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ICRAF

An Introduction to Agroforestry Diagnosis and Design

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An Introduction to Agroforestry Diagnosis and Design

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Preface

In response to reader feedback on earlier publications in the D&D manual series, this manual has been written to answer popular demand for a user-friendly introduction to ICRAF's methodology for agroforestry diagnosis and design. It replaces the earlier **Guidelines for Agroforestry Diagnosis and Design** (ICRAF Working Paper 6) and represents a new synthesis of the most generally useful and adaptable procedures to emerge from practical applications of the D&D methodology during a five year trial period in sites around the world.

The key to effective use of the D&D methodology is *flexibility*. Although the basic logic of D&D is quite generally applicable, the specific procedures may need to be adapted to fit the requirements of the user. The elementary D&D concepts and baseline procedures are presented in the first section on **BASIC PRINCIPLES AND PROCEDURES.** Within this section the main concepts are presented in larger, bolder type.

Basic procedures and key concepts are followed by more detailed suggestions on procedures for national research programmes, with the understanding that these must be *selected* and *adapted* to fit the circumstances. Some of the most important modifications of the procedures suggested for formal research programmes arise from creative adaptations of the methodology by community-based fieldworkers doing informal, participatory agroforestry research and development, as discussed in "The view from the village." Next comes a **CASE STUDY EXAMPLE** of the open-ended D&D learning process, as it was experienced in an agroforestry project in Kenya. The introduction concludes with **D&D IN ACTION** — a pictorial dramatization of the D&D process as it might be experienced in a national research programme. This section is quite helpful for gaining a rapid overview of the D&D process.

Since the development of D&D methods is an open-ended and continuing process, new methods and case studies are continually appearing in ICRAF's Working Paper series and other publications. This manual attempts to answer the need for an up-to-date, practical introduction to the methodology at an intermediate level of detail. Readers interested in more detail may wish to consult the publications listed in the Reference section. For more advanced and up-to-date methods, case studies and resource materials, interested users are referred to the periodically updated **ICRAF Publications List** and to the **ICRAF Newsletter**.

J. B. Raintree
Project Leader, Agroforestry Diagnosis and Design

BASIC PRINCIPLES

AND

PROCEDURES

What is agroforestry?

Agroforestry is a collective name for land use systems and technologies in which woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately combined on the same land management unit with herbaceous crops and/or animals, either in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economic interactions among the different components.

Criteria of good agroforestry design

There is no substitute for good design. A good agroforestry design should fulfill the following criteria:

PRODUCTIVITY There are many different ways to assess the productivity improvements which are possible with agroforestry: increased ouput of tree products, improved yields of associated crops, reduction of cropping system inputs, increased labour efficiency, diversification of production, satisfaction of basic needs, and other measures of economic efficiency or achievement of biological potential.

SUSTAINABILITY By seeking improvements in the "sustainability" of production systems, agroforestry can achieve its conservation goals while appealing directly to the motivations of low income farmers, who may not always be interested in conservation for its own sake.

ADOPTABILITY No matter how technically elegant or environmentally sound an agroforestry design may be, nothing practical is achieved unless it is adopted by its intended users. This means that the technology has to fit the social as well as the environmental and technical characteristics of the land use system for which it is designed.

What is D&D?

DIAGNOSIS AND DESIGN

D&D is a methodology for the diagnosis of land management problems and design of agroforestry solutions. It was developed by ICRAF to assist agroforestry researchers and development fieldworkers to plan and implement effective research and development projects.

There is a saying in the medical profession that "Diagnosis should precede treatment." Anyone concerned with problem-solving applies this principle in one way or another. In the work of the automobile mechanic, the radio repairman, the forester, or the farmer, the ability to solve a problem begins with the ability to define what the problem is. A clear statement of the problem is often all that is needed to suggest a solution. D&D is simply a systematic approach to the application of this principle in agroforestry.

The key features of the D&D approach are:

- **flexibility** - D&D is a flexible discovery procedure which can be adapted to fit the needs and resources of different users.
- **speed** - D&D has been designed with the option of a "rapid appraisal" application at the planing stage of a project with in-depth followup during project implementation.
- **repetition** - D&D is an open-ended learning process. Since initial designs can almost always be improved, the D&D process needn't end until further improvements are no longer necessary.

Who can make use of D&D?

Most problem solvers already use some form of the basic logic of D&D. This logic is so fundamental to human problem solving as to be almost "common sense." The systematic elaboration and adaptation of this basic logic to agroforestry which is presented in this manual has been developed with three main users in mind:

RESEARCHERS

D&D was developed in collaboration with researchers in national programmes and was initially intended primarily for use by multi-disciplinary, and often multi-institutional, teams of scientists. As a discovery procedure for identifying the agroforestry-related needs and potentials of existing land use systems, D&D assists in the identification of priorities for development-oriented research. Toward this end, the methodology provides a logical, stepwise procedure for collaboration between specialists with different disciplinary backgrounds and approaches to problem solving.

EXTENSION AGENTS

It is increasingly recognized that extension workers must also be involved in the research process if research is to develop technology that can be extended readily to farmers. Initially as members of D&D survey teams and later as collaborators in on-farm trials, extension agents can make important contributions to agroforestry research. As the stock of proven agroforestry technology increases, extensionists can make direct use of D&D to identify agroforestry solutions to local problems.

COMMUNITY DEVELOPMENT FIELDWORKERS

Government fieldworkers, non-government organizations and other community-based development catalysts perform an important function in helping local people to play a more active role in their own development. D&D has applications in grass roots development work, not only as a tool for self-help development, but also as a basis for communicating local needs and innovations to formal research and extension institutions.

Basic procedures

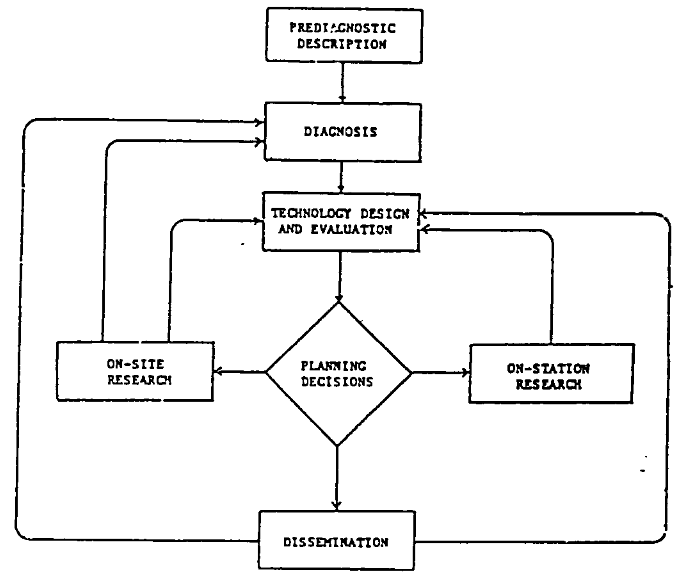
The basic logic of the D&D discovery procedure is displayed in the following table. The process can be subdivided into smaller steps (e.g. pp. 8-14) and used selectively for varying purposes, but the hierarchical logic of D&D is quite robust and generally applicable to virtually any problem in technology design. The more detailed procedural suggestions are best thought of as optional steps for collecting and processing the information needed to answer the basic questions shown in the table below. If at any time you feel you are getting "lost in the details," simply return to this outline of basic procedures for a reorientation to where you are in the process.

D&D STAGES	BASIC QUESTIONS TO ANSWER	KEY FACTORS TO CONSIDER	MODE OF INQUIRY
PREDIAGNOSTIC	DEFINITION OF THE LAND USE SYSTEM AND SITE SELECTION (which system to focus on?)	DISTINCTIVE COMBINATIONS OF RESOURCES, TECHNOLOGY AND LAND USER OBJECTIVES	SEEING AND COMPARING THE DIFFERENT LAND USE SYSTEMS
	HOW DOES THE SYSTEM WORK? (how is it organized, how does it function to achieve its objectives?)	PRODUCTION OBJECTIVES AND STRATEGIES, ARRANGEMENT OF COMPONENTS	ANALYSING AND DESCRIBING THE SYSTEM
DIAGNOSTIC	HOW WELL DOES THE SYSTEM WORK? (what are its problems, limiting constraints, problem-generating syndromes & intervention points?)	PROBLEMS IN MEETING SYSTEM OBJECTIVES (production short-falls, sustainability problems)	DIAGNOSTIC INTERVIEWS AND DIRECT FIELD OBSERVATIONS
		CAUSAL FACTORS, CONSTRAINTS AND INTERVENTION POINTS	TROUBLESHOOTING THE PROBLEM SUBSYSTEMS
DESIGN & EVALUATION	HOW TO IMPROVE THE SYSTEM? (what is needed to improve system performance?)	SPECIFICATIONS FOR PROBLEM SOLVING OR PERFORMANCE ENHANCING INTERVENTIONS	ITERATIVE DESIGN AND EVALUATION OF ALTERNATIVES
PLANNING	WHAT TO DO TO DEVELOP AND DISSEMINATE THE IMPROVED SYSTEM?	RESEARCH AND DEVELOPMENT NEEDS, EXTENSION NEEDS	RESEARCH DESIGN, PROJECT PLANNING
IMPLEMENTATION	HOW TO ADJUST TO NEW INFORMATION?	FEEDBACK FROM ON-STATION RESEARCH, ON-FARM TRIALS AND SPECIAL STUDIES	REDIAGNOSIS AND REDESIGN IN THE LIGHT OF NEW INFORMATION

D&D IS AN ITERATIVE PROCESS

The basic D&D process is repeated throughout the project implementation stage to refine the original diagnosis and improve the technology design in the light of new information from on-farm research trials, more rigidly controlled on-station investigations, and eventual extension trials in a wider range of sites. As shown in the following flowchart, the iterative D&D process provides a basis for close feedback and complementarity between different project components. By adjusting the plan of action to new information, the D&D process becomes self-corrective. In an integrated agroforestry research and extension programme, the pivotal decisions are taken in periodic meetings which evaluate new results and revise the action plan accordingly. The process continues until the design is well optimized and further refinement is deemed uneccessary. You can enter the cycle at any point, but the ultimate fine-tuning and dissemination of the technology will most likely be accomplished by the farmers themselves.

FLOWCHART OF REPETITIVE ACTIVITIES AND FEEDBACK IN A D&D-BASED PROJECT



Key concepts

D&D IS SYSTEM SPECIFIC

The focus of D&D is the **land use system.** Since different systems are likely to have different problems and potentials, it follows that each distinctive land use system must have its own diagnosis and corresponding design.

