DIAGNOSTIC AND DESIGN METHODOLOGY MANUAL SERIES NO. 1

W O R K I N G P A P E R

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GUIDELINES FOR AGROFORESTRY DIAGNOSIS AND DESIGN

DRAFT FOR COMMENT

AN INTRODUCTION TO THE ICRAF METHODOLOGY

INTERNATIONAL COUNCIL FOR RESEARCH IN AGROFORESTRY

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ACKNOWLEDGEMENTS

The development of a Diagnostic and Design Methodology for agroforestry has been the subject of concerted effort at ICRAF for over two years. It began with the identification of the need in agroforestry for a quick and reliable means of identifying research and development priorities and with the adoption of a systems approach to agroforestry as one of the cornerstone's of ICRAF's institutional strategy (Steppler, 1981). It has continued in a prominent place in ICRAF's Programme of Work, as developed by ICRAF's Director, Dr. Bjorn Lundgren, and his staff.

The basic framework of the D&D approach was developed and tested by J.B. Raintree, Diagnostic and Design Methodology Project Leader and Systems Programme Coordinator, and Filemon Torres, Collaborative and Special Projects Programme Coordinator. Dirk Hoekstra, Dianne Rocheleau and Anthony Young contributed substantially to the further testing and elaboration of the methodology. The methodology is interdisciplinary in its development as well as its application. To date, the following ICRAF staff members, representing the disciplines indicated, have contributed in one form or another to the development, field testing or review of the D&D Methodology:

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Remko B. Vonk of Wageningen University, Louise E. Buck and Edward Alitsi of the Mazingira Institute, and Patrick J. Robinson of the Commonwealth Forestry Institute also contributed to the early development and testing of the methodology. ICRAF is also grateful to Cor Veer, Michael Collinson, Hubert Zanstra, Robert Chambers and Michael Stocking for comments on earlier drafts and working papers. Thanks are also due to Stella Muasya and Fredric Gitau for their tireless effort in the typing and production of the manuscript.

This draft of the *Guidelines* was written by J.B. Raintree and Anthony Young.

ABSTRACT

ICRAF has undertaken to develop an interdisciplinary Diagnostic and Design methodology for agroforestry, to assist agroforestry workers in identifying priorities for technology-generating research, based on designs for appropriate agroforestry technologies derived from a diagnosis of the needs and potentials of land use systems. After initial development and testing of the D&D methodology in more than twenty sites around the world over the past two years, ICRAF has produced these draft *Guidelines for Agroforestry Diagnosis and Design* and a companion volume entitled *Resources for Agroforestry Diagnosis and Design.* They are being published in working paper form in order to facilitate early dissemination and wider field testing of the evolving methodology and to elicit comments and suggestions for improvements to be incorporated into subsequent editions.

The present document provides an introduction to the Diagnostic and Design methodology, covering the logical framework of the methodology, an outline and description of the step-by-step procedures, a discussion of manpower requirements, the scale and timing of D&D activities, institutional considerations, etc. Although the emphasis is on the use of the D&D methodology at the formulation stage of agroforestry projects, the role of the continuing diagnosis and design process as part of the project's 'internal guidance system' is also discussed. For more detailed procedural guidelines and a variety of useful tools and materials, the reader is referred to the companion document.

HOW TO USE THESE GUIDELINES

Although this document is intended to possess a stand-alone capability as a source of basic guidelines for the diagnosis of land use problems and potentials and the design of appropriate agroforestry systems, it is also intended to be used in conjunction with the companion volume, *Resources for Agroforestry Diagnosis and Design* (ICRAF, 1983) and other methodological publications from ICRAF (e.g. Young, 1983; Hoekstra, 1983; Huxley, in press).

The *Guidelines* present an introduction to ICRAF's Diagnosis and Design Methodology, which outlines the logical framework of the D&D approach and presents the step-by-step procedures in minimal but sufficient detail for users who wish to make use of the basic framework while filling in the details themselves. The *Resources* contain a more detailed set of suggested guidelines and worksheets, along with a compendium of useful tools and materials, to aid in carrying out the procedures outlined in the *Guidelines*.

The D&D Methodology has been designed to fit a wide range of applications and must, therefore, be tailored to the resources and requirements of specific institutional settings and types of applications. While the basic methodological framework outlined in the *Guidelines* is quite generally applicable across a broad range of circumstances, not all of the considerations and procedures contained in the *Resources* will be applicable to every situation. The user must pick and choose and, in the final analysis, assemble his own adapted set of detailed procedures. For an overview of the D&D approach and a sense of what minimally should be included in an application of the methodology, the user should consult the present *Guidelines*. For more detailed suggestions on how to carry out specific procedures, and for access to a variety of diagnostic and design tools and resource materials, the user is referred to the *Resources*. The two-volume format has been chosen as a means of facilitating ease and flexibility in the use of the D&D Methodology.

It should also be emphasised that this is an *evolving methodology*. The present set of documents have been published in Working Paper form in order to obtain comments and suggestions for improvements of the methodology to be incorporated into future editions in the D&D Manual Series. Suggestions arising from actual applications of the methodology in the field will, obviously, carry greater weight in subsequent revisions than those resulting from a mere reading of these documents, but all manner of critical review and comment is welcome.

The present documents concentrate primarily on the use of diagnostic and design procedures at the formulation stage of agroforestry projects. To develop sound technologies to fulfill the diagnosed agroforestry potentials, however, will require a sensitive approach to project guidance which could benefit from an extension of the basic D&D process into the implementation stage of agroforestry research and development projects. This will be the subject of methodology development efforts for future manuals, and specific suggestions from project implementers on how to accomplish such an extension of the D&D process will also be most welcome.

Finally, the ultimate objective of using the diagnostic and design process to advance the science and practice of agroforestry in the field can only be accomplished through knowledge arising from a large number of applications in a wide range of different physical and socioeconomic environments around the world. To facilitate the documentation and dissemination of D&D results ICRAF has initiated a publication series on *Case Studies in Agroforestry Diagnosis and Design*. Case study reports will be available from ICRAF on request, and users of the methodology are encouraged to submit

case studies for possible publication in this series. A computer-based data bank on D&D cases is also being developed at ICRAF headquarters in Nairobi. Users of the methodology are also encouraged to use the forthcoming data recording forms to place their case information on record in the data bank. In this way ICRAF hopes to assist the development of agroforestry in the same way that case studies have aided the development of medical science.

