Chapter 3

ON-FARM AGROFORESTRY RESEARCH PLANNING IN COSTA RICA

J. BEER
Tropical Agricultural Research and Training Center, CATIE-GTZ Agroforestry Project, Turrialba (Costa Rica)

R. BOREL
University for Peace, San Jose, Costa Rica, and

A. BONNEMANN
Tropical Agricultural Research and Training Center, CATIE-GTZ Agroforestry Project, Turrialba (Costa Rica)

ABSTRACT

The Tropical Agricultural Research and Training Center (CATIE) carries out research, training and technical cooperation in Central America and the Caribbean. Since 1976, CATIE's Agroforestry Programme has carried out basic and applied research in Costa Rica, Panama, and Nicaragua. It has also trained many professionals through Master of Science and short course programmes. This chapter analyzes the experiences from different projects in Costa Rica, and proposes some planning principles that have gradually evolved from one project to the next.

In addition to the criteria of "national priority" and potential for extrapolation, the area selection for new applied agroforestry research projects should generally be based on the existence of previous or actual research or extension projects, and the probability that an existing or new extension project will implement the results. The most significant area characteristics to be analyzed before establishing new agroforestry projects will probably be: topography, rainfall regime, land tenure, population density, the actual importance of trees for the farmers in the area, local history (including ethnic considerations), and the presence of other agricultural systems, where agroforestry has no role to play. The mechanisms to set goals have varied greatly between projects but should include 1) consideration from the beginning of the farmers' goals and of the extension service expectations and 2) involvement of the largest possible group of farmers and professionals in the planning stage and during each evaluation. For project implementation, the hiring of local assistants should receive high priority, while the involvement of the farmers (design and evaluation of the research) appears as another essential element. The importance of thorough monitoring of all processes, without forgetting economic and sociological aspects, is also stressed.
INTRODUCTION

1.1 The mission of the Tropical Agricultural Research and Training Centre

The Tropical Agricultural Research and Training Centre (CATIE) is a civil, nonprofit, autonomous association. It carries out, promotes, and stimulates research, training, and technical cooperation (i.e. strengthens the national programmes) in agriculture and natural renewable resources for the benefit of the American tropics, particularly the countries of the Central American Isthmus and the Caribbean.

Guidelines for the CATIE'S operations (see Appendix) are given in a ten-year strategic development plan (CATIE, 1988). CATIE focuses on generating and disseminating knowledge aimed at (a) accelerating agricultural development, (b) developing sustainable agricultural systems for the small farmer, and (c) designing and utilizing integrated natural resource management techniques.

1.2 General remarks on "planning"

Planning of agroforestry systems deals with the management of highly complex natural systems. Components (trees, crops, animals) are used in varying combinations and under different conditions (such as climate, soil, and socio-economic conditions). The theories about the application of scientific methods to managerial functions include two terms: operations research and systems engineering (Encyclopedia Britannica, 1982).

Operation research involves the application of scientific methods to the management of organized systems, in which the components are known and interaction effects calculable, and in which human behaviour may play an important part. Systems engineering is the utilization of scientific and technological knowledge in planning and designing complex systems, in which human behaviour is less important but in which the introduction of new components and their interactions may be essential.

Neither operations research or systems engineering really apply to agroforestry planning. On the one hand, the components are frequently little known and their interactions (theoretically calculable) may take years to be estimated, far beyond the time limit put onto development projects. On the other hand, human behaviour is so important in the design of agroforestry systems that systems engineering techniques are clearly out of place.

Planning in agroforestry, as a process of seeking simultaneous interrelated solutions to a set of inter-dependent problems, appears to be very complicated because of (a) the diversity of expectations and objectives, (b) the large number of possible components and their arrangements, (c) the
poorly understood interactions; and (d) the difficulty of quantifying some of the functions (e.g. environmental values and sustainability). As a consequence, the following considerations are especially important for planning an agroforestry project;

- flexibility, allowing for continuous feedback between planning, implementation, and evaluation phases;
- consideration of local human interests from the very beginning;
- avoidance of mathematical models but reliance rather on large planning teams; and
- importance of monitoring, since the significant advances in agroforestry in the next 10-20 years may not come from research but from well documented local development cases.

However, this chapter does not present a theoretical approach to agroforestry planning but rather was prepared to illustrate some of the most important considerations that have been learnt by experience. It could be termed a "bottom-up" rather than a "top-down" presentation which does indeed reflect one of the principal philosophies of CATIE's approach to agroforestry planning!

2 DESCRIPTION OF METHODS USED

The following sections describe the planning and project organizational methods used by two CATIE agroforestry projects, which were established in different priority areas of Costa Rica. The development of planning methods has been mainly an empirical process and lessons learned from a long established project (Acosta-Puriscal, established 1980) were very influential in the choice of methods used in the more recent projects (e.g. Talamanca, 1986).

