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BRIEF NOTES ON ICRAF'S DIAGNOSTIC AND DESIGN METHODOLOGY FOR AGROFORESTRY

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J.B. Raintree, ICRAF

1. INTRODUCTION

Although ICRAF is not a member of the CGIAR system it does collaborate with a number of CG centers in the area of Farming Systems Research relevant to agroforestry. In order to meet the need in agroforestry for a practical approach to the identification of research priorities in a field like agroforestry, which lacks an established tradition of research, ICRAF is in the process of developing a "Diagnostic and Design" methodology. Now, after more than twenty trial applications in a wide range of sites around the world, draft manuals of the methodology have been produced for wider dissemination and testing.

This methodology development activity takes place within the Agroforestry Systems Programme at ICRAF and is part of the Council's overall thrust in systems methodologies for agroforestry. Other projects in the Systems Programme deal with the adaptation and development of methodologies for economic analysis in agroforestry &land evaluation for agroforestry. Other current projects in the Programme include an Inventory of Agroforestry Systems and Practices and a project on Land Tenure and Agroforestry. The Agroforestry Technology Programme at ICRAF deals with the collation and synthesis of information on component technologies and with methodologies for technology generating research.

The "D&D" methodology is currently being used mainly to formulate agroforestry R&D projects in collaboration with national and international partners through the activities of ICRAF'S Collaborative and Special Projects Programme and as a major part of three week Agroforestry for Development courses offered by ICRAF'S Training and Education Programme. D&D activities provide a context in which ICRAF's other methodologies are brought into play.

The D&D methodology is basically an FSR type of approach, adapted to the special needs and potentials of agroforestry. As an observer at this meeting ICRAF is interested to learn of commonalities and differences in the Farming Systems methodologies being used by the CG centers, with a view toward improved coordination of collaborative activities. One possible future activity of the D&D Project is to develop a methodology module for use by national research institutes already using FSR methodologies, with the aim of aiding researchers to identify agroforestry potentials and research possibilities within the FSR context.

Although ICRAF's client institutions include forestry departments interested in integrating farmers, agricultural crops and livestock into forest management schemes, the main body of current work in agroforestry focuses on the integration of trees into farming systems to play a variety of production and service roles, leading to improvements in the productivity and sustainability of farming systems through integrated land management.

2. OBJECTIVES

The aim of the D&D Project is to develop an efficient procedural framework and practical tools for the diagnosis of agroforestry-related problems and potentials in land use systems and design of agroforestry systems and technologies to solve or mitigate the identified problems and develop the latent potentials of the system. The focus on land use systems provides a broad context for diagnostic activities appropriate to the wide scope of potential agroforestry designs.

In accordance with its role as a research council and with an opperating budget that does not currently allow scope for direct management of technology generating projects, the main use of the D&D methodology is to assist national and international partners to develop projects which they themselves implement, with backstopping from ICRAF. It is possible, however, that in future ICRAF will become more directly involved in project management.

One of the main differences between D&D and other FSR approaches is the emphasis on a more elaborate technology/land use system design objective. The second D in D&D stands for "design" in this concrete engineering sense.

As in the other methodologies being discussed at this meeting the emphasis on D&D is on providing a basis for technology generating research, although the potential is also present for direct application in development-oriented projects (with a research component) as well as for policy applications.

3. PROGRAMME STRATEGY

In its methodology development activities ICRAF follows a three phase strategy: 1) develop in-house capability, 2) expansion of in-house capacity (i.e. to handle an adequate volume of methodlogy applications), 3) transformation of the developed capability into a methodology which can be independently implemented by clients, through documentation (manuals, case studies, etc.) and training activities. The D&D methodology is now in phase 3. A revised version of the draft manuals will be published in late 1985. An eventual synthesis with technques of land evaluation for agroforestry now being developed will provide a means for larger scale land use planning in which D&D will provide system specific "ground truth" information.

4. STRATEGY FOR COLLABORATION WITH NARS

NARS are here taken to include forestry research institutions, watershed management authorities, etc., in accordance with the broad scope of agroforestry uses.

