

**LINKING SMALL FARMERS TO THE FORMAL RESEARCH SECTOR:
LESSONS FROM A PARTICIPATORY BEAN BREEDING
PROGRAMME IN HONDURAS**

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with members of the Association of CIALs of Yorito,
Sulaco and Victoria**

Abstract

The paper discusses co-production in the improvement of bean varieties between Honduran hillside farmers and regional scientists. The focus is at the field level where teams of farmer-researchers (CIALs), supported by a local non-governmental organisation (NGO), the Foundation for Participatory Research with Honduran Farmers (FIPAH), collaborated in a participatory plant breeding (PPB) programme with the Pan-American Agricultural School, Zamorano. Scientists at the school crossed a popular local bean variety with improved materials, and CIAL members, trained in participatory research by FIPAH, conducted successive selections in their fields. Farmers learnt formal selection techniques, including selection from early generations, in a process that has taken more than four years to complete. Organisational analysis of the way to engage poor farmers over the long term is undertaken. Issues concerning the costs and benefits of participatory plant breeding are raised.

Research findings

- Farmers trained to conduct participatory plant breeding have succeeded in improving the yield and the value of a local bean variety.
- Scientists, farmer-researchers and a local NGO have successfully worked together over a four-year period to support the participatory breeding process.
- Farmers and scientists may not make the same choices in the selection of varieties for use in marginal agricultural areas.
- The improved local variety was publicly recognised as the product of the labour of local farmers on its release in 2004 at the municipal level. The issue of property rights over the new variety remains to be established at the national level.
- Social development activities and high levels of trust between farmers and NGOs are required to maintain the involvement of poor farmers when the return from their labour investment is long-term and uncertain.
- Intermediary research and development NGOs provide a critical link between farmers and scientists in initiating decentralised participatory plant breeding at remote locations.

Policy implications

- The costs associated with participatory plant breeding at remote locations may be comparable to conventional breeding at the outset.
- The benefits from PPB should not be measured only through the development of new varieties but also through skill development and the sense of empowerment that it brings to local men and women. These effects, while difficult to measure, are likely to produce payoffs, in development terms, for many years to come.

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Acronyms

ASOCIAL	Association of Local Agricultural Research Committees
ASOHICIAL	Honduran Association of Local Agricultural Research Committees
CGIAR	Consultative Group for International Agricultural Research
CIAL	Local Agricultural Research Committee
CIAT	International Center for Tropical Agriculture
CIDA	Canadian International Development Agency
CIRAD	Centre for International Cooperation in Agricultural Development Research
IDRC	International Development Research Centre
IPCA	Participatory Research in Central America
IPRA	Participatory Research for Agriculture
NGO	Non-Governmental Organisation
NORAD	Norwegian Agency for Development Cooperation
PPB	Participatory Plant Breeding
PRGA	Participatory Research and Gender Analysis
PVS	Participatory Varietal Selection

LINKING SMALL FARMERS TO THE FORMAL RESEARCH SECTOR: LESSONS FROM A PARTICIPATORY BEAN BREEDING PROGRAMME IN HONDURAS

1 INTRODUCTION

Farmer participatory research is becoming increasingly recognised as a valuable component of technology generation in heterogeneous agricultural zones where poverty is common (Conway, 1997; Ashby, 1990; Ashby et al., 2000; Bunch and Lopez, 1999; Rhoades, 1986; Humphries et al., 2000; Haverkort et al., 1996; Sumberg and Okali, 1997, etc.). Participatory plant breeding is one area of research in agro-biodiverse regions that is gaining special attention. Breeders, who have traditionally bred for well endowed environments or a broad range of environments, have neglected small, mainly poor farmers living in low-potential agricultural areas where large genotype x environmental (GxE) interactions pose critical problems for broad-spectrum breeding and adoption. Participatory plant breeding programmes, in which farmers select germplasm for their particular environmental niches, offer the hope of providing well-adapted varieties for the poor (Almekinders and Elings, 2001; Sperling et al., 1993; Sperling et al., 2001; Ceccarelli et al., 2000; Smith et al., 2001; Witcombe et al., 2003; Sthapit et al., 1996; Joshi et al., 1997; Vernooy, 2003).

As interest in participatory plant breeding begins to grow it is important to examine the organisational requirements of this approach and the implications of these requirements on overall cost (Morris and Bellon, 2004). This will be particularly important if participatory breeding is to be mainstreamed within national and international breeding programmes, as proponents have suggested (PRGA, 2002; Ceccarelli et al., 2000).

This paper will describe a participatory bean-breeding programme with Honduran farmers, give its results and analyse its organisation. In particular, the study focuses on collaboration in the field between research teams composed of poor hillside farmers, known by the Spanish acronym CIALs (local agricultural research committees), and the Honduran NGO, FIPAH. The latter has provided an intermediary role linking farmers and regional scientists who led the programme at the Pan-American Agricultural School, Zamorano (See Rosas et al., 2003). Donor support for the decentralised breeding programme comes from USC-Canada, a Canadian NGO, and the Consultative Group on International Agricultural Research (CGIAR). The project, which is one of the first of its kind in the region, is arousing considerable interest as the results point to an important role for farmers as partners in plant breeding activities. Indeed, in 2003, the preliminary results of the project were presented by a farmer-

breeder to the Central American scientific community at its annual meeting of the Cooperative Program on Plant and Animal Improvement. This was the first time in its 49-year history that a farmer had presented research and, most interesting of all, he won first place on the Rural Development and Competitiveness panel. Clearly, participatory plant breeding is beginning to be taken seriously by members of the regional scientific community. More recently, breeders and researchers in the national agricultural sectors of several Central American countries have expressed a desire for training in participatory breeding techniques following this particular example.¹

The setting

Honduras, situated in the midst of the Central American isthmus, is one of the poorest countries in the Western hemisphere. Its population, which grew more quickly than almost any other in the region over the last decades² of the twentieth century, is still substantially rural with approximately half of the population living in the countryside (Government of Honduras, 2001). Honduran farmers, who make up the bulk of the economically active rural population, must generally farm on steep hillsides; the flatter land is mostly in the hands of wealthier individuals and corporations. Indeed, inequality of access to land in Honduras is such that 72% of holdings account for just 11.6% of cultivated land while 1.7% of holdings above 100 hectares (ha) comprise more than 39% of the total cultivated area (Government of Honduras, 2001). Inequality is further exacerbated by the nature of land use: between 1952 and 1993, the pasture area expanded by 86.3%, increasing pasturage from about one-third to nearly two-thirds of all farmland (Sunderlin and Rodriguez, 1996:5). This has affected the availability of arable land for cropping as well as decreasing the demand for labour. Needless to say, the predominant trend in land use, in conjunction with inequality in landholding, has necessarily forced the rapidly growing population to farm on fragile, and increasingly steep, hillsides with predictable consequences for the environment.

Increasing pressure on the resource base and the associated decline of the country's natural capital has helped to precipitate a high rate of rural out-migration in the direction of the country's two main cities, Tegucigalpa and San Pedro Sula. It has also stimulated rural to rural migration, which, until recently,

outstripped rural-urban migration in total migratory flows. A significant proportion of rural migrants heads towards the remaining areas of broadleaf forest on the north-eastern Atlantic slopes which are currently undergoing the highest rate of tropical forest loss in Central America (Sunderlin and Rodriguez, 1996:5). Nevertheless, rising land prices in the north-east, associated with commercial dairying and African palm oil export production, have led to a high turnover of land and further movement of the poor towards La Mosquitia – the country's last frontier and home to a significant proportion of its remaining indigenous population (Humphries, 1998). Thus the movement of poor people towards the east is not only helping to extend resource degradation across the country, but is also helping to precipitate conflicts over land between newcomers and local populations.

Pressure on the hillsides is further aggravated by the nature of grain production itself. This may generally be characterised as extensive at most locations. Farmers on remote hillsides have rarely been the targets of publicly funded agricultural research which has tended to favour the better resource-endowed areas with a view to increasing productivity in key areas of the country. Thus most poor farmers, excluded from agricultural research and extension, continue to utilise traditional slash and burn practices accompanied by low-yielding technologies, further exacerbating social and environmental problems.

