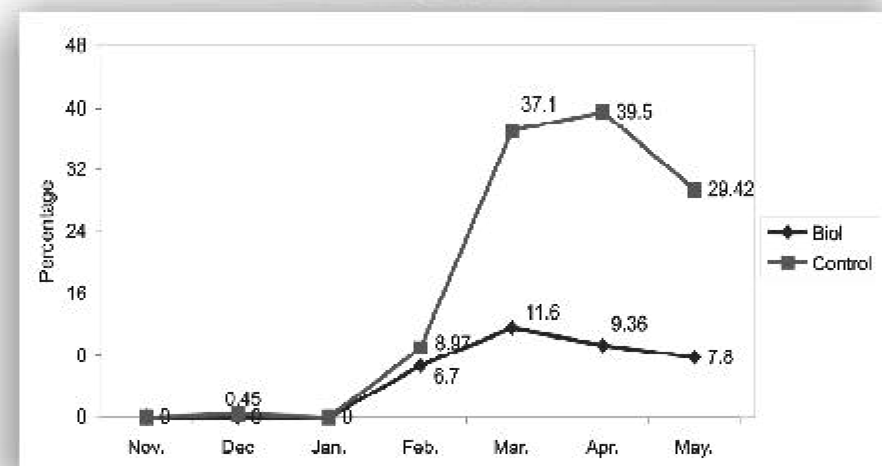

Figure 20. Incidence of mal de hilachas (Pellicularia koleroga) in La Ladera, 24 de Mayo

different, traditional harvest systems on the amount of coffee berries spilled on the ground (and providing CBB habitat)(Table 11). Some pickers harvest berries into baskets. Others spread a large sheet on the ground (made from 2 fertiliser sacks sewn together, somewhat like the picking mat in India). We agreed that it was an important topic and agreed to do it by visiting different places, measuring the size of the grove, the number of workers, documenting the harvest technology (e.g. basket, mat etc.) and sampling the number of berries left on the tree or dropped to the ground.

Table 11 *Researchers studied three harvest systems in three different communities, with no repetitions*

PLACE	HARVEST SYSTEM
10 de Agosto	Men, women and youths picking ripe berries into a bucket.
Los Angeles	Women and youths, stripping berries off the branches onto a canvas sheet.
La Cruz	Hand picking onto a canvas sheet.

However, this was more or less conventional, social or even ergonomic research. It was almost physical anthropology, with little room for farmer participation. The Ecuadorian researchers, who had done such other good studies, never got comfortable with the method for this one.

Researchers conducted the study by measuring the time it took pickers to harvest 20 plants. They also counted the number of berries on the tree and on the ground, both before and after harvesting. They also counted how many volunteer coffee plants had sprouted below each tree.

Just by doing this small study the researchers realised that harvesting is much more difficult on hills, where the pickers had to tie the sheet to the ground with stakes, so that the stake would be higher on the low end, to keep the berries from rolling off. This took more time. The researchers also began chatting with farmers about why they stripped the berries all at once, instead of hand-picking the ripe ones. The farmers said they realised that they were damaging next year's harvest, but that when coffee prices are low, they don't bother to pick properly.

The pickers were very fast, taking only two to four minutes per plant, if they stripped the fruit. Picking ripe berries took five to seven minutes. Since stripping is done once, and careful picking twice or more times, stripping is much faster, but it damages the plant and the quality of the harvested coffee is much lower. Farmers usually pay pickers by the day, not by the amount picked, if they are more concerned about quality. After the harvest, the owners pick the coffee from the ground, so there is little fallen fruit.

Discussion. In spite of certain methodological problems, something was salvaged from the research. If nothing else, we have a better idea of how people pick coffee in Ecuador and that at least some people are careful not to leave a lot of berries on the ground. But the Ecuadorian researchers were uncomfortable with the study, and eventually discarded it from their final report.

Case study: *beneficio húmedo.* This study was to be frankly qualitative, and the Ecuadorians had a significant experience with it, but failed to write up the results.

On 22 June 2001, Larco and Bentley visited a group of farmers in Las Juntas, Moraspungo, department of Cotopaxi. This was supposed to be a case study of *beneficio ecológico* (low water coffee pulping, using state-of-the-art Colombian machinery). The notion was that farmers take a low price, because they sell coffee in cherry, because they often do not have enough water to wash coffee. The Colombian pulper that uses less than two litres of water per kg of coffee seemed like a promising solution. Anecafé had loaned this group a machine. We found them on a large cement patio, where one member of the group buys coffee. Eight or ten men gathered around while the extensionist, P. T. Gómez adjusted the machine. We talked with the farmers and with Wenceslao Beltrán of Anecafé.

The people in Moraspungo sell their coffee in cherry.

They harvest a mix of ripe and unripe berries, which lowers labour costs. The price of coffee is low, $4-5 per hundredweight of cherry. Although they are only paid $4 a day (plus meals), a labourer cannot harvest a hundred pounds of coffee a day, so many people are not hiring harvesters. Many men who have coffee of their own are working as labourers instead of harvesting their coffee. People remember fondly when coffee was worth $40 to $50 per hundredweight, as recently as 1996.

The coffee flowered many times that year, and there was a great mix of ripe and unripe coffee on the plants, which made it just that much more difficult to harvest only ripe berries. People were just stripping the branches, instead of bothering to pick only ripe berries.