2.1 Acosta-Puriscal: An empirical planning process

(i) Area selection criteria. The selection was made after field visits and consultations between CATIE staff and personnel of governmental institutions responsible for agriculture, forestry and national planning, with a view to respecting the priorities of all involved. One justification for the choice of Acosta-Puriscal was the possibility for collaboration with an existing CATIE research study of agricultural economics in this area. The specific criteria used were: (a) population density and number of small farmers, (b) standard of living, (c) regional priorities of national institutions, (d) access to the area and infrastructure, and (e) production
potential (by means of a subjective evaluation) (Lagemann and Heuveldop, 1983).

(ii) Area description. The Acosta-Puriscal region is situated on the seasonally dry Pacific watershed of Costa Rica, approximately 60 kilometers southwest of the capital San Jose. It falls within the life zones "moist tropical forest" to "premontane rain forest" (Holdridge, 1967) with altitudes ranging from 800 - 1200 meters above sea level. There is little flat land in the area and slopes are moderate (20-30%) to very steep (greater than 100%). Rainfall averages are between 2,100 to 2,500 millimetres per year, but the variation in annual values is 1,300 to 3,400 millimetres per year. There is a marked dry season between November/December and May with only 10% of yearly rainfall in this period. Mean monthly temperatures vary little (20-22°C) (Platen, 1982). Soils, classified as Ustic and Typic Tropohumults, Ustic Humitropepts and Oxic Dystrandepts, are generally clayey, with pH values of from 5-6 and low mineral contents, but topography is a more important limiting factor than soil fertility per se.

Colonization, by Latino farmers from the central valley of Costa Rica, started over 100 years ago and less than 20% of the original forest cover is left. The majority of the farms are small: 0-4 hectares (48%) and 4-10 hectares (31%). The remaining large farms occupy a disproportionate percentage of the area and 65% of farmland is used for extensive cattle grazing (Lagemann and Heuveldop, 1983).

(iii) How goals were established. The farming systems approach (Bertalanffy, 1973; Hart, 1980) was used for analyzing the structure and functioning of the target group farms, in particular the traditional agroforestry systems (Lagemann and Heuveldop, 1983; Borel, 1987). A hypothesis was then formulated: "Traditional agroforestry systems can be used as a starting point to increase production and productivity, by using improved varieties and better management techniques, without a decrease of their ecological stability" (Lagemann and Heuveldop, 1983).

The identification of specific goals (i.e. research topics) and the development of improved or new agroforestry systems was a dynamic process, with modifications being made as new information became available. Initially, the project followed a relatively formal process with questionnaires providing most of the data for identification of development objectives. This was supplemented by case studies designed to give both CATIE and national counterparts a better understanding of traditional agroforestry systems (Beer, 1984a, 1984b).
(iv) Implementation: participation of farmers and national organizations. The socio-economic characterization of randomly selected farms, was based on both static (286 farms) and dynamic surveys (weekly visits to 69 farms over 1 year) (Lagemann, 1982). These on-farm surveys were carried out by specially contracted recent graduates from the local agricultural high school, who were selected because they had the same cultural, linguistic, and educational background as the cooperating farmers (Heuveldop and Espinoza, 1984). This socio-economic study was later supplemented by a survey of traditional agroforestry practices (including for example species and products), carried out mainly by collaborating government extension officers. There was an overlap of the stages of characterization of the farming systems, basic studies of the region, and the on-farm testing of recommendations.

Since bio-physical as well as socio-economic statistics for the project zone were limited, several consultants and post-graduate students (national and foreign) were brought in to work with national staff in order to provide hard data for the stratification of the area and to re-evaluate identified problems as well as proposed solutions. The main activities were a soil survey, evaluation of present land use as well as land-use capacities (Melle, 1984), a survey of firewood production and use (Angern, 1985), and a socio-anthropological study of the farmers’ perceptions of agroforestry alternatives which were then being tested by the project (Marmillod, 1987a, 1987b). The project staff carried out a detailed characterization of the traditional coffee-shade systems, identifying components, products, and system architecture (Espinoza, 1985). A complementary watershed management project was also initiated, collecting and publishing useful bio-physical data on the Parrita watershed, which includes most of the Acosta-Puriscal zone (Ministerio de Agricultura y Ganaderia-direccion General Forestal, 1985).

In the final three year phase of the CATIE project, the involvement of the national institutions was greatly increased through their participation in on-farm research (applied research; not technology testing or extension) with improved or new agroforestry systems. At this stage the intention was to investigate which of the proposed improvements of traditional systems or systems developed on experimental stations, were really practical, to provide the foundation for a bilateral agroforestry extension project (i.e. not a CATIE project). The main examples were: dry season forage production from living fence posts or cut-and-carry silvo-pastoral units; total confinement stall-feeding system for dairy goats fed partially with foliage from existing
farm trees; management of the naturally regenerated timber tree *Cedrela odorata* in coffee plantations; and the use of the tree *Glicidium sepium* in an alley-cropping system to provide a nitrogen rich mulch for black bean (*Phaseolus vulgaris*) (Beer and Heuveldop, 1987).