Participatory research provides poor Honduran farmers with the tools to test out different technological options in the context of marginal agricultural resources and marginalisation from mainstream research. Participatory plant breeding offers them additional options for innovation through locally adapted germplasm. As Berdegue and Escobar (2002) posit, where asset deprivation is severe, as it is for most farmers located on hillsides in Honduras, linkages with institutions capable of supporting rural innovation are critical in helping to reduce poverty.

2 PARTICIPATORY PLANT BREEDING

Participatory agricultural research and plant breeding fit tidily into the concept of co-production. This concept, as elaborated by Ostrom and her colleagues in a workshop on political theory and policy analysis in the 1970s, describes the complementary actions between public and private sector actors that generate a common set of goods or services (Ostrom, 1996). Contrary to the thinking of the day, the workshop participants argued that public sector services to communities were not always delivered most effectively by professionals working in large, centralised bureaucracies, but rather through myriad public and private sector organisations, particularly citizens' groups, working together. These different groups were frequently able to co-produce a particular good or service superior to that produced by the public sector acting alone. The idea is that extra benefits, or synergies, are generated by the interaction of different organisations and citizen involvement creates pressure on the formal or public sector to be more effective. It thus

helps to make people more accountable to real communities and to generate social capital or trust in the process.

While co-production argues for active citizen and formal sector participation in the attainment of synergies, it is important to recognise that the *degree* of participation provided by each party will vary, depending on the desired outcome. In the field of participatory plant breeding, Sperling et al. (2001) draw on the typology developed by Biggs (1989) to make the distinction between consultative, collaborative and collegial participation in the interaction between farmers and scientists. Consultative participation refers to a relationship between farmers and breeders in which the farmers' input into the scientific process is limited. In a collaborative relationship, formal-sector scientists take the lead but they and the farmers share more in the breeding process. Collegial participation occurs when farmers take the lead in plant breeding with backstopping provided by the scientists. These authors suggest that the differences in the degree of participation associated with the roles the actors play at different stages in the process spring from obligations implied by the different loci of control. In formal-led PPB (implying a consultative or collaborative relationship with farmers) there is an obligation on the part of the researchers to conduct research that may be validated by the scientific establishment. This means that formal scientific criteria must be met so that the researchers may extrapolate their findings, in the form of improved seeds and/or methods, elsewhere. Farmer-led PPB, by contrast, is designed to meet *local* farmers' needs for improved germplasm and there is no requirement that the findings or methods be replicable. The goals are for rapid seed improvement in order to fulfil the farmers' development objectives. The role of the scientists is to provide collegial assistance to farmer-breeders as required. Clearly these two approaches will have different associated costs. Where results must be validated scientifically, research costs will necessarily be higher than where locally improved germplasm alone is the desired end result. In other words, synergies achievable through co-production will be a reflection of the objective(s) set in each case.

Fostering partnerships between farmers and scientists

The participatory breeding programme in Honduras does not fit squarely into any of these paradigmatic categories. Instead, it is both farmer-led and collegial in nature *and* it is designed to stand up to scientific scrutiny. The initiative responds to expressed farmers' need and is carried out by farmers trained in formal research methods (Humphries et al., 2000). At the same time, the programme design seeks to meet a scientific agenda of formal comparison between conventional and participatory approaches to plant breeding (Rosas et al., 1999). This demands adherence to scientific procedure and detailed reports on farmers' selections for purposes of comparing field-level with on-station bean breeding; not surprisingly this increases the costs of the project over more informal, farmer-led

approaches. Scaling-up is anticipated through multi-location trials carried out through a farmers' federation to determine the recommendation domains of new farmers' varieties. Such a collegial, formal approach therefore has the potential to increase the breadth of future benefits over informal, farmer-led approaches.

This approach to co-production is being facilitated in the countryside by FIPAH which developed as a non-profit research and development foundation out of a participatory research project established originally by the International Center for Tropical Agriculture (CIAT) in 1993. At that time, the project known as Participatory Research in Central America (Spanish acronym, IPCA) involved a Canadian rural sociologist, who later transferred from CIAT to the University of Guelph, Canada, and two Honduran agronomists. Ten years later, the original team had grown to include two additional Honduran agronomists and a small contingent of local farmer-facilitators. Funding for the farmers' research programme has been provided through the Department of Sociology and Anthropology at the University of Guelph by two Canadian government programmes: IDRC's Minga programme (1995–2000) and USC-Canada's Seeds of Survival programme (2000–2007), supported by the Canadian International Development Agency (CIDA). CIAT has continued to be an important collaborator throughout the period. The Pan-American Agricultural School, Zamorano, has played a key role by providing experimental materials to farmer-researchers, if and when required. In 1999, a small grant from CGIAR's system-wide programme on Participatory Research and Gender Analysis (PRGA) permitted farmer-researchers and Zamorano scientists to enter into a more formal relationship. A Norwegian-sponsored³ maize improvement programme with farmer-researchers and Zamorano is also underway, as is a rice-breeding programme with CIAT-CIRAD (Centre for International Cooperation in Agricultural Development Research). In each of these cases, the partnership between farmers and breeders has been mediated by FIPAH researchers.⁴

Formation of local agricultural research committees (CIALs)

Worsening environmental degradation in Honduras, and Central America more generally, led to the development of the Central American Hillside Program in 1992 at the International Center for Tropical Agriculture (CIAT). One component of that programme comprised the formation of farmers' research committees to look for sustainable uses of agricultural resources. The first two community-based agricultural research committees, known by their Spanish acronym CIALs, were formed in late 1993 as part of a pilot project in northern Honduras. Today there are 85 Honduran farmers' research teams, involving 930 farmer-researchers supported by three local organisations, including FIPAH. These teams are generally concentrated in five geographical areas where they form local chapters of a national CIAL federation, known as the Honduran Association of CIALs or ASOHCIAL. An elected committee of CIAL members

represents each chapter and permits decisions to be made regarding regional activities within the ASOHCIAL structure. One important activity being coordinated within two of the regional chapters supported by FIPAH is participatory plant breeding. This involves 55 CIALs comprising 648 members, 44% of whom are women, as well as eight youth CIALs.⁵

The CIAL methodology

The CIAL methodology, developed by the Participatory Research for Agriculture unit (IPRA) at CIAT (Ashby et al., 1995, 1997, 2000), comes into play when a community decides to form a research committee. The motivational session provided by an NGO or research institution is followed by community selection of the committee's office bearers (coordinator, secretary, treasurer, extensionist) consisting of people who are locally regarded as being innovative and public-spirited. In Honduras, this process has also come to include the self-selection of a substantial number of non-elected members, generally referred to as collaborators, who choose to join the CIAL in order to share in the learning experience. Each CIAL has an average of around 10 people. A participatory diagnosis and prioritisation of local agricultural problems with the community sets the research agenda, which CIAL members agree to carry out. After each research cycle is complete, they report their findings back to the community. Experiments take the form of controlled trials in which new varieties or practices are tried out against local materials. Innovations are screened first on a very small scale, next the best bets are verified on a larger scale, and finally, in a third round, successful varieties are multiplied up on a plot of a hectare or more.⁶ This procedure minimises the risks and costs associated with adaptive testing. Nevertheless, each CIAL is provided with funds to underwrite the cost of its experiments. In the case of experiments that lead to saleable outputs, funds are recouped for future use; a series of lost trials will require fresh infusions into the CIAL fund. The costs of agronomic inputs for a CIAL experiment in Honduras are in the range of US\$25–55.⁷

From varietal selection to plant breeding

Over the past seven years CIALs, supported by FIPAH agronomists and farmer-facilitators, have carried out hundreds of experiments in the search for new varieties – mostly of maize and beans – that are well adapted to their particular ecological niches. Many of these experiments have been part of national as well as regional (Central American) trials. Yet the outcome of participatory varietal selection (PVS) has frequently been disappointing. First, the number of varieties released through official channels in Honduras has been limited due to institutional shifts and the virtual disappearance of government-funded crop research. Second, while breeding has aimed at providing varieties that can be adapted across a wide geographical spectrum, these materials have not performed well at higher elevations where they have mostly failed to outperform farmers' varieties, used as local checks in each experiment. Thus, for example, in multiple trials

conducted by CIALs situated on hillsides above 1000 metres, farmers' varieties or landraces have out-yielded modern varieties an estimated four out of six times in the case of beans, and five out of six times in the case of maize (FIPAH field documents). And varieties that do succeed in out-yielding local landraces at lower elevations almost invariably lack other attributes deemed important by farmers, such as the colour favoured by the market, storability, familiar taste, texture, etc. Since the poorest rural families in Honduras are mostly located high up on mountainsides, poverty alleviation must involve the development of technology adapted to these locations.