This does not mean that D&D results are "site specific" since the same basic land use system may exist in many sites. The selection of sites representative of important land use systems is an essential aspect of the art of D&D.

DEFINITION OF "THE SYSTEM" FOR D&D PURPOSES

For the purposes of a D&D exercise, a land use system is defined as a distinctive combination of three interrelated factors: the **land resources** exploited by a particular **technology** to satisfy the production objectives of a particular type of **land user.**

This definition contrasts with other commonly used definitions which do not formally recognize the land user as part of the system. The difference is more than just semantic, since all three elements are essential to a functioning land use system. If the human element is left out of the picture it becomes too easy to overlook the objectives around which the existing land use system is organized. By consciously attempting to design with the grain of the existing system rather than against it, the D&D methodology helps to avoid the kind of design error that results in technically and environmentally feasible but somehow "non-adoptable" agroforestry technologies.

THE DIAGNOSIS LEADS TO 'SPECIFICATIONS' FOR INTERVENTIONS

The *end-product* of the diagnostic procedure is a set of functional specifications which tell what the system needs and, in a general way, how these needs can best be satisfied.

SPECIFICATIONS SUGGEST 'CANDIDATE TECHNOLOGIES'

This is basically a matching exercise which narrows down the range of technical choices to those prototype technologies which are hypothetically capable of meeting the specifications.

'TECHNOLOGY SPECIFICATIONS' COMPLETE THE DESIGN

The design is not complete until the "nuts and bolts" of the selected technologies have been specified, i.e. the actual choice of component species, spatial arrangements, management practices, etc.

THE DESIGN REVEALS RESEARCH NEEDS AND EXTENSION OPPORTUNITIES

The attempt to arrive at an agroforestry design relevant to the needs of the diagnosed system is a practical way of exposing the gaps in technical knowledge. Research and extension programmes designed to develop and implement the envisaged technical solutions are likely to be more relevant and cost-effective.

IF AT FIRST YOU DON'T SUCCEED, TRY AND TRY AGAIN

Complete success on the first round of D&D is an unrealistic expectation. There is a saying in the engineering profession that "the first one never works." There are exceptions to this facetious generalization, of course, but it is true that prototype technologies can almost always be improved. The aim of the initial round of D&D is not to arrive at the "perfect solution," but simply to start the research and development process moving in the right direction and to provide a concrete focus for further design improvements.

The very act of introducing a new technology changes the diagnosed situation and necessitates at least one more round of diagnosis to evaluate the impact of the intervention on the system. In most cases this will suggest ideas for design improvements. Longer exposure to the land use system in the course of the project will inevitably result in a deepening of the initial diagnosis and may even suggest a whole new approach to design. Creative inputs from farmers may not be forthcoming until after they have been exposed to the experimental technology for some time.

Suggested procedures for national research programmes

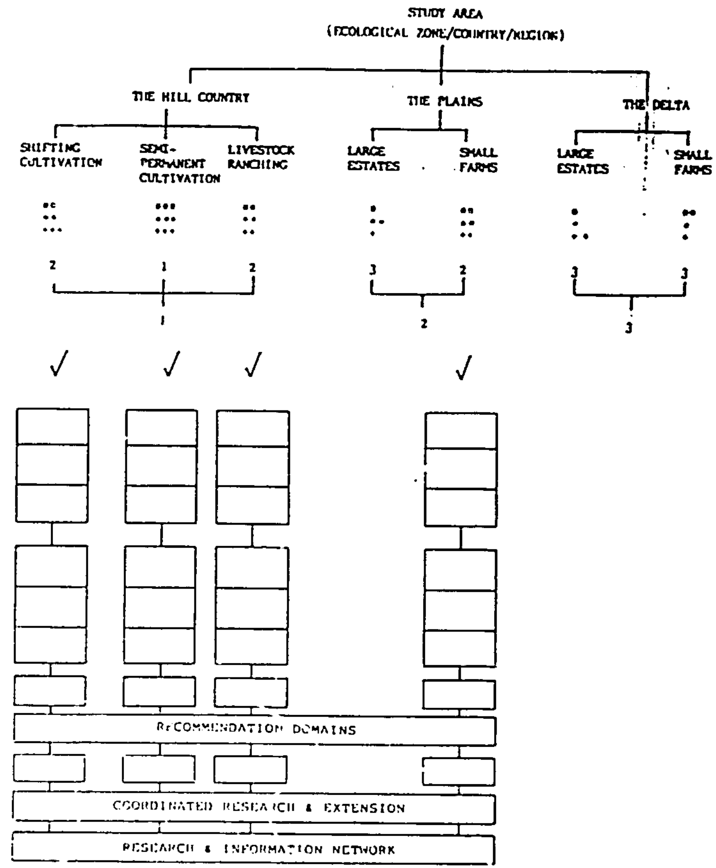
This section presents a schematic overview and a detailed step-by-step outline of the full set of D&D procedures for formulation of coordinated national research and extension programmes.

Since the implementation of such programmes may involve multi-institutional collaboration and long term committment of significant financial and institutional resources, a more elaborate and formal version of the D&D methodology is usually required. Although the procedures outlined in this section follow the logic of the "basic procedures" shown on pages 6-7, they represent a more detailed subdivision of the basic stages into steps with additional subroutines for collecting and processing the information needed to answer the key decision questions of each stage.

This outline is best thought of as a of a "prototype methdology" or provisional blueprint for large-scale, nationally coordinated D&D activities. As with all D&D applications, the suggested procedures should to be used selectively and adapted to fit the requirements of particular programmes. Adapted versions of these guidelines are currently being implemented by participating countries in ICRAF's Agroforestry Research Network for Africa (AFRENA).

For a closer focus on community-based D&D activities, see "**The view from the village**."

STAGE	STEP
PREDIAGNOSTIC	1 Planning the study
	2 Regional reconnaissance
	3 Land use systems
	4 Site selection: Severity of problems; Agroforestry potential; Regional representativeness; Priority by land use system; Priority by region; Selected land use systems
II DIAGNOSTIC	5 Diagnostic survey
	6 Diagnostic analysis
	7 System specifications
III TECHNOLOGY DESIGN	8 Candidate technologies
	9 Technology specifications
	10 Technology design
IV EVALUATION & REDESIGN	11 Ex-ante evaluation & redesign
	12 Suitability classification
V PLANNING	13 Research needs
	14 Research & extension plan
VI IMPLEMENTATION	15 Programme implementation



(Adapted from Young 1985)

I. PREDIAGNOSTIC STAGE

STEP 1. PLANNING THE STUDY

- Identify objectives
- Specify area to be covered
- Identify collaborating institutions and staff
- Select and adapt D&D methods to be used

STEP 2. REGIONAL RECONAISSANCE

- Identify, map and describe major land units and population distribution

STEP 3. IDENTIFICATION AND PRELIMINARY DESCRIPTION OF LAND USE SYSTEMS

- Differentiate and describe important land use systems
- Make a preliminary assessment of their constraints & problems
- Make a preliminary assessment of their agroforestry potential

STEP 4. SITE SELECTION

- Select land use systems for priority attention based on:
  - (i) severity of problems
  - (ii) agroforestry potential
  - (iii) regional representativeness
- Select sites representative of the chosen systems for in-depth D&D

II. DIAGNOSTIC STAGE

STEP 5. DIAGNOSTIC SURVEY

- Conduct field survey of representative managment units to identify common land use strategies and problems
- Troubleshoot the production systems to identify causal factors and contraints
- Investigate interactions between and within managment units and processes in the general landscape

STEP 6. DIAGNOSTIC ANALYSIS

- Analyze field data to identify key constraints and intervention points for development of system potential
- Assess sustainability problems

STEP 7. SPECIFICATIONS FOR APPROPRIATE INTERVENTIONS

- List system specifications:
  - (i) Functional specifications for interventions
  - (ii) Design constraints
  - (iii) Desirable attributes of new technology
  - (iv) Overall development strategy for the system

III. TECHNOLOGY DESIGN STAGE

STEP 8. IDENTIFICATION OF CANDIDATE TECHNOLOGIES

- List feasible technologies which meet the system specifications
- Select and prioritize the most promising technologies and combinations

STEP 9. DETAILED TECHNOLOGY SPECIFICATIONS

- Make a detailed list of desirable attributes of each of the selected technologies (component characteristics, mngt. considerations, etc.)
- Prioritize the attributes on this list in the light of the total knowledge of the diagnosed system

STEP 10. TECHNOLOGY DESIGN

- For each specific technology, give detailed answers to each of the following questions:
    - (i) What **functions** should each intervention address?
    - (ii) At what **location** within the farm or general landscape should these functions be performed?
    - (iii) What component or combination of **components** (plant/animal species & varieties) are the best choices for performing these functions?
    - (iv) **How many** of each component are required to meet production targets?
    - (v) What precise **arrangement** of components is envisaged? (give details of spatial and temporal associations of components at a given location)
    - (vi) What **management** practices are required to achieve the desired performance characteristics?
- Take note of all design questions to which the D&D team is presently unable to give satisfactory answers (these are topics for further consultation or research)
- Synthesize all of the above into an integrated design for an agroforestry system which best answers the needs and potentials of the existing land use system (consider stepwise introduction of component technologies if the full system is likely to be too much for local farmers to adopt all at once)

IV. EVALUATION AND REDESIGN STAGE

STEP 11. EX-ANTE EVALUATION & REDESIGN

- Check land users' response to the design proposal (optional D&D verification survey)
- Conduct a preliminary evaluation of the agroforestry design, compare with present land use and non-agroforestry alternatives in terms of:
  - (i) **productivity** (biological potential, economic efficiency & diversity o production)
  - (ii) **sustainability** (environ. impact, resource conservation)
  - (iii) **adoptability** (fulfilment of felt needs, cultural compatability, social distribution of benefits)
- Return to design stage activies to make modifications suggested by the preliminary evaluation

STEP 12. SUITABILITY CLASSIFICATION

- Summarize system evaluations for each of the designed agroforestry systems and develop classification of suitability for wider application
- Combine these classifications into suitability maps and tables for the study area/region as a whole (define preliminary "recomendation domain")

Note: Results of ex-ante evaluation and preliminary suitability classification should be considered provisional until validated by field experience at the implementation stage. Strictly speaking, favorable evaluation at this stage merely indicates that a particular technology is worth developing and testing.