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CONTENTS

ACKNOWLEDGEMENTS i

ABSTRACT ii

HOW TO USE THESE GUIDELINES iii

1. GENERAL INTRODUCTION 1

1.1 Objectives of the Methodology 1
1.2 Agroforestry Defined 1
1.3 The Diagnostic Approach 2
1.4 Criteria of Agroforestry Design 3
1.5 Rapid Appraisal and Multidisciplinarity 3
1.6 Manpower Requirements 3
1.7 The Institutional Setting 4
1.8 Duration and Timing of D&D Activities 4
1.9 The Scale of D&D Applications 6
1.10 On the Optimum Level of Documentation 7
1.11 D&D As Part of the 'Internal Guidance System' of a project 7

2. SPECIFIC PROCEDURES 10

2.1 The Logical Sequence of Steps 10
2.2 Synopsis of the Four Stage Procedure 15

3. CONCLUSION 21

REFERENCES 22

LIST OF ILLUSTRATIONS

Figure 1. Components of project design incorporating the D&D process as part of the project's internal guidance system 8

Figure 2. The iterative D&D process in the life cycle of a technology generation and dissemination project 9

Figure 3. The use of causal diagramming to elucidate the etiology of a problem and identify potentials for appropriate technological interventions in the system 16

LIST OF TABLES

Table 1. Summary of farm level diagnostic and design indications for a representative management unit at the Kathama research site in Kenya 20

1. GENERAL INTRODUCTION

1.1 OBJECTIVES OF THE METHODOLOGY

The aim of ICRAF's Diagnostic and Design (D&D) methodology is to assist in the design of appropriate agroforestry systems, as a conceptual basis for the identification of research needs and the formulation of agroforestry research and development projects. The methodology is directed toward meeting the needs, solving the problems, or realizing the potentials of specific land use systems. The procedures described in these guidelines lead to the design of one or more agroforestry technologies which appear to have the potential to effect realistic improvements in the target land use system. The resulting 'design concepts' may then serve as the basis for planning a research programme to develop the identified agroforestry technologies through a combination of on-site and on-station research.

Although the logic of the D&D methodology is applicable to a wider range of technical options, and while non-agroforestry alternatives are given due consideration in the course of the D&D process, the methodology has been designed to focus on a systematic consideration of agroforestry-related aspects of existing land use systems, i.e. not to miss, through lack of appropriate analytical techniques, any significant agroforestry potentials which may be inherent in the land use system.

A problem-oriented or diagnostic approach is adopted as a logical route to the goal of good agroforestry design and the basic methodological guidelines have been adapted to the need for an efficient 'rapid appraisal' approach (Chambers, 1981) to project formulation. The methodology incorporates elements of the Farming Systems Research (FSR) approach (Collinson, 1981; Hildebrand, 1981; Zanstra *et al*, 1981; Shaner *et al*, 1982) but goes beyond the content of existing FSR methodologies in order to address the broader range of production and conservation roles which can potentially be played by agroforestry. Although a major emphasis is placed on the household management unit as, in most cases, the basic decision-making unit vis-a-vis land use, the methodology employs a sliding scale of analysis ranging from intra-household processes to the local community, regional and national levels of socioeconomic and ecosystem organization.

While the focus of the present guidelines is on the use of the D&D methodology at the formulation stage of agroforestry projects, a continuing role for the basic D&D process is envisaged throughout the life of a project as part of its 'internal guidance system.'

1.2 AGROFORESTRY DEFINED

Agroforestry is a collective term for systems of land use in which woody plants (trees and shrubs) are deliberately combined on the same land management unit with herbaceous crops and/or animals, either in some form of spatial arrangement or in sequence. For a land use system to fall within the concept of agroforestry, there should be both ecological and economic interactions between the woody plants and other components of the system (Lundgren, 1982).

Agroforestry may involve the integration of trees into farming systems or crops and livestock into forests. In practice, a high proportion of agroforestry systems involve the growing of trees on what is primarily agricultural land. Crop or livestock production on land devoted primarily

to forestry is less common but also within the scope of agroforestry. To avoid frequent qualifications, the terminology used here and in the companion document (ICRAF, 1983) is phrased primarily in terms of agroforestry applications in farming systems, but the methodology is also applicable to the design of appropriate agroforestry systems for forest reserves (see the companion document for specific guidelines on forestry applications). Similarly, the term "farmers" is employed, for brevity, to include all actual or potential categories of land manager, including pastoralists and foresters.

1.3 THE DIAGNOSTIC APPROACH

One of the major principles underlying the Diagnostic and Design methodology is derived from an analogy with medicine i.e. that *diagnosis should precede treatment*. In the first instance, this means simply that research oriented toward the development of new land management technologies should be relevant to the actual needs and potentials of land use systems. It is no use developing a technology which works beautifully on the research station if there are reasons why it cannot be taken up by a significant proportion of the intended users. Rather than leaving such aspects to chance, or to a later 'evaluation' stage in the project cycle, the diagnostic procedures are intended to insure that the research undertaken is oriented in the right direction from the start so that the technology to be developed will be relevant to the needs of the area.

The analogy with medicine entails the further implication that priority should be given to the development of *problem solving* agroforestry technologies. While it is true that agroforestry holds promise for achieving a wide range of land use potentials, it seems obvious that the priority claim on the use of scarce research and development resources lies in developing agroforestry's potential to provide urgently needed solutions to pressing problems of failing production systems and degradation of the resource base of future generations. As in medical practice, the principle of *triage* applies.

Furthermore, there is little use in conducting sophisticated research to realise some ideal conception of the biological potential of a land use system as long as the system in question is suffering from crippling problems which prevent it from achieving those potentials. By analogy, there is no use in trying to make an athelete out of someone suffering from a chronic debility. The debility must first be removed before the patient can go on to realize his atheletic potentials. The 'patient' in D&D perspective is the existing land use system and a diagnostic approach is a direct and logical route to the realization of system potentials through the identification and removal of system constraints.