The Colombian *beneficio ecológico* machine was designed to be fed only ripe coffee. It choked up several times on the hard, unripe berries. Wenceslao had to bring a bag of ripe coffee, that he picked himself, just so people could watch the demonstration of the machine. The extensionist got the machine running beautifully on the hand-picked ripe coffee, but the farmers who gathered around to watch it lost interest when they saw that it did not handle unripe berries. They helped us load the (surprisingly heavy) machine onto the pick-up truck, and we took it to Los Colorados, but by this time the extensionists had a harder time conveying much enthusiasm about the machine to their farmer friends. It is likely, if prices had been at 1996 levels, that farmers would have been willing to selectively harvest ripe berries to feed the machine. In this case it could have earned them even more than by quickly stripping the pulp and allowing them to produce high quality parchment. As such this is an interesting case of how low prices can lead to a downward spiral in earnings from which it is difficult to recover.

Lesson learned. *Beneficio ecológico* demands a harvest quality that many Ecuadorian communities cannot match. It would be a difficult technology to adopt in Ecuador, unless it was re-tooled, though this would be a major undertaking. Perhaps the staff at Anecafé found this conclusion too qualitative, or too negative. At any rate, they opted not to write about their experience with *beneficio ecológico*.

*Discussion***.** The researchers were more comfortable with, and did a better job with research designs that resembled an agronomic trial on a research station. This is no doubt one reason agronomists are accepting the CIAL method with little trouble. But with topics that demand a different design, e.g. a one-off ergonomic study of harvesting, or a qualitative, case study of a new tool, agronomists are reluctant to write their results. The *beneficio ecológico* study could be done in the Back-&-Forth format, if the team has a mechanical engineer with the time to take the machine apart and put it back together again.

People who are going to write an account of an experience in a community would do well to take a course in journalism, and write the account like a plain, simple newspaper story.

In a country like Ecuador with weak scientific institutions, it was probably expecting too much of this Project's staff to develop the methods and the topics of participatory research, besides carrying out their other duties. They did well, given the circumstances, but if we are to develop FPR as a proper discipline, we need to think hard about where and how to first apply it and the minimum conditions required for it to flourish.

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Honduras case study

1. INFLUENCES

Like most of our other Latin American Projects, the staff of the Honduran Project had a long association with other related projects. For example, in about 1991, Raúl Muñoz, Project leader for Honduras, had previously worked on a project that taught farmers to rear wasp parasitoids, in collaboration with Dr Juan Barrera and other colleagues from our Mexican Project. Muñoz and others at IHCAFE (the Honduran Coffee Institute) had worked on extension with farmers since the mid 1980s.

Another major influence was the CATIE/NORAD program in Nicaragua. CATIE is an international agricultural research and education centre, based in Costa Rica, but with offices in the other Central American countries. CATIE has a long experience with coffee and with IPM. CATIE emphasised teaching farmers to make a lengthy, formal count of insect pests and diseases. The idea was that farmers would learn to fill out the sampling forms, and use the information to make agroecologically sophisticated decisions about pest management.

The CATIE training materials for farmers also included solid lessons on the biology and ecology of a very large range of topics, weeds, diseases, nematodes, the coffee borer and others (Muñoz & Paz 2000). IHCAFE researchers hoped that farmers who attended training events would be more likely to adopt new technology. These extension experiences were called participatory research, although the emphasis was more on encouraging farmers to adopt researcher innovations, with little emphasis on inventing technology (Muñoz & Paz 2000, especially pages 2-3).

2. STARTING

The participatory research was set up in response to these early influences. As early as 1998, at the very start of this project, Raúl Muñoz and colleagues at IHCAFE set up four participatory research plots, in farmers' groves, to compare IPM with farmers' practices. This was consistent with the researchers' previous efforts to train farmers in IPM (the communities also received training events, and the IPM plots were implicitly a kind of demonstration plot). The "IPM treatment" included cultural controls (gleaning berries from the ground, *pepena*, and picking berries left on trees after harvest, *repela*) and biocontrol (release of parasitic Hymenoptera). In this sense the treatment reflected the researchers' interest in finding alternatives to insecticides (Muñoz studied entomology with the renowned Fausto Cisneros at La Molina, in Peru). The Honduran researchers sensibly kept the trial designs simple: just an IPM treatment and a farmer control per each replicate. There were four replicates, in remarkably different locations.

Trial geography. Muñoz was based at the research station at La Fe, Ilama, Department of Cortés in north, central Honduras. He found two study sites near the station:

- *El Tigre*, a nearby community of smallholders who had received land as part of the agrarian reform of the mid 1970s. The community was formally organised, but all farming was individual. They took little collective action other than living near each other and asserting a united block to prevent encroachment on their land.
- *Babilonia*, a large, commercial estate of over 100 hectares.

Muñoz found two other sites, many hours' drive from the station, in the western highlands of Santa Bárbara Department:

- *El Corozal*, a traditional community of small and medium coffee growers, also in the western highlands.
- *Agua de la Piedra*, a smallholder community. Like El Tigre, Agua de la Piedra also benefited from the Agrarian Reform, but kept an unusually tight local organisation. They managed a few plots of coffee collectively (although most of their coffee was farmed individually). For about ten years they had attracted the support of a US-based donor (Foster Parents Plan) who had helped them first get into coffee, in 1986.