V. PLANNING STAGE

STEP 13. STATE OF KNOWLEDGE REVIEW AND ASSESSMENT OF RESEARCH NEEDS

- Assess readiness of each of the designed technologies for direct extension and/or need for further research
- Compile integrated list of research needs, including:
  - (i) Need for further D&D (pre-project follow-up and/or monitoring of field trials during project implementation)
  - (ii) On-farm trials of candidate technologies
    - farmer managed trials to assess adoptability and elicit farmer's own design ideas
    - researcher managed trials to evaluate experimental variables under
  - (iii) On-station investigations under controlled conditions to obtain detailed information on component interactions, response to management, germplasm screening, etc.

STEP 14. RESEARCH AND EXTENSION PLAN

- Develop overall plan of action, detailing:
  - (i) Individual research investigations
  - (ii) Extension activities
  - (iii) Integration of research and extension goals and activities
  - (iv) Collaboration in research & extension networks

VI. IMPLEMENTATION STAGE

STEP 15. IMPLEMENTATION OF R&D AND EXTENSION ACTIVITIES

- Continue to apply the iterative D&D process to refine prototype agroforestry systems on the basis of feedback from research and extension experience (rediagnosis and redesign)
- Institutionalize communication channels between different programme components (hold periodic meetings to pool experience, assess new developments and modify the plan of action in the light of new experience)

The view from the village

THE TWO CENTERS OF AGROFORESTRY INNOVATION

Not every village will be reached by a formal agroforestry research project on the model of the preceeding section. Indeed, for the the benefits of national research programmes to reach most villages informal processes of technology diffusion must be activated on a massive scale. Moreover, the villages themselves are important centers of indigenous agroforestry innovation. Informal sector community development workers have an significant role to play in complementing the efforts of formal sector programmes.

Although much of what is presented in this section is applicable to on-farm researchers and extension agents in formal programmes, it is primarily intended for agroforestry catalysts who work directly with local communities but who are not necessarily part of a formal research and development programme. Ways are suggested for improving the linkages between these two complementary centers of agroforestry innovation.

ARE YOU A COMMUNITY-BASED FIELDWORKER?

If you are a village extension agent or community development fieldworker already working in a particular village or regional community, much of what has been presented in the preceeding section will seem superfluous or overly formalized for the kind of work you are doing. As necessary and appropriate as the steps in the more elaborated methodology might be for large-scale, multi-institutional programmes, many of them will be irrelevant to your own needs and circumstances. You should feel free to select and adapt those aspects of the D&D methodology which would be of real use to you in your own situation. The **Basic Procedures** (pages 6-7) will probably be of most direct use to you as a guide for your D&D activites.

ADAPTING D&D TO YOUR OWN NEEDS

Since you are already working at a particular site, you will have little use for the Prediagnostic steps concerned with institutional arrangements, regional reconaissance and site selection. You may still find it useful, however, to make a systematic inventory of the land use systems and farm types in your area, and for some of these you may wish plan a more in-depth diagnosis of problems and agroforestry potentials.

The same applies to the formal exercises of the Planning Stage. Your own planning procedures are likely to be more fluid and participatory, particularly if you are working within an informal non-government, private voluntary or community-based organization. Still, any systematic thought you can give to the planning of your own informal research and extension activities is likely to pay off in greater effectiveness of your agroforestry efforts.

The heart of the D&D methodology--the iterative process of diagnosis, design and evaluation--is potentially very relevant to the effectiveness of your agroforestry work, though perhaps not in the style suggested by the more formal procedures.

IN-DEPTH DIAGNOSIS

In general, there will be much less pressure to conform to the time constraints of an initial "rapid appraisal" D&D. By living and working in close and continuous contact with your community you may already possess a deeper diagnostic understanding of the land use problems of your area, and your communication with the inhabitants is probably far better, than what could be achieved within the time frame of a short term exercise by even the most experienced and sensitive D&D team from outside the community.

Still, your perceptions might be sharpened by a more systematic application of the diagnostic logic and selective use of some of the diagnostic tools. Also, if you are working without the benefit of a multidisciplinary team, you may find it helpful to consult with outside experts on certain aspects of your diagnosis or design. If there is a formal agroforestry project dealing with a similar land use system, it may be particularly relevant to compare their results with your own.

LOCAL PARTICIPATION

Although close interaction with the intended users of technology is an integral part of all D&D-based projects, as a community-based fieldworker you may find yourself in a position to implement this principle with more thoroughness than many externally-based researchers. You may lack the sophisticated techniques and resources of formal research institutions, but your ability to maximize local participation in the development and testing of agroforestry innovations may give you the advantage with respect to the "adoptability" of the new technologies. And ultimately, given the overriding importance of adoption, you may have greater impact on the local agroforestry scene.

INTERACTIVE DIAGNOSIS & DESIGN

The way to take advantage of your opportunities in this respect is to take a thoroughly interactive approach to diagnosis and design. The principle that "diagnosis should preceed treatment" still holds as a requirement for accountability in technology generation, but once you begin the iterative cycle of diagnosis and design the process becomes circular. "Diagnosis by treatment" is a practical expedient employed by medical doctors whenever they cannot immediately confirm their diagnostic suspicions prior to treatment. If the treatment works the diagnosis was correct.

PERTURBATION EXPERIMENTS

This practice has a parallel in agroforestry in the form of small interventions undertaken to see how the system responds. If the farmers show interest in adopting a particular problem-solving technology, then this is evidence that the problem is real and important in the minds of the local people--providing, of course, that they are not adopting it for some other reason. In any case, such "perturbation experiments" are signficant insofar as they may uncover previously unsuspected problems or local development priorities.

Close monitoring of farmer-originated innovations, modifications of prototype technologies, and the reasons behinld farmer adoption behaviour not only provides important diagnostic clues but may also be a rich source of ideas for design improvements.

FARMERS AS EXPERIMENTERS

Although it is rarely given full recognition by university educated researchers in developing countries, it is an undeniable fact that farmers themselves are active experimenters. Informal experimental research has been a continuous feature of the farming scene since the dawn of agriculture. Without it we would have none of our contemporary crops and, indeed, very little agricultural technology at all!

Even when farmers adopt a technology developed by a research station, they tend to do it *experimentally*--step by cautious step on a little corner of their land. In the process it is usually *adapted* to fit the farmer's circumstances. Ultimately, it is *their thinking*, not only that of research scientists, which must be developed before change in land use practice can come about. This is not an "alternative" to what formal researchers do, but a necessary and complementary step in the sequence of rural development processes. If this step is not completed, then the technology simply sits on the shelf and nothing practical is accomplished.

TWO-WAY INFORMATION FLOW

Increasingly, researchers in developing countries are trying to reach out to farmers through on-farm experimenation, but the number of sites in which they can work is severely limited and the "partnership" is still somewhat one-sided. Even in the best-intentioned programmes the language in which this activity is couched reveals a lingering "center bias." Scientists "go out" to the farmers and "bring back" information to help them decide how best to make their technologies more relevent to their clients needs, but farmers still have relatively little scope for direct expression of their own research and development priorities. What is needed to make the partnership successful is a communication channel in which information about technology and research needs and priorities flows with equal ease in both directions.

THE COMMUNITY-BASED FIELD WORKER AS INFORMATION BROKER

As national agroforestry research programmes get underway there will be an expending stock of research results, germplasm and new prototype technology to draw upon in applying agroforestry to community development problems. Extension services will undoubtedly be called upon to play a greater role in getting the new technology out to potential users, but it is unlikely that they alone will be able to handle the potential volume of information and they tend still to be limited by a one-way approach to the flow of information. Informal sector fieldworkers have a useful role to play in obtaining relevant information and technologies for their communities and, on the other side, in providing formal agencies with better access to information on local research and development priorities and technical innovations originating within their communities. D&D concepts may provide a kind of "lingua franca" for this work.

COMMUNITY-BASED R&D

The challenge to all concerned parties, if agroforestry is to have a significant impact on the rural landscape, is to get the two complementary centers of experimentation and technical innovation working together in a mutually reinforcing relationship. This is most likely to be successful if *both* centers of research and development activity are strengthened. For the formal sector research center it should not become a question of who takes the initiative. In technology generation the initiative is where you find it (a surprising number of the technologies 'released' by international research centers have their origin on farmer's fields). The question, rather, is whether the effectiveness of the total--formal and informal--agroforestry R&D effort can be enhanced through awareness and support of farmers in their own informal research and development activities.

This is where community-based fieldworkers--in the role of development catalysts, information brokers translating between different knowledge systems and, in some cases, leaders of informal R&D teams--can make a signficant contribution to the realization of agroforestry's potential in rural development. In the hands of a skilled change agent, the D&D methodology may prove to be a useful tool for the job, particularly if coupled with an effective information network.

CASE STUDY EXAMPLE

OF THE D&D

LEARNING PROCESS

Case study example of the D&D learning process

J.B. Raintree and D.E. Rocheleau

In the course of presenting the D&D methodology in workshops and training courses over the past 5 years, we have found that nothing works quite as well as a case study for conveying a concrete idea of the kind of learning process that occurs within the D&D framework. In keeping with the abreviated format of this introductory manual, however, we will not attempt to present a full case study report. Rather, we shall draw selectively from a particular body of case material to illustrate, in a concrete form, two of the main features of the D&D methodology: 1) the iterative and self-corrective nature of the D&D learning process, and 2) the range of concerns--both technical and social--which an agroforestry project using the D&D methodology may be expected to encounter.

THE KATHAMA CASE STUDY

The case chosen for this purpose is the Kathama Agroforestry Project, located in the subhumid/semiarid midlands of Machakos Distict, Kenya. This research site has been developed and maintained by ICRAF as a testing ground for exploratory studies in D&D and related methodologies. The basic idea behind the methodology work in Kathama was to "learn by doing." Given the practical intent of D&D, the work carried out at the site naturally involved a certain amount of "technology generating" research, but the technological results have tended to be viewed as somewhat incidental to the methodological lessons which have been garnered from the activity and which are its main rationale. Although the Kathama experience has provided a number of important leads and pilot experiences with new agroforestry technology, the full-scale systematic development of agroforestry technology for the mixed farming systems of the area has been taken up by the larger and more formally organized Dryland Agroforestry Research Project in the district, involving collaboration between ICRAF, the Katumani National Dryland Agricultural Research Station and the Kenya Agricultural Research Institute (KARI).

Despite the informal character of the research activities at Kathama, as ICRAF'S oldest continuous D&D field site, it is one of the few places in the world with 5 years of experience with agroforestry field trials in a community development setting. As such it is a uniquely informative source of case material to illustrate the D&D learning process.