While the medical analogy may help in defining standards for agroforestry practice, the situation in agroforestry departs from that of medicine in at least one very important aspect: in agroforestry the methods of 'treatment' have frequently not yet been developed or scientifically proven. In the present early stage of the scientific development of agroforestry there are few 'off the shelf' solutions. Hence, the need for research before widespread extension of agroforestry technology. Hence, also, the need for a reliable and efficient methodology for identifying priorities for cost-effective research based on sound agroforestry designs.

1.4 CRITERIA OF AGROFORESTRY DESIGN

There is no substitute for good design. The criteria of good agroforestry design are threefold: *productivity, sustainability* and *adoptability*. The improvement of productivity, or output from the land, is almost everywhere required, by governments as well as by farmers themselves and needs no further discussion here. The 'sustainability' criterion is an attempt to operationalize the conservation objectives of agroforestry in terms of the farmer's production objectives. In most cases it means that production aims should be achieved without degradation of the land resources. Where degradation has already occured, agroforestry technologies may seek to reverse the process and place the production system on a sustained-yield basis.

The 'adoptability' criterion means that the techniques and systems proposed for development should be capable of adoption by a significant percentage of the intended users. This implies, for example, that the technologies must not call upon resources which the farmers are not likely to possess (e.g. excessive capital, machinery or labour requirements) nor be incompatible with unchangable features of the existing land use system, nor require forms of management the farmers are unable or unwilling to adopt (e.g. keeping livestock off pastures for prolonged periods). In recognizing adoptability as a design criterion on an equal footing with productivity and sustainability, the agroforestry designer accepts the challenge of addressing the social as well as the physical dimensions of land use systems. The D&D methodology is intended to provide assistance in carrying out this more demanding, and yet potentially far more successful, approach to design.

1.5 RAPID APPRAISAL AND MULTIDISCIPLINARITY

Although the D&D procedures are adaptable to a range of different needs and applications, the basic guidelines are designed to allow the use of rapid appraisal methods by a highly qualified multidisciplinary team. A rapid appraisal approach is adopted for practical reasons: the planning of research and development projects is usually subject to constraints on the cost and availability of skilled manpower which often severely limit the time available for survey and research planning activities. This is particularly true in the case of agroforestry, where the broad scope of the subject normally requires the participation of several disciplines in order to insure adequate diagnostic coverage and a broadly conceived approach to design.

1.6 MANPOWER REQUIREMENTS

Manpower requirements will vary with circumstances, but a minimal D&D team should normally include one or more representatives of each of the following disciplines: *agricultural science* (general agronomy, horticulture, and livestock sciences), *forestry* (in the broadest sense including, if relevant, individuals with a knowledge of horticultural and multipurpose trees), *social science* (sociology/anthropology, human geography and economics), and *natural sciences* concerned with land resource survey (ecology, soils science, climatology). Within these broadly defined disciplinary categories, generalists will normally be more useful as members of a D&D team than narrowly specialised individuals. It may often be possible to economize on the manpower requirements of a D&D team

by recruiting individuals who combine within themselves a working knowledge of more than one discipline (e.g. climate and soils knowledge in a land evaluation expert, natural and social sciences in a geographer or a human ecologist). Arrangements can usually be made for consultation with specialists to supplement the knowledge of the generalists when the need arises.

Whenever a technology generating research project is to be formulated on the basis of the D&D survey results, every effort should be made to involve the eventual technology developers directly in the process as members of the D&D field team in order to maximize the understanding and use of the results by the most directly relevant recipients.

1.7 THE INSTITUTIONAL SETTING

The intended users of the D&D methodology include: research scientists at national and international research institutes, land use planners and resource managers, development project implementation staff, rural development fieldworkers and non-government organizations, university researchers, and representatives of donor agencies involved in formulating projects to support agroforestry research and development activities at any of these levels. The methodology can be flexibly adapted to meet the needs and resources of these varied institutional settings.

Given the need for research in the present state of agroforestry, primary emphasis is placed on the use of the methodology in formulating research projects to develop and test needed agroforestry technology, but there is nothing to preclude the use of D&D procedures to arrive at agroforestry designs for more direct development-oriented applications, particularly if the development project incorporates a research component to support the testing and refinement of the proposed agroforestry systems.

Many client institutions wishing to make use of the D&D methodology will not possess a standing D&D survey team of the desired multidisciplinary composition. This is particularly true in the case of agroforestry, since agricultural and forestry staffs are often housed in separate institutions. Again, this need not prevent the use of the methodology since good D&D results have been obtained with ad hoc inter-institutional teams assembled for the purpose on a temporary basis. More permanent arrangements for inter-institutional cooperation may be necessary, however, to carry out a multidisciplinary research and development project in agroforestry.

The desirability of a multidisciplinary team approach, likewise, does not preclude the use of D&D procedures by clients lacking the resources to field such a team. Experience has shown that there is considerable scope for success in even single-person D&D applications, providing that the individual is adequately conversant with the relevant disciplinary perspectives and that there is opportunity for consultation with appropriate disciplinary experts in the course of the exercise. Simply attempting to follow the logic of the D&D procedure can be expected to produce some improvement in the planning of agroforestry efforts in almost any institutional setting, regardless of personnel or resource endowment.

1.8 DURATION AND TIMING OF D&D ACTIVITIES

There are two basic possibilities with respect to the duration and timing of D&D activities at the project formulation stage:

1. Rapid appraisal plus followup, or
2. Straightforward extended application

In a typical 'type 1' application of D&D procedures by a multidisciplinary team, it normally takes about two weeks to carry out the diagnostic survey, analyze the results and develop appropriate design concepts for agroforestry interventions to improve the existing land use system. This period of concentrated diagnostic and design effort is normally preceeded by a month or two of preparatory data gathering by a small prediagnostic working group and is followed by up to several months of less intense pre-project followup work, again by a smaller working group, to round out and refine the initial D&D results arrived at by the full multidisciplinary team and develop a detailed project implementation plan. This type of D&D application is designed to economize on the use of time and manpower resources and make the best use of limited time available for high level multidisciplinary collaboration.

The timing of 'type 1' applications also accords well with the normal phasing of activities in the formulation of donor-sponsored projects. The rapid appraisal D&D process corresponds to a substantial 'project identification' or a preliminary 'project formulation' type of exercise which defines the overall thrust and the framework of the project. This, then, serves as the basis for a request for proposals to formulate, in the pre-project followup phase of the D&D process, a detailed project implementation plan. If adopted by donor agency project identification teams, the D&D process in its rapid appraisal form could provide an efficient and reliable means of putting well conceived agroforestry projects out to bid. At present we can only speculate on the effect this would have on the cost-effectiveness of donor sponsored agroforestry projects, but one has reason to believe that it would be beneficial.

