Sustainable agriculture on the forest margin

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Photo: Barry Pound

Peach palm (Bactris gassipaes) is a native Bolivian forest species with commercial potential. Here the palm is ready for harvest, with a cover crop (Canavalia ensiformis) sown between the rows.

Slash and burn methods used by colonist farmers in Bolivia are unsustainable and degrade soil, forest and bio-diversity resources. In 1994, the Natural Resources Institute (NRI, UK) and the *Centro de Investigación Agrícola Tropical* (CIAT, Bolivia) tried to identify ways of making the present farming systems more sustainable and productive. Participatory on-farm trials combined with researcher-managed trials, case studies, participatory surveys and rural appraisals were used to validate technical options, including combinations of novel perennial crops, leguminous cover crops, agroforestry mixtures and small livestock. Effective technology options were developed but before resource-poor farmers could use them they needed information and technical support provided. In Bolivia, colonist farmers have very limited financial resources, infrastructure is rudimentary, and social cohesion is poorly. These factors hamper the dissemination and implementation of research results.

General situation

The practice of clearing forestland for agriculture is common in the humid tropics. Shifting cultivation, when practised by indigenous forest dwellers at low population densities can be ecologically sensitive and sustainable. At higher population densities the slash and burn methods used by colonist farmers in Brazil and Bolivia cause extensive degradation of soil, forest and bio-diversity resources.

Smallholder colonist farmers in the tropical lowlands of Bolivia are extremely poor and have an immediate need for cash and food. While they often have plenty of land (30-50 ha), they have limited amounts of capital and labour and so use extensive farming methods that are wasteful of natural resources but require low levels of input. Forest biomass is used as fertility capital to produce a small range of subsistence and cash crops for one or two seasons. When accessible forest is exhausted, they cultivate in the bush-fallow (*barbecho*). Each successive cycle of slash and burn weakens the land leading to a "bush-fallow crisis". The farmer is then either forced to find new land, change to farming perennial crops (mostly citrus), or keep cattle on perennial grassland.

Farmers abandon their land when pernicious weeds increase and soil fertility declines (Webb & Gonzales, 1989, Barber & Diaz, 1994). The sandy soils are low in phosphorus and nitrogen is quickly lost through leaching and volatilisation. Nitrogen, sulphur and organic matter are lost through burning, and micro-nutrients soon become limited under acid conditions and low soil organic matter. On sloping lands, soil erosion is also a serious problem.

Slash and burn farm households manage several species of small livestock although productivity varies greatly between farms (Chamón *et al*., 1999). Women and children are responsible for the chickens and guinea pigs raised for food and for the ducks and pigs sold for cash. Tropical hair sheep are also kept for household use and sale. All livestock, except guinea pigs, are free to scavenge for food and receive minimal supplements of grain, household wastes and crop residues. With no veterinary cost and no input apart from labour, the low level of production is almost entirely profit. Where markets are available, dairying is favoured. Profit margins are modest, but regular income from milk sales is important.

Ichilo-Sara project

The *Ichilo-Sara* project was developed by NRI and CIAT in the tropical eastern lowlands of Bolivia. It addressed three major development issues. First, the destruction of moist tropical forest by agriculture; second, natural resource degradation, and third, the lack of locally verified, sustainable agricultural systems suitable for smallholder farmers working in the forest margins.

An "adaptive research network" was set up with local NGO's to implement and evaluate an on-farm trial programme which would test 200 participatory on-farm experiments involving 30 novel cropping, agroforestry and livestock systems (see Figure 1). These trials were complemented by researcher-managed trials that dealt with problems requiring controlled conditions or used new technologies whose potential in local conditions had yet to be verified.

The project relied heavily on participatory methods. This made it possible to combine researcher, NGO and farmer knowledge and to empower farmers, NGOs and CIAT to carry out the type of research they thought to be relevant. Technologies were validated under farmers' conditions and the participatory approach ensured that information was disseminated during the research process.

Sustainability was a central issue in the *Ichilo-Sara* trials and on-farm and researcher managed experiments were designed with the following needs in mind.

- Reduce burning;
- Increase opportunities for perennial crops;
- Increase the efficiency and productivity of the fallow period;
- Develop technologies with low external input requirements;
- Integrate legume covers and green manure to maintain soil productivity;
- Diversify activities and income generating opportunities;
- Initiate a sustainable research effort based on participatory principles

Results

The project verified the local suitability of perennial species, and identified cropping systems and sequences that were economically viable for colonist farmers. The association of perennial tree crops, including citrus, peach palm, and tamarind with annuals, semi-perennials and legume covers proved that it was possible for small-scale farmers, with limited capital, to diversify into perennial systems. The annuals and semi-perennials offset establishment costs, and provide a source of income in the short and medium term. The legume covers prevent weeds building up and reduce the amount of labour needed for weeding. Trials also showed that the financial burden of establishing perennial systems could be overcome if the cultivated area was gradually increased and farmers used home-produced planting material. Experiments with intercropping and rotating rice with legume, food and cover crops proved that weed build-up and the cost of weed control could be significantly reduced. However, these systems did not halt the yield decline. Farmers also tested two novel agroforestry systems. The first was based on the enrichment of bush fallow with native fruit and timber species, while the second took cleared land through a sequence of annual, semi-perennial, and perennial species to a

permanent, tree-rich system. After two years, results indicated that these options - whose components can be modified to suit the circumstances of individual farmers - were appropriate for those households that had a positive attitude towards trees and appreciated the income and environmental benefits they could bring.