CHRONOLOGY OF D&D ACTIVITIES AT THE SITE

<u>Prior Research</u>

1980-81	A study of the role of trees in local farming systems (Gielen 1982) and a botanical survey of local tree & shrub species (Fliervoet 1982)

<u>Phase I: Farm Level D&D</u>

1981	First rapid appraisal D&D survey (Raintree 1982, Vonk 1983)
1981-83	On-farm trials of prototype agroforestry technologies (Vonk 1983a,b,c)
1981-83	Short-term (3-6 month) "special studies"(in-depth followup to confirm and explore critical aspects of the initial "rapid appraisal" D&D)
	- Wood fuel consumption survey (Wijngaarden 1983a)
	- Potential role of self-help organizations in agroforestry (Wijngaarden 1983b)
	- Nutrient balance of soils in local cropping system (Nÿssen 1984)
	- Measurement of stickwood increment in grazing lands (Boer 1984)
	- Landscape analysis and watershed design study (Hoek 1983)
1984	Study of soil moisture depletion in the alley cropping system (Ssekabembe 1984)

<u>PHASE II: Watershed and Community Level D&D</u>

1983	Watershed and community level D&D analysis (Rocheleau and Hoek 1984)
1983-86	On-site trials of agroforestry landscape interventions (Rocheleau 1984, 1985)
1984-86	"Special studies"
1984	- Survey of household use of off-farm land (Cantor 1984)
1985	- Survey of women's use of gathered food and medicinal plants (Rocheleau et al. 1985)
1985-86	- Survey of local knowledge and scope for domestication of wild food and medicial plants in AF systems (in progress)
1985-86	- Exploratory farm trials of home gardens incorporating wild and semi-domesticated leafy vegetables and fruits (in progress)

This outline indicates the typical sequence of phased research and development activities in a D&D-based agroforestry project: 1) initial rapid appraisal D&D survey, 2) commencement of field trials of initial "best bet" agroforestry technologies, with 3) concomittant "special studies" to confirm and explore critical aspects of the initial D&D results in greater depth. Feedback from successive rounds of agroforestry trials, together with the results of the in-depth diagnostic and design studies at the site and parallel investigations on research stations, all provide inputs to the self-corrective learning process by which the D&D process gradually approaches an an optimized set of agroforestry technologies and supportive social structures for a given land use system.

At the Kathama site, a phased approach was also followed in applying the two scales of diagnosis and design. (This needn't be the case in all projects, since both of these as well as other scales could be covered in the initial D&D application.) Phase 1 of the Kathama project concentrated on "farm-level" agroforestry interventions. The experience at this scale suggested the need for a larger-than-farm "watershed and community" scale D&D for general landscape interventions. The methods for this approach were developed and implemented in Phase 2. A third phase is being planned which focuses on regional and national scale analysis of marketing and processing potentials for agroforestry cash crops.

As examples of the concrete concerns which come up during the D&D process, two specific lines of learning are presented--one dealing with a central technical problem, the other with a crucial aspect of the social organization of agroforestry activities at the site.

PHASE 1: FARM LEVEL D&D

Tree establishment methods under drought conditions

The case material for this example is taken from Vonk (1983a:32-85). Inasmuch as all of the diagnostically derived agroforestry interventions depended upon the successfull establishment of trees, little could be accomplished until the problems of tree establishment under the prevailing drought conditions could be solved. Initially the emphasis in the farm trials was on labour-saving methods of tree establishment that involved a minimal change in the farmers' normal cropping practice, as it was anticipated that this would be a requirement for adoption of novel technologies like alley cropping. Consequently, *direct seeding* methods were used in the initial alley cropping trials.

Method 1: Leucaena seeds were scarified and then planted in appropriately spaced furrows by simply following along behind the plough and dropping the seeds in the furrow. The seeds were covered with soil by the moldboard plough on the next pass when the adjacent furrow was made. No special seed bed preparation was done beyond the normal ploughing for the maize crop.

Results: This method was used in the first trials (during the "short rains" of 1981) with little success. A dry spell following the onset of the rains killed most of the recently germinated seedlings. Those trees that survived the dry spell were too weak to survive through the next dry season.

Conclusion: Since uncertainty in the onset of the rains and mid-season droughts are common in this area, a better method of establishment had to be found. It was hypothesized that if the fertility of the seedbed were improved in the spots where the leucaena seeds are dropped, growth would be vigorous enough for the seedlings to become established and survive the next dry season. Innoculation of the seed would probably also have helped, but this was not adopted for the farm trials because of the lack of access of local farmers to innoculum.

Method 2: Same as method 1 except that manure and triple superphosphate fertilizer were mixed with the soil where the tree seeds were placed.

Results: This method was used in the next round of trials (during the "long rains" of 1982). Although initial seedling growth appeared to be more vigorous, this rainy season was very short, only 4 weeks, and the survival rates were very low.

Conclusion: Although most trees in this trial failed to establish, inasmuch as the labour requirement for this method is still relatively low it was thought to have potential for the area in seasons of higher rainfall. However, in order to ensure establishment of the alley cropping trials during the next planting season it was decided to plant *seedlings* in individually prepared planting holes, rather than persist with direct seeding methods. Even though the labour requirement would be substantially higher, the participating farmers were becoming discouraged with the low survival rates experienced thus far and had expressed a willingness to invest more labour in planting if they could be assured of a reasonable survival rate.

Method 3: Seedlings were raised in polyethylene bags in a nursery. Meanwhile, planting holes were prepared during the dry season in rows between the "alleys" where the crops were to be grown. Manure and triple superphosphate were mixed with the soil in the planting hole and the seedlings were set out at the beginning of the rains when the crops were planted. The labour requirement for this method was expected to be high but the survival rate of the seedlings was also expected to be significantly higher than the previous methods. A labour bottleneck at planting time could be avoided by preparing the planting holes during the latter part of the dry season, when there is little competition for labour.

Results: This method was used during the next planting season (the "short rains" of 1983) with considerable success. High survival and growth rates were acheived in many of the trials. However, the total labour requirement was very high due to the digging of the planting holes during the dry season when the soil was hard. 7 to 14 minutes was required to dig a single hole, depending on the clay content of the soil. At an average in-row spacing of 0.5 m, this works out to between 23 and 46 man-hours per 100 m of hedgerow, or 96 to 192 man-days per hectare (assuming 4 m spacing between hedgerows and a 6 hour workday for this kind of heavy labour).

Conclusion: The method has the potential to achieve high survival and growth rates but some way would have to be found to reduce the labour requirement.

Method 4: Farmer-Originated Design Improvment

As it turned out, one of the farmers in the 1983 trials did not follow the directions concerning preparation of the planting hole during the dry season. Instead, he merely scooped out a shallow circular microcatchment of about 1 m diameter at the planting site during the dry season. After the first rain, when the soil inside the microcatchment had become soaked and quite easy to dig, he then dug the remainder of the planting hole, mixed in the manure and phosphate fertilizer, and planted the seedling.

Results: Survival and growth rates were high and the labour requirement for digging the planting holes was reduced to 1-2 minutes per hole. Adding an estimated 2 minutes to scoop out the shallow microcatchment during the dry season (actual labour data were unavailable since the farmer did this operation without the prior knowledge of the researcher), this brings the total labour to 3 to 4 minutes per planting hole, for a total labour requirement of 10 to 13 hours per 100 m of hedgerow, or 42 to 54 man-days/ha (assuming 0.5 m in-row and 4 m between-row spacing and 6 hrs/man-day).

Conclusion: The farmer's innovation reduced the labour requirement for preparation of planting holes by 60-70%. Although further reductions would be desirable, Method 4 is getting to be within an acceptable range for farmers who are otherwise movitvated to adopt the alley cropping system, provided they spread out the work of establishing the system over a period of several planting seasons. (Which is consistent with the cautious, experimental way most small farmers adopt new technologies.)

This example illustrates the way in which a specific line of technical inquiry can be adjusted to accomodate the learning experience associated with successive cycles of trial-and-error in the iterative D&D process. In accordance with scientific method, each progressive design improvement should be regarded as an "hypothesis" for testing. There is no blame in being "wrong" at any point, as long as the appropriate corrections are made in subsequent trials.

A similar process of trial-rediagnosis-redesign was applied to rehabilitation and improvement of badly eroded grazing lands in Kathama. In this case, the iterative D&D process led, in the end, not to the adoption of a set of incremental improvements but to a whole new design approach: the *rehabilitation of existing trees* instead of the planting of new ones. This approach appears to have merit for serverely degraded grazing lands, where drought and degraded site conditions make it extremely difficult to establish new trees, but where useful existing tree cover can be rehabilitated as a first step in the improvement process (Vonk 1983a). Later, after the site has recovered some of its condition, silvopastoral enrichment plantings can be made to increase diversity and introduce new germplasm. The method has been taken up for further research in the nearby Dryland Agroforestry Research Project (Sang et al. 1985a).

PHASE 2: WATERSHED AND COMMUNITY LEVEL D&D

At the time of the initial farm-level D&D exercise it was recognized that *not all* of the agroforestry related problems within the area could be assigned to individual farms, nor could they adequately be addressed by farm level designs alone. It was felt, in particular, that the erosion problems experienced on many of the farms had at least part of their origin in wider landscape patterns and processes, and that the runoff from individual farms had effects on other farms in the area. Although the initial round of agroforestry trials with farmers was focused on individual farm interventions, it was also recognized that the household was not the only social unit capable of carrying out agroforestry trials. Two "special studies" were undertaken to provide insights into possibilities for broadening the diagnosis and design to a *larger-than-farm scale*: 1) An investigation into the activities of existing self-help groups in the community, to see whether they had any potential for agroforestry development (Wyjngaarden 1983b); and 2) a *watershed level diagnosis* of erosion patterns, leading to a general landscape design for a more broadly conceived approach to erosion control (Hoek 1983).

It was anticipated that these two, seemingly rather distinct, areas of concern might in fact be mutually reinforcing: the study of existing community organizations might suggest ways of organizing farmers to implement larger-than-farm scale agroforestry designs required for effective erosion control. When the watershed and community scale D&D activity was systematically taken up in Phase 2 of the project, it was discovered that *social scale factors* were much stronger and had much wider implications for the organization of agroforestry projects than originally hypothesized. This will be illustrated by a brief review of the lessons learned about the role of neighborhood self-help groups in the development of agroforestry potentials at the Kathama research site (the case material is drawn from Rocheleau 1984 and 1985).