Although the developers of these guidelines have taken pains to insure that the suggested D&D procedures are compatible with a rapid appraisal approach (see detailed guidelines and suggested procedures in *Resources for Agroforestry Diagnosis and Design)*, there is nothing to prevent the application of the D&D logic in lengthier 'type 2' exercises in cases where time and personnel resources are not constraining. In that case, rather than a 'type 1' D&D application which reaches the required depth through a two-stage process which postpones some of the more detailed and time consuming work until the followup stage, the 'type 2' application would proceed straightforwardly through the logical sequence, taking everything as it comes up in whatever detail is deemed necessary.

Thus, in 'type 2' applications it might take 6 months to a year to work through the D&D procedures, rather than 2 weeks for an initial 'type 1' application. It goes without saying that there are a whole range of intermediate possibilities as well. One variation worth mentioning is that of allowing a substantial pause in 'type 1' applications between the diagnostic and design phases in order to allow the D&D team to fully digest the design implications of the diagnosis and to informally explore notional design alternatives.

It should be pointed out, however, that even when time is 'unlimited,' there may be distinct benefits to an initial rapid appraisal application. Anyone who has ever managed a multidisciplinary research team knows how difficult it can be to reach an interdisciplinary consensus. Experience with the rapid appraisal form of the D&D methodology would suggest that the pressure of having to arrive at a definite consensus within a circumscribed time period can result in a higher degree of interdisciplinary synthesis than would otherwise be possible under less pressured conditions. Such a consensus, achieved at an early stage of the project cycle and regarded as 'provisional' and subject to revision as the project progresses, can have a beneficial impact on the quality of

interdisciplinary collaboration throughout the life of the project. Even in the rare case where an excellent base of interdisciplinary collaboration has already been established in an existing multidisciplinary team, it may still be of value to first conduct a 'type 1' exercise to obtain an overview of the essential aspects of agroforestry diagnosis and design before getting down to the more detailed work of diagnostic elaboration and design refinement.

1.9 THE SCALE OF D&D APPLICATIONS

It is often said that agroforestry technologies are 'location specific,' but it is more correct to say that agroforestry technologies are 'system specific,' if by 'system' we mean a combination of biophysical and socioeconomic factors associated with a given land management unit which make it suitable for some specific and limited set of land management technologies and not some other. It follows, then, that any process of diagnosis and design undertaken for the purpose of developing appropriate technologies must, of necessity, be a system-specific exercise for the simple reason that technologies appropriate to one system of land use may not be appropriate to another.

There is considerable latitude possible, however, in the definition of 'the system' for D&D purposes. In the companion volume to these guidelines (*Resources for Agroforestry Diagnosis and Design*) specific suggestions are made as to the application of the basic D&D logic to a sliding scale of analysis involving a nested hierarchy of systems ranging from national and regional levels, to local watersheds and communities, to household and intra-household levels of organization.

For most purposes, however, the *focal system*, which is defined as the basic departure point or 'touchstone' for all other scales of D&D analysis, will be the household, family farm, or other similar land management unit, since this is where most land management decisions are made. If other, larger or smaller, decision-making units are present in the area and relevant to the D&D exercise (e.g. forest management units), then they too must be analysed to expose their own agroforestry-related objectives, constraints and potentials. All other relevant processes which are not under the jurisdiction of decision-making systems are treated as part of the *environment* of such systems.

In saying that applications of the D&D methodology must be system-specific it does *not* mean that the methodology is only applicable to very small areas or that the D&D team cannot deal with more than one land use system in a given exercise, and it certainly does not mean that a separate D&D analysis must be conducted for each and every farm. What it does mean is that the design of specific agroforestry technologies must be linked to the diagnosed needs and potentials of specific land use systems, at whatever scale they may exist. One of the first tasks in the D&D procedure is to *define* the relevant systems for D&D purposes.

It is assumed that agroforestry research and development efforts will not be undertaken for truly minor and insignificant land use systems within a country and it is expected that users of the D&D methodology will exercise judgement in the definition and selection of land use systems for D&D treatment. It is further assumed that the sites selected for D&D exercises, and within the sites the management units selected for D&D survey, will be broadly representative of major land use systems within the country which are important enough to justify the expenditure of scarce research and development resources. (See *Resources for Agroforestry Diagnosis and Design* for detailed guidelines and suggested criteria for the definition and selection of land use systems for D&D purposes.)

On completion of the D&D-based agroforestry research and development project it is very likely that the technologies developed for the selected land use system(s) can be treated as 'prototype' technologies which can be adapted to the needs of similar systems outside the original project area. Thus, even within the system-specific context of the D&D methodology, a certain amount of generalization will be possible with respect to the resulting technological products.

1.10 ON THE OPTIMUM LEVEL OF DOCUMENTATION

Regardless of the type of application, the purpose of the D&D methodology is not to generate a massive volume of documentation for its own sake. Documentation of the results of each step in the D&D process should be regarded, not as an end in itself, but as a *means* of 1) aiding the D&D team toward greater clarity and specificity in the consensus developed, and 2) communication of the consensus to others. Minimally, the team should strive for a level of documentation which adequately communicates the *design result* (in sufficient detail to avoid misinterpretation of precisely what technology is envisaged) as well as the *diagnostic rationale* for it. In regard to the maximal limit, the users of the D&D methodology should avoid producing such a volume of documentation that no one would be tempted to read it. As an aid to documentation the companion volume to these guidelines (*Resources for Agroforestry Diagnosis and Design*) contains a set of Worksheets for use at each step in the D&D procedures. These might form the basis for something like an 'optimal' level of documentation, but they would have to be tied together by a prose account to produce a readable case study report.

In an effort to assist in the documentaion and dissemination of D&D results, ICRAF has inaugurated a series on *Case Studies in Agroforestry Diagnosis and Design*, where suitable case studies might be published. Also, to foster the use of case study material to aid in the development of agroforestry, similar to the use of case studies in the development of medical science, ICRAF is establishing a computer-based D&D data bank at its headquarters in Nairobi. A recording form for coding of case study information is being developed for users of the methodology who may wish to contribute to the global data bank, without necessarily having to produce a full case study report. All users of the D&D methodology are urged to contribute to this global documentation effort in one form of the other. Due acknowledgement will be given to the contributors of such information in any publication making specific use of it.

