Adaptive Research and Extension Manual in Agroforestry

The

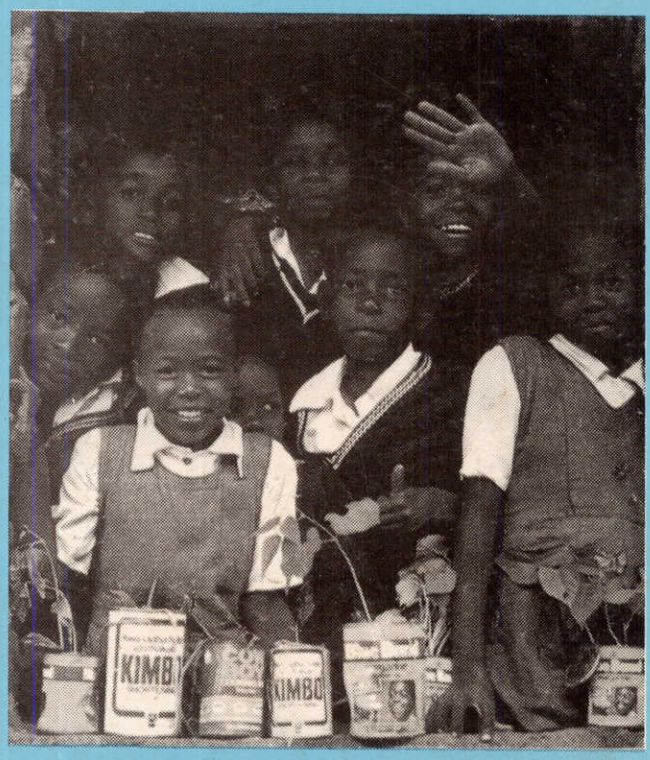
CARE-KEFRI Agroforestry Project Experience

By

Njuguna J W; Wanjiku J and Nyamai D O

With contributions from:

Omollo A; Gathumbi S M; Muoriah F K; Agunda J; Okinda R and Maina S N



Adaptive Research and Extension Manual in Agroforestry

The

CARE-KEFRI Agroforestry Project Experience

By

Njuguna J W; Wanjiku J and Nyamai D O

With contributions from:
Omollo A; Gathumbi S M; Muoriah F K; Agunda J; Okinda R and Maina S N

CARE INTERNATIONAL IN KENYA - Kisumu Office
P.O. Box 88 Kisumu, Telephone: 035 - 41770/41767, Fax: 035 - 43820

KENYA FORESTRY RESEARCH INSTITUTE KEFRI

Series editors
D O Nyamai[1]; A Omollo[2]

Published 1996

KEFRI, P. O. Box 20412, Nairobi, Kenya

Telephone: 254-154-33530, 32891/2/3
Telefax: 254-154-32844

Cover design and layout by *SAFI PRINTERS & STATIONERS*
P. O. Box 23454, Nairobi, Kenya

---

1 Kenya Forestry Research Institute (KEFRI), P. O. Box 20412, Nairobi, Kenya

2 CARE-International in Kenya, Western Kenya Regional Office, P. O. Box 88, Kisumu, Kenya.

CONTENTS

List of Tables

List of Figures

Preface

Adaptive research is one approach to on-farm research aimed at empowering farmers to carry out research in a participatory manner. This form of research provides a link between researchers, extension agents and the farmer who then form the adaptive research team. The main objective is for the team to design appropriate technologies geared at solving the felt needs of a farmer or farming community.

In this manual an attempt is made to provide the sequence of activities undertaken for successful adaptive research process. The activities discussed include diagnosis of land -use problems, training of the adaptive research workers/staff and farmers, the process of technology design, implementation and management. Development and dissemination of extension messages is also discussed.

This manual is based on the CARE Agroforestry Extension experience in Western Kenya. It is intended for use by extension workers and farmers wishing to conduct adaptive research.

Acknowledgements

The production of this manual has been a joint responsibility between CARE Agroforestry Extension (AE) senior staff and KEFRI scientists. The role of KEFRI in completing the formatting of the publication has made this first attempt a reality.

Special appreciation goes to CIDA (Canada) for making funds available for preparing and publishing this document.

Finally the cooperation and good working environment provided by CARE Region office, Kisumu has been instrumental in enabling timely production of this publication.

Sources of Illustrations

FAO, (1991). Fruits of our work: Women in community Forestry, Tanzania, Forest, Trees and People, 28pp.

Kimwe, S. and Noordin, Q. (1994). Management and uses of Agroforestry Trees, Agroforestry Field Manual -KWAP, ETC Kenya Consultants B. V. Nairobi, 36 pp.

Getahun, A. and Reshid, K. (1988). Agroforestry in Kenya: A field guide, Motif Creative Arts Limited, Nairobi, 59 pp.

Raintree J. B., (1987). D&D User's Manual: An Introduction to Agroforestry Diagnosis and Design, ICRAF, Nairobi, 100 pp.

Simute, S. (1992). Agroforestry Manual for extension workers with emphasis on small scale farmers in Eastern province, Zambia, Regional Soil Conservation Unit SIDA, Technical Handbook No: 2, Nairobi, 93 pp.

Tengnas, B. (1993). Guidelines on Agroforestry Extension Planning in Kenya Regional, Soil Conservation Unit Technical handbook No.3 71 pp.