The selection of the farmers for these collaborative trials was from a group of sixty-nine farmers who were involved since the first surveys were made. The individuals therefore were known personally by the project assistants for several years. Selection criteria were not formally organized but included: (1) the availability of a suitable site, (2) the productive potential of the proposed agroforestry system for each candidate farm, (3) accessibility, (4) farm size and structure, (5) the desire to distribute the trial plots over as much of the region as possible, (6) the interest of the farmer, and (7) most importantly, the evaluation of the farmer's potential as a collaborator, which was primarily based on the experience and opinions of the project assistants.

These research trials were managed by the project team (CATIE and government technicians) on land provided by the collaborating farmers. The farmers gave their labour and some inputs which were available from the farm, but the majority of the costs were covered by the project (seed, wire, fertilizers, and even labour). Labour and economic inputs were recorded but have a limited value, since these biological experimental plots are too small, and non-representative of the management intensity, to really judge the profitability of a system (Working Group C, 1987).

The selection of sites took into account possible follow-up extension activities, but only a limited number of experiments could be established for each activity (generally 3-6) due to logistical/financial limitations. Some of the trial plots were subsequently taken over, and the number of sites increased, by the bilateral agroforestry extension project which continues the work in this area (i.e. transfer to national institutions was achieved).

When the on-farm research began, the counterpart contribution changed from being almost exclusively the forestry department to include the regional agricultural centre (Puriscal) of the Ministry of Agriculture. The follow-up agroforestry extension project is, in fact, based in this centre with several full-time team members from both the forestry and agricultural departments working together with two international technicians (an agronomist and a forester). The focus is on promoting self-help agroforestry initiatives through local community organizations.

(v) Evaluation and monitoring. Monitoring of the project was initially only carried out internally as part of the reporting procedure to the funding
agency and CATIE at six or twelve month intervals. In the final phase of the project, when consultants and post-graduate students were involved at the same time as on-farm research was being carried out, a more frequent evaluation of progress and distribution of project resources (vehicles, equipment, and field assistants) became necessary. This was achieved through the joint preparation of a one-page summary of a monthly work plan, during a half-day meeting in the regional agricultural centre (not CATIE) of all project personnel, counterparts and students. These meetings had three results: (1) improved coordination of all project activities, (2) consistency in the presentation, to farmers or other technicians, of project goals, methods and organizations, and (3) development of a good understanding with the regional extension officers of this centre, who would eventually be involved in the follow-up project but who had not yet worked directly with the agroforestry project.

The provisional results of the basic studies were used to carry out an interdisciplinary D&D exercise (ICRAF, 1983a, 1983b; Raintree, 1989), wherein the problems and research topics were reviewed by a team of ICRAF, CATIE, and national institutions, that spent two weeks in the area revising available information and interviewing farmers. The project proposal (ICRAF, n.d.) which resulted from this exercise was never implemented as a whole, but it confirmed the choice of existing priorities and introduced some useful modifications into the research programme. A particularly useful concept was the linking of the problems perceived by the farmer to those identified by the technicians, and hence the search for systems which could resolve both at the same time.

The final evaluation of the CATIE project (activities in Nicaragua and Turrialba as well as Acosta-Purisical) was carried out by an independent consultant contracted by the funding agency, together with their own personnel (Maydell, 1985). The utility of the specific agroforestry systems developed for Acosta-Purisical, was also evaluated during an "Objectives-Orientated Project Planning" (ZOPP) exercise carried out in 1988 during the implementation of the new extension project (Deutsche Gesellschaft Fur Technische Zusammenarbeit, 1987, 1988). These evaluations emphasized identifying specific problems on the farms, objectives which would lead to the solution of these problems, and an assessment of how far the project activities had contributed to solving the problems. Appraisal of the quality of the research was not the main aim. A change in some agroforestry priorities for on-farm research was recommended in order to emphasize cash generation systems (some on-farm research continues as a component of the new
extension project). There were also changes in the list of activities which would be immediately promoted by the extension service. For example, an alternative commercial perennial crop, *Bixa orellana* (natural food dye), was given high priority.

In summary, it can be stated that the biological feasibility of these agroforestry systems for small-medium sized farms in Acosta-Puriscal was proven, but the economics were often poor and much more attention must be given to the socio-economic limitations. If the farmers are given the appropriate support (for example credit, extension, and germplasm), then a significant number would adopt some of the proposed agroforestry technology. Without support, they will probably continue with many of their destructive methods and additional research will not improve this situation.