Role of neighborhood self-help groups

The first indication that larger-than-household scale social organizations were more than just a potential to be tapped for larger-than-farm scale designs--but in fact an essential factor in the successful implementation of even *farm-level* agroforestry designs--was brought to light in connection with water problems associated with the raising of seedlings for the on-farm trials. Of the ten farmers in the first round of on-farm agroforestry trials, three tried to produce seedlings on their own farms in order to expand the experimental plantings. Two of the three failed in this effort and others refrained from trying because of a shortage of water for the seedlings caused by difficulty of access to permanent water during the dry season. The one farmer who suceeded had a private spring on his own farm. It was realized then that, for most families, access to water involves use of public water sources, often at great distance from the farm.

Also, while most of the participants in the initial set of farm trials happened to be men, the traditional expectation regarding the division of household labour gave primary responsibly for transporting water for the nursery seedlings to women. However, there were no clear guarantees that the women would share directly in the fruits of the labour they provided to the men's tree planting activities. When hard pressed by other chores and the generally difficult conditons of the drought period, many women were reluctant to put in the long hours of water hauling required to ensure survival of the seedlings.

This observation pointed up two preconditions for successful nurseries: 1) the need to involve women as individual beneficiaries of tree planting activities and as co-planners of any activity involving their own labour (i.e. in general, the need to ensure that individuals, whatever their social identity, would benefit from the fruits of their own labour), and 2) the desirability of organizing the nursery work as a group activity located near a permanent water source on the farm of one of the group members. Recalling the finding of the "special study" on local self-help groups that most of the active groups in the area were women's groups, it was recognized that such groups constituted the natural social unit around which the nursery groups could be organized. It proved to be a relatively easy matter for the community to set up the required groups on a neighborhood basis and to find a permanent water source (usually a spring on one of the group member's farms) near which to locate the nursery. As it turned out, although the women's self-help groups formed the nucleus of the neighborhood nursery groups, the groups did not not restrict their membership to women only. Men also participated.

To carry out the objectives of Phase 2 of the project, a small catchment within the local watershed was selected for a pilot study with the following specific objectives:

1) to develop AF methods for implementation, monitoring & evaluation of watershed and community scale group projects
2) to build rapport with the groups and assess their organizational and technical capabilities and potential
3) to modify the agroforestry designs and implementation plans to fit #2

In the course of setting up the nursery groups it was discovered that the traditional self-help groups were not "communal" in nature and not primarily focused on "public works" (despite occasional mobilization by village authorities for conservation works), but rather, small neighborhood-based associations primarily intended for reciprocal and rotational labour exchange for the benefit of individual member households. When approached by the researcher to work on critical agroforestry-conservation sites within the overall watershed plan, they agreed to do so but only on the basis of a negotiated exchange of 15 tree seedlings (a multi-species "sampler package") in return for carrying out this work. In the subsequent season, while some of the groups continued to ask for advice on placement and construction of soil conservation works, they gave first priority to nursery construction and plant propagation activities. The self-defined objectives of the nursery groups centered on collective production of fruit, fodder, fuelwood and timber trees for use by the individual members on their own farms.

Once the the participants in the nursery activities could see what the new trees and shrubs looked like and how they performed in new niches on their farms, they were better able to choose tree species (both exotic & indigenous) to meet their needs, and to consider alternative planting arrangements and management techniques. Thus, the provision of seedlings for private use to and by the group members was stimulus and precondition to a dramatic expansion of awareness about the potential role of agroforestry on their farms. Once they had begun take an active interest in the agroforestry possibilities of their farms, they gave insightful suggestions for improvements in the on-farm trials. The nursery activities also provided an important tool for sharpening the diagnosis of felt needs and potentials. By providing a range of tree species to choose from and by monitoring the preferences for different trees, the researcher was able to get a better indication of the participants' actual perception of farm needs and development priorities.

Out of this consultation and testing came a suggested change of emphasis from hedgerow intercropping for mulch (the "green manure" strategy behind the initial alley cropping trials) to hedgerow intercropping for fodder and fruit, with wider spaceing between hedgerows. Although a few farmers maintained their interest in widely spaced hedgerows for mulch, most farmers expressed a preference for cattle pen-composting of tree biomass from fencerows and dispersed trees in grazing land to increase the supply of "manure" for subequent application to their croplands (a modification of the traditional "brown manure" strategy).

The focus of group activities on propagating trees in small neighborhood nurseries was accompanied by an active search for new tree species compatible with the individual group members' needs and priorities. One focus of this collecting activity was on indigenous leafy vegetables, wild fruits and exotic drought-resistant marketable fruit compatible with local food cropping systems, emerging home garden prototypes, and/or hedgerow plantings (living fences on farm boundaries or hedgerows on internal field borders). Another search was focused on tree-based pesticides available in the area, carried out with the help of foresters and local herbalists.

COMPLEMENTARY ON-STATION RESEARCH

Of all of the agroforestry technologies in the on-farm trials in Kathama, alley cropping is clearly the most experimental. The main research questions center on 1) alternative uses of tree herbage for fodder rather than mulch in mixed farming systems of the dry tropics and 2) the effects of competition for soil moisture between hedgerows and the associated crops (Ssekabembe 1985).

The first question is of the type that can only be answered by on-farm trials, inasmuch as it is the farmers' response to the experimental technology, in the context of the prevailing land use system, which has to be monitored. The second question, however, requires an investigation of plant and soil interactions which might best be taken up on the research station, where more complex and rigorously controlled experimental designs and sophisticated monitoring techniques are easier to carry out.

Since both kinds of information are needed, the question for research planners is not which type of research to undertake, but in what order they should be taken up. There are two arguments: One is that, for highly experimental technologies, a workable prototype should *first* be developed on-station before submitting it to farmer trial in order to minimize the farmers' risk. The other, and opposite, argument is that it may take a long time to develop a rigorously researched prototype technology on-station and that before committing resources to a long term investigation researchers should *first confirm* that the technology has real relevance to the felt needs of the intended users. This can best be accomplished through a kind of "perturbation experiment" on-farm to see how the farmers respond to an initial "best bet" design. Another side of the second argument is that farmer-originated modifications may suggest "adoptability-enhancing" attributes of the technology which should be incorporated into the prototype research before it goes too far down the wrong road.

There is no universally "correct" resolution to this issue, but the Kathama experience suggests that it may be possible to take up both kinds of investigations *simultaneously*. Thus, while the on-farm trials of the initial "best bet" design were getting underway in Kathama, a more basic set of phased investigations into the alley cropping technology were started in the on-station component of the nearby Dryland Agoforestry Research Project (Sang et al. 1985b). Not long after this, a third set of related investigations was initiated on the ICRAF field station. It is too early to cite conclusive results, but these three sets of investigations are proving to be complementary to each other, and together they are capable of providing a better basis for the next generation of dryland alley cropping technololgy for the area than any of them alone.

From the Kathama trials we have learned that for alley cropping to be adoptable to farmers with an animal-based approach to fertility maintenance in mixed farming systems (the traditional "brown manure" strategy), emphasis should be given to the production of fodder in the alley cropping hedgerows. The farmers most likely to have an abiding interest in mulch and green-manure production (the new "green manure" strategy) are those with insufficient grazing land to support enough livestock to supply the manure needs of their fields. Farmers of either type with a strong interest in cash crops would like to incorporate marketable tree crops into their alley cropping hedgerows. Thus, the farm trials have provided a basis for cautious optimism regarding the appropriateness of certain functional aspects of the basic alley cropping concept and suggested the kinds of design modifications which would be needed to ensure widespread adoption by local farmers. The most important modifications are: 1) widening of the spacing between hedgerows of green manure trees (to avoid moisture competition during drought periods) with the possibility of multiple rows in the hedgerow design to compensate for the wider spacing, 2) fodder or fruit trees instead of green manure trees in the hedgerows (i.e. same basic spatial arrangement with different functions), and 3) pen-composting of woody biomass and leaf material from other locations on the farm and surrounding landscape (i.e. same function with different spatial arrangement).

The initial set of on-station alley cropping investigations in the Dryland Agroforestry Research Project focused on assessing the effects on yields of maize and bean crops of green manure from 3 different tree species, with the green manure grown separately from the crops. Results have been quite positive for *Leucaena leucocephala* and *Cassia siamea* and somewhat less positive for *Terminalia brownii*. While providing quantitative data on the beneficial effects of green manure per se, these experiments shed no light on the potential competitive effects of *in situ* green manure production in hedgerows. Nevertheless, encouraged by these results and by estimates which predict a net beneficial effect on crop yields, the project researchers have decided to move out to on-farm trials for further experiments on the full alley cropping system (with *in situ* production of applied green manure).

Meanwhile, on the ICRAF Field Station nearby, quite a different kind of experiment has been established using "systematic" and "geometric" designs. By providing data on optimal ranges for in-row and between-row spacing of leucaena trees in the alley cropping system, these kinds of experimental layouts have the potential to fill an important gap in the information required to optimize the design. On-farm research in Kathama has provided qualitative indications that, for this climate zone, the between-row spacing should be wider than the original 3.5-4 m used in the early alley cropping trials, but this variable is difficult to investigate systematically in on-farm trials. Since the experiments on the ICRAF station are also fully instrumented for monitoring of above-ground microclimatic as well as soil moisture and fertility, they will be able to complement the farmers' observations with quantitative data on shelter effects and other components of the total complex of plant-plant and plant-soil interactions involved in alley cropping in dryland farming systems. It is expected that these basic investigations will also contribute to the development of robust experimental methodologies for use in the on-farm trials.

D&D IN ACTION

An Illustrated Scenario of the Process

(1)

IT IS LATE EVENING. TWO SMALL GROUPS OF PEOPLE MEET ON THE ROAD TO THE VILLAGE. EVERYONE LOOKS VERY TIRED

1ST FARMER (heavily loaded with firewood): GREETINGS, NEIGHBOR. HOW DID THE DAY GO WITH YOU. WHAT'S THE NEWS NOW THAT THE RAINS HAVE COME?

2ND FARMER (lowering his hoe): GREETINGS . . . BUT THIS IS A SAD DAY FOR ME. THAT FIELD I HAD FINISHED TERRACING . . . THE PATH THAT WENT ACROSS IT HAS COLLAPSED INTO A DEEP GULLY! IT'S ALL RUINED . . .

1ST FARMER: AIEE, NEIGHBOR! WHAT IS HAPPENING TO US? THE SAME THING HAS HAPPENED ON THE NEXT RIDGE, AND THEY DON'T THINK THEY'LL GET A CROP THIS YEAR! SOMETHING HAS GONE WRONG SOMEWHERE.