The main outreach arm of ICRAF is the Collaborative and Special Projects Programme (COSPRO), whose aim is to strengthen national capacity for agroforestry research and development. COSPRO has participated in seven project formulation exercises

to date, in which joint multidisciplinary teams of ICRAF and national scientists have applied the D&D methodology to arrive at plans for technology generating projects. These applications have resulted in the training of some 50 national and regional scientists in the use of D&D for project formulation purposes. COSPRO also seeks to assist in the institutionalization of agroforestry research capacity through catalyzing the formation of national and regional research networks.

The Training and Education Programme of ICRAF also seeks to build national capacity. To date some 62 scientists have been trained in ICRAF's approach to agroforestry. The three courses held so far have included a 1½ week module on D&D built around a central case study exercise in which the trainees participate. ICRAF'S Information and Documentation Programme is another channel for dissemination of the buildup of agroforestry knowledge (databases, etc.) and methodologies.

In all of these outreach programmes ICRAF has collaborated with CG centers. One of the most interesting forms of collaboration is in the formulation and backstopping of national research projects.

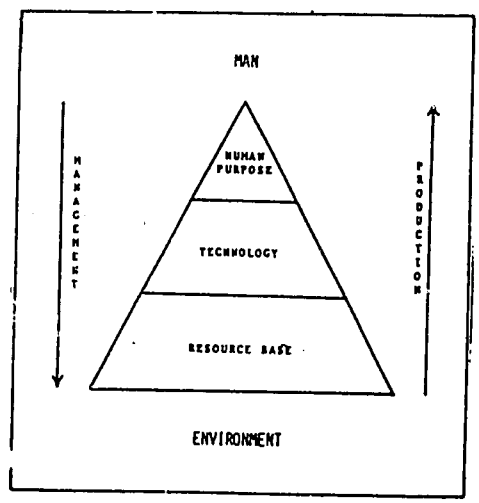
5. SCOPE OF D&D

To identify agroforestry-related needs and potentials of land use systems we have to cast our diagnostic net pretty wide. While D&D concentrated initially on the basic land management and decision-making unit (usually the family farm, household herd, etc.), it was soon realized that many AF-related problems and potentials require a larger-than-farm scale approach to diagnose problems whose origins cannot be assigned exclusively to individual management units and/or which require larger scale, often cooperative approaches to the design of solutions (watershed management problems and the overexploitation of communal fuel and fodder resources are typical examples). In principle this same situation may arise in non-agroforestry oriented diagnoses as well, although they are not often addressed by most FSR methodologies (even those purporting to be "whole system" approaches, let alone those which explicitly restrict the focus to the "enterprise" level).

The point is that it is more difficult, if not impossible, to ignore larger than-farm scale factors in agroforestry diagnosis and technology design. Likewise with smaller scale factors. In Africa, where women often have quite distinct production opportunities and responsibilities from men (including often primary responsibility for fuelwood and fodder collection as well as the main burden of food production), it was found necessary to focus D&D activities onthe intra-household scale of analysis. Tenure problems vis-a-vis both land and trees cut across all levels of analysis and have a major impact on agroforestry potentials within existing land use systems. Accordingly, the D&D methodology attempts to address 3 levels as a routine practice: 1) watershed/community level, 2) management unit level (usually the household but it could also be a forest management unit), 3) intra-household level.

In taking the "land use system" as the focus for D&D activities we have been led toward a hybrid concept of "the system" for D&D purposes. As suggested by the following figure, a land use system is conceived as that part of the total human ecosystem of an area which is comprised of all those interactions by which by which Man exploits his perceived Resource Base by means of available Technology to satisfy Human Purposes. Accordingly, the diagnosis of the systems starts from an analysis of the production objectives of the land users. Those production subsystems in which the land user experiences difficulties in meeting his/her production objectives are then subjected to a "trouble-shooting" analysis to expose the constraints and causal factors implicated in the etiology of these problems. Although the D&D methodology attempts to provide a logical and efficient sequence of queries, heavy reliance is placed on the competance of the multidisciplinary D&D team, using the quidelines and checklists, to trace the lines of causality through as many levels in the sociobiophysical system as necessary to define the syndromes behind problems whose main "symptoms" are ~~are~~ experienced as particular types of failure in meeting the objectives around which the system is organized.