List of Acronyms

AE	Agroforestry Extension
AR	Adaptive Research
ARF	Adaptive Research Farmer
ARW	Adaptive Research Worker
ICRAF	International Centre for Research in Agroforestry
ITK	Idigenous Technical Knowledge
KEFRI	Kenya Forestry Research Institute
PARENA	Participatory Adaptive Research and Extension Needs Assessment
PERT	Programme Evaluation and Review Techniques
PRNA	Participatory Research Needs Assessment
STS	Senior Technical Staff
D & D	Diagnosis and Design
NGO	Non Governmental Organizations

WHAT IS ADAPTIVE RESEARCH? 1

1.1 *Introduction*

Adaptive research (AR) is defined as research carried out with the farmers and not for the farmers. Adaptive research aims at empowering farmers to carry out research on their farms by facilitating them to utilize their vast indigenous knowledge in developing and modifying relevant techonologies (in this context agroforestry technologies) for immediate application to solve their land use related problems. Agroforestry can be defined as a land use system in which woody perennials (trees or shrubs) are grown together with crops and or livestock on the same land management unit. The woody perennials are either deliberately left in the field or planted. The aim of agroforestry is to maximize the positive interaction, both biological and economical while minimizing the negative ones. The main benefits of agroforestry include the production of poles and timber, fruits and other foods, fodder, fuelwood and medicinal products. Agroforestry also plays a service role in soil fertility improvement, control of soil erosion and the ameriolation of climate.

The main objective for adaptive research is to strengthen the link between the researchers, extension agents, and the farmers in the development of agroforestry technologies.

This document borrows from the experience of adaptive research and extension activities in Western Kenya which is a collaborative effort between KEFRI and CARE agroforestry extension project.

In the development of adaptive research, 9 major elements are considered critical in the process of executing adaptive research activities. These include the following:

- Planning of the project work and Training AR staff
- Selection of farmers
- Training farmers
- Participatory Adaptive Research and Extension Needs Assessment (PARENA)
- Designing and laying out research plots
- Establishment and management of research /demonstration farm/plots
- Data acquisition, analysis, interpretation and presentation
- Development and dissemination of extension messages
- Evaluation

The stake holders in the entire process are detailed in the matrix indicated in Table 1, which clearly shows the role of all key players at different stages.

Table 1. Stake holders and their roles

Activity	Participants
Farmer Selection	G F R E
Diagnosis (PRNA)	G F R E
Trial Design	F R E
Visits to plots and research stations	F R E
Trial layout	F R E
Planting	F
Crop management	F
Tree management	F
Data collection	F R
Trial monitoring	G F R E
Harvesting	F R
Post harvest evaluation	F R
Research result presentation	F R E

Legend: G- Group, F- Research farmer, R- Researcher, E- Extension worker

2

PLANNING OF THE PROJECT WORK AND TRAINING OF ADAPTIVE RESEARCH WORKERS (ARWS)

2.1. *Planning*

Proper planning is crucial to the success of any project. It is important to draw up a proper time frame within which each component of the project should be implemented (where, how, when etc.) and completed. During planning process it is important to clearly state the following;

- Objectives of the technology or activity to be undertaken
- Purpose and benefits of the project/activity
- Funds and Logistics
- Project phases
- Envisaged potential collaborators
- The implementors of the project
- Time frame
- Expected outputs etc.

2.2. *Action Planning*

The following exercises can help a group that has reached the stage of planning action. Clear definition of objectives (goal setting) will aid in building a progressive movement action.

2.2.1. *Mapping the situation*

This exercise deals with Decision-making process regarding information about the situation.

Procedure

i) Divide the group into teams that work together in real situations.

ii) Ask each team to draw on a 'map' of their situation. This includes every group, organization and category of people in their environment that they relate to, try to influence, work with, etc. They should draw their own team in the picture.

iii) When they have finished, ask them to answer the following questions:

- Which of these groups or units are you really trying to influence?
- How well are you doing this?
- Look critically at each of these groups in relation to their class position
- How good is the relation with each unit?
- In what areas do you have a problem?
- How can you improve?

iv) One way to share this information between teams is to ask each team to walk around looking at other teams maps. Anyone with questions can ask after they have seen all the maps.

2.2.2. *Seven Steps of planning*

This outline helps a real working group plan practically.

a. Diagnosis

   What are the problems?

   What are the needs?

b. What do we want to achieve (objective) in a particular period? in a week, a month, or a year?

c. What are the possible ways of achieving this objective?

   Brainstorm for proposals

d. What are the advantages and disadvantages of each proposal?

   How much time, money and personal effort will be needed for each proposal?

e. Which proposal (plan) do we accept?

   This may include several suggestions e.g. community afforestation, construction of soil and water conservation structures etc.

f. Who will do what, when, where and how?

g. At what point do we need to evaluate?

   Who should be involved in the evaluation?

Note: Emphasis on field Analysis can be one way to work through steps b, c, and d of the 7-Steps above.

2.3. *Programme Evaluation and Review Techniques (PERT)*

After a group has decided on its goal, it is very helpful to organize activities to achieve the goal. One way to do this is to make a chart and a visual plan. This can be important to a team because:

- it shows how simple or complex the plan is,
- it leads to realistic planning,
- it organizes activities in a way that ensures the goal can be reached,
- it helps motivate and keeps the team to deadlines,
- it provides immediate information for self-evaluation.

2.3.1. *How to do a PERT*

Events are usually the end of the end of the task and do not take much time in themselves. Lets us use an example of hiring a new community agroforestry co-ordinator. The following tasks will have to be done:

- decision to hire a new agroforestry co-ordinator
- a selection committee is formed
- a job description developed
- recruitment of candidates begins
- candidates are interviewed
- final selection is made

In this example, one can see that one activity must follow the other. If the group has a deadline, it is important to plan time backwards.

For example, if you want to have the final selection of the candidate made by August 1, all the candidates might have to be interviewed before July 15 th.

May 20 ← June 1 ← July 15 ← August 1

But not all activities have to follow one another in order. It is very possible that some tasks can be done at the same time.

2.4. *The Planning Kit*

The idea of using a series of pictures to help groups plan a project well. The purpose of using visual methods for planning, is to help people see what is needed to start and complete a practical project.

The planning process includes the following steps:

a. Choosing a specific project
b. Planning each step of the project
c. Deciding how much money resources will be needed for each step
d. Deciding how much time will be needed for each step
e. Deciding what other resources will be necessary for the project
f. Discovering, before a project begins, the benefits likely to be realized
g. Deciding, before a project begins, how the group benefits will be used

This planning kit is only helpful to a group which has already discussed its needs thoroughly and is ready to decide on a practical project

2.5. *Training of ARWs*

After planning, the project team selects and trains adaptive research workers (ARWs) to be involved in the project. Training of ARWs proceeds all other activities.

