ICRAF

PROGRAMMES ON

COLLABORATIVE AND SPECIAL PROJECTS

AND

AGROFORESTRY SYSTEMS RESEARCH AND EVALUATION

CONCEPTS AND PROCEDURES FOR DIAGNOSIS OF EXISTING LAND MANAGEMENT SYSTEMS AND DESIGN OF AGROFORESTRY TECHNOLOGY

- A PRELIMINARY VERSION FOR COMMENT* -

* The views presented in this document do not necessarily represent those of ICRAF.

1. INTRODUCTION

It is now evident that trees and shrubs, which are important components of practically all indigenous land management systems in the tropics, play important roles in providing many non-food essentials, maintaining and restoring soil fertility, minimizing soil erosion, providing livestock feed and preventing degradation of the overall ecosystem. Unfortunately, there are many areas of the tropics where population pressure has reduced the effectiveness of indigenous systems, and man, in an effort to increase his food supply to meet immediate needs, is destroying trees which appear essential for his long term survival.

The agroforestry approach to land management appears as a promising way to mitigate this apparent conflict. Unlike other approaches focusing on the improvement of components or bioeconomic sub-systems, the agroforestry one considers the entire landuse system. In doing so it may integrate woody and herbaceous crops with livestock on the same unit of land to design a sustainable and productive system of landuse compatible with prevailing ecological, cultural and economic circumstances, and consistent with the development goals of local people and governments.

It is in this context that ICRAF has been given the responsibility of contributing to the promotion of research activities leading to the development of agroforestry technology. Land management systems constitute the object of such activities, and the Council's contribution will be mainly channeled through a methodological capability for diagnosing existing land management systems to design agroforestry alternatives, whenever appropriate.

Since land management systems are conditioned by the agro-ecological and socio-economic circumstances in which they operate, that institutional capability would be enhanced by exposing it to problems arising from

different circumstances. As this could hardly be accomplished at a particular site, ICRAF decided to develop a Programme on Collaborative and Special Projects.

2. THE COLLABORATIVE AND SPECIAL PROJECTS PROGRAMME

The objective of the Programme is to develop a network of collaborative institutions interested in carrying out research on agroforestry, as an alternative approach to land management. It is expected that activities of network members will be complementary to each other in both the land-use circumstances involved and their contribution to the different stages in the cycle of technology development. In this respect, ICRAF's main contribution will be focused on the diagnosis and design stage, while the collaborating institution will emphasize the generation and dissemination of technology.

It is the strategy of the Programme to provide a framework to facilitate the implementation of and estimate resources involved in cooperative activities, by:

- defining agroecological zones where prevailing conditions indicate a potential for an agroforestry approach to landuse systems;
- identifying within target areas national and international institutions whose functions and infrastructures makes them potential partners for joint agroforestry endeavours;
- formulating joint projects aimed at understanding existing land-use systems for designing and disseminating alternative agroforestry technologies;
- establishing for each case the specific nature of inter-institutional cooperation, including resource allocation and management;
- monitoring and evaluating project developments.

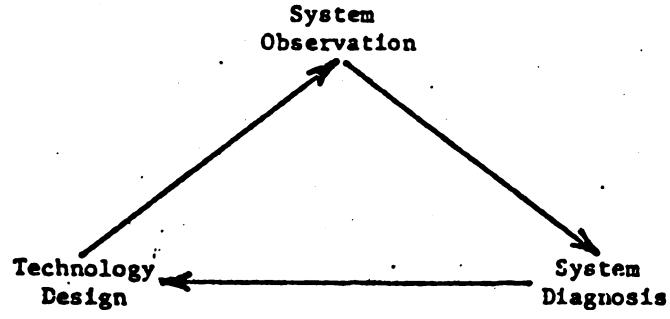
To achieve the mentioned complementarity with regard to land management

circumstances, research projects within the Programme will preferably be carried out on sites representing combinations of geographical and ecological regions. The underlying assumption is that geographical regions (Sub-Saharan Africa, Tropical America, South Asia, South-east Asia and Mediterranean) enclose broadly similar cultural conditions. Developing projects for different ecosystems within each region will expose the agroforestry approach to a spectrum of circumstances where it could play a role.