Again, this approach to the analysis of systems which are organized by human purpose needn't apply only to agroforestry oriented FSR, but in agroforestry, where the relevant production objectives can be quite wide ranging, a more generalized approach of this type is virtually unavoidable.



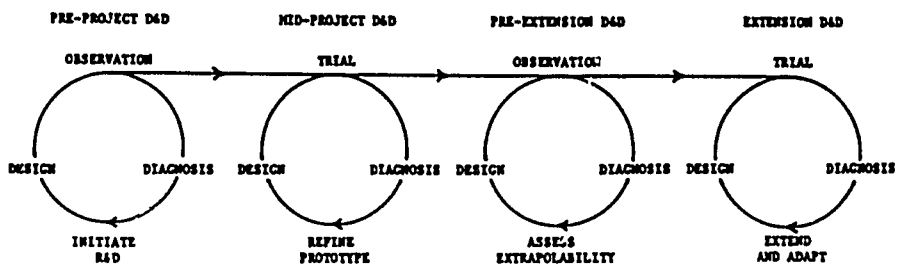
Faced with a diagnostic task of potentially great complexity, we have attempted to simplify the type of systems analysis required for agroforestry by defining subsystems in terms of the desired outputs. A "production subsystem" in this sense is comprised of any and all resources, activities and factors involved in the production of a desired output. As a kind of checklist for rapid entry into the diagnosis of any system (but particularly relevant to household production systems) we have taken a "basic needs" approach to the identification of subsystems. The following needs are considered basic and universal: food, energy, water, cash, savings/investments, raw materials for local processing industries, shelter and social production. The heuristic hypothesis is that, whatever else they might do, land use systems are organized so as to satisfy these basic needs. To describe the system it is merely necessary to identify the preferred products or forms of needs satisfaction (e.g. maize rather than sorghum, etc.) and describe the location, resources used, technology employed and [illegible] activities involved in meeting the production objectives of the management unit.

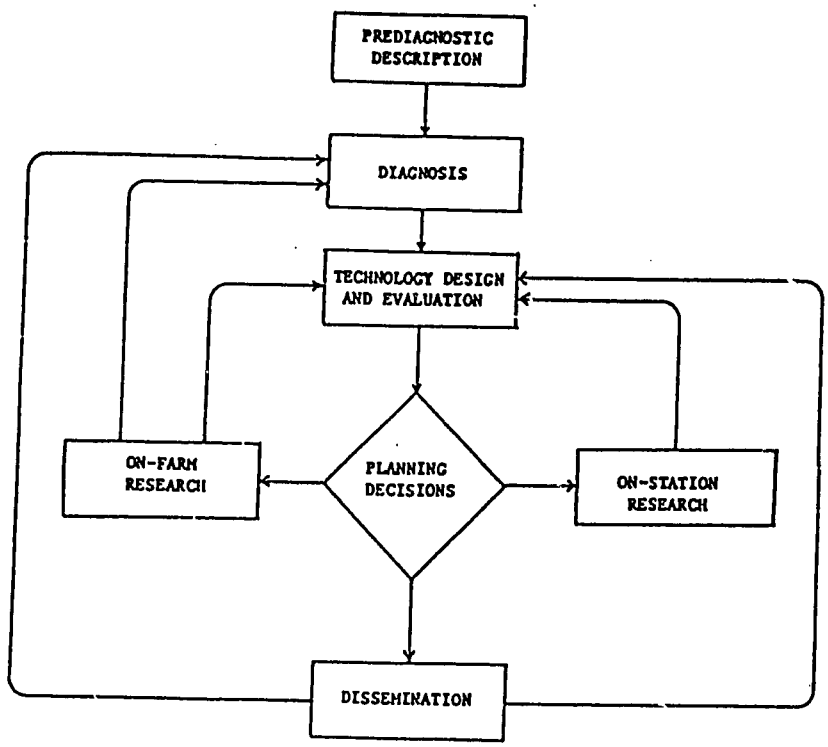
This approach provides a quick entry into the system and sets the stage for the assessment of problems and trouble-shooting exercise which follows in the diagnostic phase, but it may need to be supplemented by similar analyses at different levels in the nested hierarchy of system organization (watershed/community and intra-household levels). It has the advantage of clearly linking technical subsystems to the objectives of the producers and of streamlining the diagnosis to focus on those subsystems in which problems are evident. Of course, it always has to be broadened to deal with potentials not suggested by the analysis of presently percieved problems, but this is where the skills of the multidisciplinary team come into play in rounding out the diagnosis of problems and potentials. In agroforestry, where conservation is the other side of the coin of production, it is often necessary to make an independent assessment of resource degradation problems (particularly those amenable to an agroforestry solution). But this criterion can be operationalized in terms of the "sustainability" of the existing production subsystems, thus relating conservation objectives to the production objectives of the land user, and suggesting possibilities for technology "packages" which make use of the "piggy-back principle" to address a wider range of system needs and potentials than are currently percieved by the unit managers.