(2)

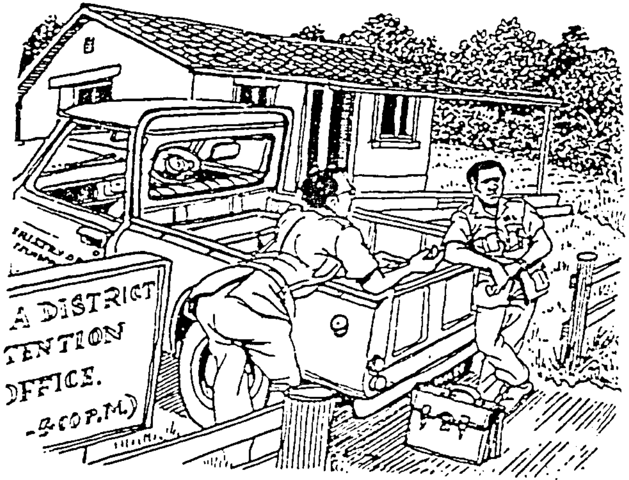
2ND FARMER (mopping his brow): I DON'T KNOW WHAT IT IS. IT'S AS IF THE VERY LAND IS TIRED AND HAS GIVEN UP THE STRUGGLE!

1ST FARMER (laughing wryly): THEN IT MUST FEEL LIKE ME! WE SET OFF EARLY THIS MORNING TO COLLECT THIS FIREWOOD . . . AND EVEN SO IT WILL ONLY LAST A DAY OR SO.

2ND FARMER (sighing deeply): I DON'T KNOW WHAT TO DO . . . THE YIELDS SEEM TO BE LESS EACH SEASON. THAT'S WHY THEY TOLD ME TO BUILD TERRACES . . . ALL THAT WORK! AND NOW? HUH! SOMETIMES I JUST FEEL LIKE MOVING AWAY!

1ST FARMER: AWAY TO WHERE? WHO CAN FIND NEW LAND?

2ND FARMER: YOU'RE RIGHT, OF COURSE . . . AH, WELL. BY TOMORROW I'LL BE READY TO START PLANTING, AS USUAL.



(3)

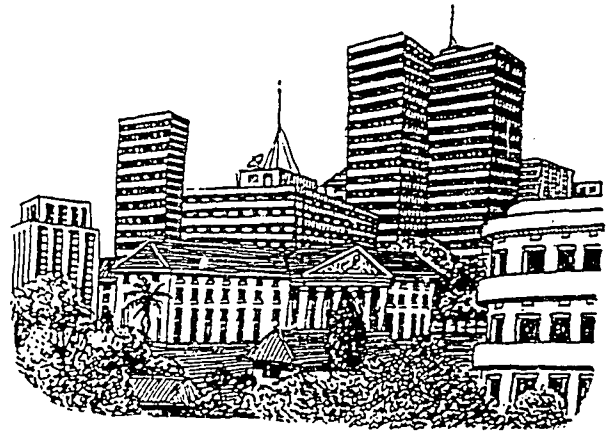
NOT FAR AWAY THE SAME PROBLEMS WERE BEING DISCUSSED AT THE DISTRICT DEVELOPMENT OFFICE . . .

FIELD OFFICER: WE OBVIOUSLY GOT ON TO THE TERRACING TOO LATE, BUT WHAT ELSE COULD WE DO? THIS WHOLE THING DIDN'T START YESTERDAY!

2ND OFFICER: WELL, IT'S ALL LITERALLY GOING DOWN HILL NOW! BUT AT LEAST WE'VE GOT ENOUGH SEED AND FERTILIZER FOR THIS SEASON . . .

FIELD OFFICER: BUT THAT'S NOT THE ANSWER, IS IT? WE NEED MORE THAN THAT! . . . WHAT HAVE YOU HEARD ABOUT THIS NEW "AGROFORESTRY" APPROACH?

2ND OFFICER: IT ISN'T REALLY SO NEW, IS IT? FARMERS IN THIS AREA HAVE BEEN DOING SOMETHING LIKE THAT FOR A LONG TIME. WHO KNOWS? WITH A LITTLE RESEARCH SUPPORT IT MIGHT GO A LONG WAY . . .



(4)

MEANWHILE, BACK IN THE CAPITOL CITY URGENT DISCUSSIONS WERE TAKING PLACE AT THE HIGHEST LEVEL . . .

MINISTER'S VOICE: GENTLEMEN, IF THIS CONTINUES THE COUNTRY WILL BE IN SERIOUS TROUBLE! AGROFORESTRY SEEMS A PROMISING APPROACH BUT WE CAN'T WAIT YEARS FOR PRACTICAL RESULTS! WE APPOINTED THIS NATIONAL COMMITTEE ON AGROFORESTRY TO LOOK INTO WAYS OF SPEEDING UP INTER-AGENCY COLLABORATION ON AGROFORESTRY RESEARCH. WHAT ARE YOUR RECOMMENDATIONS?

COMMITTEE CHAIRMAN: WELL, MR. MINISTER, WE ALL KNOW HOW DIFFICULT IT IS TO GET AGRICULTURALISTS AND FORESTERS TO COLLABOROATE ON ANYTHING! BUT WE'VE FOLLOWED UP ON THE CONTACTS WITH ICRAF AND WE THINK WE OUGHT TO GIVE THIS "D&D" BUSINESS A TRY.

MINISTER: ALRIGHT THEN GENTLEMEN, I WANT TO SEE THIS "D&D" IN ACTION!

(5)

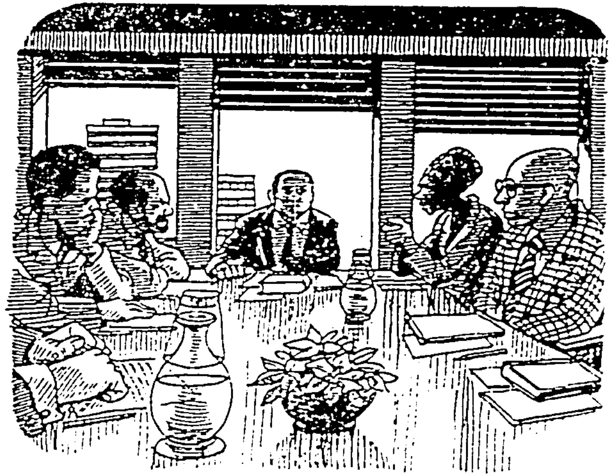
AN INTER-AGENCY AGROFORESTRY TASK FORCE WAS SET UP AND IT WASN'T LONG BEFORE ITS FIRST MEETING . . .

FIELD OFFICER: WHAT'S THIS MEETING ALL ABOUT? I'VE GOT URGENT WORK TO DO . . . WHAT IS THIS 'D&D' BUSINESS ANYWAY?

1ST RESEARCHER: DON'T BE ALARMED, THEY SAY ITS NOTHING MORE THAN A PROBLEM SOLVING APPROACH TO AGROFORESTRY . . . A LITTLE MORE SYSTEMATIC THAN USUAL PERHAPS . . .

2ND RESEARCHER: OH YEAH, I'VE HEARD THAT ONCE YOU PUT THIS 'D&D' PROCESS INTO MOTION YOU START TO REDEFINE THE VERY MEANING OF WORK!

FIELD OFFICER: WHAT? . . . WHAT DO YOU MEAN BY THAT?



(6)

IN THE CONFERENCE ROOM THE MEETING IS CALLED TO ORDER. . .

DIRECTOR: GOOD MORNING . IT'S NICE TO SEE YOU ALL HERE TOGETHER. I KNOW THIS IS A BUSY TIME FOR YOU, BUT FORGET ALL THAT! AS YOU KNOW, YOU ARE HERE BECAUSE YOU'VE BEEN NOMINATED BY YOUR DIVISIONS TO WORK TOGETHER ON A PROJECT OF THE HIGHEST PRIORITY . . . THE MINISTER WANTS US TO DO MORE TO HELP THE FARMERS AND HE HAS INSTRUCTED THIS TASK FORCE TO CARRY OUT A 'D&D' EXERCISE . . . THE PURPOSE OF THIS MEETING IS TO LEARN WHAT THIS 'D&D PROCESS' IS ALL ABOUT AND TO WORK OUT A PLAN FOR INTERDISCIPLINARY COOPERATION . . .

WE'VE ENVITED A TEAM HERE FROM ICRAF TO SHOW US HOW WE CAN GO ABOUT IT . . .

(7)

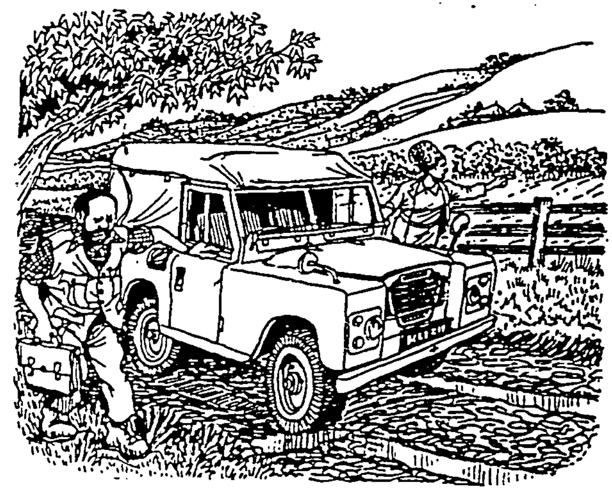
IT ISN'T LONG BEFORE THE TASK FORCE BEGINS WORK ON THE **PREDIAGNOSTIC STAGE . . .**

1ST RESEARCHER: THESE ARE THE BEST MAPS OF THE STUDY AREA WE HAVE, AND HERE ARE SOME REPORTS WE'VE COLLECTED WHICH CONTAIN USEFUL BASELINE INFORMATION . . .

2ND RESEARCHER: HOW MANY DIFFERENT LAND USE SYSTEMS ARE THERE IN THE STUDY AREA, ANYWAY? YOU KNOW THAT AREA, GEORGE, WHAT DO YOU THINK?

FIELD OFFICER: WELL, ITS HARD TO SAY . . . BUT THE FARMS IN THIS AREA ALL HAVE A PRETTY SIMILAR CROPPING PATTERN . . . OVER HERE THEY TEND TO HAVE MORE LIVESTOCK . . .

3RD RESEARCHER: WHERE ARE THOSE GUIDELINES FOR THE PRE-DIAGNOSTIC STAGE? WE'VE GOT TO BE SYSTEMATIC ABOUT THIS!