1.11 D&D AS PART OF THE 'INTERNAL GUIDANCE SYSTEM' OF AN R&D PROJECT

These guidelines concentrate on procedures for Diagnosis and Design at the formulation stage of agroforestry research and development (R&D) projects, but the need for the basic process of diagnosis and design does not vanish once the project is under way. Even with adequate pre-project D&D preparation it is unlikely that the project implementation staff will have the same view of technological prospects for the project area at the end of the project as at the beginning. There is usually a learning process which causes project staff to modify their view of technical options as the project progresses. Unfortunately many projects are 'writ in stone' from the beginning and there is little opportunity to benefit from this learning process.

The suggestion that the D&D process should be continued throughout the life of the project is intended as a corrective to this situation by formally acknowledging the importance of the mid-project learning process and giving it a central place in project design. Figure 1 presents a schematic representation of the key features of the D&D paradigm, showing the feedback linkages which enable it to fulfill its potential role as part of the project's internal guidance system.

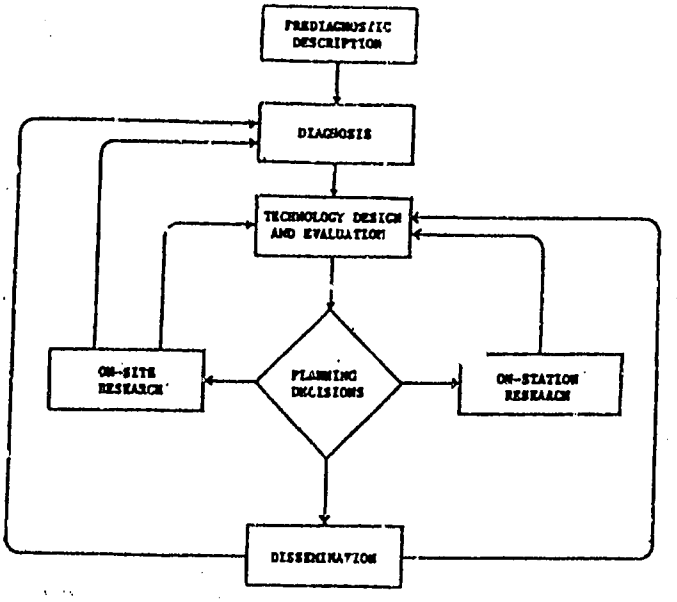


Figure 1. Components of project design incorporating the D&D process as part of the projects internal guidance system. Note feedback loops.

Both *on-station research,* involving controlled experimental investigation of fundamental aspects of the proposed technologies, as well as *on-site research,* involving in situ trials of candidate 'technology packages' on representative land management units in the project area, are necessary components of a coherent and effective R&D programme to develop appropriate agroforestry technologies. The initial guidance for the type of research which is needed for both of these research components is given by the initial D&D exercise. As the project progresses, however, new information will be generated, both from a deepening of the diagnosis resulting from longer exposure to the client land use system at the research site as well as from an improved understanding of the technical options from on-site and on-station research. This information provides feedback which may suggest refinements in the diagnosis and modifications in the design. The *diagnosed situation itself will change,* moreover, as a result of the introduced technology, thus requiring a fresh diagnosis of the new condition of the system. Feedback of these various types of information will allow the project implementation team to 'track' the changing situation and 'home in' on an increasingly optimal design for improved system performance.

If we may be allowed a martial analogy, an R&D project without a mechanism for continuing diagnosis and redesign is like a missile without an internal guidance system. Without it the ability of the project to reach its target will be dependent on the accuracy of the initial 'sitings.' With it the project can redirect its efforts in accordance with continuously improved information on what is needed and how to achieve it.

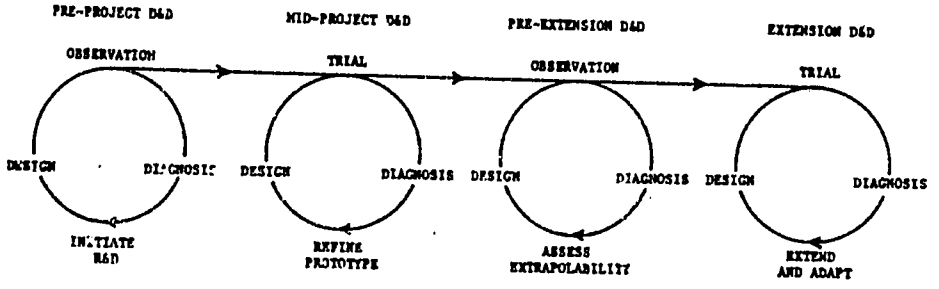


Figure 2. The iterative D&D process in the life cycle of a technology generation and dissemination project.

In its fully developed form D&D is an iterative process which is repeated throughout the project cycle for different purposes at different stages (see Figure 2). In the initial 'pre-project' or 'project formulation' stage the D&D process is used to arrive at prototype designs to initiate the R&D project and set it moving along *generally appropriate* lines. At the 'mid-project' or 'project implementation' stage, the D&D process is repeated more-or-less continuously to deepen the diagnosis and refine the prototype designs in order to develop *specifically appropriate* designs for the given land use system. In the course of time the project will arrive at the point where the technology developed is considered ready for dissemination throughout a wider recommendation domain. At this 'pre-extension' stage a modified D&D process incorporating an expanded land evaluation exercise comes into play to assess the extrapolability of the developed technology and define the recommendation domain. The dissemination to new sites at the 'extension stage' will, in turn, generate new feedback information which can be used, through a scaled-down D&D process, to adapt the technology to a wider range of site-specific conditions (see Raintree, 1983a for an elaboration of this scheme).