Again, there is nothing to restrict this kind of approach to agroforestry applications, but in agroforestry, where expermental systems take a long time to establish and test and where, once established, they are likely to be a long time on the ground, there is a higher premium on well conceived designs.

6. APPROACH

We think of Diagnosis and Design as a basic process which is fundamental to all problem-solving approaches and we have made a deliberate attempt to reduce it to its fundamental components and logical requirements, weeding out unproductive ideosyncracies as we've gone along, in response to user feedback. We also think of it, in its elementary form, as an iterative process which continues throughout the life of a technology generating and disseminating project from formulation, through implementation of R&D activities, to dissemination and adaptive research. As such it becomes part of the "internal guidance system" of an applied "research for development" project. Uses of D&D at different stages in the life cycle of such a project and the basic structure of feedback linkages are suggested by the following illustrations.





Diagnosis-and-Design is an iterative process which continues throughout the life of a project as part of its internal guidance system. Note feedback linkages.

In presenting the D&D methodology to potential users we have encountered different responses to the level of detail in the guidelines we are currently able to provide. Some users want only minimal guidelines, the basic bones and logic of the basic procedures, with full freedom to workout the details themselves. Others want detailed "recipies," step by painful step. We also note that interest in more detailed procedural suggestions increases with exposure to and familiarity with the methodology in the fields (we notice the same effect with all of our training materials).

Accordingly, the current documentation (relating mainly to the project formulation process) is presented in terms of a four stage breakdown of the procedural logic (level 1, "minimal guidelines," summarized in the following table), a further subdivision into twelve steps (level 2, "semi-detailed guidelines," given in outline form in the succeeding pages), and a companion "resource" document (level 3, "detailed guidelines" which also contains a substantial number of optional resource materials keyed to the different steps). (cf. Raintree, 1984, ICRAF 1983a and 1983b, respectively.) Comparable guidelines for the later phases of the project cycle have yet to be developed, due to the longer time required to gain experience with these phases on the ground. Four case studies of the D&D project formulation process, undertaken in collaboration with national and in some cases international (CGIAR) partners, have been published in the ICRAF Working Paper series and others are in preparation. A computerized D&D databank is being established at the Nairobi offices to record D&D results for comparative analysis and generalization.

In the next phase of the D&D development effort it is hoped that we may find national partners to collaborate in revising the current guidelines to incorporate adoption facilitating adaptations to local needs and resources and to simplify the presentation and cast it in the local research idiom.

Table 1. Summary of level 1 guidelines for project formulation based on a four stage breakdown of the 'minimal' logic of the D&D process.

D&D STAGES	BASIC QUESTIONS TO ANSWER	KEY FACTORS TO CONSIDER	MODE OF INQUIRY
PREDIAGNOSTIC	HOW THE SYSTEM WORKS (what does it look like, how is it put together, how does it work?)	PRODUCTION OBJECTIVES AND STRATEGIES	SEEING THE SYSTEM
DIAGNOSTIC	HOW WELL THE SYSTEM WORKS (what are its problems, limiting constraints and problem-generating syndromes?)	PROBLEMS IN MEETING OBJECTIVES CAUSES OF IDENTIFIED PROBLEMS	TROUBLESHOOTING THE SYSTEM DERIVING SPECIFICATIONS
DESIGN	HOW TO IMPROVE THE SYSTEM (what is needed to improve system performance?)	PROBLEM SOLVING OR PERFORMANCE ENHANCING INTERVENTIONS	BRAINSTORMING AND EVALUATING ALTERNATIVES
PLANNING	WHAT TO DO TO DEVELOP THE IMPROVED SYSTEM (what specific R&D actions are needed to develop and implement the envisaged improvements?)	R&D PRIORITIES	PROJECT PLANNING AND RESEARCH DESIGN