The rather poor performance of breeders' materials in the upper reaches of the hillsides helped to stimulate the farmers' interest in the possibility of enhancing local varieties through PPB. The decision to move to PPB is a logical one once alternatives available through PVS have been exhausted (Almekinders and Elings, 2001). PPB is generally distinguished from PVS by the fact that farmers make selections at an early stage (second [F²] or third [F³] generation)⁸ from within segregating populations, rather than from amongst advanced or genetically stable lines (Witcombe et al., 1996; Almekinders and Elings, 2001). This requires farmers to have some understanding of selection from unstable materials where phenotypic characteristics are unlikely to express themselves consistently in early generations. CIALs, which have long been involved in PVS, are a natural group for such work. Relative to most other people in their communities, CIAL members stand out as critical thinkers in the field of agriculture: through group learning and inquiry they have become more observant than their neighbours, they are better informed about plant diseases and pests and how to control them, and they are very open to change – if and when this is in their own and their community's interest. Moreover, as members of a national federation of CIALs (ASOHCIAL) covering five different regions of Honduras, the CIALs are also natural units for dissemination of enhanced varieties both within and across geographical boundaries. In other words, the CIAL structure comprises an ideal institution for 'scaling-out' successful lines across a much wider geographical zone than their own local communities.

PPB in practice

Between 1999 and 2004,⁹ six CIALs in two regions of Honduras were involved in PPB of beans in collaboration with Zamorano (see Rosas et al., 2003). In the Lake Yojoa region in north-central Honduras, the participatory breeding programme did not have a successful outcome, being hampered by poor weather and geographical location. As mentioned, PPB begins with plant selection in early generations. In this case, the committee members were provided with third-generation materials by the breeder, which implied that they were required to remain working as a team over a four-year period (given cropping patterns of two cycles per year), before any finished line would be ready for dissemination. The Lake Yojoa region, which is approximately an hour's bus ride from Honduras's

second largest city, San Pedro Sula, made CIAL membership stability hard to achieve. Various members shuttled back and forth between the city and the countryside as family finances dictated and opportunities presented themselves. Moreover, the relative abundance of other NGOs in the region meant that competition between projects for the farmers' time was often intense. Such conditions made it hard to sustain stable membership over a four-year period, particularly in the growing seasons of 2000 and 2001 when poor weather, leading to crop loss, forced people to look elsewhere to make a living. By contrast, the other programme site, Yorito, is located further from major urban centres and concurrent assistance from other NGOs has been limited. Moreover, it is important to stress that women play a much greater role in the CIALs in Yorito than they do in the Lake Yojoa region, providing for greater flexibility in long-term household participation if family circumstances dictate that someone must leave for city work. The different patterns of women's participation is related to ethnic and socio-economic differences between the two zones.¹⁰ Finally, it must be acknowledged that facilitation of the PPB process in Lake Yojoa failed to overcome these obstacles, raising questions about how it was handled and how it might be improved, given such constraints in the future.

In Yorito, four mixed gender CIALs (30 men and 23 women) stayed the course over a four-year period and in summer 2004 successfully released one improved bean variety at a public ceremony involving the municipal government, national and international researchers and local organisations. The process, which has been highly educational for all those participating in it, is detailed below.

PPB in Yorito

As discussed earlier, PVS at high altitudes utilising breeder-improved materials has failed to provide farmers with good alternatives to their own tried and tested local varieties. In the case of beans, commercial varieties such as Zamorano's Tio Canela or the Honduran government's Dorado, have generally not succeeded in out-performing the preferred local farmers' variety above 1000 m and have nearly always received a lower market price than local varieties. Studies carried out by two agronomy students in 1999 in a number of Yorito communities situated at 1200–1300 m above sea level, showed that only 20% of farmers had ever tried modern bean varieties; even so, 100% continued to employ local landraces (Alvarado, 1999). In many cases, what are regarded as local varieties may be creolised varieties, created by farmers' adaptation of improved varieties over a number of years to local conditions (see Bellon et al., 2003)).¹¹ Nevertheless average yields of landrace/creolised varieties were generally very low in the highest reaches of the hillsides.¹² These farmers identified grain colour and appearance (shine, colour consistency), grain form (size, weight), type (non-trailing, erect bush bean), disease resistance, yield, long pods (with at least seven beans), amongst others as the principal traits for

inclusion in a participatory breeding programme (Alvarado, 1999; FIPAH field documents, 2000). The most widely employed farmers' bean variety in the area is Concha Rosada, probably a creolised variety derived from an improved variety originally introduced in the 1980s.¹³ It met the desired commercial profile for grain appearance and form (small, light red bean) but generally failed on other attributes, particularly disease resistance¹⁴, architecture, even ripening and yield. The importance placed by small hillside farmers on the commercial attributes of their beans is a consequence of their key role in the cash economies of poor Honduran farmers, especially in recent years with the decline of coffee prices. Hillside farmers generally have a comparative advantage in bean production over farmers on flatter land because of better drainage and lower humidity, while the preference for small reds in Honduras and Nicaragua (over the darker beans preferred in other Central American countries) caters for a regional market long dominated by local farmers. By contrast, commercial maize production by hillside farmers is less common because maize commands a lower unit price than beans while prices have been negatively affected by cheap imports from North America.

To correct for undesirable traits identified by farmers, namely disease susceptibility, trailing architecture, uneven ripening and low yield, the breeder crossed their most popular local variety, Concha Rosada, with elite lines¹⁵ at the experiment station at Zamorano. The first two populations from these crosses were received by CIAL members in the Yorito area in spring 2000. A second set of materials was sent to farmers in the second cycle (*la postrera*) in September 2000; two further populations were received in 2001.¹⁶ Zamorano maintained parallel sets of trials utilising the same materials at its experiment station, located in the department of El Paraiso in the south of Honduras.

Participatory breeding activities in the municipality of Yorito were initially centralised at one collective selection site in the community of Mina Honda. CIAL members from Mina Honda and three surrounding communities (La Patastera, Santa Cruz and Chaguitio) began by selecting promising materials from amongst the first two populations comprising 120 families. As originally conceived by Zamorano scientists, selection from segregating materials would take place at one collective site until the sixth generation when CIAL members would begin adaptive trials in their own communities (Rosas et al., 1999). In short, a centralising element was originally built into programme design. However, CIAL members made an early decision to take segregating materials selected from the collective site back to their respective communities for evaluation and selective advancement in each subsequent generation. This paved the way for the maintenance of a greater range of genetic diversity than would have been likely under the more centralised selection plan conceived by the breeder. Thus, the process was quite flexible and marked by continuous learning both for the farmers and the FIPAH agronomists who supported the initiative in the field.¹⁷ Decisions taken at the field

level, and their outcomes, were reported back to Zamorano scientists.

The process of selective advancement of materials showed substantial variation between communities; there was little variation based on gender at the community levels. Thus farmers in Chaguitio selected a variety that was generally darker than the preferred local red because it had other desirable characteristics (e.g. high yield). This, combined with the fact that they sold their crop to a village intermediary who marketed it to buyers from Guatemala where consumer preference is for darker beans, permitted local farmers to access better prices than if they had been forced to sell in the domestic market. Soil and climatic conditions also varied between communities and affected output. Of the participating communities La Patastera is at the highest elevation (1650 metres above sea level), and it was here that farmers advanced far more materials than the other communities but lost them all in (F5) trials because of low temperatures and very wet weather.¹⁸ Nevertheless, the best materials from the remaining three communities were advanced to comparative trials (F6). At this stage, the best bets (10 materials) from these communities were compared with five materials selected by Zamorano on-station, along with the local check, Concha Rosada, in the four participating communities where each community managed three replicates, following a randomised block design. After processing the results of these trials, participating farmers chose four lines for multiplication (F7) and subsequent verification (F8) trials. The latter, which included universal (Tio Canela) and local (Concha Rosada) checks, were conducted in three of the communities. Farmers finally selected one line for varietal release, PPBY-8, which they named Macuzalito after the highest point in the municipality and shared landscape of the four participating communities.¹⁹ On 20 August 2004, at a ceremony in Yorito's municipal palace attended by more than 100 people, Macuzalito was recognised through a special act of the local government as being the property of the members of the ASOCIAL Yorito, Victoria and Sulaco.²⁰

At the time of writing, forty-two trials of Macuzalito were being conducted by CIALs in high-elevation communities around Yorito and in two neighbouring municipalities. Two other materials, PPBY-14 and PPBY-2,²¹ will be maintained mainly for local use. PPBY-1 was discarded because of agronomic deficiencies identified by farmers.²²

The results of F8 adaptive trials in spring 2002 are given in Table 1. The incidence of disease was similar in all four lines (information from FIPAH field report, autumn 2002).