It should also be noted that agroforestry cannot cure all the land-use problems of a region. In the case of Acosta-Puriscal, the original goal was to develop appropriate sustainable systems for small to medium farms. In fact the major land-use problem in the region is extensive grazing of beef cattle on steep slopes in large farms, i.e. outside of the target group. Even for the smaller grazing units, it is hard to design an agroforestry system (or any other system) which will reduce erosion from this totally inappropriate land use. The solution must come from another level of agricultural development which involves political and financial decisions (e.g., a critical appraisal of bank loans for pasture establishment) (Borel, 1987).

One general decision which originated from the evaluation of the Acosta-Puriscal project, was to reduce future emphasis on basic regional studies and to increase the on-farm collaborative research. This decision was implemented during the establishment and management of the subsequent CATIE project which began in late 1986 in Talamanca.

2.2 Talamanca: A participative planning process

(i) Area selection criteria. In 1986, new pilot zones were chosen on the Atlantic watersheds of both Costa Rica and Panama, using the following guidelines agreed upon between CATIE and the funding agency:

(a) In contrast to the more common suggestion of choosing the most ecologically damaged areas for new projects, which are usually on the seasonally dry Pacific watershed of Central America where population density is highest, select areas where most new colonization is occurring in order to develop appropriate land use with the settlers before they irrevocably damage their new lands. These new colonization areas are mostly in the low humid
tropical zone where ecosystems are especially fragile. This philosophy has been simply expressed as "Run before the problems; not after them".

(b) Test the general research and development philosophy and methodology developed in Acosta-Puriscal, in a completely different ecological zone, with suitable bio-physical and socio-economic conditions for the development of agroforestry systems.

(c) Respect national priorities for forestry and agricultural development.

(d) The final aim should be to establish the foundation for another agroforestry extension project.

Field visits and meetings over a period of nearly six months preceded the final decision by CATIE and the Costa Rican forestry service to select the Canton Talamanca, in the province of Limon. These meetings and field visits involved the Ministry of Agriculture’s regional centre (Siquirres); an international private voluntary organization, the Association of New Alchemists Incorporated (ANAI); farmers organizations and cooperatives; local agricultural high school staff; other CATIE projects with experience in the area; and most importantly on-farm interviews to assess, in a general way, the interests of the farmers. The existence of the ANAI community nursery project was quite influential in the choice of Talamanca because it provided a vehicle for gaining access to, and subsequently the confidence of, the farmers. It was also seen as one of the possibilities for concurrent and/or subsequent implementation of the applied research results, through its existing extension organization.

Other specific reasons given for the selection of Talamanca were the following:

(a) Most farms are classified as small to medium.

(b) From the point of view of extrapolation, the Talamanca pilot area is valuable since it falls within the life zones (Holdridge, 1967) "tropical wet forest" and "premontane rain forest" which together occur in 46% of Costa Rica and 49% of Central America (CATIE, 1986).

(c) The existence of several complementary projects in Talamanca, some of which could provide basic data whilst others already carry out agroforestry extension activities.

(d) The importance of agroforestry systems as a traditional practice provided an essential starting point for planning decisions and choosing applied research topics, as well as clearly demonstrating the interest, experience and acceptance of this land-use option by the Talamanca farmers. This was shown by the success of the ANAI community nursery project in which
many farmers participated in order to obtain perennial crops (e.g. cacao) and trees (principally little-known fruit species).

(e) The Talamanca farmers associations (reforestation, agriculture), were also seen as useful mediums for contact to the farmers to facilitate on-farm research, and later to promote adoption of the results. The association for reforestation had in fact been pressuring the forestry service for technical assistance.

(ii) Area description. The Canton Talamanca is one of the largest, least developed cantons of Costa Rica. The project has concentrated on the low altitude area ("Baja Talamanca"; 0-300 meters above sea level) which includes coastal plains and hills as well as river valleys. The limits of this area include: on the north side, the Caribbean; and on the west side, the border with Panama. The following description is of the "Baja Talamanca".

"Baja Talamanca" falls within the life zone "tropical wet forest". The temperature varies little throughout the year with an average of 26°C. Annual precipitation is 2,500 millimetres per year and there is no dry season, but soil moisture deficits may occur in September and October. The majority of the alluvial soils have been classified as Typic Trophorthent and the soils of the coastal hills as Oxic Palehumults and Aeric Tropaquepts.

Until recently the only areas without the original forest cover were the accessible lands near the coast or the rivers navigable by canoe, and the alluvial soils occupied by a banana company for the last 100 years. The activities of the indigenous people (e.g. Bribri Indians) living inland had had little impact on the forest cover. In the mid 1970s a significant area of relatively flat fertile land, temporarily abandoned by the banana company, was invaded by white settlers who immediately removed all the existing secondary forest in order to claim the land. The coastal area had long been settled (since the last century) by negro fisherman-farmers who established mixed cropping systems in which root crops, fruit trees, and perennial crops (especially cacao) play an important role. Thus, the work zone includes a complex racial mix and settlement history. The infrastructure in this area, including the government’s forestry and agricultural extension services, was poorly developed until recently, but is now being improved.