Thus, in its fully developed form, the D&D methodology is a *process approach* to project implementation which, it should be noted, cannot be simply equated with 'Monitoring and Evaluation' as this is normally understood. In Monitoring and Evaluation various components of the project are monitored and the degree to which the project is meeting its objectives is evaluated. There is no explicit mechanism within the 'passive-critical' role conception of Monitoring and Evaluation to actively follow through with project modifications, let alone redesign project technology. What makes D&D different is its explicit focus on the technology generation process and its incorporation of active feedback mechanisms for institutionalizing the project learning process at the level of the implementing personnel. D&D does not replace Monitoring and Evaluation in the overall adminstration of the project, but it does provide an additional means by which project personnel may improve on their ability to generate appropriate technologies.

2. SPECIFIC PROCEDURES

2.1 THE LOGICAL SEQUENCE OF STEPS

The procedures for project formulation consist of a series of information gathering and analytical steps, leading logically from one to the next. This sequence entails a hierarchical progression from the general to the particular, which is designed to economize on time and effort by excluding irrelevant information from further consideration while developing a progressively sharper focus on essential information. By this open-ended but structured approach the D&D methodology avoids the seemingly endless and needlessly complicated data collection and processing task characteristic of an unstructured approach to systems analysis. The progression of steps is divided into four stages as follows:

Prediagnostic Stage (Steps 1-3)

This stage covers 1) background description of the study area, including diagnostically relevant aspects of the biophysical and socioeconomic environment, 2) differentiation and selection of land use systems within the study area for further D&D attention, and 3) preliminary description of diagnostically relevant aspects of the selected systems.

Diagnostic Stage (Steps 4-6)

This stage includes 4) diagnostic survey of the selected systems and relevant aspects of the environmental setting, 5) diagnostic analysis and identification of major land use problems and potentials, and 6) derivation of specifications for appropriate technology (including non-agroforestry options but with special attention to agroforestry potentials).

Technology Design Stage (Steps 7-9)

This stage involves 7) appraisal and selection of candidate technologies for possible inclusion in the design, 8) synthesis of a general design concept for an improved land use system and development, if possible, of initial 'best bet' designs for component technologies, and 9) ex ante evaluation and refinement of the proposed design. The activities of this stage may involve reiteration of the above steps.

Follow-up Planning Stage (Steps 10-12)

This stage covers 10) identification of research needed to develop and/or test the identified agroforestry technologies, 11) identification of areas needing further D&D attention in a followup stage, and 12) development of a detailed project implementation plan to carry out the envisaged R&D programme.

The remainder of this section contains an overview of the step-by-step procedures in outline form, showing the content of each step. This is followed in the next section by a prose summary which might usefully be read in parallel with the outline. Most of the methodological aids mentioned in the outline under 'Useful Tools' can be found in *Resources for Agroforestry Diagnosis and Design* (ICRAF, 1983).

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, 1983)

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, 1983)

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 techniques and other useful tools (ICRAF, 1983)

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 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)
- Farmers' strategies for coping with identified problems

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

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, 1983)

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, 1983)

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, 1983)

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, 1983); 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, 1983; Hoekstra, 1983; Etherington and Mathews, 1983)

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, 1983); Huxley (in press)

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: 1) a general outline of major project activities (research and/or dissemination), suggested by the D&D team; 2) a more detailed project proposal suitable for submission to potential donors, prepared by a small pre-project working group; 3) detailed project implementation plan, prepared by the project implementation team; 4) 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 (1); pre-project followup activities (2 & 3); the iterative D&D process during the course of project implementation (4)

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: Documentation of the previous steps; step-by-step worksheets contained in ICRAF (1983)

2.2 SYNOPSIS OF THE FOUR STAGE PROCEDURE

THE PREDIAGNOSTIC STAGE

This stage commences with a description of relevant background conditions in the study area: the physical environment, economic and social conditions, and the functioning of the human ecosystem. The background description provides an overall framework within which the analysis is to take place and indicates broad limits on the nature of contemplatable developments (e.g. as conditioned by climatic zone or overall income levels).

The next step is to identify the *land use systems* within the area. A land use system consists of a combination of a *land unit*, as set by the physical environment, with a *management unit*, with distinctive production objectives and resources.

The land use systems which result from such combination of land resources with management units form the subject of agroforestry diagnosis. Frequently, one or more dominant land use systems will be singled out as the focus for diagnosis and design. Where more than one land use system is identified for diagnosis, the steps which follow are conducted with respect to each selected system.

The prediagnostic stage is concluded by *description of the selected land use systems*. This covers their objectives, production activities, output and internal organization. As a basis for subsequent activities, particular attention is given to identifying the *output subsystems* geared to meeting the basic needs of the land users. The following needs are considered: food, water, energy, shelter, raw material, cash, savings/investment, and social needs. Food and water are self-explanatory. The most common energy need is for domestic fuelwood. Raw materials refers to needs for cottage and local processing industries. Cash, for regular day-to-day expenditure, is distinguished from savings/investment, for infrequent expenditure on special purposes. Finally, there may be forms of output required to meet ceremonial or social obligations which cannot always be translated into money terms.

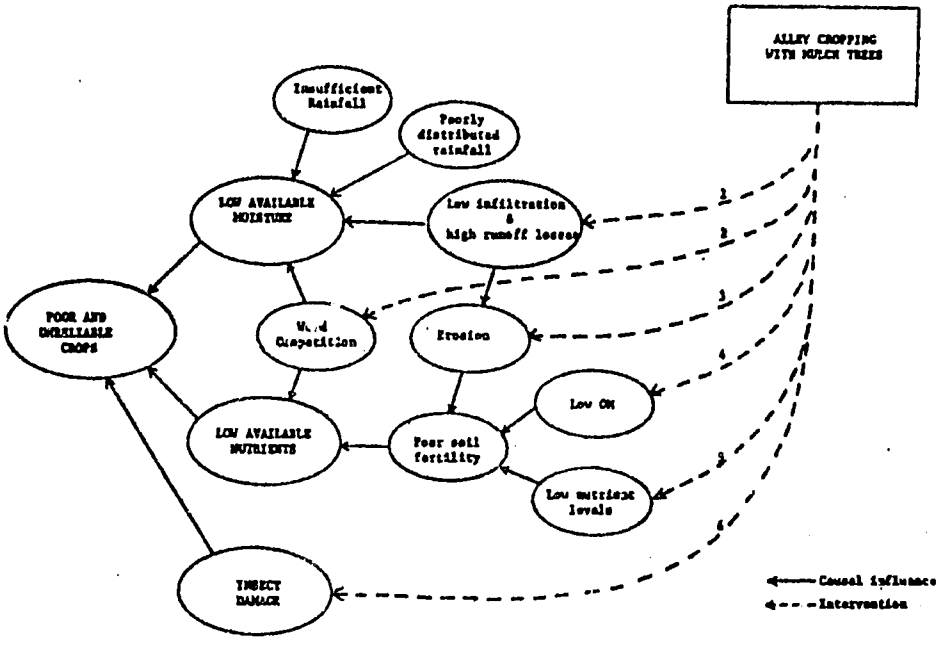
The prediagnostic stage establishes the basis for the steps which follow, by giving basic physical and socioeconomic information and identifying and describing the land use systems to be considered.