The training objectives are to;

- Introduce ARWs to the concept of adaptive research and its importance
- Impart participatory techniques necessary for data collection, analysis and interpretation to ARWs
- Expose the ARWs to land use/farming systems, characteristics and associated problems
- Familiarize them to the process of identifying and appreciating the existing Indigenous Technical Knowledge (ITK) as a prelude to identification of researchable areas

2.5.1. *The expected output of training ARWs*

- Impart the skills acquired during training to the adaptive research farmers
- Participatorily acquire information/ bio-physical and socio-economic data, analyze and interpret it
- Recognize land use/farming systems characteristics and assess the degree of associated problems thereof

Topics covered in training ARWs

2.5.2. *General introduction to adaptive research and extension*

Expose the ARWs to the various types of on-farm agroforestry research and how to distinguish each from the other. Four types of research have been identified:-

- ***Contractual research***

  Where the researcher rents the farmer's land, designs and implements the technology to address a certain problem with no farmer input and involvement.

- ***Consultative research***

  Where the researcher in consultation with the farmer designs the technology to be tried and the farmer implements the proposed activities.

- ***Collaborative research***

  Where the farmer and the researcher jointly identify a problem, design the technology together and the farmer implements.

- ***Collegial research***

  Where the farmer is provided with the necessary information, appropriate agroforestry technologies as well as seedlings of a particular species. Farmers are also given advise on the species characteristics, uses and management and the farmer then designs and implements his/her own research.

2.5.3. *Adaptive research and extension concept*

The idea and philosophy behind adaptive research and extension is to empower the farmers to initiate experiment with new or innovative technologies on their own farms. By so doing, adaptive research aims to strengthen the farmers' existing abilities to identify, analyze and prioritize their own problems and constraints in their land use systems. The key issue in adaptive research and extension is that the farmers' experience and views are given priority but are also modified where necessary.

2.5.4. *Diagnosis of land use problems, design of relevant technologies and location of appropriate research sites on the farm*

i) Land use problem analysis (diagnosis) and technology design

Diagnosis and design *(D & D)* is a methodology for the diagnosis of land use problems and design of appropriate agroforestry technologies to address them. The D & D process is conducted with a view to developing appropriate technologies to solve the land use related problems identified by farmers in the different ecozones.

The objective of the diagnosis and design process is to develop technologies (agroforestry technologies) whose design (type of intervention) is tailored to meet the needs and the conditions of the users (farmers).

This aspect deals with the training of ARWs on how to apply D & D principles in diagonizing land use problems such as; low crop productivity due to declining soil fertility, losses due to pests and diseases, decreasing land availability, problems associated with soil erosion, rainfall unreliability etc. as well as to solve the problems using appropriate agroforestry technologies.

ii) Location of appropriate research site

Before a site is set aside for research purposes, it is important to determine its; Geographical location in relation to other regions, vegetational and soil types (texture, structure, colour etc), total and usable land area, slope characteristics, uniformity, representativeness, accessibility within the farm, organic matter content, suitability for the technology to be tried and the land use systems already in use. It is important to avoid steep slopes because they are potentially highly erodible except for soil erosion control purposes.

iii) Selection of representative areas on the farm

Due consideration should be made to use of uniform plots and also locations that conform to much of the land in the area in terms of soil characteristics, slope, vegetation type etc.

2.5.5. Participatory Research Needs Assessment process (PRNA)

PRNA is a process or tool of gathering information from the farmers that include, indigenous technical knowledge (ITK), past and current farming situations, problems, opportunities available and researchable issues arising. During training the ARWs are introduced to the principles, processes and importance of PRNA in the adaptive research concept in solving land use problems through the validation of agroforestry technologies at the farm level. (For further details see chapter three).

Other topics covered in the ARW training are shown in the Table 2 below.

Table 2. Topics covered by the ARWs training.

TOPIC	ACTIVITY
Project Planning	Stating the project objectives, time frame for each project phase, identifying the farmers, and making contacts etc.
Research /demonstration site selection and characterization	Setting criteria for site selection, Diagnostic soil sampling and Baseline soil sampling
Layout, establishment and management of the trial/demonstration plots	Factors to consider when laying out field plots, Methods of and when to apply organic inputs and fertilizers during planting and establishment of trials. Trial management, observations and record keeping
Assessment of crop and tree performance	Recording parameters such as, height, diameter etc.
Assessment of weeds and pests	How to determine weed biomass, species composition, control measures for striga weed, pests, diseases etc
Above ground biomass assessment of trees	Sampling strategies, biomass determination (dry weight, destructive sampling) etc.)
Crop yield assessment	Sampling considerations eg for maize (grain, stover and cobs) and other crops as well
Socio-economic assessment of agroforestry technologies	Issues to consider for economic assessment eg ethnic groups involved, economic status of the farmers, social structure (matrilineal, patrilineal, polygamamous or monogamous), land tenure, cultural, gender considerations etc.
Data collection and management	field data collection and data management
Dissemination of information	Methods of information dissemination

Please note that it is to important to emphasize the necessity of collecting, analyzing and storing relevant data and to determine whether the ARWs have understood the objectives, principles, processes, and the value of adaptive research.

SELECTION OF ADAPTIVE RESEARCH FARMERS (ARFs) 3

3.1. *Introduction*

Selection of ARFs is carried out by the community members. In the case of CARE Agroforestry Extension Project that works with women/farmer groups, this exercise is carried out by the groups themselves. Four farmers (indicated by coverage of the projects) are identified and selected from in each agro-ecological zone using the criteria outlined below and others that could be developed at the moment of selection. These becomes the Adaptive Research Farmers (ARF's). The whole process is facilitated by the project adaptive research workers and field extension staff.