Promotion pathways

The *Ichilo-Sara* project was designed to help resource-poor farming families living on the margins of the forest. By collaborating with institutions such as CIAT Bolivia and local NGOs it was hoped that experimental results would be widely disseminated. Results have, in fact, been good. Through collaboration, staff training and specially prepared materials the concepts, methods, systems and technologies investigated during the *Ichilo-Sara* trials have been widely adopted and the project has influenced other Bolivian projects and programmes.

The rate of adoption was monitored after 2-3 years (Warren, 1997), and at the end of the project (Pound et al, 1999). Among those farmers who had worked on the trials, adoption rates were found to be high. Adoption rates by neighbouring farmers who had not taken part in the project, however, were low partly because of a lack of community involvement in the way collaborating farmers were selected (Warren, 1997). When the project ended in 1998, high levels of adoption were still being recorded among collaborating farmers.

In 1996, farmers were tending to adopt single component technologies, rather than the complete systems being tested (Warren, 1997). This was a matter of considerable concern because the development and promotion of "sustainable systems" was a major objective. By 1998, the situation had changed and many farmers were including mixtures in their expansion plots. Cover crops were being integrated into perennial systems and perennials were being intercropped with annuals and semi-perennials. A high level of farmer-experimentation was also recorded. Farmers were modifying the components included in the original systems, and were comparing alternative management strategies.

Analysis

Several lessons can be drawn from the *Ichilo-Sara* trials. First, it takes time to clarify objectives with stakeholders, and to design a methodology that meets these objectives. It is important that all members of the research team - researchers, NGOs and farmers - understand the methodological and technical concepts behind the trials and training should be given if necessary. Experience showed that data collection should be limited to the needs of the project and that participatory research requires the same rigour and discipline as conventional research.

There is a potential contradiction between the collection of on-farm research results and providing farmers with an opportunity to adapt technologies. The *Ichilo-Sara* trials showed clearly that a balance must be found between these contrasting objectives.

The project concluded that the qualitative and quantitative information from participatory research can be successfully integrated but that an early feedback of results to collaborating institutions and communities is important. Projects should also plan a strategy to help farmers at the end of the project so they do not feel "abandoned".

Ensuring impact

Locally, the *Ichilo-Sara* project is regarded as having had an important impact. However, during the final project workshop (Pound *et al,* 1999) it was concluded that identifying potential alternative technologies is just one step towards achieving sustainable and stable systems. A co-ordinated strategy must also be identified and implemented to ensure that these technologies are adopted and utilised. Such a strategy might include the following elements:

- dynamic dissemination systems;
- technical assistance, especially for technologies that require long-term investment (e.g. fruit and agroforestry systems);
- accessible credit for small farmers with limited collateral;
- knowledge on adding value to primary products;
- appropriately structured and resourced community-based institutions;
- marketing information and structures;
- a policy environment conducive to sustainable land use.

The *Ichilo-Sara* project succeeded in using participatory methods to identify and validate sustainable technologies and disseminating them to the farmers in the project. Many of them are now using these ideas in their farming activities. CIAT is complementing "conventional" research methods with participatory methods and NGOs and extension projects in the area are promoting and adapting technologies identified by the project. However, further work is needed before small farmers can be assured of technology, resources and market access. ■

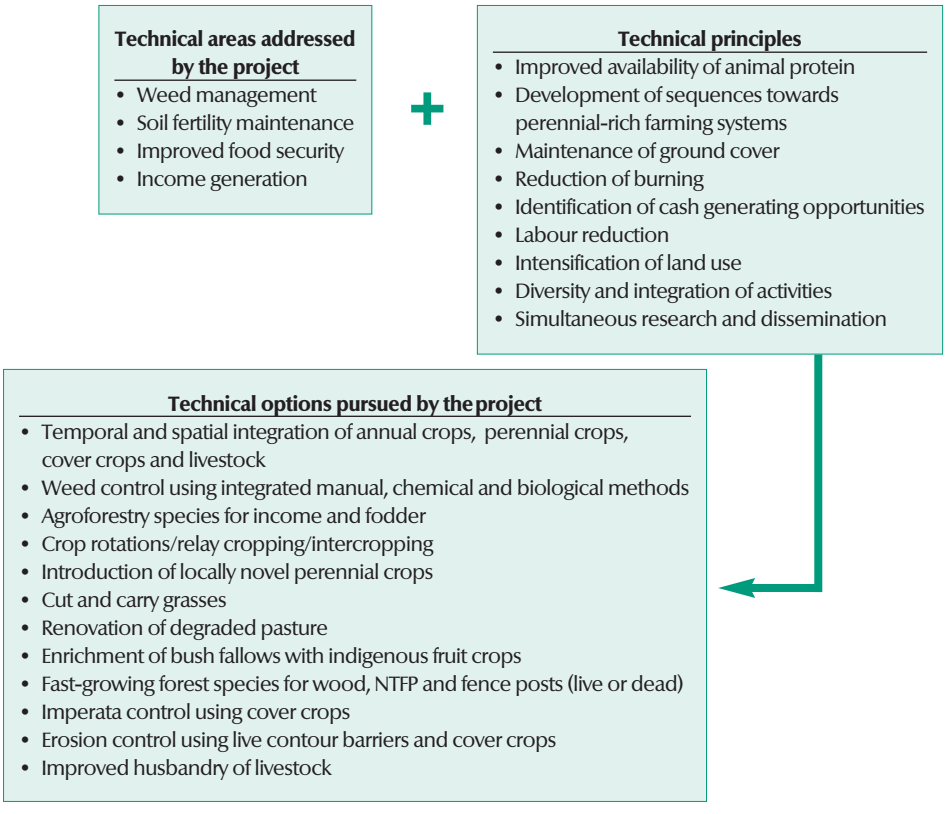

Figure 1. The development of technicaloptions

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