THE DIAGNOSTIC STAGE

Two steps, diagnostic survey and analysis, are closely linked. Diagnosis commences with *identification of land use problems*. At the level of management units they are initially idenfified as *shortfalls in the output subsystems:* for example, occasional food shortages, present or anticipated fuelwood shortages, lack of materials for shelter or cottage industry, inadequate or unreliable income, etc.

Parallel with these problems at the level of the management unit, there may also be problems at the community or ecosystem level, beyond the control of individual farmers, which also need to be identified, e.g. erosion gullies along the boundaries between farms or lack of adequate marketing facilities for cash crops.

Having identified problems in achieving the objectives of the output subsystems, the *causes* of these problems are then ascertained. For example, food shortages might be caused mainly by recurrent drought, by decline in soil fertility through over-intensive cultivation, through inability of the farmers to obtain fertilizers, or any combination of causes. Where cash income is dependent on sales of livestock, the causal chain might involve overstocking and pasture degradation, seasonal fodder shortages or protein deficiency. Fuelwood shortage is most frequently caused by over-exploitation, sometimes complete removal, of indigenous trees.



Potential Mulch Trees

N-fixing	Insect-repellent
Leucaena leucocephala	*Adhatoda vasica*
Albizia scabrella	*Azadirachta indica*
Sesbania bispinosa	*Lerrie indica*

Potential Interventions

1. Improved infiltration, reduced runoff
2. Weed control with reduced labour
3. Reduced splash and runoff erosion
4. Increased organic matter
5. N-fixation and nutrient pump action of deep penetrating roots
6. Use of insect-repellent mulch species

Figure 3. The use of causal diagramming to elucidate the etiology of a problem and identify potentials for appropriate technological interventions in the system.

The output shortfalls or other problems and the causes which underlie them may be summarised in a *causal diagram*. Attention is then given to *potentials for removal of constraints*, and thus for improving output. These potentials may include non-agroforestry solutions (e.g. improve the fertilizer supply system, or provide rural credit) as well as agroforestry techniques. An *agroforestry intervention* is an apparent potential for agroforestry techniques or systems to remove output constraints; for example, to ameliorate energy shortage by growing fuelwood-producing hedgerow trees, protein shortage for cattle by growing browse-producing trees, or low soil fertility through the soil-improving effects of tree leaf litter. Figure 3 shows the use of causal diagraming to elucidate the causal background to a problem and to assist in identifying appropriate interventions (in this case the suggested intervention is 'alley cropping').

Constraints to such production-improving technologies are set by considerations of sustainability and adoptability. Improved sustainability, or resource conservation, may be involved as an element in the removal of constraints. However, further consideration needs to be given to ensure that the proposed agroforestry solutions themselves meet sustainability requirements.

Adoptability is given particular attention during diagnosis. The technological level, attitudes, capital resources and labour availability of the farmers are examined, together with the institutional and social framework within which they operate (e.g. land tenure systems). Economic conditions, notably markets and levels of income expectancy, are also critical. This stage of the study leads to identification of the *constraints to adoption of improved technologies*.

The discovery of potentials for removal of constraints in the existing pattern of production, or of potentials for new production patterns which make better overall use of available resources to meet the farmer's objectives, together with considerations of sustainability and adoptability, leads to the formulation of *design specifications for appropriate technological interventions* in the system. These consist of a set of functional specifications for what the technology must accomplish (e.g. 'relieve fodder protein shortage in the dry season'), together with constraints on candidate technologies (e.g. 'inadequate capital to purchase feed concentrates'). Considered within the context of an appropriate development strategy for the system, the design specifications provide the link between the process of diagnosis and that of design.

THE DESIGN STAGE

Starting from the design specifications, the procedures of design commence with the process of *technology appraisal*. This is based on the body of available technical knowledge, from research stations or farming experience. In the future it should become possible to an increasing degree to draw upon experience from agroforestry projects in comparable settings.

This leads to the process of *technology design* per se, in which selected elements of agroforestry technology are combined in a design for an improved land use system. Combining agroforestry techniques with the existing farming practices may lead to constraints and require modifications in the design as a whole, e.g. as arising from labour peaks.

Merging with the design process comes *design evaluation*. In this process, the proposed design is reviewed with respect to the three criteria of productivity, sustainability and adoptability using various techniques of economic, ecological and social evaluation. The agroforestry proposals

are also compared with non-agroforestry solutions to the diagnosed problems. Since the evaluation may suggest modifications in the design, in practice there may be an alternation between the two processes leading to a progressively more refined design.

THE FOLLOWUP PLANNING STAGE

In the present state of knowledge it is unlikely that many of the proposed agroforestry technologies will be ready for widespread implementation. In most cases they will need to be developed and tested through a research programme tailored to the specifications of the *research needs* assessment. This is based on an assessment of gaps in present knowledge with respect to the technologies identified in the design stage. Research to fill in these gaps may include *on-station research*, conducted under controlled conditions (usually at field stations), and *on-site research*, conducted on farms or under other natural conditions at sites within the study area.

On-site research is designed to allow monitoring of social attributes of the candidate technologies, such as ease of adoption, labour problems, management difficulties, etc., along with technical elements. On-site research, particularly if conducted on farms, will usually involve testing of 'best bet' technical packages, and should not normally involve elements of high risk. One of the unique aspects of on-site research is the possibility of obtaining valuable feedback in the form of spontaneous modifications of the design made by farmers to adapt it better to local farming conditions. On-station research is designed more-or-less according to the normal principles of agricultural and forestry research, e.g. with replication, deliberate exceeding of limits of plant spacing, etc., in order to determine boundary values and design curves. The types of layouts involved in on-station research may bear little resemblance to the designs for 'technology packages' tested on farmers' fields. Although plant research in agroforestry may involve departures from standard designs developed for agronomic or forestry experiments, the main departure from 'conventional' on-station research is that the specifications arising from the diagnostic process are used to limit and direct the technological range and focus of the research undertaken.