A representative farmer should meet the following selection criteria:

- Availability of land and tenure rights over it and possibly head of the household
- Be interested and willing to participate in research and extension activities
- Be resident, practical and hardworking farmer who is well known in the community and perceived as innovator
- Ability to communicate and willingness to interact with other farmers
- Representativeness in terms of resources, age, sex, and other social-cultural considerations etc.

3.2. *Availability of land, tenure and head of household*

Land issues in terms of who has rights to the land, who controls it, rights to plant trees, traditional values and beliefs etc. are important issues to consider in selecting a candidate farmer. This determines to a large extent the success of the adaptive research objectives. Willingness to avail land for research also indicates a farmer's readiness and commitment to the research and extension activity or the technology being tested. It also indicates that a farmer is also willing to help in the maintenance of the research/demonstration plot.

3.3. *Interest and willingness to participate in research activities*

The success of the technology under research depends on the farmer's willingness to co-operate with the researchers, extension agents and other farmers. This is especially important in the selection of the research site, technology to be tested, setting up of the experiments, maintenance of the trial plots, data collection analysis and the dissemination of research results.

3.4. *Resident, practical and hardworking and innovator*

These are farmers who are perceived as better farmers than others, hardworking, knowledgeable in the local farming practices. They are also well informed about the farming constraints within their own farming systems. Permanent residency in the area is also important as it ensures the consistency of record keeping, maintenance of plots etc.

3.5. *Ability to communicate and willingness to interact with other farmers*

A farmer's ability to communicate with researchers and extension agents is critical for a successful technology transfer. This is particularly so because the goal of the adaptive research project is that the adaptive research farmers would be able to teach other farmers during farmer field days and other occasions. Properly communicated messages ensure that the researchers and the farmers understand each other on a particular issue. Selected farmers should be articulate individuals who are willing to put their thoughts into words. These farmers are also able to clearly explain a local practice, and the advantages and disadvantages of two or more alternative local practices.

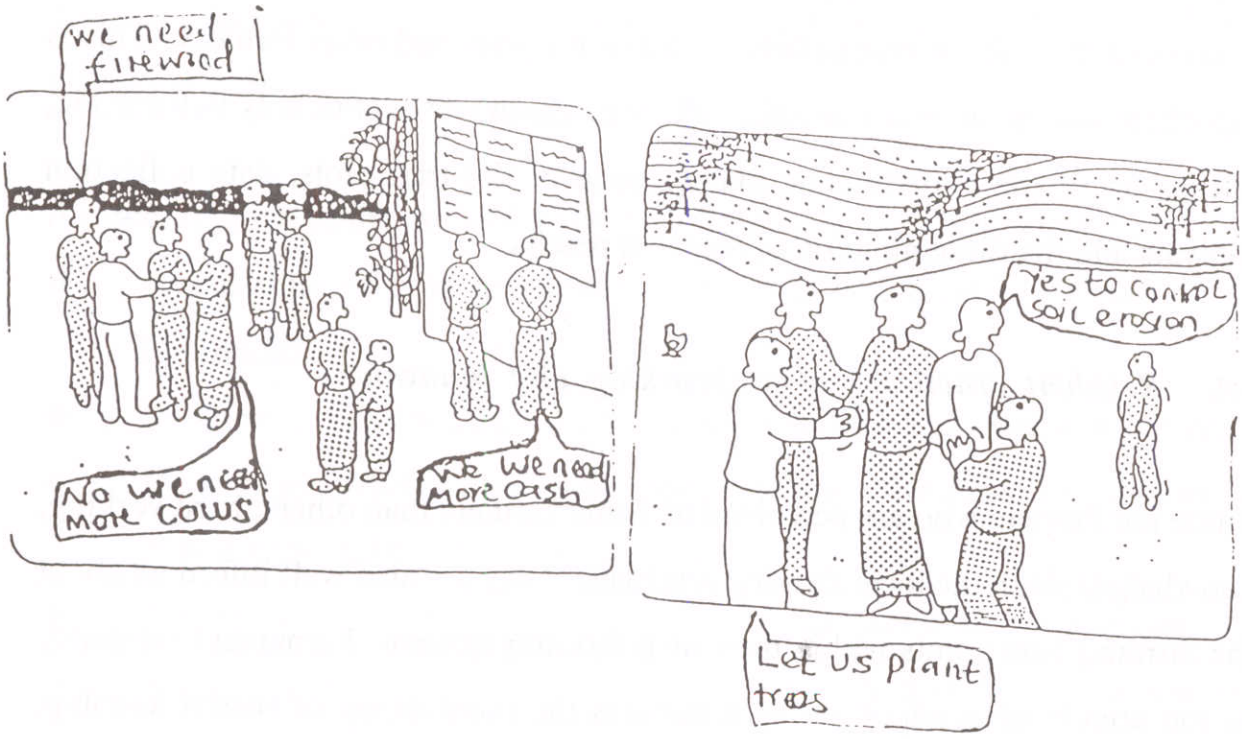


Fig. 3.1. Well communicated messages (increases the project's chances of adoption).

3.6. Representativeness in terms of resources, age, sex and other social-cultural considerations

Farmers should be selected outside the elite farmers who are a minority in the community. All in all resource availability is important to cater for risks. Representative farmers should represent at least 70% of the local farmers in terms of the above factors. All gender involvement in farm activities ease work and especially when one member of the household cannot be available to carry out the planned or implement research and extension activities.

After selection, visit the farmers to verify whether they meet the selection criteria outlined above.

Fig. 3.2. Farmers meeting to select adaptive research farmers.

4 ADAPTIVE RESEARCH FARMER TRAINING

Regular farmer training is necessary and should be organized by extension and technical staff, in this case from CARE and KEFRI. Training sessions for adaptive research farmers (ARFs) are done before the commencement of the adaptive research work. Training ARF is normally carried out in a simplified language preferably the local language. During the training, introduce adaptive research farmers to research concepts and other activities listed below:-

4.1. *Concepts of adaptive research and extension*

This covers the basic principles of research such as;

- What is research and its importance
- Various types of research
- Distinction between adaptive research and general research etc.
- To make farmers understand why they are chosen as adaptive research farmers and what is expected of them.
- Definition of extension
- Methods and approaches used in extension etc.