The farmers' evaluations of three materials in spring 2003, PPBY-8, PPBY-14 and PPBY-2, are given in Table 2. These results were presented by CIAL members at the local ASOCIAL research meeting in March 2004. It should be noted that in *primera* 2003 and *postrera* 2003, PPBY-2 out-yielded the two other lines. This contrasted with the result obtained in *primera* 2002 (Table 1). PPBY-14 showed a susceptibility to anthracnose (information from FIPAH field reports, autumn 2003 and spring 2004).

Table 1 Average yields (kg/ha) in three Yoro communities, spring 2002

No.	Line	Santa Cruz	Mina Honda	La Patastera	Total	Average
1	PPBY-8	1823	1686	2727	6236	2079
2	PPBY-14	1648	1629	2822	6098	2033
3	PPBY-2	1686	2008	2292	5985	1995
4	PPBY-1	1515	1610	2405	5530	1843
5	C. Rosada**	1515	1174	2386	5076	1692
6	Tío Canela*	1563	1023	1705	4290	1430

*Universal Check
**Local Check

PPB agronomic outcomes

As can be seen from Table 1, materials selected by farmers by means of PPB out-yielded local and universal checks (Concha Rosada and Tío Canela) in the verification trials. However, as Table 2 demonstrates, farmers did not select for yield alone. Instead they selected for a group of attributes ‘on average’ rather than for individual traits in isolation. Important considerations included early maturation, a positive trait for poor farmers in high-risk, food insecure areas, disease tolerance, high yields, good seed quality and commercial value. Finally, architecture²³ and pod colour are also important traits for farmers who dislike very low bushes because of the effects of humidity on plant health and the problems they pose for weeding. Pink pods are regarded as especially desirable because they make identification easy at harvest time and, as Macuzalito actually loses all its leaves at this time, the pods are even easier to identify. Thus it is the aggregation of favourable traits for PPBY-8 that made this the first choice for broader dissemination. However, the high-yielding and slow-maturing PPBY-2 was considered to be a good material for the longer spring cycle and important for local consumption purposes, while PPBY-14 would be conserved mainly for the shorter autumn cycle when early maturity is of the essence to escape the forthcoming dry season. The results underline the importance accorded to bean quality by small farmers because of the critical role played by commercial sales in the economies of very

poor people. In the case of bean sales in Honduras, a recent study (Mather et al., 2003) shows price discrimination against improved varieties to be as much as 16% compared to the prices paid for local, small red varieties.²⁴ Thus the farmer-breeders’ decision to look for a balance between yield and bean quality is highly rational within the constraints imposed by local commercial options. Finally, maintaining a range of materials as a means to minimise risk in a highly uncertain environment is also of central importance to poor farmers.

It should be mentioned that farmers are well aware that while the PPB-improved lines are more disease-tolerant than the unimproved parent, Concha Rosada, they are still susceptible to common local diseases,²⁵ and they have asked the breeder look for more resistant materials to cross with Macuzalito. In other words, farmers see this as an ongoing, long-term process.

None of the materials that farmers advanced to adaptive trials in their communities were selected in parallel trials at Zamorano. Some materials that did well on-station performed poorly in farmers’ fields; others that were high-yielding lacked the seed quality or other traits that farmers valued.²⁶ As discussed previously, upland communities in the same area may exhibit different preferences associated with variable market opportunities and biophysical conditions. One variety does not necessarily suit all. One solution put forward by the breeder to this apparent diversity of preferences was to provide farmers with a broad

Table 2 Farmers’ evaluations of PPB varieties

Attributes	PPBY-8 (Macuzalito)	PPBY-14	PPBY-2
Maturity	Moderate	Early	Late
Uniformity of maturation and colour	Uniform with attractive red colour	Uniform but a lighter red colour	Uniform but with white pods*
Disease tolerance	Medium	Medium-low*	Medium-high
Architecture	Excellent, medium height with well distributed pods	Good, low height* with well distributed pods	Good, medium height with well
Yield	Good yield	Regular yield	Excellent yield
Commercial value	Good	Good	Poor*

*Traits considered unfavourable by farmers

selection of small red bean materials, both segregating and stabilised, to allow them to make their own selections (Rosas et al., 2003). However, when farmers were provided with a set of (F6) stabilised materials, which had been advanced without selection at Zamorano, none was finally selected by the CIALs.²⁷ This points to the critical role of environment on the evolutionary process and why decentralised, in-situ breeding programmes are so important. Indeed, the implications of this study's findings on plant breeding and poverty alleviation cannot be dismissed; it is clearly imperative that local residents of marginal agricultural areas take an active role in in-situ breeding and selection from early generations rather than relying on breeders to deliver finished lines to their regions.

Organisational analysis of the PPB process

The PPB process in Yorito has followed formal scientific procedure. Farmers have carried out comparative and verification trials, employed the use of controls and replicates, learned how to work with segregating materials, managed negative selections,²⁸ etc. As might be imagined, the level of support to the farmers has necessarily been intense. If PPB is to be institutionalised within the formal research agenda, it is important to recognise the extent of this support and the costs it entails. While some support had already been provided to the CIALs through previous capacity building for PVS management, much of it has been more specific to PPB. However, it is worth mentioning that such collaborative plant breeding could not have been carried out with farmers who had not received substantial prior support and training in formal research methods. Thus if this approach is to be adopted, it is appropriate to include the costs of research training amongst the overall expenditures associated with PPB.

Managing the divide between farmers and scientists

The programme in Yorito has been supported from the outset by FIPAH facilitators; Zamorano scientists only occasionally visited farmers in the field during the intensive learning process involved in selection. As noted by Bentley, a social scientist employed by Zamorano in the early 1990s, in the past the scientists in the region have not demonstrated any willingness to conduct research at remote locations. The distances – both geographical and social – are simply too large to permit them to establish an effective relationship with hillside farmers, and the economic costs of doing so are too high (1994). In the face of such constraints, Zamorano scientists relied on their partnership with FIPAH to provide the critical linkages between themselves and local farmer-breeders.

Mediation of the farmer-scientist relationship by NGOs requires certain skills. Relatively few NGOs supporting poor Central American farmers have strong research capacity. FIPAH, by contrast, is composed of agricultural researchers recognised by both formal-sector scientists and farmer-researchers. The principal agronomist is a twelve-year veteran of the Honduran

government's agricultural research and extension programme and former director of the national bean programme. Another agronomist is currently a member of the research department of the Honduran National Autonomous University's agricultural school, and a third was formerly a member of the same school. Since joining FIPAH, each agronomist has become avowedly 'farmer-first' and a strong advocate of the value of farmers' participatory research over conventional on-farm approaches to agricultural research. However, the agronomists' relationship with the farmers extends beyond research to involve affective ties as each becomes personally acquainted with CIAL members, and understands and sympathises with their individual problems. In short, through participatory research, the single-stranded research relationship is likely to evolve into a multi-stranded relationship of trust and friendship allowing researchers to better understand the farmers' situation. This commitment to human and social capital development and poverty alleviation, rather than to technology development alone, has been strongly reinforced by the FIPAH social scientist and Canadian donor organisations.²⁹ It is this orientation, and the trust that it has helped to engender, that have permitted the agronomists to be particularly valuable to the formal-sector scientists. Boundary-spanners capable of mediating between farmers in the field and scientists in the formal sector must have a good stock of social capital on which to draw on both sides of the divide.