Farm sizes can be quite variable, but the actual area worked on each farm is limited and nearly all farms can be classified as small to medium. In the largest valley, which is occupied by white settlers, the average land holding per community is between 8 and 33 hectares (Segleau and Mora, 1989).
(iii) **How goals were established.** As mentioned before, the final aim of the CATIE project was to establish the foundation for an agroforestry extension project (i.e. provide applied research results; establish demonstration plots; train national personnel; and establish contacts with national, local, and farmers' organizations). Although this was the same aim as that of the Acosta-Puriscal project, an important difference was the decision to emphasize on-farm research and to de-emphasize basic studies (including the detailed evaluations of traditional agroforestry techniques). This implies the need for some kind of rapid appraisal methods (Chambers, 1981) to identify the main problems which could be at least partially resolved by promoting agroforestry development. It also implies the need to rapidly select farmers and farms for on-farm research, without having the experience and knowledge which come after carrying out detailed dynamic surveys (e.g., the case of Acosta-Puriscal).

The first step, therefore, which was concurrent with the area selection phase, was consultation with all knowledgeable persons and institutions, both governmental and non-governmental. However, the most important step was the development of a simple methodology to determine the farmers' problems, interests, and priorities at the same time as evaluating their potential as possible collaborators for on-farm research. This process should not be confused with a survey!

(iv) **Implementation: participation of farmers and national organizations.** Interviews of 125 farmers (Segleau and Mora, 1989) were carried out whilst walking around their farms, using a checklist of 12 obligatory open-ended questions, which included: (1) some minimal statistics, e.g. farm size, actual principal farming activities; (2) interests, especially which potential agroforestry activity appealed to him most; (3) experiences and problems encountered when trying to develop his farm; and (4) willingness to collaborate with on-farm research. The interviewer (local project assistant) was by no means limited to these questions, and the second page of a form he had to complete, during or immediately after the visit, was a checklist of observations to be made with respect to (1) the farmer's suitability as a collaborator (such as his age, personality, other commitments) and (2) the suitability of the possible sites on the farm (mainly bio-physical criteria). The final page of this form was designed for the preparation of an approximate map of the farm, showing main activities, and possible sites for on-farm trials (Beer, 1989). The farmers to be interviewed were mostly selected in consultation with the secretary of each community nursery, who also helped present the idea of the project to the
community and to programme the on-farm interviews. This implies a bias towards past and present community nursery participants which was considered acceptable since at this early stage there was no intention of trying to identify and collaborate with a representative cross section of all types of farmers within the target group, with whom there was the highest probability of demonstrations.

The need to include a more representative group comes later during the phases of technology testing and extension, when hopefully the project and the agroforestry activities it wished to promote have gained credibility. It was also thought better to postpone quantitative survey work until a later phase, in order that the practical problem orientated approach of the project be first demonstrated and thus reduce mis-interpretations (and hence misinformation!) about the real objectives of the project in this socio-economically sensitive region of Costa Rica (mixed cultures, large groups of squatters, and absence of land titles even for long established farms).

The general conclusions from the interviews, about farmers’ interests and possible project activities, were discussed with both governmental and non-governmental organizations, as well as with farmers’ representatives and groups. A national technician was in charge of the evaluation of the results (Segleau and Mora, 1989). The selection of the agroforestry technologies to be developed and tested by the project were most strongly influenced by the farmers’ interests but they were modified according to the technicians’ opinions and the project’s capabilities, i.e. the selection of agroforestry systems to be developed did not include any which were not frequently requested by farmers, but on the other hand many agroforestry or other systems which were requested had to be left out. This decision-making process does not exclude new agroforestry systems which are not traditional, since these ideas can be introduced and demonstrated through existing extension and community projects, and if considered sufficiently attractive will then be rapidly requested by the farmers. This is exactly what occurred with one of the main lines of applied research chosen by the farmers and hence by the project: testing different living support poles for black pepper vines, an agroforestry system which is certainly not traditional in any part of Costa Rica.

Once a sufficient number of farmers (usually 15-20) had been interviewed in any one community, the interviewer and project coordinator (together with each farmer) made a review of the results in order to prepare a short list of candidates for follow-up farm visits to discuss concrete proposals for collaborative trials and to select a suitable site. This
selection of candidates was made using a list of desirable characteristics for collaborating farmers, based on the criteria used in Acosta-Puriscal but greatly modified and expanded with experience in Talamanca. In particular the importance of socio-economic criteria (farmer), rather than just biophysical criteria (farm), was emphasized (Beer, 1989).