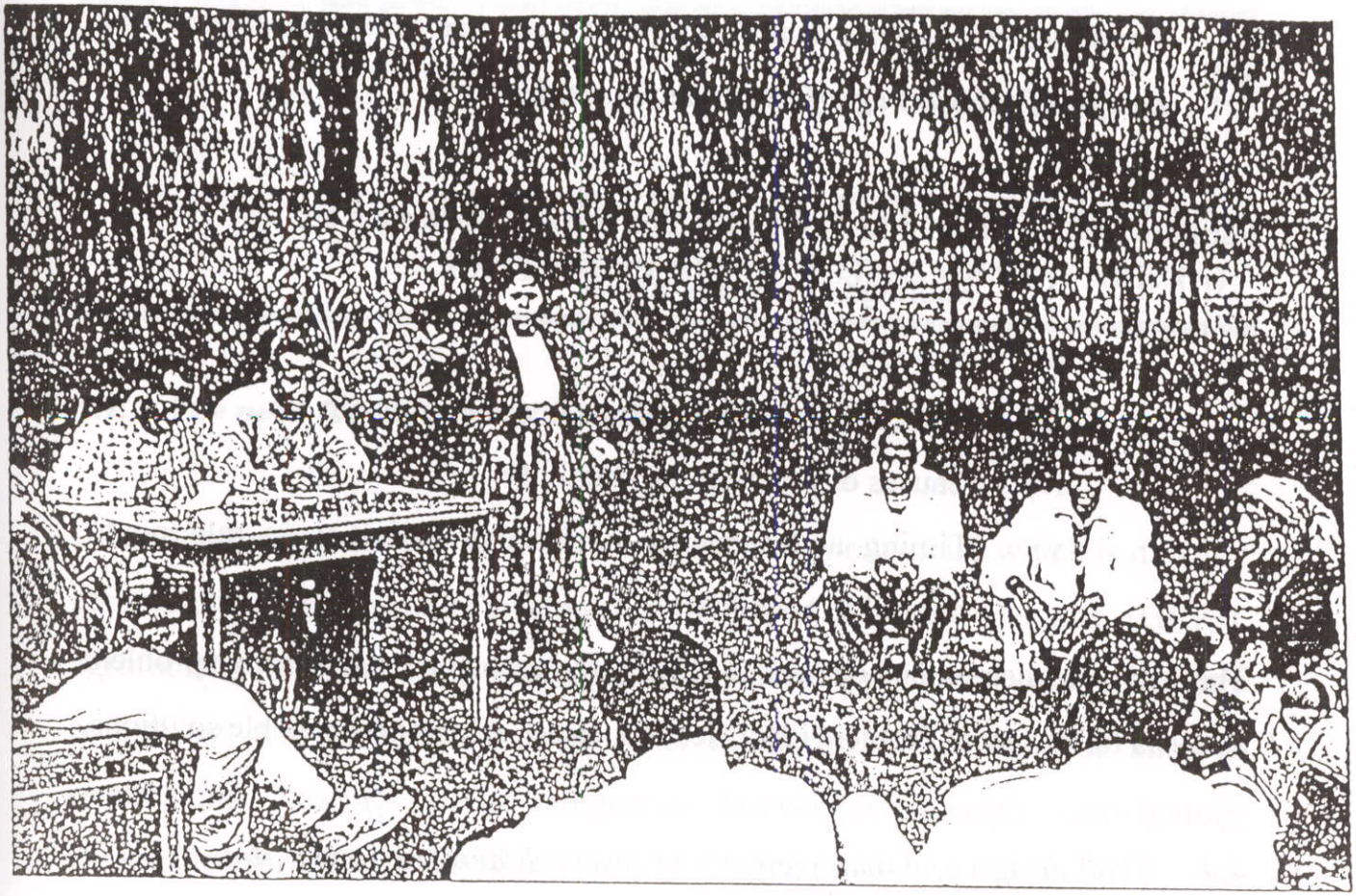


Fig. 4.1. Adaptive research workers training a group of farmers.

4.2. *Roles of adaptive research and extension farmers*

- To carry out adaptive research and extension according to the group needs and successful results used to train other group members, farmers, and the community at large
- To act as links between researchers, extension agents and farmers.

4.3. *Participatory diagnosis and design of land use related problems and design of relevant agroforestry technologies*

Farmers are trained on how to identify land use problems such as;

i) Shortage of wood products
ii) Soil erosion
iii) Pests and disease problems in crops and animals
iv) Causes of low farm productivity
v) Timing and sequence of farming activities in relation to rainfall availability

The ARFs are also trained on how to identify researchable issues through problem analysis for instance: Problem identification, cause, effects and possible solutions.

4.4. *Trial design and management of research/demonstration plots*

The ARFs are trained in details on the processes involved in;

i) Trial design
ii) Layout and management of research/demonstration plots
iii) Monitoring, data collection, record keeping and
iv) Data analysis, interpretation and presentation.

For further details on the above refer to Chapters 6, 7, 8 and 9.

5

PARTICIPATORY ADAPTIVE RESEARCH AND EXTENSION NEEDS ASSESSMENT (PARENA)

5.1. *The need for indigenous technical knowledge (ITK)*

Gathering indigenous technical knowledge is a major exercise which is done by community members, ARFs, project staff Group Resource Persons, (GRPs), agroforestry teachers from participating schools, the locational agroforestry committee, and counterparts from other ministries. This exercise aims at establishing existing useful indigenous knowledge through participatory diagnostic surveys with the farmers.

Gathering of indigenous technical knowledge involves the following steps:-

5.1.1. *Step 1: Meeting with farmers, collaborators and extension staff to discuss the purpose and objectives of ITK*

The objectives of the ITK are to:-

- Find out why farmers were increasingly becoming incapable of managing the environmental resource base given that they were able to do so in the past.
- Build upon indigenous technical knowledge when developing new technologies so as to increase technology transfer process.
- Enrich the communities' ability to carry out research.