Facilitating formal research and breeding with the CIALs in order to meet the needs of both farmers and breeders is not without cost. Each CIAL receives on-going technical support and the inputs for each experiment. At the outset of the participatory research programme in the mid-90s, FIPAH agronomists provided technical support to each CIAL until a team of paraprofessional farmers or local facilitators had been identified and trained from amongst the membership. Six years after the first CIALs were formed in Yorito, and at the other sites in Honduras, most only require support from local facilitators with occasional agronomic backstopping for the management of field trials. Under this arrangement, one full-time agronomist can easily maintain contact with 20 CIALs over the experiment cycle, depending on the distance between communities and planting locations, etc. While visits by the agronomists have declined significantly over time as CIAL members and local facilitators become more experienced, the relationship between the CIALs and the agronomists is an extremely powerful motivator for both parties. CIAL members take enormous pride in the agronomist's approval of their management of the experiment, while the agronomist derives significant satisfaction from the very evident learning that has taken place over the years, while maintaining a strong interest in the results of the experiments themselves. Moreover, as others have found, more research experience does not mean that the agronomist can withdraw from the process altogether; rather it signals a different kind of involvement as farmers begin to formulate new questions stimulated by their increased knowledge (Bunch, 1999). Local farmer facilitators may not always

Table 3 Training and practical support provided by FIPAH

Nº	Theme	Mina Honda	La Patastera	Santa Cruz	Chaguitio	Total
1	Planning the sowing of segregating populations	1	1	1	1	4
2	Sowing of segregating populations	6	6	6	3	21
3	Identification of diseases	2	1	2	1	6
4	Selection of individual plants	2	1	1	1	5
5	Evaluation and selection	3	2	2	1	8
6	Harvesting segregating populations	6	6	6	3	21
7	Negative selection of plants in segregating populations	2	1	1	0	4
8	Seed selection	2	1	1	1	5
9	Commercial evaluation	6	6	6	2	20
10	Methodology adjustment	1	1	1	0	3
	Total	31	26	27	13	97

be able to fulfil this need for new knowledge, and support by the agronomist may be required. Therefore, a certain level of involvement on the part of the agronomist, although increasingly behind the scenes, is deemed essential over the longer term.

3 SUPPORT FOR CIALS

Participatory plant breeding has dramatically increased the demand for professional agronomic support to the CIAs. As seen in Table 3, over the course of four years, a FIPAH agronomist conducted 97 training and practice sessions with the four CIAs involved in PPB (information from FIPAH report, spring 2003).

Each training session has taken place in the communities themselves, all of which are located high up in the watershed with poor or no road communications to them. Travel time by motorbike and on foot is an hour or more. Thus the capital and labour costs involved in moving between the valley bottom, where FIPAH has an office, and the upper hillside communities, are significant. While the training of local facilitators in PPB is already well underway, the process has required constant monitoring and evaluation, and methodological adjustment, necessitating agronomic support throughout. Given the detailed nature of the scientific data, collecting it will probably require some professional supervision in the future. Indeed, it must be recognised that the willingness of the Zamorano scientists to work with farmer-researchers is precisely because of the high quality of the data assured through this process. This carries a cost that cannot be ignored.

Another factor in the support costs has been the inclusive nature of the CIAs which are only natural units for PPB if their members embody the preferences and needs of local stakeholders. At the outset of the CIA process in Honduras, as reported earlier (Humphries et al., 2000), the CIAs were not properly representative of their communities. Specifically, the community's election of the four-member committee involved locally imposed criteria such as literacy, prior leadership in the community, experience in other projects and land ownership. These criteria effectively excluded women and the very poor who were almost never voted onto the committees (ibid.). This was why the FIPAH team decided to change the nature of the membership by encouraging all interested people to

join the CIAs as collaborators. The result has been a substantial increase in the number of members per community, from a much broader cross-section of the population, including women and the poorest. At present 44% of CIA members are women and the overwhelming majority are very poor, with indigenous Lenca and Tolupan farmers making up a significant proportion of the membership of FIPAH-supported CIAs.³⁰ It is worth mentioning that research in Honduras shows women are normally precluded by local norms from engaging in agricultural activities beyond the confines of the household plot (Sturzinger and Bustamente, 1997; Chiriboga et al., 1996). Thus the inclusion of such a high percentage of women farmers in crop improvement represents a considerable break with local tradition. Furthermore, as mentioned previously, mixed CIAs are more likely to provide for long-term research stability since spouses (or older children) can more easily substitute for CIA members in the event that family circumstances dictate the need to look for outside sources of income.

The importance of inclusive stakeholder representation in participatory plant breeding cannot be overstated. Clearly, breeders located far from the field have neither the skills nor the capacity to undertake such analysis or the necessary institutional support to ensure the representative nature of farmer-breeders. Such a task requires an organisation closely associated with the farmers at field level and a willingness to embrace the goal of inclusiveness, even though this may impact negatively, at least at the outset, on the uptake of new ideas and technologies.

This inclusive approach to CIA formation pursued in Honduras is supported by a range of ancillary activities, such as credit groups, post-harvest storage facilities, local seed banks, biodiversity seed fairs, exchange visits between CIAs in different regions, national and regional farmers' research meetings, monitoring and evaluation training, sewing and cookery classes for women, micro-enterprise development, etc. Since very poor farmers are constantly confronted with the necessity of attending to immediate livelihood needs³¹ such ancillary activities have acted both as incentives to participation in long-term, uncertain research (such as plant breeding) while helping to offset the (albeit low) opportunity costs of doing so.³² The

interdisciplinary make-up of the FIPAH team and the nature of donor support have been instrumental in emphasising the CIAL role in social development, rather than technology generation alone.

Needless to say, the emphasis on the social dimensions of the CIAL programme in addition to technology generation raises the support cost. Thus while costs for direct technical assistance are estimated at around US\$800/CIAL/year (Humphries et al., 2000), if social and other programme support is included, overall costs increase considerably.³³ The actual support provided specifically for PPB has been only a fraction of the real cost of capacity building required for decentralised PPB as practised in Yorito; rather PPB has successfully piggy-backed onto existing farmer capacity and core donor funding. Nevertheless, if similar collaborative PPB efforts are to be institutionalised as alternatives to conventional breeding, many of these costs will have to be absorbed by the breeding programmes themselves. The inherent risk of relying on the unstable nature of NGO funding is very great. Moreover, where high poverty rates generate livelihood instability, social incentives to secure involvement in PPB over the long term may be significant. Presently, PPB in Yorito is being subsidised by positive externalities derived from FIPAH's other programmes (both past and present) and there is a danger that in the general enthusiasm to embrace PPB, these realities will be overlooked. Certainly, estimated costs for releasing a new variety through conventional methods (Mather et al., 2003b), do not suggest that formal PPB may necessarily be any cheaper – *at least at the outset*.³⁴ However, a full cost-benefit analysis of PPB must await a later adoption study. In comparison to conventional breeding programmes, one might assume that the scale of adoption would be limited by cultural criteria and biophysical conditions. Nevertheless, the breadth of the recommendation domain remains to be proven. If the farmer-improved varieties are broadly adopted in poor households, the benefits may outweigh the costs. To assess this, the more than 900 members of the national federation of Honduran CIALs (ASOHCIAL) will have access to Macuzalito for testing in five different regions across the country.

4 FARMERS' REACTIONS TO PPB

Finally, mention must be made of farmers' reactions to PPB. While all those who have participated in the process are keenly aware of the personal investments of time and energy involved, they are also aware of the opportunities and benefits that PPB provides. In group discussions with Yorito farmer-breeders in 2001, farmers mentioned the degree of knowledge acquired through the breeding process, the potential for improved harvests and future income generation through larger sales, the sense of self-esteem derived from their knowledge of PPB and the potential for development of seed micro-enterprise. Thus, the four Yorito CIALs involved in PPB have embraced the process with enthusiasm. As with participatory research, the element of formality contained in the breeding method has served to engage people in a process of

collective learning over time. Such collective action has not only helped to support human capital development but also social capital development – something that would have been much less likely, had farmers simply evaluated materials on their own. However, one would have to wonder if in the future – once the novelty of PPB has worn off – farmers would not prefer to receive materials that require less investment of their time in selection and testing. While this cannot be known at this stage, we have seen that where there has been pressure on farmers to migrate for work, engage in other NGO activities, etc., PPB could not be sustained. Thus we should not be complacent about the self-sustaining nature of PPB. If it is to be adopted as a breeding strategy, it will have to be sufficiently attractive to farmers.