3. OUR APPROACH TO PROJECT DEVELOPMENT

The assumption which underlies our approach is that the most suitable basis for formulation of an agroforestry development project is a careful analysis of the actual circumstances and problems of land management in the project area. It is further assumed that the most appropriate and adoptable technology is one which is designed specifically to solve those problems. We also recognize, of course, that a quick turn around is necessary on survey activities in order to have an influence on the project planning cycle. The aim of our methodology development efforts, therefore, is to develop a practical, effective, and quickly accomplishable diagnostic protocol for use in a wide range of environments around the world. Fig. 1 depicts the basic logic of the technology development cycle.

FIG. 1: LOGIC OF THE TECHNOLOGY DEVELOPMENT CYCLE



The cycle begins, naturally enough, with OBSERVATION of the existing land management system whose improvement is sought. In the initial entry cycle, this observation takes a form analogous to a medical examination and results in a *description* of the landuse system in terms of the essential features of system structure and function against the background of prevailing agro-ecological and socioeconomic conditions. In subsequent cycles system observation takes the form of a "perturbation experiment" with extended monitoring and special studies.

With the results of the examination and the aid of rapid assessment survey methods and modeling techniques we arrive at a DIAGNOSIS of land management constraints and problems which, on analysis, allows us to identify the corresponding *potentials* for agroforestry type solutions. The diagnosis determines what problems are to be solved and specifies the functional attributes and other design characteristics of appropriate technologies. The final output of the diagnostic phase is a set of type-specifications which define the design problem to be tackled in Phase 3.

The internal workings of DESIGN phase are best understood by referring to the flowchart depiction in Fig. 2, together with the step by step outline that follows. Suffice it here to note that there are two possible kinds of outputs from the design phase:

1. Designs for improved land management systems incorporating known "off-the-shelf" agroforestry components and practices which are *deemed generally appropriate* and sufficiently promising to warrant immediate farm trial.

2. Notional technologies suggested by the diagnosis and design process which seem to hold promise for filling significant gaps in the current inventory of technology and which would appear to merit further R&D on a collaborating Research Station.

Assuming that the Diagnosis and Design phases find that there is a role for agroforestry in the project area, and if there is an appropriate agroforestry technology at the ready, the next step in the cycle is to submit the candidate

technology to FARM TRIALS. Conceived as a type of "perturbation experiment" designed to study the response of the system to an intervention, the purpose of these *in situ* trials is twofold:

1. To evaluate, through farmers' feedback and field measurements, the *specific appropriateness* of candidate technologies as effective and acceptable solutions to diagnosed land management problems.
2. To extend and refine the diagnosis by means of a kind of "diagnosis-by-treatment" procedure analogous to the practice followed by medical diagnosticians in the absence of a complete diagnostic laboratory.