- Identify farmers' unresolved land use related problems and how best to help them solve these problems.
- Identify common researchable issues between the farmers and the researchers.

5.1.2. *Step 2: Setting dates and appointments for the interview*

This has to be a date convenient to all the groups and persons to be involved in the adaptive research and extension process.

5.1.3. *Step 3: Develop information capture tools*

This is best done by arranging for;

- Open ended discussions that encourage farmers to volunteer information on their preference for a certain technology and/or species.
- Using designed forms, tables or questionnaires, unserialised posters, relevant manuals, activity sheets etc.
- Transect walk within the farm to collect relevant information on the prevailing land use practices and problems.

Fig. 5.1. ARWs conduting interviews through a transect walk in the farm

5.1.4 *Step 4. Conducting interviews through focused discussions*

During the interview seek the following information;

- Historical background on the areas farming methods
- Problems encountered and how they were solved
- Introduced varieties, their adoption and impact
- Farmers's knowledge on crops in particular;
  - Species diversity
  - Tree resources utility
  - Cultural relations
  - Uses of wood and non wood products
  - Medicinal values of trees/shrubs etc
  - Crop/animal pests and diseases, and their methods of control
  - Crop propagation methods etc.
- Timing of planting (farming calendar) etc.

Fig. 5.2. Conducting interviews through focused discussions.

5.1.5. *Step 5: Documentation of results thereof*

This process involves the documentation of all the information gathered through ITK. The information derived is used as a source of reference and baseline.

5.2. *The need for participatory adaptive research and extension needs assessment (PARENA)*

Participatory adaptive research and extension needs assessment is a process that involves farmers in their problems' identification, analysis and prioritization. In so doing PARENA gives better understanding between the farmer's interests, problems and needs and the researcher's ideas whose major aim is to assist the farmer in developing sustainable technologies/interventions in addressing the problem or need identified. Participatory in this context is used to refer to the voluntary involvement of the community's representatives (farmers) in the adaptive research and extension process. PARENA gives farmers the opportunity to decide upon the technology they want to validate. This exercise encourages discussion of all potential objectives so as to enhance the communities' willingness and commitment to undertake experimentation on their farms.
PARENA process has 3 major steps viz:-

5.2.1. *Step 1: Meeting with all the groups involved*

It is essential for the team to arrange for a meeting that brings together all the groups to be involved in the adaptive research and extension process (ARFs, technical staff, groups and school resource persons, agroforestry teachers, the locational agroforestry committees, and counterparts from other ministries).

During this meeting discuss the purpose and benefits of participatory assessment.

It is important to;

- Let each group list down their objectives, expectations, limitations etc.
- Identify land use systems problems and possible solutions in each agroecological zone.
- Identify researchable areas of interest to all the groups.

Fig. 5.3. A group of farmers discussing their objectives and problems.

5.2.2. *Step 2: Visiting the area and groups involved*

This is mainly done by ARWs. When visiting the groups, the ARWs should document the following information;

a) Group status
b) Farming problems that affect the groups and their intensity
c) Factors that bring about the above problems
d) Opportunities that can be exploited to solve the problems identified
e) Prioritization of the problems identified

When surveying the area, document the following;

a) Types of land utilization
b) Technologies being practiced
c) Level of land productivity
d) Prevailing land use problems

5.2.3. *Step 3: Discussion of PARENA results (through problem analysis, prioritization and prescription of the relevant technology)*

Discussion of PARENA results is done collectively by all the groups interviewed and is facilitated by ARWs, Senior Technical Staff (STS), extension agents and researchers. This is done through the analysis of the problems (needs) identified. Problem analysis builds on the farmers' pre-existing problem solving methods, laws and structures to help them identify, analyze and find solutions to their problems.

Examples of the problems identified through PARENA are;

a) Low crop yields
b) Striga weed infestation
c) Methods of combating soil erosion
d) Low soil fertility
e) Measures to control pests and diseases on animals and crops
f) Tree/crop species screening trials for each ecozone

These problems are then prioritized and form researchable issues.

TECHNOLOGY DESIGN 6

6.1. *Purpose*

The purpose of the technology design is to;

- Enable farmer group members to list feasible improved agroforestry technologies
- Establish agreement on practical implementation activities
- Obtain a commitment to begin them

6.2. *Technology design protocol*

- From the menu of technologies listed by the group members, the team selects/identify those that are common to group members and prioritize them
- In case of a wide variety of choices the group can be subdivided into subgroups according to their specific preference of technologies
- A detailed list of desirable attributes of each of the selected technologies is then made. This include component characteristics, component combination and arrangement as well as management considerations
- Identify the major land use systems within the farm and map them. This is best done by conducting a transect walk with the farmer through the farm
- Soil sampling may also be done
- Appropriate sites for trial and control plots are then identified

NOTE:

During the transect walk the farmer is able to critically examine the farm and to specify appropriate configurations and locations for selected agroforestry interventions. Locations with paths, tree trunks, livestock yard, waterways, rock outcrops and termite hills increase variability and should be avoided. Variability in soil and crop performance in the farm is also noted. Ask the farmer for explanation of site with exceptionally poor and good crop performances in the past.

Soil depth is particularly important in experiments with deep rooted crops or trees. The purpose of soil sampling or analysis before experimental plot layout is to guide selection of appropriate fields. With the exception of studies on control of soil erosion and runoff, slopping land is generally not desirable because of movement of soil and nutrients within and across plots. It is advisable to avoid locating trials adjacent to a habitation unless it is the environment in which the trial is going be planted normally.

It is important for the researchers to explain that the work is an activity from which both parties will learn. Farmers must understand; who will be expected to provide what, who will take what risk and; who will take what product. The plots are then laid out on the ground according to the design.

