Evaluating technology performance in agroforestry

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To help develop suitable methodologies for technology monitoring and evaluation, ICRAF conducted in 1988/89 a worldwide state-of-the-art review of activities and methods currently employed by development projects involved in agroforestry. The article summarizes the results of the review and looks at methods of technology evaluation.

An agricultural extensionist discusses traditional agroforestry with farmers in central Kenya. Cropping includes potato, banana, citrus and indigenous trees. Photo: ICRAF/ A. Njenga.

In general, technology performance evaluation in agroforestry includes the assessment of three different aspects of the technologies:
– the quantity and quality of products from technology components and of trade-offs resulting from the combined production of crops, trees and/or livestock.
– the quality of service functions of the technology, i.e. their effectiveness and efficiency. Such service functions may include soil fertility improvement, soil erosion control, provision of shade, aesthetic functions, marking of boundaries, fencing, improvement of microclimate, windbreaks, weed suppression, or live staking for climbing plants.
– socioeconomic costs and benefits of the technology (input/output relations, opportunity costs, risk, tenure effects, division of labour, etc).

The three aspects of technology performance need to be evaluated from the point of view of biological, as well as socioeconomic sustainability. Evaluation of the latter emphasizes the perspective of the farmer, taking into account their own assessment of technology performance in relation to other alternatives available to them.

Evaluating agroforestry is complicated

The nature of agroforestry, i.e. the combination of several different components and multiple objectives, complicates monitoring and evaluation of technologies in a number of ways:

- Multiple products from different components require production trade-offs which may not be easy to evaluate.
- A wide variation in management practices exists, especially for trees. In addition, management objectives may change over time to favour certain products or services over others.
- A general lack of scientific information about multi-purpose trees, seed provenances and genetic variability introduces additional sources of error and levels of uncertainty when evaluating agroforestry technologies.
- Due to the introduction of a tree component, agroforestry is a long-term undertaking. As a result, conclusive results from technology evaluation may often be obtained only after several years. In addition, the tree component may have to be evaluated differently in juvenile and mature stages.
- Some of the service functions of agroforestry are difficult to assess, for example microclimatic changes, windbreak effects or soil fertility changes. External factors may introduce additional sources of error and changes may only occur after many years.
- In subsistence farming, inputs and outputs often have non-monetary values, which complicates the assessment of economic costs and benefits.
- The mechanisms for interactions between the different components, especially crops and trees, are currently poorly understood. For this reason, observations may be misinterpreted and inaccurately evaluated.

Variables assessed

The potential problems related to evaluating agroforestry technologies are reflected in the types of information collected through the reviewed projects. In summary, it seems that technology evaluation is mostly limited to biological aspects and to indicators that are conventionally assessed in agriculture and forestry research. Those aspects of the technologies that are more specific to agroforestry, like for example tree/crop functions, were evaluated by relatively few projects. This may in part be due to the fact that assessment of these is not as straightforward as, for example, counting tree survival.

Service functions can in most cases only be evaluated through indirect and often subjective indicators, and relationships may not always be clear because of other intervening factors. There are currently no easy methods available to projects to assess the performance of most agroforestry-specific indicators.

In addition, there seemed to be a general bias toward emphasizing the tree component. While the majority (73%) of the projects that reported technology evaluation were monitoring MPT (Multiple-Purpose Trees) performance, crop or livestock components were mentioned by relatively few projects (29% and 6% respectively).

Methods used

An overview of methods employed by reviewed projects and their frequency is provided in Table 1. It should be noted that most projects used a combination of different methods. The relatively large number of projects involved in technology field testing indicates the demand for more site specific, techni-

cal information in agroforestry, which is currently lacking. It is notable that 40% of the development and extension projects which reported technology evaluation activities are actually involved in field testing of new technologies. In many cases it was difficult to determine the exact types of technology testing because project information was not conclusive in this respect. Often, a clear understanding of the objectives, requirements and design criteria for different technology testing methods seemed to be lacking. The relatively low frequency of farmer surveys, field days and meetings suggests that the farmers' perspective on technology performance was not given high priority by many projects.

Priority variables

Priority variables to be assessed in technology evaluation will change as technologies mature, but generally include biological, as well as socioeconomic variables. Important biological indicators of technology performance for use by extension projects might include tree survival, growth characteristics and condition of crops, trees and livestock; and yields of these components. Important socioeconomic parameters might include the assessment of farmer preferences for species and technologies, economic yields, changes in risk and access to resources and quality of the human environment. It is not necessary to monitor all the variables. Projects may select a few priority variables according to objectives and available resources. Service functions of agroforestry technologies are often difficult to assess directly and the use of indirect indicators is recommended.

Table 1: Methods used for technology evaluation by 92 projects

Method	No	%
Formal farmer surveys	12	13%
Informal farmer surveys	5	5%
Informal field surveys	17	18%
Informal field surveys and observational methods	20	22%
Combined farmer and field surveys	13	14%
Farmer meetings/field days	14	15%
On-farm or demonstration plot monitoring	25	27%
On-farm experiments or technology trials	23	25%
Experiments or technology trials on research plots	24	26%

Selection of methods

The types of methods to be used for evaluating agroforestry technologies for a given objective depend to a large extent on the level of resources available to the project. Resources which determine the level of evaluation activities include the number and skill level of field staff and access to expertise, either within the project, or from external sources such as research centres or expert consultants. Where staff time is a constraint, technology evaluation should be integrated as much as possible with extension activities. For example, a simple format may be provided to extension workers to routinely record observations on technology performance during extension visits to farms (Carlson 1989). Table 2 indicates the relative appropriateness of technology evaluation methods for different project resource levels.

Future needs and priorities

Collaborative or collegial relationship between farmers and extension staff for technology evaluation in agroforestry projects requires specific kinds of staff skills. Extension workers need to be trained in effective communication with farmers, interviewing and group discussion techniques and observational and measurement skills. The general project approach needs to emphasize learning from farmers. Monitoring and evaluation activities can thus become a learning experience for extension workers, increasing their awareness and technical knowledge and ultimately helping them to be more effective in their extension work.

On the other hand, the review of technology monitoring and evaluation by projects has shown a lack of available methods for evaluating variables that are specific to agroforestry, particularly the effectiveness and quality of service functions. It is therefore suggested that projects and researchers work much more closely together in agroforestry research and development. Projects can play valuable roles in generating hypotheses to be tested by researchers and also in identifying needed methods which can be developed through research.

But in order for the potential of this approach for technology development to be achieved, national ministries, donors and project managers will need to support, encourage and direct resources to technology monitoring and evaluation activities. This may require a fundamental shift of thinking about the role of extension in agroforestry development. ■

References and further reading

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Table 2: Appropriateness of technology evaluation methods for different project resource levels (1 = most appropriate; 2 = appropriate for projects at the higher end of scale; 3 = less appropriate)

Method	Resource constraints		Staff skills		Access to expertise	
	More	Less	Primary school or below	Secondary school or above	No	Yes
Informal farmer surveys	1	1	2	1	1	1
Formal farmer surveys	3	1	2	1	2	1
Farmer meetings/field visits	1	1	1	1	1	1
Informal field surveys	1	1	2	1	1	1
Formal field surveys	3	2	2	1	2	1
On-farm plot	2	1	2	1	1	1