Level 2 'Semi-detailed' Guidelines

To give greater detail to the suggested procedures, ICRAF (1983a) has further subdivided the basic four-stage process into a set of 12 steps, 3 for each of the above listed stages. These are presented in outline form below, along with the suggested *output* of each step, *sources of information*, the *main factors to consider*, and an optional list of *useful tools* and resource materials which the user might wish to consult at the various steps (the latter are found in ICRAF, 1983b).

PREDIAGNOSTIC STAGE

Step 1. Environmental Description of the Study Area

Output: A descriptive understanding of the diagnostically relevant characteristics and organization of the selected environment

Sources of information: Mainly existing documentation on the study area, supplemented by limited field survey and interviews with qualified informants

Factors to Consider:
- Biophysical parameters
- Socioeconomic parameters
- Structure and function of the human ecosystem of the area

Useful Tools: Environmental Data Base for Agroforestry (Young, 1983); worksheets for relevant biophysical and socioeconomic data and guidelines for description of the human ecosystem (ICRAF, 1983b)

Step 2. Differentiation of Land Use Systems Within the Study Area

Output: Identification of distinctive land use systems requiring separate D&D treatment; selection of priority system(s) for D&D attention

Sources of Information: as above

Factors to Consider:
- Land units (possessing a similar set of biophysical characteristics)
- Management units (with similar production objectives and resources)
- Land use systems (distinctive combinations of land units and management units)
- Criteria for system selection

Useful Tools: Worksheet for differentiation of land use systems and suggested criteria for selection of systems for D&D attention (ICRAF, 1983b)

Step 3. Preliminary Description of the Selected Land Use System(s)

Output: A preliminary characterization of the objectives and the internal organization of the land use system(s) (for reference use by the D&D team at the Diagnostic Stage)

Sources of Information: As above

Factors to Consider:
- Structure and function of supply subsystems at the management unit level
- Additional descriptive information on production activities (agricultural, forestry, livestock and agroforestry practices; water management)

Useful Tools: Various worksheets, guidelines and appendices on the use of ICRAF's 'basic needs' approach for description and diagnosis of household production systems, with supplementary guidelines for forestry and watershed applications, input-output analysis, matrix tools, modeling techniqeus and other useful tools (ICRAF, 1983b).

DIAGNOSTIC STAGE

Step 4. Diagnostic Survey

Output: Information necessary for a diagnosis of land use problems and potentials (both agroforestry and non-agroforestry) at the management unit (farm) and ecosystem/community level

Sources of Information: Area reconnaissance and diagnostic surveys of representative management units (the latter is based on a 'trouble-shooting' procedure for identification of the causes of problems within the supply subsystems)

Factors to Consider:
- Problems and potentials at the ecosystem level
- Problems and potentials at the management unit level (supply problems, causal factors involved in the creation of supply problems, present constraints and problem-causing syndromes, future sustainability problems, undeveloped potentials)
- Farmers' strategies for coping with identified problems

Useful Tools: Suggested survey techniques and interview guidelines, sample diagnostic survey instrument (ICRAF, 1983b)

Step 5. Diagnostic Analysis

Output: A diagnosis of major land use problems and potentials

Sources of Information: Findings of the diagnostic survey; information provided by all preceeding steps

Factors to Consider:
- Present problems and potentials at the ecosystem level
- Present problems and potentials at the management unit level
- Sustainability problems

Useful Tools: Analytical worksheets, detailed analytical guidelines and queries, causal and functional diagramming tools (ICRAF, 1983b)

Step 6. Derivation of Specifications for Appropriate Technology

Output: A reasonably complete set of design specifications for problem-solving and potential-realizing technologies appropriate to the needs and potentials of the diagnosed land use system

Sources of Information: All preceeding steps

Factors to Consider:
- General development strategy for the system
- Functional potentials for problem-solving interventions
- Potentials for improving resource utilization
- Possible constraints on candidate technologies