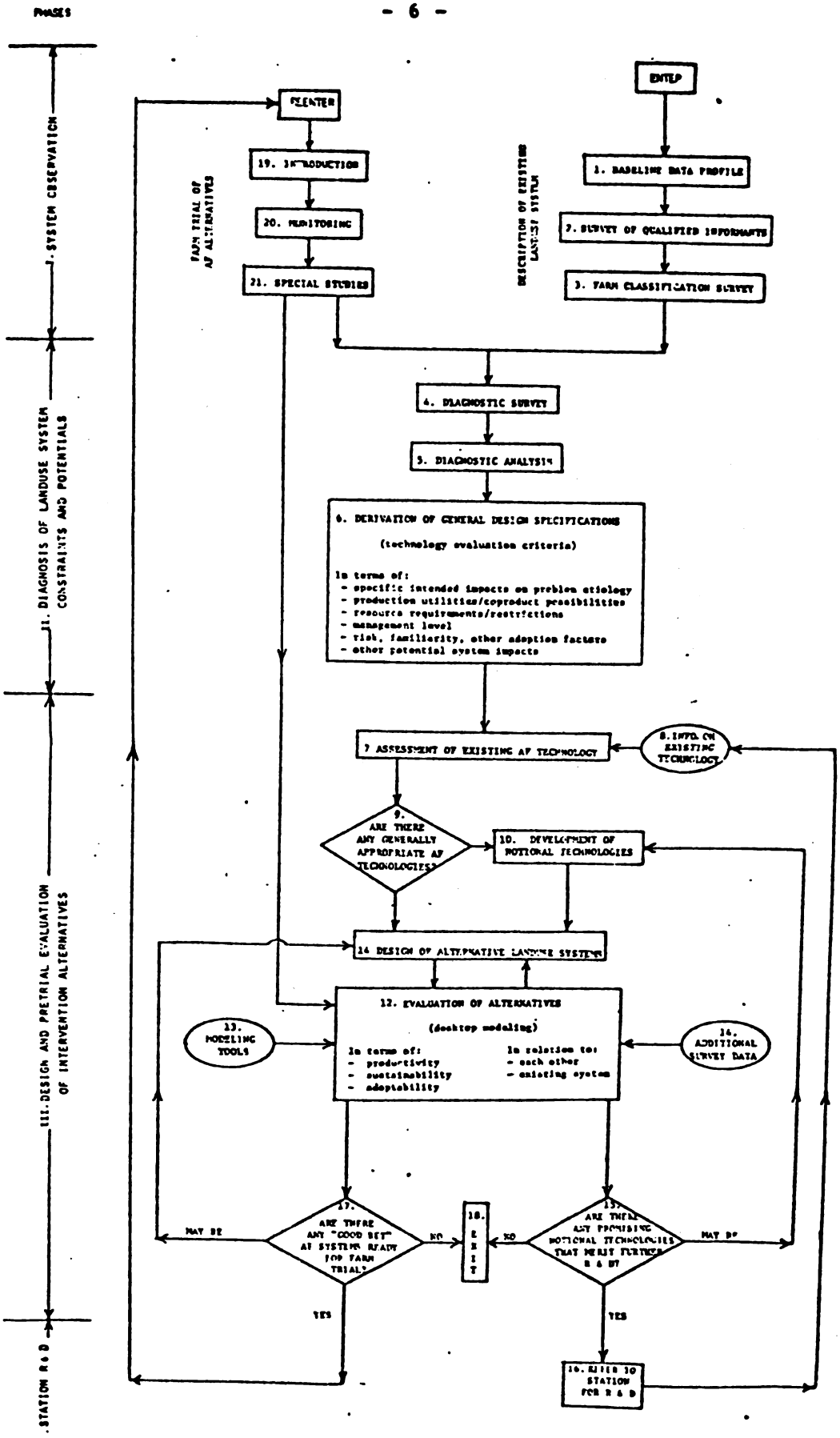
From the farm trials comes information which may modify the diagnosis and/or suggest redesign of the technology in the direction of a more optimized or adapted version.

If there is no readily applicable agroforestry technology in the current inventory, then the emphasis shifts to the development of promising notional technologies through R&D at the RESEARCH STATION. In practice, both pathways may be taken simultaneously: farm trials of good bet AF technology and on-station development of better ones. Feedback from farm trials of the former will enter into and improve the quality of the R&D effort for the later.

The entire cycle represents an iterative process which may be repeated until further refinement is considered superfluous.

The diagram in Fig. 2 is a detailed implementation flow-chart for the diagnostic and design process.

FIG. 2: FLOW-CHART OF THE DIAGNOSTIC AND DESIGN METHODOLOGY



The following is a key to the diagnosis and design flow-chart

PHASE I (Entry Cycle): SYSTEM OBSERVATION

Step 1. Baseline Data Analysis

Methods: Compilation and analysis of relevant geographical, historical and statistical information on the project area. (See Appendix 1).

Output: A preliminary classification and mapping of agroecological zones and landuse systems in the project area and a general picture of regional and local development needs and potentials.

Step 2. Survey of Qualified Informants

Methods: Informal individual and group interviews with qualified informants (articulate farmers, district officers, extension agents, project managers, other researchers, etc.), complemented by informal "windshield reconnaissance surveys" of the project area.