5 CONCLUSIONS

PPB is a co-produced endeavour *par excellence*. However, the degree and quality of participation provided by farmers and scientists will generally be a function of who is in the driving seat. Where PPB is formally led, farmers are either consulted or they may collaborate more actively but in either case the locus of control remains with the breeder. Where PPB is farmer-led, the relationship between farmers and breeders is likely to be more collegial in nature but the results are likely to lack the scientific rigour of formally led breeding. In the case of PPB in Honduras, collegiality between farmers and breeders has been raised to a new level: farmers have become real partners with scientists in scientific inquiry. However, the relationship between farmers and breeders has more often than not been indirect with a research NGO playing the role of broker. Since breeders are unlikely to be able to support farmers at remote locations, formal, farmer-led PPB programmes of this nature will depend on local mediation. This clearly has cost implications for PPB and may make such decentralised, farmer-led breeding programmes – *at least in the learning phase* – comparable to the estimated cost of conventional breeding programmes.

Investment in formal, farmer-led breeding, as discussed in this case study, may partially be justified by the power of the demonstration effect upon the formal sector. Had farmers sought to pursue an informal approach to breeding, the results would not have resonated in the same way with the region's scientists. And since on-station conventional breeding trials were performed parallel to those in the farmers' fields, with such starkly different results, the comparative research methods added substantial weight to the findings. There has been a great deal of interest from the region's scientists in the outcome of this programme and this is likely to lead to the greater involvement of farmers in plant breeding efforts in the future. However, the optimal degree of participation between farmers and breeders in future partnerships remains to be seen and probably must await adoption studies to assess the extent of dissemination of the improved local variety.

What is clear at this stage is that farmers' preferences may not be the same as those selected by the breeder

on their behalf. If poor people residing in marginal agricultural areas are to intensify production and improve their wellbeing, they must have access to appropriate technology. Varieties that are well adapted to their particular environmental niches clearly play a key part in this. Breeders have not always been successful in putting themselves into the shoes of very poor farmers, as the rather low adoption rates of improved varieties amongst this group attest. Thus, the involvement of farmers in co-breeding – at some level – is clearly warranted in the pursuit of effectiveness and efficiency in plant genetic improvement. However, efficiency will ultimately depend on the extent of diffusion and the breadth of the recommendation domain. National networks of farmer-researchers, such as the Honduran Association of CIAs, have a critical role to play in determining how broad this domain might be. Inclusion of the materials in regional scientific trials provides another route.³⁵

Concern with establishing the breadth of diffusion also raises the issue of how farmers, who have been involved in developing the new varieties, might be compensated for their work. While effective property rights would be difficult to establish, given that local (community) materials and the breeder's lines were both involved, CIAL members' skills and the effort invested in the creation of new varieties must be recognised and rewarded if the process is to be sustained (see Tripp, 2001). This is a complicated issue outside the scope of this particular paper.

Compensation to CIAL members up to this point has largely been in the form of skill development. Training in participatory research, and PPB in particular, has resulted in personal and group learning and a strong sense of team achievement. An informal, farmer-led process would not have generated the same degree of social learning and the sense of self-esteem that has resulted from the formal process. The sense of empowerment has been particularly keenly felt by the women; they are now regarded as equal partners in research and development and their stature in the community has risen accordingly. Group learning has also increased the social bonds between members and contributed to the growth of social capital amongst the members and more broadly within the community. CIAL members are strongly committed as a team to improving the technological options not only for themselves but also for their communities. Additionally, through the Yorito chapter of the ASOCIAL, they have strengthened key linkages with outside institutions and organisations (e.g. Zamorano, the Ministry of Agriculture, the regional scientific community, etc.) which are likely to provide payoffs to farmer-breeders for years to come. Thus, while it is necessary to consider the issue of compensation to farmers as a long-term strategy to sustain the breeding process, we should not underestimate the benefits that CIAL participants feel they have acquired to date. Although they are difficult to measure they should not be excluded from the cost-benefit analysis of formal, farmer-led PPB.

Finally, this model of formal, farmer-led PPB supports the institutionalisation of research NGOs as

intermediary agents between poor farmers in remote locations and scientists – certainly in the start-up phase of PPB and arguably beyond that. NGOs that have a close relationship with farmers are more likely to be in a position to balance the long-term needs for stability in plant breeding with short-term projects offering more immediate payoffs to farmer collaborators. Realistically, plant breeders would be unlikely to have either the time or the skills to achieve such a balancing act. For this reason, intermediary NGOs capable of supporting research and social development with farmers are indispensable for the establishment of co-breeding. But this also means that NGOs involved in brokering co-breeding will require stable funding. Many, if not most, lack such financial stability. Thus co-breeding programmes will have to generate funding mechanisms to ensure the persistence of these three-way partnerships. This may be the trickiest part of the equation yet and certainly something to keep in mind when considering institutionalising PPB in the future.

REFERENCES

- Almekinders, C.J.M. and Elings, E. (2001) 'Collaboration of farmers and breeders: Participatory crop improvement in perspective'. *Euphytica*, Vol. 122, pp. 423–38.
- Alvarado, N. (1999) '*Diagnostico participativo de la problematica en el cultivo del frijol comun en cuatro comunidades del municipio de Yorito, departamento de Yoro*'. Undergraduate Thesis presented at the Universidad Nacional Autonoma de Honduras, La Ceiba, Atlantida, Honduras.
- Ashby, J.A., Braun, A., Gracia, T., Guerrero, M.P., Quiros, C.A. and Roa, J.I. (2000) *Investing in farmer researchers: Experience with local agricultural research committees in Latin America*. Cali, Colombia: CIAT.
- Ashby, J.A., Gracia, T., Guerrero, M.P., Patino, C.A., Quiros, C.A. and Roa, J.I. (1997) 'Supporting local farmer research committees' in *Farmers research in practice: Lessons from the field*. London: Intermediate Technology Publications.
- Ashby, J.A., Gracia, T., Guerrero, M.P., Quiros, C.A., Roa, J.I. and Beltran, J.A. (1995) 'Institutionalizing farmer participation and technology testing with the CIAL'. *Agricultural Research and Extension Network Paper No. 57*. London: Overseas Development Institute.
- Ashby, J.A. (1990) 'Small Farmers' Participation in the design of technologies'. *Agroecology and Small Farm Development*. Eds. M. Altieri and S. Hecht. Boca Raton, Flida: CRC Press. pp. 245–253.
- Bellon, M., Adato, M., Becerril, J. and Mindek, D. (2003) 'The impact of improved maize germplasm on poverty alleviation: The case of Tuxpeno-derived material in Mexico'. *IFPRI Discussion Paper Briefs, Discussion Paper 162* (www.ifpri.org/divs/fend/dp.htm).
- Bentley, J. (1994) 'Facts, fantasies, and failures of farmer participatory research'. *Agriculture and Human Values*. Vol. 11, No.2 Spring-Summer, pp.140–150.
- Berdegue, J. and Escobar, G. (2002) 'Rural diversity,