(8)

HAVING FAMILIARIZED THEMSELVES WITH THE PREDIAGNOSTIC DATA AND DEFINED A FOCUS FOR THE FIELD SURVEY, D&D TEAM TAKES TO THE FIELD TO CARRY OUT THE **DIAGNOSTIC SURVEY . . .**

1ST RESEARCHER: WELL, HERE'S THE FA[illegible] . . . . ARE YOU SURE THIS ONE IS TYPICAL OF THE LAND USE SYSTEM WE ARE SUPPOSED TO DIAGNOSE?

FIELD OFFICER: IT SHOULD BE. LET'S TALK TO THE FARMER AND FIND OUT. . . HERE SHE COMES NOW!

2ND RESEARCHER: SHE? . . . I DIDN'T EXPECT THE FARMER TO BE A WOMAN!

1ST RESEARCHER: REALLY! YOU DON'T GET OUT MUCH, DO YOU?

(9)

THEY GREET THE FARMER AND START THE INTERVIEW . . .

FIELD OFFICER: WE'D LIKE TO TALK WITH YOU ABOUT YOUR FARMING PRACTICES AND PROBLEMS . . . THERE MAY BE SOMETHING OUR RESEARCHERS CAN DO TO HELP . . .

FARMER: WE'VE ALREADY GOT SEEDS AND FERTILIZER.

2ND RESEARCHER: WELL YES . . . BUT PERHAPS THERE IS SOMETHING ELSE . . . WOULD YOU MIND SHOWING US AROUND YOUR FARM? WE CAN TALK AS WE GO . . .

(10)

1ST RESEARCHER (to field officer): THERE CERTAINLY SEEMS TO BE A LOT OF SHEET EROSION HERE . . . AND LOOK! OVER THERE A GULLY IS BEGINNING TO FORM . . .

2ND RESEARCHER (to farmer): WHAT ABOUT FIREWOOD AND FODDER FOR YOUR LIVESTOCK? . . . DO YOU ALWAYS HAVE ENOUGH?

(11)

LATER THAT EVENING, THE D&D TEAM REASSEMBLE TO COMPARE NOTES AND MULL OVER THEIR FIRST DAY OF FIELDWORK . . .

1ST RESEARCHER: YOU KNOW, I KEEP WONDERING HOW ALL THAT RUNOFF WE SAW UP ON THE RIDGE TODAY IS AFFECTING THE FARMERS FURTHER DOWN THE SLOPE . . .

FIELD OFFICER: WELL . . . WHY DON'T SOME OF US GO DOWN THAT WAY TOMORROW AND TALK TO THE PEOPLE THERE? . . . THE REST OF THE TEAM CAN CONTINUE WITH THE FARMS UP ON THE RIDGE.

(12) [THE D&D TEAM ON THE WAY BACK TO THE LAND ROVER]

1ST RESEARCHER: YOU KNOW, THESE LAST FEW DAYS OF SURVEY HAVENT REALLY TURNED UP ANY NEW INFORMATION. EVERYTHING WE'VE LEARNED SEEMS TO ADD UP TO A PRETTY CONSISTENT PICTURE OF THE PROBLEMS ON THESE FARMS . . .

2ND RESEARCHER: I AGREE. PERHAPS IT'S TIME TO GO BACK TO THE CITY AND ANALYZE OUR FINDINGS CAREFULLY. . . THE ANALYSIS WILL REVEAL IF THERE ARE ANY GAPS IN OUR INFORMATION . . .

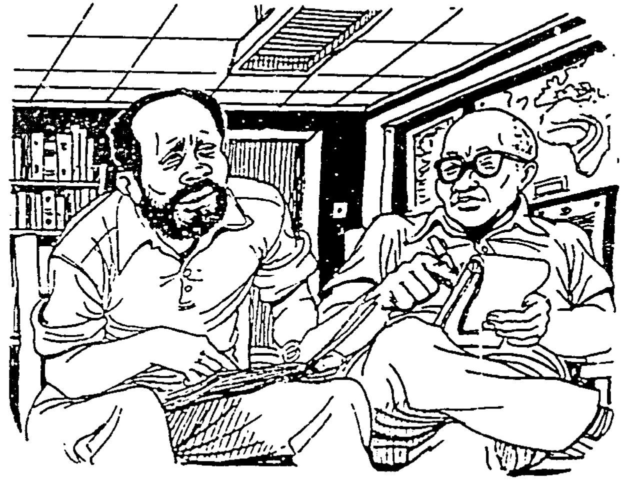
3RD RESEARCHER: RIGHT, WE CAN ALWAYS COME BACK OUT HERE TO CHECK ON SPECIFIC POINTS . . .

(13)

SO . . . AFTER A COUPLE OF WEEKS IN THE FIELD, THE TEAM RETURNS TO THE CITY TO BEGIN THE **DIAGNOSTIC ANALYSIS** . . .

1ST RESEARCHER (standing at the blackboard): LET'S BEGIN BY WRITING DOWN THE PROBLEMS WE'VE IDENTIFIED . . . AND THEN WE CAN MAKE A LIST OF ALL THE FACTORS CONTRIBUTING TO EACH OF THE PROBLEMS . . .

2ND RESEARCHER: AFTER THAT WE CAN WEIGH THE DIFFERENT FACTORS AND IDENTIFY THE MAIN CONSTRAINTS. THESE MAY SUGGEST 'LEVERAGE POINTS' WHERE SPECIFIC AGROFORESTRY INTERVENTIONS COULD MAKE A DIFFERENCE . . .



(14)

3RD RESEARCHER: RIGHT! THEN WE CAN DRAW UP A LIST OF 'FUNCTIONAL SPECIFICATIONS' FOR WHAT EACH OF THE INTERVENTIONS SHOULD DO FOR THE SYSTEM . . . THIS IS THE FINAL LINK TO THE DESIGN . . .

FIELD OFFICER: WAIT! . . . WE'RE ALL ANXIOUS TO GET ON WITH THE DESIGN, BUT FIRST LET'S NOT FORGET TO LIST THE 'DESIGN CONSTRAINTS' . . . TO REMIND US WHAT WE SHOULD **NOT DO** IF WE HOPE TO COME UP WITH A DESIGN THAT CAN BE ADOPTED BY THE FARMERS!

(15)

ONCE THE TEAM HAS ARRIVED AT A MORE OR LESS COMPLETE SET OF SPECIFICATIONS, THE **DESIGN STAGE** BEGINS . . . IT ISN'T LONG BEFORE THEY ARE WRESTLING WITH THE SPECIFICS OF THE DESIGN.

1ST RESEARCHER: HMM . . . ALRIGHT, WHY DON'T WE COMBINE FODDER PRODUCTION WITH EROSION CONTROL INTO A MULTIPURPOSE HEDGEROW DESIGN FOR PLANTING ALONG THE CONTOURS IN THE CROPLAND? . . . I MEAN, THE ESSENCE OF THIS IS MULTIPURPOSE DESIGN, ISN'T IT?

2ND RESEARCHER: THAT'S RIGHT. . . SO WHICH TREE OR SHRUB SPECIES WILL BEST SUIT THE PURPOSES HERE?

3RD RESEARCHER: THAT WILL DEPEND UPON WHAT SORT OF SPACING AND MANAGMENT SYSTEM WE ARE THINKING OF USING. LET'S NOT BE TO QUICK TO JUMP TO CONCLUSIONS . . .

4TH RESEARCHER: I AGREE . . . NOW THAT WE KNOW WHAT WE'RE LOOKING FOR IT'S TIME TO FIND OUT WHAT THAT NEW MULTIPURPOSE TREE UNIT IN THE FORESTRY DIVISION HAVE COME UP WITH IN THEIR FIELD TRIALS. SHALL I CONTACT THEM? . . . AND WHILE WE'RE AT IT WHY DON'T WE GET BACK TO THE LIVESTOCK RESEARCH GROUP OVER AT THE UNIVERSITY . . .

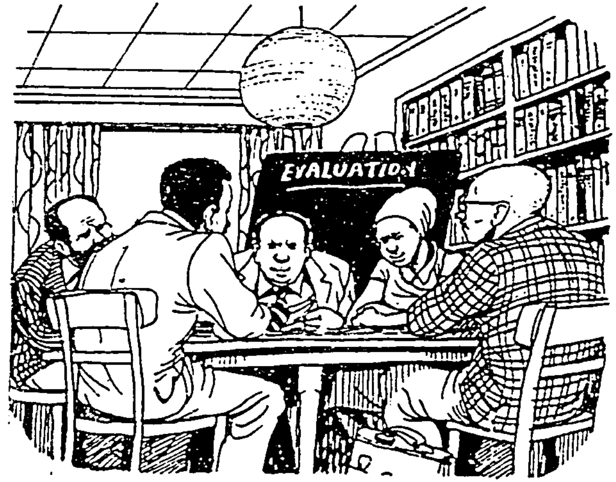
(16)

AND SO THE PROCESS CONTINUES AND A PRELIMINARY AGROFORESTRY DESIGN STARTS TO EMERGE . . .

DIRECTOR (entering the room):
HOW IS IT GOING? . . . HEY, THAT LOOKS LIKE AN INTERESTING AGRORCESTRY SYSTEM . . . DOES IT SATISFY ALL OF THE DESIGN SPECIFICATIONS?

1ST RESEARCHER: WELL . . . I THINK WE MIGHT NEED TO CONSIDER SOME MORE BOUNDARY PLANTINGS TO REALLY DEAL WITH THE FIREWOOD PROBLEM . . . BUT I THINK WE'RE GETTING THERE!

2ND RESEARCHER: WE'RE GOING BACK OUT TO THE FIELD AGAIN TOMORROW TO CHECK OUR IDEAS WITH SOME OF THE FARMERS AND GET THEIR INPUT. . .



(17)

EVENTUALLY THE EMBRYONIC DESIGN REACHES THE STAGE WHERE IT'S READY FOR THE **EX-ANTE EVALUATION . . .**

1ST RESEARCHER: WELL . . . IT LOOKS AS IF WE HAVE ARRIVED AT A PRETTY GOOD OVERALL DESIGN . . . BUT LET'S EVALUATE IT CAREFULLY NOW AND SEE IF WE CAN FIND WAYS TO IMPROVE IT.