Output: Refinement of zonal landuse classification, an overview of local landuse history, a familiarity with typical management units and enterprise patterns, and a generalized understanding of major land management problems affecting the types of units.

Step 3. Farm Classification Survey

Methods: Rapid survey of farms in the project area (or other management unit) using a short formal survey instrument devised by senior diagnostic staff and administered by enumerators to a statistical sample of farms stratified according to agroecological zone; the survey focus is restricted to diagnostically salient factors.

Output: Classification of farms according to major farm types in each agroecological zone; a stratified sampling frame for the diagnostic survey.

PHASE II: SYSTEM DIAGNOSIS

Step 4. Diagnostic Survey

Methods: Structured but open-ended interview survey (See Appendix 2) and visual inspection of sample farms conducted by senior diagnostic staff. Survey oriented toward gathering data sufficient for: a) identification of problems in household basic needs supply subsystems (food, fuel, cash, shelter, raw materials; see Appendix 3) and trouble-shooting of antecedent causal factors and associated land management problems; and b) assessment of the sustainability of the present production system.

Output: Provisional spot diagnosis together with adequate data for subsequent detailed analysis (Step 5) of land management problems affecting the productivity and sustainability of the system.

Step 5. Diagnostic Analysis

Methods: a) graphic techniques (e.g. graphic overlays to identify climatic constraints, labour bottlenecks, etc.);

b) interaction matrices, causal network diagramming, etc. to identify and map interactions among system constraints (See Appendix 4);

c) hand calculator and microcomputer techniques to model critical system interactions;

d) forecasting methods and scenario construction techniques to assist in assessing system productivity and sustainability over time.

Output: Identification and rank ordering of significant problems, constraints and bottlenecks; analysis of problem etiology and

interrelationships among constraints; simple heuristic models of critical system interactions (e.g. qualitative simulation models); assessments of system performance over time under various scenarios. The main output or bottom line of this step is the identification of potential intervention points in the system where it may be possible to relieve constraints and improve system performance.

Step 6. Derivation of General Design Specifications

Methods: The crucial link between diagnostic and design processes, this step proceeds by a kind of intuitive "lock-and-key" logic from the preceeding analysis of potential intervention points to a specification of the functional requirements for point specific interventions (e.g. Is runoff a problem? Then we need something to reduce runoff and increase infiltration). Other desirable attributes of candidate technologies (see Flowchart Step 6) are derived from analysis of survey data.

Output: A set of general specifications for design of appropriate (i.e. problem-solving and adoptable) technologies.

PHASE III: SYSTEM DESIGN

Step 7. Assessment of Existing Agroforestry Technology

Method: Using the criteria of appropriateness given by the diagnosis, sources of information on existing technology are consulted to identify potential "off-the-shelf" solutions, if any.

Output: Knowledge of candidate technologies; awareness of the gaps in the current stock of technology.

Step 8. Sources of Information on Existing Technology

Immediate information:

a) ICRAF and Project staff

b) Consultation with other agroforestry experts around the world

- Delphi method consultations with experts in ICRAF network
- Solicitation of input from a wider group of AF practitioners through publication of notices and articles in ICRAF Newsletter and the Agroforestry Systems Journal (published by Martinus Nijhoff in cooperation with ICRAF).

c) Bibliographic database searches conducted by ICRAF Information and Documentation Services.

d) Cumulative punchcard and microprocessor storage files on AF components and systems at ICRAF headquarters in Nairobi.

Longterm information:

a) Experience gained in other Projects in the Collaborative and Special Projects Programme.

b) Findings of ICRAF's world Agroforestry Systems Inventory and Evaluation Project in the Systems Research Programme.

c) Results of networking and research activities conducted under ICRAF's Technology Research and Evaluation Programme.

d) Results of research conducted at ICRAF's Machakos Field Station.

Step 9. Decision Step

Q: Are there any generally appropriate agroforestry technologies?

If NO, GOTO 10: Development of Notional Technologies

If YES, GOTO 11: Design of Alternative Land Management Systems.

Step 10. Development of Notional Technologies

Methods: Various techniques to aid the technological imagination, e.g. brainstorming sessions followed by critical evaluation.