- agricultural innovation policies and poverty reduction'. *Agricultural Research and Extension Network Paper* No. 122. London: Overseas Development Institute.
- Biggs, S. (1989) Resource-poor farmer participation in research: A synthesis of experiences from nine national agricultural research systems. OFCOR Comparative Study Paper. The Hague: ISNAR, pp. 3–37.
- Bilsborrow, R.E. 1992. 'Rural poverty, migration and the environment in developing countries: Three case studies', *World Bank background paper for the 1992 World Development Report on Development and Environment*.
- Bunch, R., (1999) 'Investigando la convergencia'. *II Taller de Investigación Participativa. Actas del Taller*; Centro Agronómico Tropical de Investigación y Enseñanza, 25–27 August 1998. Turrialba, Costa Rica.
- Bunch, R. and Lopez, G., (1999) 'Soil recuperation in Central America: How innovation was sustained after project intervention' in F. Hinchcliffe, J. Thompson, J. Pretty, I. Guijt and P. Shah (eds). *Fertile ground: The impacts of participatory watershed management*. London: Intermediate Technology Publications.
- Ceccarelli, S., Grando, S., Tutwiler, R., Baha, J., Martini, A.M., Salahieh, H., Goodchild, A. and Michael, M. (2000) 'A methodological study on participatory barley breeding'. *Euphytica*, Vol. 111, pp. 91–104.
- Chiriboga, M., Grinspan, R. and Perez, L. (1996) *Mujeres de maíz. Proyecto de análisis de la política del sector agropecuario frente a la mujer productora de alimentos en Centroamérica y Panamá*. San José, Costa Rica: IICA and IDB.
- Chirinos, A.R. (1999) '*Diagnostico participativa de plagas insectiles del frijol comun en cuatro comunidades del municipio de Yorito, Dept. de Yoro*'. Tesis de Grado presentado a la Universidad Nacional Autonoma de Honduras, Centro Universitario Regional del Litoral Atlantico, La Ceiba, Honduras.
- Classen, L, Humphries, S., FitzSimons, J., Kaaria, S., Jimenez, J., Gallardo, O. and Sierra, F. (2004) Preliminary Impact Report: CIAL Project, Honduras, 2004. Unpublished report.
- Conway, G. (1997) *The doubly green revolution: Food for all in the 21st century*. London: Penguin Books.
- FIPAH field reports, 2002–2004. Fundación para la investigación participativa con agricultores de Honduras. La Ceiba, Honduras.
- Government of Honduras (2001) *Honduras: Poverty reduction strategy paper*. (www.imf.org/external/np/jsa/2001/hnd/eng/091701.pdf)
- Haverkort, B., Van de Kamp, J. and Waters-Bayer, A. (eds). (1996) (reprinted) *Joining farmers' experiments: Experiences in participatory technology development*. London: Intermediate Technology Publications.
- Humphries, S., Gonzales, J., Jimenez, J. and Sierra, F. (2000) 'Searching for sustainable land use practices in Honduras: Lessons from a programme of participatory research with hillside farmers'. *Agricultural Research and Extension Network Paper* No. 104. London: Overseas Development Institute.
- Humphries, S. (1998) 'Milk cows, migrants and land markets: Unravelling the complexities of forest to pasture conversion in Northern Honduras'. *Economic Development and Cultural Change*, Vol. 47, No. 1, pp. 95–124.
- Joshi, K.D., Subedi, M., Rana, R.B., Kadayat, K.B. and Sthapit, B.R. (1997) 'Enhancing on-farm varietal diversity through participatory varietal selection: A case study for Chaite rice in Nepal'. *Expl. Agriculture*, Vol. 33, pp. 1–10.
- Mather, D., Bernsten, R., Rosas, J.C., Viana Ruano, A. and Escoto, D. (2003) 'The economic impact of bean disease resistance research in Honduras'. *Agricultural Economics*, Vol. 29, pp. 343–52.
- Mather, D, Bernsten, R., Rosas, J.C., Viana Ruano, A. and Escoto, D. (2003b) 'The economic impact of bean research in Honduras'. Staff paper 03–10. Department of Agricultural Economics, Michigan State University, East Lansing, MI.
- Morris, M. and Bellon, M. (2004) 'Participatory plant breeding research: Opportunities and challenges for the international crop improvement system'. *Euphytica*, Vol. 136, No. 1, pp. 21–35.
- Ostrom, E. (1996) 'Crossing the great divide: Co-production, synergy and development'. *World Development*, Vol. 24, No. 6, pp. 1073–88.
- PRGA (2002) CGIAR systemwide program on Participatory Research and Gender Analysis: Summary annual report, October 2002.
- Rhoades, R. (1986) 'Breaking new ground: Agricultural anthropology', pp. 22–61 in E. Green (ed.) *Practicing Development Anthropology*. Boulder, Colorado: Westview Press Inc.
- Rosas, J.C., Gallardo, O. and Jimenez, J. (2003) '*Mejoramiento genetico del frijol comun mediante enfoques participativos en Honduras*'. *Agronomia Mesoamericana*, Vol. 14, No. 1, pp 1–9
- Rosas, J.C., Castro, A., Humphries, S., Jimenez, J., Gonzales, J. Gamero, N., Mejia, P. and Almekinders, C. (1999) *Metodologias participativas para el mejoramiento genetico del frijol comun*. Project proposal presented to the Participatory Plant Breeding Program of the PRGA.
- Smith, M., Castillo, F. and Gomez, F. (2001) 'Participatory Plant Breeding with Maize in Mexico and Honduras'. *Euphytica*, No. 122, pp. 551–65.
- Sperling, L., Ashby, J., Smith, M.E., Weltzien, W. and McGuire, S. (2001) 'A framework for analyzing participatory plant breeding approaches and results'. *Euphytica*, Vol. 122, pp. 439–50.
- Sperling, L., M. Loevinsohn, B. Ntabomvura. 1993. 'Rethinking the local farmer's role in plant breeding: Local bean experts and on-station selection in Rwanda' in *Experimental Agriculture*, Vol. 29, pp. 509–519.
- Sthapit, B.R., Joshi, K.D. and Witcombe, J.R. (1996) 'Farmer participatory crop improvement: A case study for rice in Nepal' *Experimental Agriculture* No. 32, pp. 479–96.

- Sturzinger, U. and Bustamante, B. (1997) *La distribución de tareas entre hombres y mujeres en el área rural: Resultados de un diagnóstico participativo aplicado en comunidades rurales de Honduras*. Colección ASEL Agricultura Sostenible en Laderas, INTERCOOPERATION, Tegucigalpa, Honduras.
- Sumberg, J. and Okali, C. (1997) *Farmers' experiments: Creating local knowledge*. Boulder, Colorado and London: Lynn Rienner Publications.
- Sunderlin, W. and Rodriguez, J.A. (1996) 'Cattle, broadleaf forests and the agricultural modernization law of Honduras: The case of Olancho'. *Occasional Paper 7*, Centre for International Forestry Research, Jakarta, Indonesia.
- Tripp, R. (2001) *Seed provision and agricultural development: The institutions of rural change*. London: Overseas Development Institute.
- Vernooy, R. (2003). *Seeds that give: Participatory plant breeding*. Ottawa: IDRC.
- Witcombe, J.R. Joshi, A., Joshi, K.D. and Sthapit, B.R. (1996) 'Farmer participatory crop improvement' in Varietal selection and breeding methods and their impact on biodiversity. *Expl. Agriculture* No. 32, pp. 445–60.
- Witcombe, J.R., Joshi, A. and Goyal, S.N. (2003) 'Participatory plant breeding in maize: A case study from Gujarat, India'. *Euphytica*, Vol. 130, pp. 412–22.

ENDNOTES

1. In November 2003, at a meeting in Nicaragua of regional plant breeders from Nicaragua, Honduras, Guatemala and Costa Rica, Cuba, El Salvador, the International Centre for Tropical Agriculture and the Pan-American Agricultural School, Zamorano, Honduran farmer breeders and the NGO facilitator involved in the programme presented their findings. These were met with substantial interest and an expressed desire to replicate the process in the countries represented at the meeting.
2. During the 1980s, population grew at 3.2% per annum; at present it is growing at 2.5% per annum (Bilsborrow, 1992, Government of Honduras, 2001)
3. The programme is supported by the Norwegian Agency for Development Cooperation (NORAD).
4. In 2004, four of the farmers' regional organisations, known as ASOCIALS, received legal NGO status. This clearly opens the way for independent action in the future.
5. The youth CIALs comprise 299 members, 46% of whom are girls/young women. These CIALs were originally funded through a three-year CIDA Canada-CGIAR Linkage Fund involving CIAT, the University of Guelph/FIPAH and the University of British Columbia. Since 2004, they have been supported by CIAT and FIPAH from their regular operating budgets. The youth CIALs are mainly engaged in natural resource management.
6. Amongst FIPAH-supported CIALs, screening takes place on plots of 140–300m²; verification plots are 400–700m²; multiplication plots are 1,000m² and up. Those members who have larger amounts of land generally donate this for use in the early stages of trials. If and when a CIAL reaches the stage of multiplication trials for commercial production, the group may have to rent land, at a real cost to the members.
7. This range refers to the costs, depending on the stage, of an experimental cycle, involving a number of trial plots. Most experiments comprise two to three replicates.
8. 'F' refers to family in the lexicon of plant breeding and indicates the specific generation. Between F1-F6 plant materials undergo segregation and are characterised by high genetic instability. Farmers are not typically invited to evaluate materials until after they have stabilised at F6 generations and above.
9. Selection from third generation materials derived from landraces (or creolised varieties) began in June 2000. However, prior to this, farmers were introduced to the process of selection from segregating materials using other germplasm supplied by Zamorano.
10. The much lower participation rate of women in the Lake Yojoa region, compared to Yorito, is associated with the more exclusive roles attributed to men and women in the former region. In Lake Yojoa, even when women do join CIALs, they tend to be involved in women-only groups which undertake activities closely associated with traditional roles, i.e. activities that can be performed within the confines of the household plot. This rules out grain production for the most part. It should be noted that the women from Lake Yojoa region have much lighter complexions than the substantially indigenous population in Yorito and frequently comment that they do not want to burn their skin doing field work – a complaint rarely heard in Yorito. Furthermore, machismo is much more pronounced in the Lake Yojoa area and the men do not like their wives participating in mixed CIAL groups. This has not been an issue in Yorito where nearly all the CIALs are mixed-gender. Poverty is also higher in Yorito, making women's participation more essential to family survival.
11. The most innovative farmers typically try out new varieties but become disillusioned once they recognise their shortcomings. Nevertheless, some of them adapt improved varieties to their local conditions, creating creolised varieties in the process. Such varieties eventually become widespread and are considered landraces or farmers' varieties by the local population.
12. Chirinos (1999) reports that yields in upper altitude communities in Yorito were only 412 kg/ha and 343 kg/ha in the first (*primera*) and second (*postrera*) planting, respectively.
13. Three focus groups comprising 17 women and 20 men were held in the communities of La Patastera, Mina Honda and Santa Cruz in July 2000. During the discussions, participants traced the histories of different beans in use today. While several black climbing beans have very long histories in the