3. RESEARCH WITHOUT REPLICATES

The researchers carefully set out the plots in equal sizes of one *manzana* (7,000 m^2) per treatment, and began to establish the same IPM treatment in each one. However, even with a great deal of participation by the scientists, by 2001, after three years, they were forced to admit that the experiment had no replicates (Muñoz, Trejo & Paz 2001). Each research site had a unique set of treatments. This was because of modifications made either by farmers, or by researchers in response to different conditions.

Researchers lost replication, in spite of the fact that this was not even a highly participatory trial; it was level 1, on-farm research largely controlled by the researcher. However, with a highly commercial, perennial crop, over 3 years, farmers are bound to eventually introduce enough changes into the crop management to eliminate strict experimental replication.

Farming systems determine pest incidence more than control tactic. The researchers collected a great deal of data. They also paid community members to take data (more on this later). This carefulness allowed them to salvage at least one very important conclusion from the research.

Besides the high annual variation, observe (Table 11) how there is little difference between control (farmer) and IPM plots. There is however, wide variation between farms. By far the place with the most CBB damage is the large estate, Babilonia. The smallholders achieve reasonably good control in every year. The best control of all is achieved in El Corozal, the traditional coffee farming community.

Large estates have more berry borer incidence because they are large. The owner is often absente, and leaves management to a hired professional. No matter how conscientious the owner and manager are, they cannot invest the amount of time per hectare that a smallholder can. During a visit, the manager complained to one of the senior authors that the quality of hired hands was poor and that he had to compete for labour with a maquiladora factory.

Large estate managers must hire overseers to supervise workers, who are paid by the amount harvested, so workers do not bother to pick up spilled berries, and may skip some trees entirely if they are poorly laden with fruit. This provides ample CBB habitat for following years.

More coffee left in groves on large estates. Direct evidence of the above idea comes from data on the amount of coffee that researchers paid to have gleaned from the IPM treatments in each of the 4 "replicates." (They did not glean coffee from the control plots, which were managed by farmers.)

Here we see clearly that there is far more coffee left on the ground and after harvest on a large estate than on the small farms (Table 13).

Farmer experiments. The Project anthropologist (Bentley) visited Honduras twice in 2000 to work with Muñoz and other Honduran researchers. The first visit was a tour of research sites (5-11 June 2000) and the second was to lead a workshop in ethnoscience and participatory research with the Honduran, Mexican and Guatemalan staff (21-24 August 2000). Although these were short visits, they helped spark an interest in farmer experiments. By the end of the Project, Honduran researchers documented at least two experiments by farmers themselves (Muñoz, Trejo & Paz 2001).

Stump & spray a strip. This technique was invented by the management of the Babilonia estate after three years of interaction with Project staff. The estate had divided its holdings into five plots of 30 manzanas (21 hectares) each; they stumped one every year. Based on researcher's observation that the berry borers abandoned the newly stumped groves, to fly to neighbouring ones, the owner, José Angel Saavedra, began directing his workers to spray insecticide in strips, on the edge of groves next to the stumped one. Muñoz, Trejo & Paz (2001) report that this lowers CBB incidence by 4%, compared with plots that are not sprayed.

Dry fruits. Jorge Villanueva of El Tigre has invented a control combining the picking of dried coffee berries from the trees in March, followed by insecticide applications (Muñoz, Trejo & Paz 2001). This is interesting because it is at the height of dry season, not immediately after harvest. By waiting, the farmer is able to pick the berries during the agricultural "down season," when there are fewer tasks competing for his time. There is also probably less foliage on the trees, and the berries are easier to see and reach. The practice makes sense if the farmer can do it before any significant rains, which would stimulate emergence, since the adult borers tend to wait inside the berry until they become fully moistened by rain.

Experiments. Both of these experiments involve insecticides. They are both influenced by new bioecological information they received from the Project regarding CBB movement and habitat. They were clearly not copied from Project recommendations, since the Honduran staff was quite reluctant to recommend insecticides. Muñoz also notes that the farmers who have worked with the Project are harvesting more thoroughly, so that on the smaller farms there is hardly any coffee left to glean.

Hot-spots. The Honduran staff and CATIE edited a manual on extension material for coffee farmers (Muñoz & Paz 2000). It stresses IPM, including the classic notion that chemical insecticides may be used as a last resort, but only after sampling the pest population to determine that it has reached the threshold level of economic damage. It does not specifically mention the idea of applying insecticide only on CBB hot-spots. However, it is possible that the Honduran staff told farmers something about it.

Counting. For one thing, by the end of the Project, researchers were downplaying the idea of pest scouting. The farmers could do the counts, which involved filling in some 500 or 600 little boxes, an effort that takes three hours or more. But farmers were unwilling to take the time. The Project paid a farmer at each site to count the pests in the experimental plots, and give the completed sheets to the researchers. It seems that no farmers adopted the practice spontaneously.