Output: Promising notional technologies, still in the idea stage but with at least a hypothetical potential for filling identified gaps in the current technology inventory.

Step 11. Design of Alternative Land Management Systems

Method: The process of design involves integration of AF tree components and existing or potential herbaceous crops and livestock into viable space-time arrangements which are optimal within the limits of the landusers resources, production priorities and management capabilities. The general design specifications are given by the diagnostic activities described above. Components and practices for inclusion in a design are given by the technology assessment and development activities (Steps 7, 10 & 16). The design process is facilitated by various design tools and modeling aids (described under Step 12 below). In any process of design, of course, there is no substitute for imagination. The aim of the ICRAF methodology is not to replace the design imagination with a sterile mechanical formula, but to *enhance* it and empower it with greater relevance by contriving to present it with the maximally coherent and suggestive stimulus.

Output: Relevant designs for agroforestry land management systems.

Step 12. Evaluation of Alternatives

Method: Despite its close linkage with the preceeding activity, this step is formally separated from the preceeding design step for the reason that it is usually best to first open up thinking about alternatives before evaluating any of them in detail. In practice, of course, there will be feedback between the two processes, as shown in the flowchart. With the aid of appropriate

modeling tools (see following) the alternative land management systems are compared with each other and with the existing system and evaluated for their relative productivity, sustainability and adoptability. An effort is made to realistically evaluate the relative merits of agroforestry systems in comparison with conventional agricultural and forestry systems.

Output: A thorough pretrial understanding of factors affecting the productivity, sustainability and adoptability of alternative land management systems for a given site. This then serves as the basis for the decisions made in Steps 15 and 17.

Step 13. Modeling Tools

** - graphic aids

- hand calculator and microcomputer/"slide rules" (e.g. for calculation of AF intercropping ratios);
- simple simulation models of system interactions over time (e.g. GSIM QUALITATIVE SIMULATOR);
- modest partial budgeting and simple linear programming models of intercrop and farm enterprise mixes at the field and whole farm level (LP design application).

The emphasis at ICRAF is on the development, use, and dissemination of practical, cost-effective modeling aids and design tools which are appropriate to the actual needs and resources of field staff and researchers in developing countries. This means that the hardware and software requirements should not exceed the now very respectable capabilities represented by the rapidly developing low-cost *microcomputer* technology and high-level *user friendly languages*, expected to become widely disseminated throughout the world in the near and medium term future.

Step 14. Additional Field Data

Methods: Surveys, in-depth interviews with local land users, direct observations, field measurements, monitoring, etc.

Output: Whatever additional field information is needed in the course of the design and evaluation exercise.

Step 15. Decision Step

Q: Are there any promising notional technologies that merit further R&D?

If YES, GOTO 16: To Research Station for R&D

If MAYBE, GOTO 10: Development of Notional Technologies

If NO, GOTO 18: Exit.

Step 16. To Station for R&D

Method: Controlled experimental evaluation of components and interactions.

Output: New AF technologies to add to current inventory (8).

Step 17. Decision Step

Q: Are there any "Good Bet" Agroforestry Technologies ready for Farm Trial?

If YES, GOTO 19: Farm Trials

If MAYBE, GOTO 11: Design of Alternative Land Management Systems

If NO, Exit.

Step 18. Exit Step

(Agroforestry is not the solution to every problem!).

PHASE 1 (Repeat Cycle) FARM TRIALS

Step 19. Introduction

Method: Layout and planting of agroforestry field designs on farmland in collaboration with cooperating farmers. Farmers in develop-countries are more capable and willing to collaborate with researchers in explicitly *experimental* on-farm undertakings than is normally supposed by members of the scientific community.

Cooperation may include an insurance formula.

Output: Establishment of experimental agroforestry systems under realistic conditions on farmer's fields.

Step 2C. Monitoring of Farm Trials

Farm trials, conceived as "pertubation experiments", are designed to probe system response to particular technological stimuli. Does the system respond in the intended way, (i.e. with a reduction in the problem condition, an improvement in system performance?). How does the farmer evaluate the intervention? What new design criteria come to light? How might the system be improved? Does the experience suggest whole new approaches? How does this modify the initial diagnosis? These are all questions to be answered through monitoring of the farm trials.