Logically the project needs more basic data for area characterization and planning than could be gathered through meetings, field reconnaissance trips and simple on-farm interviews. Hence, other activities are supported, such as compilation and synthesis of all relevant published and unpublished information (Kapp, 1989). Basic research activities, usually carried out by CATIE or visiting post-graduate students, are also supported in the Talamanca work zone. A constant effort is needed to evaluate other traditional or new agroforestry systems as sources of new ideas to support existing applied research lines or suggest new possibilities. The support research carried out by the CATIE Nitrogen-Fixing Trees Project is an example of one source of information for Talamanca (CATIE, 1987). As mentioned above, now that the project is established and respected by the target group, quantitative socio-economic studies are being planned, in part to generate the base line data against which future impact can be measured.

(v) Evaluation and monitoring. Evaluation and monitoring activities have already begun even though the project has few quantitative results. Annual review meetings are being planned for each community (not necessarily the nursery group only) in order to present a summary of results and to discuss future priorities. One external evaluation of the impact of the project by a sociologist, supported the selection procedure of farmers and on-farm research activities, but suggested that even more attention needs to be paid to the farmers’ interests, limitations, and expectations about the project. In other words, it may not be acceptable to foresee extension activities only in a later phase. There is, for example, an urgent need for explanations of the differences between the management intensity of an experimental plot and of a commercial plantation. Hopefully, such explanations will reduce the expressed doubts of the farmers that these systems are "too expensive for us" (Brenes, 1988). One information gap, which should be closed in 1989, is to record the collaborating farmers' observations and opinions (both criticisms and suggestions) about the management and potential of their plots. A simple form, with a few obligatory questions, will be used as the basis for this evaluation at the same time as some of the monthly bio-physical evaluations are carried out.
The results of these three means of regularly assessing project progress (annual community meetings, external reviews by sociologists, and assessment of on-farm plots by collaborating farmers) will be discussed during an annual meeting of project staff (CATIE personnel and national counterparts) and, together with the medium-term (3-4 years) project action plan (Deutsche Gesellschaft Fur Technische Zusammenarbeit, 1987) will serve as a basis for the measurable indicators of progress.

3 CONCLUSIONS

CATIE's agroforestry research projects must aim at the implementation of results. Thus, the choice of national counterparts and the possibilities for extrapolation of pilot area results are important considerations. Insofar as national resources are available, government technicians are continuously involved (even before research starts) to increase the probability that the results will be accepted, understood, and used. On-the-job training is obviously another benefit. Transfer of the planning methodology, through these technicians to their institutions, is thus a continuous process. After approximately six years, CATIE hopes to hand over all responsibility for each project to an extension organization and then restart the process in a new area (in reality several areas are at different stages of development at the same time). In addition to a transfer of plots and results, there is also a transfer of the planning methodology to each group of national technicians. This same planning methodology has also been transferred during technical assistance (consultancy) missions to rural development projects, both within and outside the region (Beer, 1989).

In order to facilitate extrapolation of the results, the research methodologies and multiple purpose tree germplasm are selected in agreement with other CATIE projects. Results are entered into regional data banks and can be compared with similar trails in other countries. Thus, in addition to their local significance, the results can be used for modelling exercises for areas where trial plot data are not available. However, agroforestry systems are site specific and small changes in environmental variables can significantly affect the interactions between components with unpredictable consequences. Moreover, socio-economic factors can be of overriding importance as determinants for the success of any agroforestry system.

Irrespective of the identity of the cooperating organizations, the final target group is the small to medium farmer (not the farm!). If this aim is really respected at all stages of project planning and development, then many decisions are easily made.
3.1 *Area selection*

(i) *National priority*. The criteria of national priority has been mentioned in each project analyzed. It must be stated, however, that in most of the countries, national priorities, as far as the agrarian sector is concerned, are weakly defined and are easily subject to pressures like the expectation of a new (externally funded) project. Although the national priority criteria should in all cases be ascertained, it does not automatically assure, for example, the full support of the central government.

(ii) *Extrapolation*. The choice of an area has been frequently justified by its ecological resemblance with large tracts of land elsewhere. Again, projects should not be established in unique areas, but to automatically assume that the results can be extrapolated to ecologically similar areas would be an error, particularly when human factors are not taken into consideration.

(iii) *Existing projects*. The comparative analysis shows that the presence of past or existing projects was always a critical consideration in the selection of new work areas. Of particular significance was the presence of extension projects and of local farmer's organizations.

3.2 *Goal setting*

(i) *Farmers' interests*. The interests of the farmers must be ascertained: (a) during project initiation, (b) by frequent monitoring, and (c) during evaluations. At the beginning of a project, rapid rural appraisal methods are more palatable to farmers than detailed surveys but sufficient time and resources must be devoted to developing the relationship and getting more than a superficial impression of the farmers' interests.