6.3. *Tree species selection*

Selection of appropriate tree species is important since this will help meet the farmers expectations. When making the selection consider:-

- The end use of the trees
- Suitability in terms of local ecological conditions. This includes the annual rainfall, altitude, temperatures, soils and the length of the dry season and silvicultural requirements such as;

- Resistance to fire, pests and diseases
- Ability to coppice
- Size and form
- Compatibility with other crops
- Seed availability
- Ease of handling and establishment, low input requirement

6.4. *Guidelines on how to set out plots*

- Plots should be the most representative land parcel
- Consider uniform plots - avoid improper blocking layout across soil type or slope fertility gradient
- Location to avoid when laying out the trial plots such as corners of the field, trees, paths, unfenced area etc

6.4.1. *Equipments to use in laying out plots*

- Steel or cloth tape
- Rulers
- Corner marking stakes
- Soil augers
- Machetes
- Inclinometers, A-frame
- Water proof note books
- Envelopes
- Sisal or manila twines

6.5. *Plot layout techniques*

Mark the plots according to the specification of the trial design

For square and/or rectangular plots where one may want to mark 90 degrees angles, the triangular principle of 3 - 4- 5 should be used as shown in Figure 6.1 below;

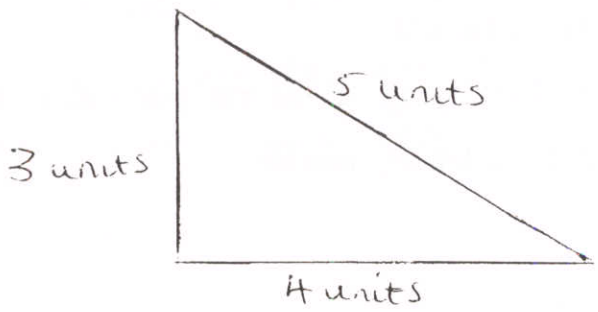


Fig.6.1. Triangular principle of making right angles for square or rectangular plots.

NOTE:

- Plots should be along the contour and not across
- Border rows/zones should be included. These will vary with the inter and intra row spacing, crop and treatment
- Leave paths between plots to avoid walking within them
- Draw the field plan after marking

7

ESTABLISHMENT AND MANAGEMENT OF AGROFORESTRY TECHNOLOGIES

7.1. *Establishment of plots*

7.1.1. *Objectives*

- To facilitate the screening and verification of technologies most suitable to the locality
- To act as demonstration plots within the locality
- To ensure that the plots established are comparable

7.2. *Site preparation*

The site should be well cleared of all shrubs and bushes. If the intention is to establish a woodlot holes for the seedlings may be dug. It is advisable to avoid planting seedlings on termite infested sites as susceptible species are likely to be severely damaged.

7.2.1. *Planting*

Planting should be done when the rains are well established in the months of March/April. Ideally planting should commence when the top 30 cm of the soil is moist and the rains are firmly set.

7.2.3. *Direct seeding in the field*

This saves on labour since it eliminates the time needed to raise seedling in the nursery and out planting them.

Disadvantages

- Germination rates can be low due to
  - Seeds being buried or washed away by rain
  - Insects and animals feeding on the seeds
  - Poor viability of seeds

Direct seeding should only be done if the seeds are plentiful, inexpensive and have a good germination

7.2.4. *How direct seeding is done*

- Seeds should be clean, free of dirt and disease, unbroken, and from a reliable source
- Pretreatment of some seeds is necessary
- Planting of seeds should be done at the beginning of the long rains
- Plant 2 - 3 seeds if germination is known to be good and 3 - 4 if the germination is not known or poor. If more than one seed germinate, the extra can be transplanted elsewhere

7.3. *Establishment from seedlings*

Seedlings have an advantage over direct sowing due to the care they receive from the nursery.

Nursery raised stock is inevitable where:-

- The species have very small seeds
- The germination rate is low or uncertain
- The seeds are in short supply
- The species is valuable
- The intention is to plant seedlings on land where harsh conditions prevail e.g. open land, poor soil etc.

Seedlings can be raised either as bare rooted or in containers.

7.4. *Establishing from cuttings*

7.4.1. *How to establish*

- The mother tree must be healthy and of good form
- Cuttings should be made from young, healthy branches usually 1-2 cm in diameter
- The section to be used for cutting is separated from the main by two clear angled cuts
- The length can be 30-200 cm
- The cutting should contain several nodal points from which branches and roots will sprout
- The cutting should be placed at least 2 nodal point in the soil (see figure 7.1)
- Cutting must be started in well watered soil until roots sprout

The advantages of using cuttings are:-

- Good for growing identical trees with desired characteristics
- They have a fast grow rate compared to seedlings
- They can save on the cost of buying seeds as well as reducing nursery production costs