Methods: Regular collection of pertinent agronomic and farm management data by the "cost-route" method or other monitoring technique. Interview information complemented by direct field measurements whenever feasible. Monitoring duties accomplished by resident field staff and participating farmers.

Output:

a) Sufficient hard data from field measurements and summary feedback from farmers to render an objective assessment of the specific appropriateness of the experimental technology as an effective and acceptable solution to diagnosed land management problems.

b) Modification and refinement of the initial diagnosis in the light of the experimental evidence.

c) Redesign and improvement of the experimental technology (adaptive R&D).

d) Indications and priorities for controlled on-station research to adapt and optimize existing technologies, develop new prototypes,

and establish the scientific basis for optimum design of adaptive technologies across a broader range of agroecological conditions.

Step 21. Special Studies

Methodology: In-depth studies of topics with special importance to system management (e.g. charcoal production, rangeland management practices, the manure economy, the labour bottleneck, etc., etc.

Output: Information needed to complete the evaluation of system performance.

4. THE DEVELOPMENT OF A PROJECT

In developing ICRAF-promoted Collaborative Projects for each geographical region, three main stages are envisaged: identification, planning and implementation (of Projects). In each stage, a series of steps will be followed. They, specially those in the planning and implementation stages, should be carried out in close cooperation with the collaborating institution; implying that activities will be developed in house and abroad.

A tentative sequence of steps with the corresponding human resources and time involved is schematically presented in Fig. 3. A more detailed description of each step follows:

6.1. Identification Phase

Resources involved in this stage will be shared by all Projects within each region.

Step 1: Ecological zoning: an iterative process delimiting target areas on the basis of climatic, edaphic, topographic and landuse characteristics.