Surveys. The Honduran researchers began and ended their work with a formal survey. The 52 questions may have taken two hours to administer. The first survey was given to 74 farmers in three areas of Honduras (La Libertad, Comayagua and the Lake Yojoa area, Cortés & Santa Bárbara) in April 1998 (Muñoz, Paz & Trejo 2000). The second survey in 2001 was administered to 66 farmers in two communities where the test plots are located (El Tigre, Cortés and Agua de la Piedra, Santa Bárbara) and on some farms near the research station at La Fe (Muñoz 2001). In other words, the two surveys had a lot of overlap, but the second survey was more biased in favour of farmers who were more likely to have had contact with the Project. Both surveys report many farmers spraying insecticide only on hot-spots. The practice does not appear to have increased or decreased as a result of the Project. This was certainly an opportunity wasted: we still do not know how farmers identify hot-spots, or how effective their hot spot spraying is for CBB control, nor do we know how natural enemy populations respond to it. The Project should have validated this farmer practice.

4. EXTENSION

The Honduran researchers hoped that participatory research would help extend IPM technologies. In their final report, Muñoz *et al.* report that farmers learned from the test plots and adopted the techniques (Muñoz, Trejo & Paz 2001). This seems questionable. For one thing, we have seen above that the IPM technologies were not significant in reducing pest populations. Secondly, in the final survey, carried out only in the communities where the experimental plots were sited, only half of the farmers surveyed had even heard of the test plots. Over half of those who did know the plots existed had no idea what the research was about (Muñoz 2001).

5. VALIDATION

Collecting the first fruits (i.e. some weeks or months before the main harvest they selectively remove infested berries of early minor flowerings, see Table 12 is a farmer invention, practiced on some plots in Agua de la Piedra. An important part of FPR is validating such innovations. The Honduran researchers collected some basic cost data, concluding that first fruits could be collected at a cost of $7 per hectare. Table 13 shows that Agua de la Piedra has very low berry borer incidence. It is possible that this practice is cost effective for very poor farmers, although more research may be necessary. (Bentley noticed that many people in the community did not use the technique on their individual plots, even though helped carry it out on the collective plot. This lack of adoption suggests that

Table 12 *Why there are no replicates*

PLACE	UNUSUAL THINGS ABOUT THE IPM PLOT	UNUSUAL THINGS ABOUT THE CONTROL PLOT
El Tigre	*Is the only trial where the IPM plot and the control are separated by several (3) km.*	*Separated from the IPM plot. (At the other sites the IPM and farmer plot are contiguous).*
Babilonia	*The estate workers spray endosulfan.* *Was near a recently stumped grove in 1999.* *Very light shade (other farms are in moderate to dense shade).*	*Endosulfan is used.* *Is near a recently stumped grove.* *Very light shade.*
El Corozal	*The farmer stumped half of the plot.*	*All of the control was stumped.*
Agua de la Piedra	*The community hand pick the first fruits, i.e. they remove the coffee berries that are infested with the coffee berry borer.* *Researchers did not release parasitic wasps.*	*No wasps are released.*

Source: Adapted from Bentley 2000

Table 13 *Coffee berry borer (CBB) incidence by location*

PLACE	CBB INCIDENCE IN IPM PLOT CBB			INCIDENCE IN FARMERS' PLOT		
	1998	1999	2000	1998	1999	2000
El Tigre	*11.0%*	*2.3%*	*7.5%*	*10.0%*	*7.9%*	*15.3%*
Babilonia (Estate)	*35.6%*	*6.2%*	*25.2%*	*32.0%*	*10.0%*	*49.2%*
El Corozal	*0.1%*	*0.5%*	*0.3%*	*0.3%*	*0.5%*	*0.3%*
Agua de la Piedra	*2.0%*	*3.3%*	*0.8%*	*2.1%*	*2.7%*	*0.8%*

Source: Adapted from Muñoz, Trejo & Paz 2001

there may be a reason for not adopting it, such as lack of labour at that time of year).

Fallen fruits. In another study, the Honduran researchers calculated that of the berries that fall to the ground, 58% of them either rot or sprout, and thus are not habitat for the coffee berry borer. This modest study was a nice touch, one of many formal studies done by the hard working Honduran scientists. It is a kind of a cross between a natural history study and a validation of farmer practice (harvesters drop some grains, but most are not CBB habitat).

Farmers from the 1991 project abandoned rearing of parasitoids. In 2000, Bentley asked Muñoz what had happened to the farmers who had received training in rearing parasitoids. Muñoz reports that these farmers have now all abandoned rearing wasps, because of low coffee prices (Muñoz, Trejo & Paz 2001). More information on this case would be interesting. As a result of this intensive, probably high-quality training, did farmers adapt the concept of rearing wasps? Did they innovate any other technologies based on it?

Table 14 Amounts and costs of coffee gleaned in IPM treatment, 1999 and 2000

PLACE	COST OF GLEANING 1999	AMOUNT GLEANED 1999	COST OF GLEANING 2000	AMOUNT GLEANED 2000
El Tigre	*$16*	*46 lb*	*$29*	*46 lb*
Babilonia estate	*$136*	*1,000 lb*	*$128*	*717 lb*
El Corozal	*$9*	*19 lb*	*$4*	*7 lb*
Agua la Piedra	*$6*	*9 lb*	*$3*	*2 lb*

Source: Adapted from Muñoz, Trejo & Paz 2001

6. SYNOPSIS

The Honduran researchers made a concerted effort to include a wide range of farm types from the largest to the most humble. They achieved a good rapport with farmers, but were beset by methodological problems. They were insufficiently analytical of things that did not work and through inexperience in FPR they did not fully appreciate some of the potentially interesting things that farmers did. They responded well to on-the-job training.