Useful Tools: Checklists and guidelines to assist in developing a complete set of specifications for appropriate AF technology (ICRAF, 1983b)

TECHNOLOGY DESIGN STAGE

Step 7. Technology Appraisal

Output: A relevant set of candidate technologies with potential for inclusion in a design for an improved land use system

Sources of Information: Review of the body of technical knowledge

Factors to Consider: Main criteria are given in the design specifications (output of step 6); state of the art with respect to the various candidate technologies (both agroforestry and non-agroforestry)

Useful Tools: Classification and examples of agroforestry systems and practices from around the world, lists and characteristics of multipurpose trees and shrubs, their uses and ecological requirements, selection considerations, design concepts, etc. (ICRAF, 1983b).

Step 8. Technology Design

Output: General design for an improved land use system and specific designs for component technologies

Sources of Information: Creative synthesis of relevant information from all preceeding steps; supplementary design information from additional sources, as needed

Factors to Consider:
- Design specifications (Step 6)
- Candidate technologies (Step 7)
- Function and location of components within the system, component species, number and spatial arrangement of components, and management of component combinations
- Overall productivity, sustainability and adoptability of the design

Useful Tools: General design principles for agroforestry systems, an iterative initial design algorithm, plant arrangement considerations, notes on shelterbelt design, etc. (ICRAF, 1983b) see also design materials listed under step 7

Step 9. Design Evaluation

Output: Ex ante evaluation of the design; improvements in the design suggested by the evaluation process

Sources of Information: Relevant information from all preceeding steps; farmers' preliminary evaluation of the design proposals; the D&D team's own experience and judgement

Factors to Consider:
- Productivity
- Sustainability
- Adoptability

Useful Tools: Design evaluation scoresheet, guidelines for ex ante economic, ecological and social evaluation (ICRAF, 1983b, Hoekstra, 1983; Etherington and Mathews, (1984).

FOLLOWUP PLANNING STAGE

Step 10. Research Needs

Output: Identification of the type of research needed to develop and test the component technologies and overall land use system designs

Sources of Information: Team review and assessment of the following factors

Factors to Consider:
- State of the technology art and the suitability of different classes of technology (notional, preliminary, validated) for different types of research (on-station, on-farm)
- Whether the envisaged followup to the D&D exercise is essentially research-oriented or development/dissemination-oriented
- Farmers' and research/extension officers' attitudes toward on-farm experimentation
- Riskiness of the proposed technologies
- Need for candidate technologies to be exposed to a wider or more realistic set of environmental and farming system conditions (than would be available on research station)

Useful Tools: Suggested criteria for initial state of the art evaluation, notes on experimental approaches in agroforestry (ICRAF, 1983b; Huxley, in preparation).

Step 11. Topics Requiring Further D&D Attention

Output: Identification of topics needing further diagnostic survey or design thinking, particularly in rapid appraisal applications where time constraints may have left gaps in the D&D outcome; suggested procedures for collection and processing of additional information required to deepen the diagnosis and/or refine the design

Sources of Information: Team review and assessment of D&D results

Factors to Consider:
- Requirements for additional diagnostic information and analysis
- Requirements for more complete information on candidate technologies needed to refine the initial design
- Requirements for in-depth economic, ecological and social evaluation of the proposed design

Useful Tools: N/A

Step 12. Project Implementation Plan

Output: Guidelines for implementation of followup project activities, at different levels of detail appropriate to different stages in the project cycle: a) a general outline of major project activities (research and/or dissemination), suggested by the D&D team; b) a more detailed project proposal suitable for submission to potential donors, prepared by a small pre-project working group; c) detailed project implementation plan, prepared by the project implementation team; d) revised mid-project working plans prepared by the implementation team from time to time, reflecting modifications in technology design suggested by experience in the field or from on-station research

Sources of Information: Results of previous D&D steps (a); pre-project followup activities (b&c); the iterative D&D process during the course of project implementation (d)

Factors to Consider:
- Topics needing further D&D attention (output of Step 11)
- Research needs (output of Step 10)
- Feedback from on-site trials (including farmers' evaluation and suggestions) and on-station experimental work in the course of the project (suggesting modifications and refinements in the technologies and the plan of work).

Useful Tools: Forthcoming; see also ICRAF (1983b).

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