LUS = land use system

FIG. 3: STAGES OF PROJECT DEVELOPMENT

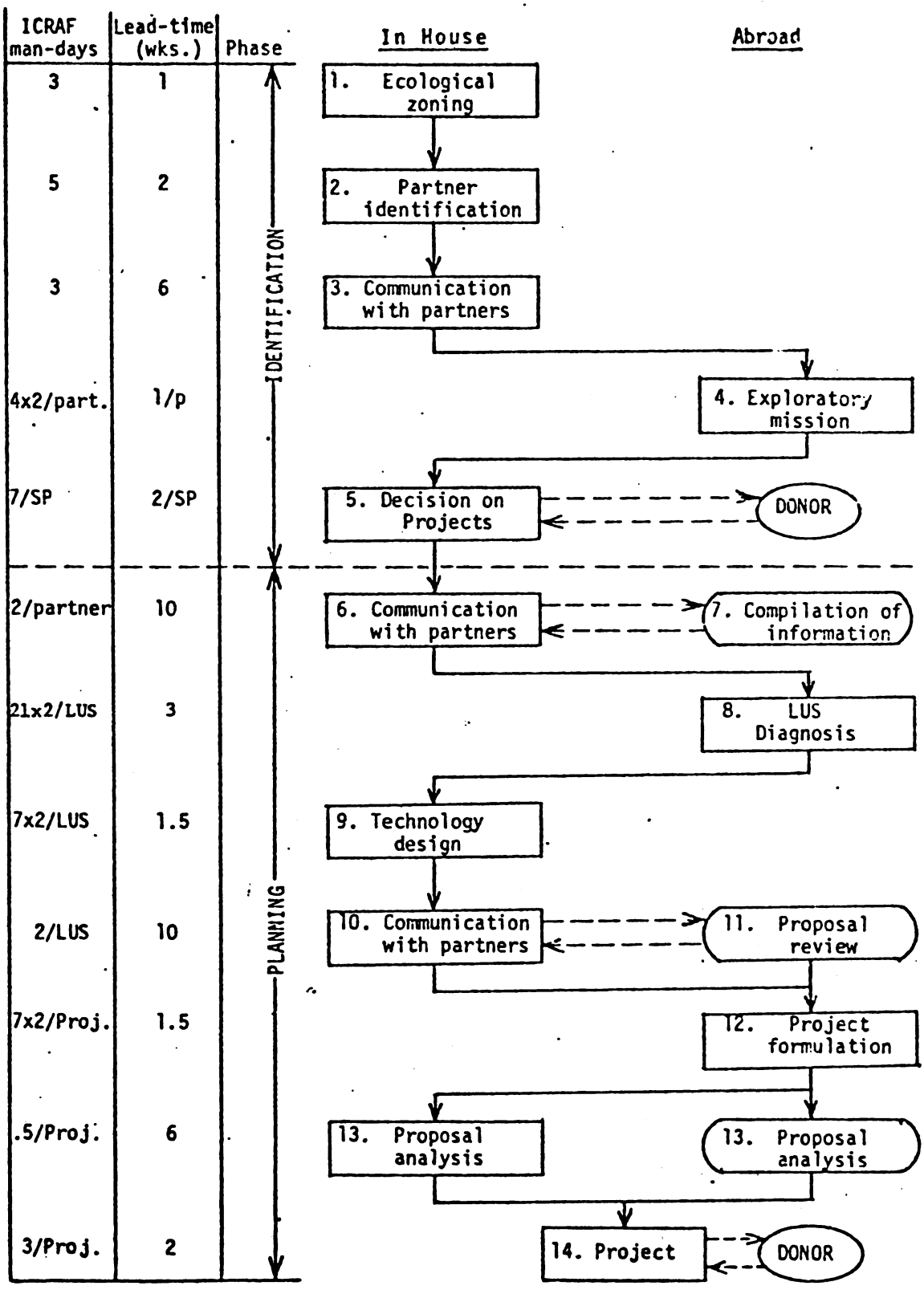
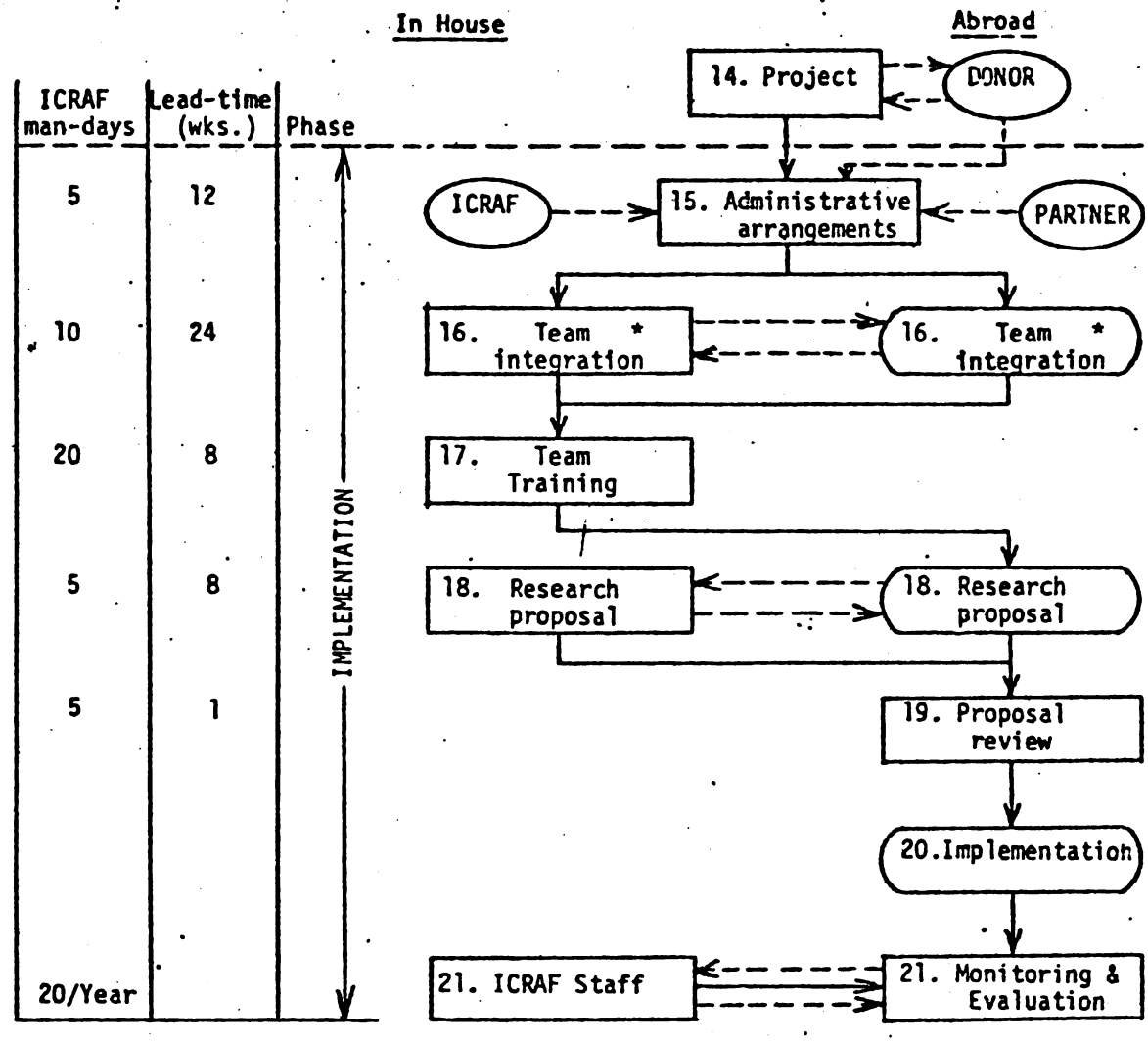