We now realise how difficult it is to change established research practices and that workshop-style training may not be the best use of resources for this subject. The fact that researchers were receptive to the new ideas they encountered during inter-disciplinary field work and practical, field-training makes us optimistic that change in attitude is possible and that a longer term project, well structured, could yield significant sustainable improvements.

After nearly 20 years work on coffee, Raúl Muñoz has now left to do other things.

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México case study

BACKGROUND

The leader of the Mexico project, entomologist Juan Barrera, had a long history of research and extension with parasitic wasps. Besides classic biocontrol, in the early 1990s, Dr Barrera designed and implemented a project to train farmers to produce parasitic Hymenoptera in rural rearing centres, and to use *Bb* to control the berry borer. (*Bb* is *Beauveria bassiana,* a fungus which attacks and kills certain insects.) This innovative effort even included writing a comic book as an aid to teach farmers in an enjoyable format (Barrera & Castillo 1996). For reasons still not fully understood, in spite of these best efforts, farmers either did not adopt the techniques (Damon 2000), or as in the Honduran case, adopted rural centres for rearing wasps, only to abandon them after project staff stopped visiting the field. This previous experience had a profound effect on this current project. Dr Barrera hypothesised that biological control was an effective tool for control of the berry borer, and that farmers would adopt biocontrol if it was properly taught to them.

The current Mexico project was housed at ECOSUR (El Colegio de la Frontera Sur), which is a university with campuses in Tapachula and other southern cities. This was a departure from our other country projects; most were housed at national coffee institutes. The university setting may have given the Mexican Project more of an academic framework. It certainly had a solid scientific foundation.

Barrera enlisted a Ph.D. candidate, Ramón Jarquín, to implement much of the Project, and to write his thesis on it. Jarquín designed his research as an extension experiment: to test the hypothesis that participatory extension was more effective than institutional extension. Thus, unlike most of the other countries, the Mexico project was based on two clear, cross-cutting research objectives:

1) To prove that proper extension would convince farmers to adopt parasitic wasps and *Bb*.

2) To compare participatory extension with non-participatory (Table 15a y b).

The Mexican staff had a sophisticated notion of participation. They also understood that participatory extension was not research.

1. STUDY NUMBER ONE

Participatory vs. Traditional Extension

Selecting the communities

Unlike the Honduran and Guatemalan cases, in Mexico, the Project staff did not simply chose communities where they had previous, agreeable relationships with farmers. The Mexican Project started with a large survey of communities. In 1998 ECOSUR contacted the Unión de *Ejidos Lázaro Cárdenas*[27], near Tapachula, Chiapas. Unión leaders said that farmers were interested in controlling berry borer. Project staff held meetings in 33 communities in 1998. In 18 of the communities, the local people walked out when they realised that the Project was not going to donate materials. Project staff conducted farmer surveys and promoted sampling in the other 15 *ejidos*. We have noted elsewhere in this manual that smallholders do not like quantitative pest sampling. Of the 15 communities in Chiapas that showed interest in berry borer, people were only willing to do sampling in seven communities. The project selected four communities to work with, the four that showed the most interest. In other words, the collaborating communities were selected to:

- Have coffee berry borer
- To show concern about it
- And to be willing to sample.

In 1999, the Project started the extension experiment, with the following two treatments:

In each of the four communities, Project staff helped establish two berry borer trials. Each trial had two plots of 0.5 ha each: an IPM plot and a control plot. The Project staff helped farmers gather data on rainfall, temperature and soil. In each half-hectare plot, the Project took samples on 10 sites, five trees per site, and 20 berries per tree.

[27]An umbrella organisation linked to the PRI. It provides technical assistance and other services to *ejidos* in Chiapas. It used to distribute fertiliser and credit.

Table 15a *Description of the treatments in the extension experiment*

TREATMENT	A: PARTICIPATORY	B: INSTITUTIONAL
Interactions with farmers	*Collective*	*Individual*
Decision-making	*Horizontal*	*Vertical*
Data-taking	*Collective*	*Project staff*
Teaching style	*FFS*	*Demonstration plots*
Diffusion	*Workshops for analysing results*	*Written flyers and field days*
Training	*Field and workshops*	*Talks and practical demonstrations*
Design	*Farmer suggestions are incorporated*	*A program is established and followed*
Evaluation of results	*With community*	*By technical staff*

Table 15b *The four communities in the extension experiment*

COMMUNITY	MUNICIPALITY	ALTITUDE IN METERS	MODEL
Piedra Partida	*Motozintla*	*1000*	*Participatory*
Santa Rosalía	*Tapachula*	*960*	*Institutional*
Tiro Seguro	*Tapachula*	*608*	*Participatory*
Mixcum	*Cacahoatán*	*585*	*Institutional*

The IPM treatment included

- cultural control (collecting perforated berries, *pepena* and *repela*)
- releasing parasitoids
- *Bb*

As in the Honduran case, the control group was managed by the farmers.

Project implementation

Monthly visits. The team visited each community about once a month, as inspired by the FFS model. The personable Mr Jarquín handled most of the community relations, but was accompanied by extensionists who did most of the teaching. One extensionist stayed with the Project for three years, and taught the villagers in the participatory treatments. Although it was not part of the experimental design, there was a high turnover of extensionists on the institutional treatment (as frequently happens with public institutions). A succession of three extensionists worked in the communities of the "institutional" treatment.