(ii) *Extension requirements*. The probability of successful technology transfer will be greatly increased if extension activities are foreseen and planned from the first day of research. This implies: (a) immediately identifying who will carry out future (or simultaneous) extension activities, (b) selecting the research topics with extension possibilities in mind, (c) selecting collaborating farmers for research who can also act as local extension agents, (d) distributing the long term agroforestry research plots with respect to future extension needs and not just using scientific criteria such as a bio-physical stratification, and (e) include some extension activities in the research project, in particular with a view to developing methodologies for the transfer of the results; i.e., make the researchers think about extension.
(iii) **Planning team.** In the absence of hard data on agroforestry components and interactions, especially the human factors, the necessity of putting together as many experiences as is practically feasible should be emphasized. This applies to farmers and extensionists as well as to senior professionals. A large group at the planning stage is no guarantee for a successful design, but a small group will most likely be biased and may produce an unbalanced work plan which ignores some critical factors.

3.3 **Implementation**

(i) **Local assistants.** It is more important to have assistants who intimately know the target group and their surroundings than those with research experience. The latter can be taught, the former not. Respecting this principal, CATIE transferred its field assistants, who had been contracted and trained in Acosta-Puriscal, to the new extension project. CATIE subsequently had to contract and train new local assistants, from the Talamanca zone, for the next project.

(ii) **Farmers as actors.** If the farmers are to be true partners in the on-farm research (rather than "sleeping" partners or worst, treated as another farm labourer), great care must be devoted to selecting the most motivated candidates, and secondly by developing the trial together (e.g., by selecting the site together).

3.4 **Evaluation and monitoring**

(i) **Emphasize social and economic aspects.** Bio-physical research is not enough. Even if the areas of expertise of the research team do not include economics and sociology, these aspects can not be ignored until a later extension phase. Consultants and local universities should be contacted to provide advise on methodologies for studying these topics.

(ii) **On-farm research monitoring.** On-farm research has been a constant in all analyzed projects, which is a consequence of the specific orientation of CATIE. There are, however, on-going field projects without formal research components. Nonetheless, these projects are "experimenting" with new species, arrangements, and management methods. The number of formal research activities is grossly insufficient. However, valuable information, some of it quite innovative, could be gained from development projects, provided good quality data are gathered over sufficiently long periods. This consideration calls for a greatly increased effort in monitoring agroforestry development projects. A number of well documented case studies should replace or complement many formal experiments.

With much observation from field researchers.
4 ACKNOWLEDGMENTS

The authors thank C. Burgos and C. Reiche for their constructive comments on this report. Financial and technical support were provided by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) and by CATIE.

5 FOOTNOTES


2 It is assumed that the farmers had automatically carried out a pre-selection since the decision to participate in a nursery suggests a motivated and innovative person with a special interest in perennial crops (particularly cacao) and agroforestry systems.

6 REFERENCES


Centro Agronomico Tropical de Investigacion y Ensenanza, 1987. Informe Tecnico Anual del Proyecto Erythrina spp. Fase II. CATIE, Turrialba,
Costa Rica, (unpubl.), 123 p.
Centro Agronomico Tropical de Investigacion Y Ensenanza, 1988. Facing the
Challenge: A Ten-Year Strategic Plan for 1988 to 1997. CATIE, Turrialba,
Costa Rica, 112 pp.
Administration and Development, 1: 95-106.
Planungsverfahren (ZOPP). In: Organisationshandbuch. GTZ. Eschborn,
Germany, (unpubl.), 10 pp.
Deutsche Gesellschaft Fur Technische Zusammenarbeit, 1988. Informe sobre el
taller "ZOPP" (IV): Proyecto Desarrollo Agrícola y Forestal de Acosta y
Espinoza, L., 1985. Untersuchungen über die Bedeutung der Baumkomponente bei
agroforestwirtschaftlichem Kaffeeanbau an Beispielen aus Costa Rica.
Hart, R.D., 1980. Agroecosistemas: conceptos basicos. CATIE, Turrialba,
Heuveldop, J. and Espinoza, L., 1984. El uso de encuestas en la
investigacion de tecnicas agroforestales tradicionales. In: J.W. Beer y
E. Somarrriba (Editors), Investigacion de tecnicas agroforestales
tradicionales. CATIE, Turrialba, Costa Rica, Boletin Tecnico No. 12, 42
pp.
Holdridge, L., 1976. Life Zone Ecology. Tropical Science Centre, San Jose,
Costa Rica, 207 pp.
Agroforestry Diagnosis and Design. ICRAF, Nairobi, Kenya, 25 pp.
Agroforestry Diagnosis and Design. ICRAF, Nairobi, Kenya, 383 pp.
International Council for Research in Agroforestry, No date. Research
proposal to improve and develop agroforestry systems for the seasonally
dry uplands of Western Costa Rica. ICRAF-CAR-CATIE, Nairobi, (unpubl.),
90 pp.
Lagemann (Editors), sistemas de Finca en Acosta-Puriscal, Costa Rica.
Lagemann, J. and Heuveldop, J., 1983. Characterization and evaluation of
agroforestry systems: The case of the Acosta-Puriscal, Costa Rica.
Fassbender and J. Heuveldop (Editors), Advances in Agroforestry Research.
Marmillod, A., 1987b. Farmers attitudes and behaviour with respect to trees
"Agroforstliche Zusammenarbeit mit dem CATIE" PN 79.2259.4 GTZ,
Frankfurt, Germany, (unpubl.), 62 pp.
Melle, G. van, 1984. Estudio sobre la capacidad de uso de la tierra en dos
areas de las subregiones Puriscal y Cariagres, Costa Rica. CATIE,
Ministerio de Agricultura y Ganaderia-direccion General forestal, 1985. Plan
de Manejo de la Cuenca del Rio Parrita: Anexo II, Sector I-A,
Rodriguez y J. Lagemann (Editors), Sistemas de Finca en Acosta-Puriscal,
24-28.
Raintree, J., 1989. Diagnosis and design procedures. Presented at the
International Symposium on Planning and Implementation of Agroforestry,
Pullman, Washington, April.
Segleau, J. and Mora, F., 1989. Actividades agrícolas de finqueros en el
Canton Talamancas; sus limitaciones y prioridades. CATIE-DGF, Turrialba,
Beer, H.W. Fassbender and J. Heuveldop (Editors), Advances in
Agroforestry Research. CATIE, Turrialba, Costa Rica, Informe Tecnico No.
117, 368 pp.