FIG. 3 (Cont'd)



ICRAF staff directly participating in activities

Only Partner or Project staff participating in activities

Personnel

Information

* If expatriates needed

Step 2: Partner identification: a pre-selection of potential cooperating institutions within ecological zones, based essentially on their objectives, stability and infrastructure.

Step 3: Communication with partners: to let them know about our institutional objectives and programme, as well as the type of cooperation envisaged.

Step 4: Exploratory mission: visiting the interested partners to discuss institutional objectives, evaluate infrastructure, appraise regional landuse problems and explore avenues for inter-institutional cooperation.

Step 5: Decision on Projects: to be carried through the planning phase, based on information gathered by the Exploratory mission and Donor's interest.

6.2. Planning Phase

Step 6: Communication with partners: to indicate interest and remit a "tailored" LUS-description check list for their consideration.

Step 7: Compilation of information: to be carried by the partner's staff, based on the agreed check list (Step 1 of Fig. 2: D & DM)

Step 8: LUS Diagnosis: carried together with local staff to identify problem sub-system and main limiting factors. (Steps 2, 3 and 4 of Fig. 2: D & DM).

Step 9: Technology design: based on the identified problems and alternative role(s) of woody components to circumvent or ameliorate them. (Steps 5-17 of Fig. 2: D & DM).

Step 10: Communication with partners: on envisaged technological alternatives and additional information that may be required for the design stage.

Step 11: Proposal review: by the local staff, including collection and collation of new information, if required.

Step 12: Project formulation: a proposal on objectives, strategies, programme and resources necessary for on-farm and/or on-station research-cum-development activities.

Step 13: Proposal analysis: to be carried out by ICRAF and partner teams.

Step 14: Project: a final version of the proposal based on comments and suggestions by both teams.

6.3. Implementation Phase

Initiation of this Phase depends on firm commitments by donor institution(s), if needed.

Step 15: Administrative arrangement: to accommodate Project needs with institutional requirements.

Step 16: Team integration: which will be responsible for carrying out the Project.

Step 17: Team training: on ICRAF's agroforestry approach to LUS.

Step 18: Research proposal: by Team on specific objectives, methods and lay-out of experiment(s) to be carried out, in consultation with ICRAF staff (either core or consultants).

Step 19: Proposal review: by both ICRAF and partner research staff.

Step 20: Implementation: of research plan by Project's team.

Step 21: Monitoring and Evaluation: carried out by ICRAF and Partner's staff twice a year.