Little difference between treatments. By 2000, the Project staff recognised that in practice, there was little difference between the two treatments. Both allowed for community input. For example, the trial plots in all communities were placed on land selected by farmers. Even in the "institutional" *ejidos*, the local farmers helped conduct the sampling, just as in the "participatory" ones. In fact during our visit in June 2000, more farmers participated in helping researchers sample for pests in the "institutional" than in the "participatory" villages; this was due to individual decisions by the farmers. Project staff concluded that there was little difference in results: that both participatory and institutional styles "worked."

In his presentation at the final Project meeting in Costa Rica, in October 2001, Jarquín returned to the idea of the extension treatments, saying that there was a significant difference between the two. Bentley questioned him about it, and he said after looking at it again carefully, the differences had emerged.

Observations on Study 1

Sampling is cumbersome. In June 2000, Bentley observed researchers and farmers in Mixcum, sampling berry borer on two plots of half a hectare each. Sampling is inherently time-consuming, and even though the Project staff and farmers were experienced with the plots and with the method, it took them most of the morning to sample the two plots. Such numerical sampling methods are too complicated and time-consuming to be adopted by most smallholders.

Adoption was low. The Project recommended that farmers glean coffee berries. The farmers that Bentley interviewed in June 2000 said that the traditional practice was to allow poor neighbours to enter the groves after harvest, to glean. The trend among commercial farmers was to stop allowing gleaning, because some gleaners broke trees, trying to reach the berries left on top branches. As a result of the Project, at least some farmers were aware that gleaning helped manage the CBB, and were allowing their neighbours to still come into the groves.

Those same farmers also knew about *Bb*, as a result of Project extension, but they found it difficult and expensive to use. There was little or no adoption.

Parasitic Hymenoptera were still important to Project staff, who monitored them closely and told farmers where the wasps were (e.g. that by 2000 the wasps were being found in the control plot, not just in the IPM plot). Farmers seem interested in this, and observed staff members releasing wasps from jars. However, as part of this Project, the staff did not try to teach farmers to rear parasitoids themselves.

Human experiments. Entomologists may have a disciplinary tendency to divide human subjects into groups, and to test different extension strategies formally. Keith Andrews inspired a large set of these in Honduras in the late 1980s, early 1990s. Like the Mexican case, those experiments were also frustrating, in part because it was difficult to keep the treatments separate. It feels insincere to treat one community one way and another in a different way. It seems more natural to be consistent with all of them, and to let each relationship evolve on its own course (del Río *et al.* 1990, Bentley & Andrews 1991, Bentley & Melara 1991).

Bentley suggested that Jarquín write the experience qualitatively, instead of describing it as a comparative study of two treatments.

2. STUDY NUMBER TWO

An Experiment Arising from Listening to Farmers

Hot-spots

In June, 2000, farmers said that they knew which parts of the grove had more berry borer. Barrera and Jarquín agreed that other farmers claimed to know where CBB hot-spots occurred. For example, at the beginning of the Project, collaborating farmers helped the Project to site the IPM test plots. Although the staff did not know it at the time, farmers always put the IPM plots over large hot-spots.

Barrera, Jarquín & Bentley designed the following sampling experiment:

Background

- Farmers find numerical sampling difficult and tedious.
- Sampling of berry borer is time-consuming even for specialists.
- Berry borer occur in hot-spots of several contiguous trees.
- Sampling attempts to create a model of those hot-spots.
- The model is flawed, because of the geometrical (checkerboard) sampling design.
- At best, sampling creates a simplistic mathematical model of a more complex reality. Sampling is based on the premise that some plants represent others. A number of plants are sampled in a "site," which is rectangular and arbitrarily defined.
- To counteract this problem, statisticians have developed "adaptive" sampling where the sampler has the option to change his plan based on what has been observed during the course of the sample (Thompson, 1992). Perhaps farmers intuitively do something similar when they locate hotspots.
- Researchers' knowledge of sampling is out of date and this may also apply to statisticians advising them.
- Sampling is difficult and even experts get it wrong. At worst, sampling is an artefact.

Hypothesis

H[1]: Farmers know where the berry borer hot-spots are in their coffee groves. Farmers know the size and boundaries of the hot-spots.

Research protocol

1. Interview farmers. Ask them if they can identify places in their groves where there are more berry borers.

2. Ask the farmers to take the researchers to those spots.

3. Ask the farmers if they can identify the boundaries of the hot spot. If they say yes, mark the boundaries (e.g. with plastic tape tied to trees).

4. Do an entomologically sophisticated sampling of the grove to determine where the hot-spots are. This should be done with the farmer's permission, but the farmer does not need to take part in the actual sampling. This sampling is being done for scientific purposes, and is not intended to be something that a commercial grower would find useful. The sampling can take up to several hours. The main point is accuracy, not developing a farmer-friendly sampling method.

5. At first, it may be a good idea to hone the method, by working with farmers already well-known by Project staff. Later, researchers can work with friends of those farmers, and later with farmers who have had little or no contact with the Project.

6. Researchers will repeat the method—a) interview, b) mark hypothetical hot spot boundaries, c) sample—with many farmers, until the scientists can confirm or reject the idea that farmers know where their berry borer hot-spots are.