This will complete the technical aspects of the D&D exercise, but before the exercise can be concluded two further aspects of followup planning need to be addressed: identification of *topics needing further D&D attention*, and development of a *plan for project implementation*. In rapid appraisal type applications of the methodology, the design result will normally be regarded as preliminary and provisional, pending more detailed elaboration and refinement in a 'pre-project followup' exercise, when a smaller working group will have ample time to develop the ideas initiated by the full multidisciplinary D&D field team. Likewise with any unresolved diagnostic issues which the D&D team may not have had time to cover in what it considers sufficient detail for final project planning. Requirements for further diagnostic and design work to be carried out during the followup phase (including more in-depth ex ante evaluation and redesign work) should be specified by the D&D team before it adjourns.

The D&D field team in rapid appraisal type applications will also not be likely to develop a final, fully detailed project implementation plan, not only because of time limitations, but also because crucial financial and other administrative decisions may not have been taken.

What the team should aim for, rather, is to produce an outline of its recommendations, specifying likely manpower, land and other resource requirements to carry out the envisaged research, and giving its suggestions on how to set up internal feedback mechanisms, project review procedures, etc. Even though these recommendations may be modified, as a result of the wider range of technical and administrative consultations that may occur in the post-D&D exercise period, an effort should be made to give project planners the benefit of the perspective developed by the full multidisciplinary team.

If, rather than a rapid appraisal type exercise, a straight-forward extended application of the D&D procedures has been undertaken, the above mentioned limitations will not apply.

Before concluding this account of the Diagnostic and Design methodology, it may be useful to show an example of the type of result that may be obtained. Table 1 on the next page gives a site summary of D&D indications from an application undertaken at an ICRAF research site in Kenya. While it by no means exhausts the full spectrum of D&D results and followup activities undertaken at the site, this tabular summary may serve to give an impression of the type of perspective which the methodology can be used to create.

Table 1. Summary of farm level diagnostic and design indications for a representative management unit at the Kathama research site in Kenya (adapted from Raintree, 1983b).

KATHAMA
MACHAKOS DISTRICT
KENYA

SITE SUMMARY OF AGROFORESTRY DIAGNOSIS AND DESIGN INDICATIONS ON A REPRESENTATIVE FARM

SYSTEM DESCRIPTION	LAND USE SYSTEM DIAGNOSIS		AGROFORESTRY POTENTIALS
	HOUSEHOLD SUPPLY PROBLEMS	PRODUCTION CONSTRAINTS	
Climate Semi-arid/ Sub-humid **Soils** Sandy loams over sandy clay loam to sandy clay; imperfectly drained in places **Farming System** Mixed farming **Crops** Maize, beans, pigeon peas, cowpeas **Livestock** Zebu cattle, goats and sheep **Economy** Subsistence farming **Population Density** 172/Km^2 **Growth Rate** 3.5% **Avg. Farm Size** 3.5 ha	**Problems in Basic Needs Supply Sub-Systems** FOOD - Seasonal staple food shortages normal, must purchase; drought related crop failure on avg. of once in every five years; low milk and meat production due to dry season feed shortage for livestock FUEL - Insufficient production from own land, must purchase fuelwood for household and cottage industry uses; lack of large trees for brick baking SHELTER - Lack of construction quality timber and poles, must purchase; lack of large tree for brick burning; lack of fencing and shade trees RAW MATERIALS FOR HOUSEHOLD INDUSTRY Must purchase fuelwood for brick making CASH - Low net household income due in part to cash outflow for staple foods, fuelwood, and construction wood; lack of viable cash crop enterprise SAVINGS/INVESTMENT - Lack of savings/ investment alternative to livestock; livestock potential limited by dry season feed gap SOCIAL PRODUCTION - Difficulty in making 'harambee' contributions	**Antecedent Causal Factors** **Crop Land** 1. Low fertility and declining yields 2. Lack of manure 3. Low available moisture 4. Oxen too weak for dry season ploughing/planting; hence inefficient use of limited soil moisture 5. Soil erosion and water loss due to heavy runoff 6. Waterlogging on low spots 7. Labour bottleneck at ploughing and weeding time 8. Insect pests **Grazing Land** 1. Small grazing area 2. Insufficient dry season feed production 3. Insufficient production of fuelwood **SUSTAINABILITY PROBLEMS** Erosion Declining Soil Fertility Degradation of grazing land vegetation **DESIGN CONSTRAINTS** Low capital Labour bottlenecks Long dry season, frequent droughts Termites & other pests	**Specific Problem-Solving Agroforestry Potentials** 1. Elimination of dry season feed gap by planting of multipurpose fodder trees in grazing areas and as hedgerow in cropland with concomitant erosion control effects and fuelwood and mulch coproduction possibilities; improved feed situation should allow dry season ploughing/planting 2. Cut-and-carry fodder trees for increased pen feeding and usable manure production 3. Alley cropping/mulch farming with leguminous and other trees to control erosion, increase water infiltration, conserve soil moisture, improve soil fertility and structure, reduce the need for tillage and lessen the labour requirement for weeding, insect repellence (?) 4. Hedgerows and living fences of high-yielding fuelwood species and fruit producing thorn bushes (as a hedge against famine in bad years, for supplementary livestock feed in average years) 5. Multistorey fruit trees with undersown grass-legume pasture.

3. CONCLUSION

The process of diagnosis and design in its wider sense does not end when the rapid appraisal team packs up and goes home. A fully operational plan of action based on the use of D&D procedures is expected to lead, first to the production of research results which will validate or modify the candidate technologies and, secondly, to the dissemination of successful technologies throughout the recommendation domain by local extension services. In the course of time, further experience will be generated concerning the success or limitations of prototype agroforestry systems under field conditions. This information can be cycled back into the diagnostic and design process; thus leading, by an iterative discovery procedure, to successive gains in knowledge and to the development of genuinely productive, sustainable and adoptable agroforestry systems.

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