upland communities, red beans were mostly introduced in the 1980s and 90s once access to markets became more established. Black beans have almost no market because of consumer preference in Honduras for small reds.

14. The main diseases that affect bean production in the area are anthracnose, powdery mildew, angular leaf spot, rust.
15. Materials used to cross with Concha Rosada included Tio Canela -75, SRC 1-12-1, MD 23-24, SRC 1-1-18, UPR 9609-2-2 (FIPAH field records).
16. Later populations failed to yield materials of interest to the farmers, when compared to materials from the first two populations.
17. The learning process was particularly focused upon trait evolution and trait selection. Farmers learned about trait inheritance through reference to the process in humans. Thus the appearance of a particular trait in one generation and its disappearance in the next could be explained through concrete local example. The plant selection process therefore was understood as one in which they were selecting amongst the offspring (great or great-great grandchildren, etc.) of their bean Concha Rosada and just like children the plants would all be different. Farmers learnt that since each plant in the early stages of segregation had the potential to become a new variety, each one had to be examined separately for beneficial traits. While these beneficial traits were not guaranteed to reappear in the next generation, they learnt that some traits stabilised earlier than others. For example, they learnt to ignore colour (typically a trait highly valued by small farmers) in the early stages of segregation because it stabilises late in the process. Thus during fourth generation post-harvest evaluations, farmers evaluated plants for architecture, number of beans in a pod, number of pods while colour was ignored.
18. The other three communities made overly stringent selections too early in the process, limiting the range of materials available for selection later on.
19. Mount Macuzal is the source of water for one of the country's largest rivers, the Aguan, which flows northwards to the Atlantic coast.
20. The special act recognises that Macuzalito was produced by CIAL members for use by upland farmers and that permission to distribute or commercialise it outside of the ASOCIAL requires the written consent of the organisation. Meeting national government requirements for registration of Macuzalito as a new variety will depend upon having sufficient basic seed.
21. PPBY-2 is the darker bean selected by Chaguitio CIAL.
22. Despite the high ranking given to the commercial value of the beans, farmers found PPB-1 unacceptable because of the risk of rot in the spring or *primera* planting associated with low architectural stature.
23. The most serious architectural concern the farmers identified is the trailing form of most local varieties. This was one of the first traits screened out of Concha Rosada. Trailing beans mature unevenly and are difficult to harvest. None of the four varieties in the F8 verification trials exhibited this characteristic.
24. This was the price discount calculated on the varieties Dorado and Don Silvio. Tio Canela, the modern variety used most frequently by Yorito farmers, received a negative price discount vis-a-vis farmers' varieties in the range of 4-9% (Mather et al., 2003: 346). Price discrimination by intermediaries must also be viewed as a function of the monopoly power of local buyers in the absence of any farmers' organisation at the point of sale. Many farmers are in debt to intermediaries and are forced to accept whatever price they are willing to offer.
25. Another local material, a black bean called Pedreño, has been identified by farmers as a possible source of resistance to angular leaf spot disease, one of the most common bean diseases.
26. Zamorano's highest yielding selection out-yielded other materials in the Yorito hillsides in F6 comparative trials. However, farmers rejected it both because of low grain quality and because it was susceptible to powdery mildew (*Oidium*). Powdery mildew was not identified as a problem at the experimental station. By contrast, farmers selected a variety that showed only minor susceptibility to *Oidium* and, importantly, had excellent grain quality.
27. Only 67 of the original 120 families were given by the breeder to farmers. The reduction in the number of families presumably related to on-station losses, rather than preselection.
28. The process of negative selection refers to the removal of individual plants with negative traits (outliers) from amongst materials in trials during the last stage of segregation. In other words, it helps to create uniformity in emerging lines.
29. IDRC's Minga programme, which supported the IPCA project between 1995 and 2000, is staffed by social scientists. In particular, Ronnie Vernooy, a rural sociologist, was instrumental in getting the project started. USC-Canada is strongly committed to linking farmers and scientists to improve local livelihoods and conserve agro-biodiversity. The current director of USC-Canada is an anthropologist.
30. An impact assessment of the CIALs in Yoro is currently being analysed. Preliminary results (Classen et al., 2004) demonstrate that CIAL members show no significant difference from non-CIAL members except for education, where they have more years of primary schooling on average. They own marginally more small livestock (pigs, chickens). Where land ownership, area under cultivation, housing, off-farm labour, use of hired labour and larger livestock are concerned there are no significant differences.
31. As mentioned previously, certain conditions, such as closeness to urban centres, a very poor harvest, or competition for members' time from a new – and more immediately rewarding – NGO programme, can temporarily destabilise CIAL membership and derail the plant breeding process.

32. Estimated opportunity costs associated with the PPB project are low, as training has frequently taken place in the afternoon, after work in the fields is completed (i.e. involves 'leisure' time). Moreover, CIAL members from Mina Honda, who tended the collective plot, were paid the local wage for keeping this clear of weeds. CIAL members' work on the decentralised community plots, plant evaluation and selection, etc. was voluntary, as is the norm in all CIAL work. Calculation of exact opportunity costs is difficult and would have required monitoring of all CIAL work over the four-year period. This was not done. The opportunity cost of a recent experiment in one community was estimated at 257 hours in total, or 28.7 hours/CIAL member (approximately 4 labour days/per member).
33. If all costs are considered (administration, vehicles, social development, etc.) the approximate cost per CIAL would be close to US\$2000 per year. However, it would be *inappropriate to apportion all costs* to existing CIALs supported by the FIPAH programme since USC-Canada funding also supports national CIAL activities involving around 85 CIALs. FIPAH administrative costs include a small office in La Ceiba where activities in three geographical regions of Honduras are centralised, a parttime administrator/social facilitator and secretary. Other programme expenses include the maintenance of two four-wheel drive trucks and three motorcycles for use by farmer facilitators and agronomists. The University of Guelph absorbs less than 5% of the budget for research, travel and accounting. USC-Canada's budget in Honduras is CAD\$200,000/year, which averaged approximately US\$130,000/year between 2001 and 2004.
34. According to Mather et al, (2003b), the cost of releasing a new bean variety is around \$120,000. This figure approximates to that estimated by CIAT (communication with Nancy Johnson). This, however, almost certainly does not include all administrative and overhead costs. If 20 CIALs are considered to be the minimum for cost-effective CIAL support in a given geographic area, a four-year breeding programme would need to count on a budget somewhere between \$64,000 (i.e. \$800/CIALx20x4, excluding all non-field administrative and social development expenditures) and \$160,000 (i.e. \$2,000/CIALx20x4, including all administrative, vehicular and social development programme costs). See previous endnote.
35. Early generations of the improved Concha Rosada have been included in regional multi-location trials for the last several years.

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