In fact, when the research was actually conducted (see Section 3, below) not all of these points were covered. For example, it seems that researchers did not ask farmers to mark the boundaries of the hot-spots, but merely point out the spots. However, in all fairness, carrying out all six of the above points would take a long time. Section 3 reports on a preliminary effort, and while it may not _prove_ that farmers can identify hot-spots, does suggest that they can.

Applications of experiment results

Berry borer control technologies tend to be expensive. If coffee growers could apply them only to hot-spots, farmers would lower IPM costs, while maximising the benefits. This may help some technologies or farming systems become profitable. For example, *Bb* or hand-picking may not be profitable if applied to a whole grove, but it may be, if applied to a single hot spot.

Confirmation of the notion that farmers can identify hot-spots

Jarquín later wrote a paper on hot-spots. It was a short study of two farmers, but it did suggest that farmers could accurately identify the hot-spots in their own groves (Jarquín, Montes & Barrera 2001).

In November 2001, Ramón Jarquín sent us a draft paper that suggests that farmers can identify hot-spots. Farmers' notions of the factors associated with hot-spots (e.g. sun, shade, humidity) are not unlike those of researchers. Farmers also suggested some novel ideas, e.g. that hot-spots were near paths, which researchers had not noticed, but which were validated by Jarquín and his colleagues. See Section 3 for a translated and slightly abbreviated version of Jarquín (2001).

3. VALIDATING FARMER KNOWLEDGE OF HOT-SPOTS IN CHIAPAS[28]

Entomologists have reported that the coffee berry borer has a patchy distribution, forming "hot-spots" (Decazy *et al.* 1989, Barrera 1994). Hot-spots have been shown to be related to coffee grown in shade (Baker 1984, Baker *et al.* 1989, Barrera & Covarrubias 1984). However, studies in Honduras (Muñoz *et al.* 1986) and Nicaragua (Monterrey 1994) did not ob-

[28]This section was written by Ramón Jarquín (ECOSUR, Tapachula, Chiapas, Mexico), edited and translated by Jeffery Bentley. Javier Valle Mora helped with the statistical analysis, and project extensionists Manuel Figueroa & Román Montes assisted with the fieldwork.

serve a relationship between shaded coffee and CBB incidence. Other authors (Bustillo *et al.* 1990) consider that high relative humidity (90 & 98.5%), consistent with shady groves, favours the CBB.

Intercropping of Arabica coffee (*Coffea arabica*) with robusta coffee (*Coffea canephora*) may favour berry borer, since robusta bears fruit over a longer period and so provides alternate habitat for CBB (Leach 1998).

Until now, the method most often recommended to growers to identify hot-spots has been systematic sampling. It supposedly allows farmers to identify hot-spots and then apply a control measure only to those areas that require it. Nevertheless, few farmers have adopted quantitative sampling (Guharay 1997, Jarquín *et al.* 1999, Jiménez 1999, Jarquín *et al.* 2001).

Recent fieldwork in Chiapas, as part of the CFC-sponsored Coffee Berry Borer Project suggests that farmers can identify hot-spots without quantitative sampling. To further test this hypothesis, and to validate farmer knowledge, we studied farmers' perceptions of CBB hot-spots (which farmers call *focos* or *manchones*) and compared this with scientific knowledge of hot-spots.

Context

The research was conducted with coffee growers in the Soconusco and Sierra regions of Chiapas, Mexico, in the communities of Santa Rosalía and Tiro Seguro of the municipality of Tapachula, Mixcum of the municipality of Cacahoatán and Piedra Partida of the municipality of Motozintla. The research team took a representative sample of each community. In each area, some farmers had been trained by staff of the CFC Coffee Berry Borer Project.

Step one. In June-July 2001 the team administered 171 short questionnaires on berry borer to farmers. The basic question was, did they think that the berry borer had a uniform distribution within the grove or not. Of the 171 farmers, 108 (63%) said that the distribution is not uniform; 85.1% mentioned at least one reason, in order of frequency:

- Coffee is exposed to sun (37.9%)
- To shade (19.4%)
- The spot is near a road or path (11.1%)
- Arabica coffee is intercropped with robusta (10.1%)
- Lack of integrated pest control (3.7%)
- Humidity (2.7%)

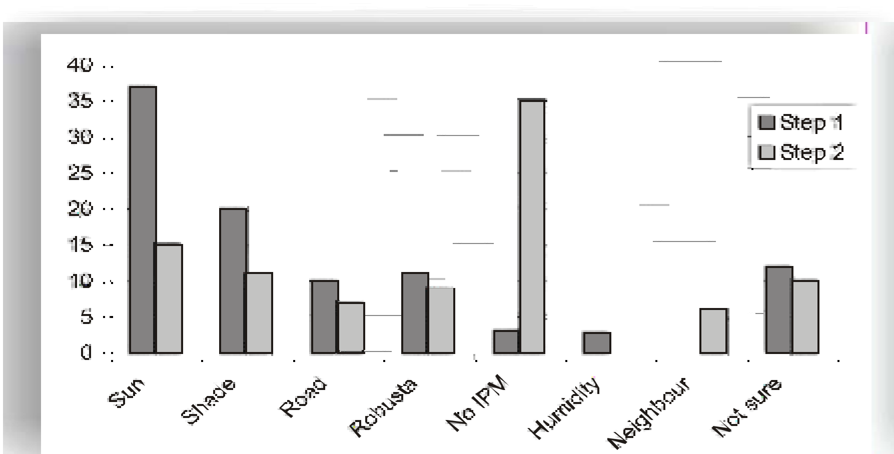

Figure 21. What causes hot-spots? Responses from farmers surveyed in January-April (1st step n = 171) and August-October (2nd step n =25) 2001 in Soconusco and the Sierra of Chiapas, Mexico

The rest of the respondents (14.8%) said they did not know the reason for hot-spots (Figure 21).