6 APPENDIX: CATIE RESEARCH AND TRAINING ACTIVITIES

6.1 Research activities
CATIE conducts its research activities through six priority areas:
(a) Perennial Crops (coffee, cacao and plantain). Emphasis on
biology and genetics; plant production; tropical soils and climate, and
socio-economics.
(b) Annual Food Crops (rice, corn, beans, sorghum). Emphasis on plant
protection, plant nutrition and socio-economics.
(c) Promising Tropical Crops. Conservation of germplasm, biology and
genetics, emphasis in biotechnological research.
(d) Tropical Livestock (meat, milk, mainly dual-purpose cattle).
Research on biology and genetics, emphasis on breeding and nutrition.
(e) Forestry and Agroforestry. Emphasis on biology and genetics,
nutrient cycling, socio-economics and crop management.
(f) Production System Development. Integration of production-oriented
research activities (crops, tropical livestock, forestry and agroforestry)
within the framework: research-education-development.
(g) Integrated Management of Watersheds and Regional Natural
Resources. Emphasis on water, soil and vegetation conservation, development
of agro-climatological and geographical data bases taking the watershed as
the planning unit.

6.2 Scope of CATIE’s international development involvement
While Central America and the Caribbean are CATIE’s primary areas of
influence, the centre serves the needs of other tropical regions around the
world. Within the context of horizontal cooperation, universities outside
the region play an important role. For example, the Universities of
Missouri, Iowa State, Colorado State, Wisconsin, and Wageningen have begun or
are planning collaborative activities in some of CATIE’s priority areas.
Reciprocal cooperation exists with many Latin American institutions and CATIE
has provided consultancies in most regions of the world. CATIE is a fundamental part of the most important agricultural research and training network in its working area (Red Regional de Cooperacion en Educacion Superior y Capacitacion Agropecularia y de los Recursos Naturales Renovables; REDCA).

6.3 Financial support

There is a long list of international institutions cooperating through support and providing human resources. In the actual funding structure about 75% of CATIE’s annual budget (13 million US dollars estimated 1989) comes from externally financed members’ contributions (IICA and member countries), overhead charges, and some productive commercial activities.

6.4 Review of CATIE's involvement in agroforestry

In a history of agroforestry in Central America, Budowski (1987) reviews CATIE's activities and mentions the first descriptive publications (Master of Science thesis and reviews written in the 1950s). Formal research ideas were formulated in the 1970s and the term "agro-silvo-pastoral systems" was introduced in 1976 as part of a programme in CATIE's agroforestry research and education programme. Borel (1987) describes the general research objectives of the centre's agroforestry programme as (1) finding the circumstances in which the use of agroforestry systems is an advantage and (2) developing improved systems for specific areas of the mandate region of CATIE.

The ongoing activities include basic research, e.g. long term tree/crop trials with nutrient cycling modelling, interspecific tree/crop competition, animal nutrition based on tree forage, and selection of germplasm. Emphasis in now given to applied on-farm research, which is carried out through trials in Costa Rica, Panama and Nicaragua.

6.5 Role of education

CATIE has a Latin American mandate for education (Master of Science and other post-graduate training) which includes the option of specializing in agroforestry. Most of the graduate students are qualified professionals working in the agricultural or forestry sectors of their respective countries, to which they return after graduation.

Short courses (2-12 weeks) and seminars on agroforestry are offered by CATIE, several of them annually. Most are conducted by CATIE staff on the centre’s campus in Turrialba, others in different countries of the region.
The increasing awareness of the discipline's importance is demonstrated by the rising demand for this kind of continuing education. For a smaller number of professionals, an in-service-training is possible, accompanying the ongoing research work.