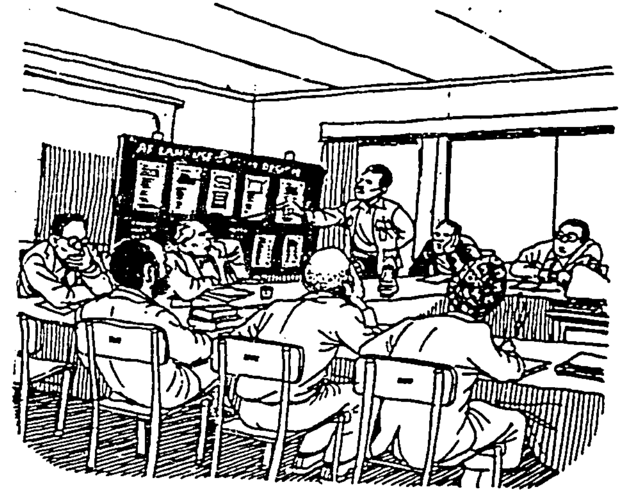
2ND RESEARCHER: UH . . . I DON'T THINK IT'S OUT OF ORDER TO SUGGEST THAT WE SHOULD ALSO CONSIDER WHETHER THERE ARE ANY NON-AGROFORESTRY ALTERNATIVES THAT MIGHT DO A BETTER JOB!

FIELD OFFICER: YES, OF COURSE, BUT DON'T FORGET WE NEED TO GO BACK OUT THE FIELD AGAIN TO TEST OUR PROPOSALS WITH A LARGER SAMPLE OF FARMERS . . . AFTER ALL, THEY ARE THE ONES WHO WILL MAKE THE FINAL DECISION ABOUT WHETHER TO ADOPT THE TECHNOLOGY OR NOT . . .

(18)

DIRECTOR: YOU PEOPLE ARE GOING TO WRECK MY PETROL BUDGET! OK, ONE MORE FIELD TRIP . . . BUT AFTER THAT I WANT YOU TO SPEND MORE TIME DEFINING THE 'RECOMENDATION DOMAIN' FOR THIS TECHNOLOGY. I MEAN . . . I WOULD HOPE THAT THIS SYSTEM COULD BE RELEVANT TO FARMERS WITH SIMILAR PROBLEMS IN OTHER AREAS OF THE COUNTRY! I'VE GOT TO JUSTIFY THE EXPENDITURES . . .

RESEARCHER: YES SIR, WE ALL AGREE! IN FACT WE HAD THAT IN MIND RIGHT FROM THE START WHEN WE SELECTED THIS STUDY AREA. IT IS REALLY QUITE REPRESENTATIVE OF A LARGE PORTION OF THE HILLY REGION . . . NOW THAT OUR DESIGNS ARE TAKING CONCRETE FORM WE HAVE A BETTER IDEA OF EXACTLY WHERE . . .



(19)

FINALLY A PROTOTYPE DESIGN FOR AN IMPROVED LAND USE SYSTEM IS COMPLETED AND A MEETING IS HELD TO FORMULATE A **PLAN OF ACTION** FOR THE FOLLOW UP ACTITIVIES . . .

1ST RESEARCHER: FIRST WE NEED TO CONSIDER WHICH OF THE TECHNOLOGIES IN THE DESIGN ARE READY FOR IMMEDIATE EXTENSION, AND WHICH OF THEM ARE GOING TO NEED FURTHER RESEARCH . . . I MEAN, WE WANT THE FARMERS TO PARTICIPATE WITH US IN THE R&D PROCESS, BUT WE CAN'T ASK THEM TO TAKE TOO MANY RISKS!

2ND RESEARCHR: YES. ON THE RESEARCH SIDE, WE SHOULD PLAN FOR 'ON FARM' TRIALS TO GET EARLY FEEDBACK FROM THE FARMERS ON SUITABLE TECHNOLOGIES, AND MORE CONTROLLED 'ON STATION' INVESTIGATIONS TO GIVE US HARD INFORMATION ON ASPECTS OF THE DESIGN WE ARE NOT SO SURE ABOUT . . .

(20)

3RD RESEARCHER: RIGHT, THEN WE CAN GO ON TO MAKE AN INTEGRATED PLAN OF ACTION, WITH OUTLINES FOR SPECIFIC RESEARCH INVESTIGATIONS, EXTENSION ACTIVITIES AND . . .

4TH RESEARCHER: WELL, YES . . . TO GET THE PROJECT OFF TO A GOOD START WE'LL NEED TO COME UP WITH SPECIFIC SUGGESTIONS ABOUT EXPERIMENTAL DESIGNS, BUT WE SHOULD LEAVE ENOUGH FLEXIBILITY FOR THE IMPLEMENTERS OF THE PROJECT TO WORK OUT THE DETAILS FOR THEMSELVES . . . AND TO MODIFY THE PLANS AS THEY GO ALONG. YOU KNOW HOW SCIENTISTS ARE . . .

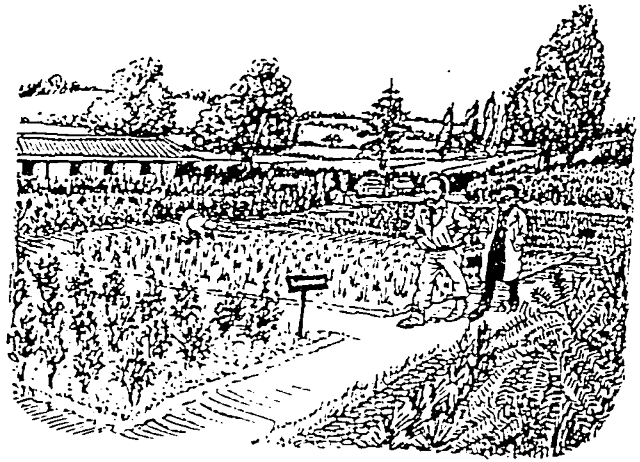
(21)

ALL THROUGH THE **IMPLEMENTATION STAGE** THE ITERATIVE D&D PROCESS CONTINUES . . . THE DIAGNOSIS DEEPENS AS ON-FARM RESEARCHERS REALLY GET TO KNOW THE AREA . . . FARMERS PROVIDE FEEDBACK THROUGH THE FARM TRIALS AND SUGGEST IMPORTANT DESIGN INNOVATIONS OF THEIR OWN . . .

RESEARCHER: WHAT HAPPENED DURING THE HEAVY RAIN LAST WEEK? WAS THERE MUCH RUNOFF? DID THE HEDGEROWS CONTAIN IT?

FARMER: PRETTY WELL . . . BUT WHEN IT WAS VERY HEAVY, IT BROKE THROUGH THE HEDGEROW IN SOME SPOTS . . . I WAS THINKING OF PUTTING SOME EXTRA FODDER GRASS ALONG THE TOP HERE. DO YOU THINK THAT WOULD HELP HOLD THE SOIL?

RESEARCHER: HMM . . . MAYBE. LET'S TRY IT AND SEE!



(22)

MEANWHILE, BACK ON THE RESEARCH STATION . . . FUNDAMENTAL INVESTIGATIONS CARRIED OUT UNDER MORE CONTROLLED EXPERIMENTAL CONDITIONS ARE BEGINNING TO YIELD INTERESTING RESULTS .

1ST RESEARCHER: AS YOU KNOW WE'VE BEEN MONITORING THE VARIOUS PLANT-ENVIRONMENT INTERACTIONS AND IT'S BEGINNING TO LOOK LIKE THERE'S A SIGNIFICANT WIND SHELTER COMPONENT TO THE YIELD IMPROVEMENTS OBSERVED WITH CROPS IN THE HEDGEROW SYSTEM . . .

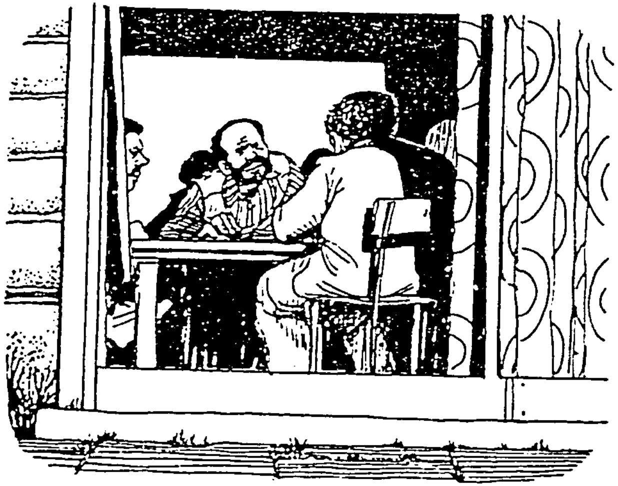
2ND RESEARCHER: REALLY? . . . IN ADDITION TO THE SOIL FERTILITY EFFECTS? THAT'S INTERESTING! WE'VE BEEN TURNING UP SOME PROMISING NEW FUEL AND FODDER SPECIES IN OUR REGIONAL SCREENING TRIALS . . .

(23)

THROUGHOUT THE IMPLEMENTATION STAGE, PERIODIC MEETINGS ARE HELD TO POOL INFORMATION FROM THE ON-FARM AND ON-STATION RESEARCH . . . TO "REDIAGNOSE" AND "REDESIGN" IN THE LIGHT OF THE NEW INFORMATION, AND TO REVISE AND UPDATE THE ACTION PLAN . . .

1ST RESEARCHER: AND SO, TO CONCLUDE OUR REPORT ON THE ON-FARM TRIALS, THE NEW HEDGEROW DESIGN IS PERFORMING WELL IN REDUCING EROSION . . . BUT THE FARMERS STILL DON'T HAVE ENOUGH FODDER FOR THEIR ANIMALS.

DIRECTOR: ALRIGHT THEN . . . LET'S APPOINT A WORKING GROUP TO LOOK INTO THE POSSIBILITY OF INCORPORATING SOME OF THOSE NEW HIGH-YIELDING FODDER SHRUBS INTO THE HEDGEROW DESIGN . . .



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FIELD OFFICER: MR. CHAIRMAN . . . PERHAPS I COULD TAKE THIS OPPORTUNITY TO MENTION THAT SOME OF THE WOMEN IN THE AREA ARE STILL COMPLAINING ABOUT THE DISTANCE THEY HAVE TO WALK TO GATHER FIREWOOD . . .

DIRECTOR: WELL, LET'S HOPE THE WORKING GROUP ON WINDBREAK DESIGN HAS DEVELOPED A SUSTAINABLE HARVESTING SCHEME FOR FUELWOOD FROM THE WINDBREAKS . . . WE'LL HAVE THEIR REPORT RIGHT AFTER THE BREAK . . . THEN, SINCE IT DEALS WITH A RELATED CONCERN, WE'LL HEAR THE REPORT ON WAYS IN WHICH CUSTOMARY TENURE REGULATIONS COULD BE ADAPTED TO SUPPORT TREE PLANTING ON COMMON LAND . . .

TO BE CONTINUED . .

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