Step two. From August to October 2001 the team worked more closely with a smaller group of 25, farmers selected at random from those in the first set who had said that CBB is not distributed uniform. The team gave them another questionnaire to flesh out their earlier answers and did field verifications of the existence of hot-spots.

First, farmers identified a hot spot. Next, researchers confirmed that the area had a high level of berry borer damage. The research team documented intercropping with robusta, shade density, proximity to a road and to neighbouring plots. Shade was quantified with a spherical densometer, using the methodology of Lemmon (1956). Researchers and farmers collaborated in carrying out a systematic sampling of berry borer in each plot.

In the second survey, 36% of the farmers claimed that the lack of integrated pest management was the main cause of the hot spot. This was probably what they thought the research team wanted to hear. The lack of shade was mentioned in 16% of the cases, and the presence of robusta and excess shade were each mentioned 12% of the time. Another 12% said they didn't know. Proximity to a neighbour's grove or to a road or path were only mentioned 4% and 8% respectively (Figure 21). In both questionnaires, farmers explained hot-spots by either shade, sun, being near a path, or to intercropping with robusta.

Validation

Of the hot-spots farmers showed us, 64% had arabica-robusta mixes, and 36% were pure stands of Arabica. The difference was not statistically significant (c21= 1.96, P=0.1615).

68% of the hot-spots indicated by farmers were within five metres of a road or path, while proximity to the grove of a neighbour who does not control pests, or to a permanent body of water, were found in 17.4% and 8.6% respectively. Being near a path was statistically significant (c22= 14.16, P=0.000083).

23 of the 25 hotspots were in shade of over 64%, which was highly significant statistically (c21= 20.16, P=0.0000007).

Discussion

Most farmers claim that berry borer hot-spots are correlated with some environmental factor, but farmers do not attribute clusters of CBB to any one cause. Some farmers consider shade to contribute to CBB hot-spots, and by far, most of the hot-spots that farmers showed us were in dense shade.

During the first questionnaire, most farmers attributed CBB hot-spots to an excess of sun, consistent with studies from Colombia (Cárdenas & Posada, 2001), which report that spots of light attract the CBB. The team did not find intercropping with robusta coffee to be significant, in contrast to an earlier modelling study by Leach, (1998), using data from the Soconusco region. Many hot-spots are found close to paths and roads, which could be due to exposure to contamination from people passing by with harvested coffee berries. Only a few farmers blamed hot-spots on roads.

External change agents should take local knowledge and experiments into account in order to find solutions that are consistent with local economic and ecological conditions (Bentley 1992). Our study supports the hypothesis that farmers can accurately identify hot-spots of CBB without quantitative sampling. This study of local knowledge has created an opportunity to identify berry borer hot-spots quicker, and much more efficiently than by using systematic sampling.

Conclusions to Section 3

Hot-spots are linked to a complex of biotic and abiotic factors, which farmers recognise. We did not confirm the accuracy of all of the farmers' explanations for hot-spots, but more research on this is needed. For example farmers linked hot-spots mainly with sun, but researchers found that the spots were almost all in dense shade. However, research in Colombia has found an association between canopy holes and hot-spots.

This study is a first step to developing a method, which can be used in follow-up studies to monitor the causes of hot-spots, relating the information closely with the local knowledge of farmers. The confirmation that farmers can accurately identify coffee berry borer hot-spots, without doing difficult and time-consuming numerical sampling opens a door to more farmer-friendly sampling programmes.

4. SYNOPSIS OF MEXICO CASE STUDY

The Mexican team tried to develop a rigorous and scientific approach to evaluating participatory extension vs. traditional extension. While there are some indications that there were differences between the two treatments, at least one team member (Bentley) remains sceptical. The epistemological problem with such a study is that the researchers carrying it out invariably have a bias, and may sub-consciously either favour one treatment, or on the other hand, they may treat all of the communities in a similar manner, blurring the difference between the treatments. Thus it is difficult for the researchers to modify their behaviour systematically and arbitrarily within communities of different experimental treatments. The extension study was certainly a heroic effort, and we await the discussion of it in Ramón Jarquín's Ph.D. dissertation.

The hotspot study was a good initial attempt to access farmers' knowledge and present it in a concise and scientific way. Further work is needed to determine how the farmer comes to recognise the hotspot, and whether he takes the optimal amount of effort to control these. The work throws up some interesting questions:

- What is the definition of a hotspot, and do farmers concur in this definition?
- Do we have sufficient scientific knowledge to be able to predict the effect of controlling only hotspots or to be able to tell farmers how much extra time and money to spend on them?
- Could our understanding of hotspots help to improve control measures by encouraging or discouraging their formation?

This is an example of how work with farmers can inform researchers' ideas and help to steer the research agenda towards solving their problems.

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