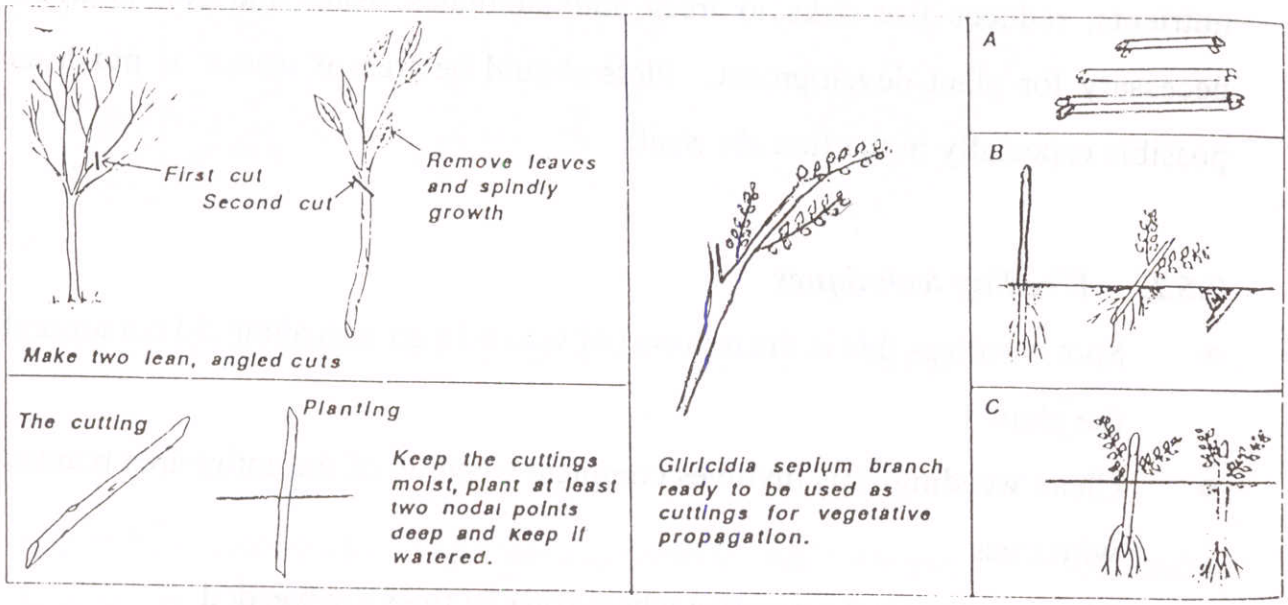


Fig. 7.1. Tree establishment from cuttings.

7.5. *Plot management*

All the treatments and control plots should be exposed to the same management practices.

7.5.1. *Weeding*

This is an important operation since it minimizes competition for moisture and nutrients, reduces fire risks to trees and facilitates water and soil aeration necessary for plant development. Plots should be free of weeds as much as possible especially in the first six weeks.

7.5.2. *Weeding techniques*

- Spot weeding- this is the removal of weeds in an area about 50 cm around the plant
- Clean weeding- this involves complete weeding of the entire area planted with trees
- Line weeding is the practice where rows of trees are weeded

7.6. *Protection of young trees*

7.6.1. *Protection against livestock*

Trees need to be protected in the first 2-3 years. The most common way is by fencing. Various materials can be used for fencing such as thorny branches, sticks and poles. The disadvantage with this method is that it may lead to tree destruction, it is not permanent and requires frequent repair and replacement.

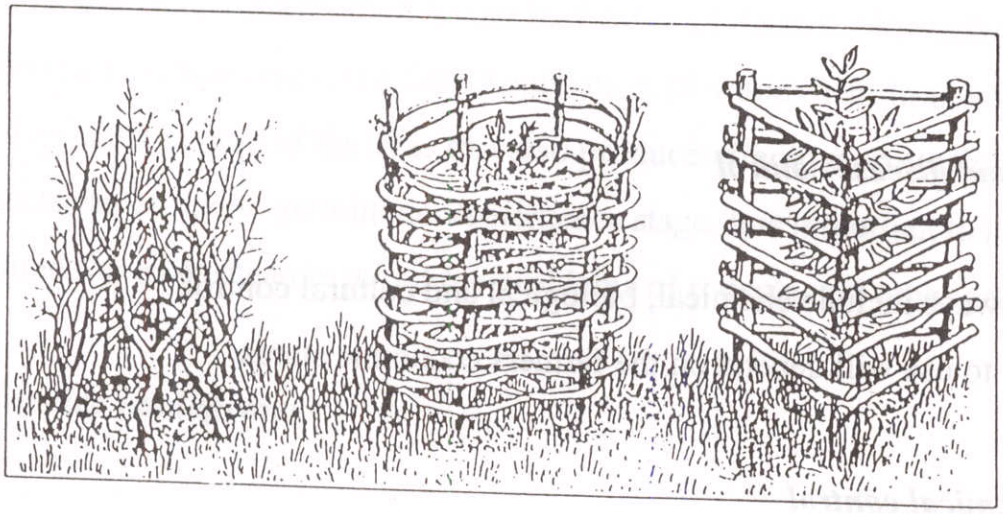


Fig. 7.2. Protection of seedlings by using dead plant materials

Use of live plants such as *Euphorbia tirucalli* is another popular method used in fencing. This is a more permanent method and requires little labour for repair. An alternative method is the use of animal's own dung or urine. This could be mixed with soapy water and either painted or spread around the plants. This acts as a repellent to the invading animals.

7.6.2. *Protection against fire*

The young plants must be weed free as this ensures that there is no grass to fuel a fire.

7.7. *Pest and disease control*

Three basic ways include chemical, biological and cultural control.
The method to use will depend on the farmers economic status.

7.7.1. *Chemical control*

Termites are among the most serious pests that damage growing trees. One way of solving this problem is to grow termite resistance trees. Chemicals such as carbosulfanes can control termites during the early stages.

7.7.2. *Biological control*

This has the disadvantage of not being known to people.
In case of aphid infestation, ladybirds and hymenoptera parasites (wasp parasites) would be useful in controlling the infestation. Hymenoptera parasites would also control defoliators. Poultry plays an important role in termite control. Trap-nests can be made by digging small ditches, placing small sticks over it and covering it with grass and soil. The trap is left overnight to trap termites for poultry.

7.7.3. *Cultural control*

This is the simplest and cheapest of the three methods. It involves the removal of the pest, its food or conditions that favour it. Leaves of *Azadirachta indica* (neem) and *Gliricidia sepium* repel termites. Application of woody ash in the planting hole and around the base of the trees can also produce effective protection. Birds and rodents can attack at germination/emergence stage. It is important to keep the area around the trials clean to avoid the problems of rodents and other pests.

7.8. *Coppice management*

This is the cutting back of trees at a height of 10 - 50 cm from the ground to stimulate the production of new shoots:-

7.8.1. *How to coppice*

- The cut should be slanting
- The bark should not be damaged
- If coppicing is done to produce poles or timber, new shoots should be removed leaving only the best 2 - 3 shoots arising from the edge of the stump to grow
- When the coppice is about 1 m long all the shoots except the best one should be removed
- Young coppice should be kept weed free
- In inter-cropping system the coppicing should be done before the crop is planted
- In other systems coppicing may be done whenever a farmer wishes to harvest poles or fodder

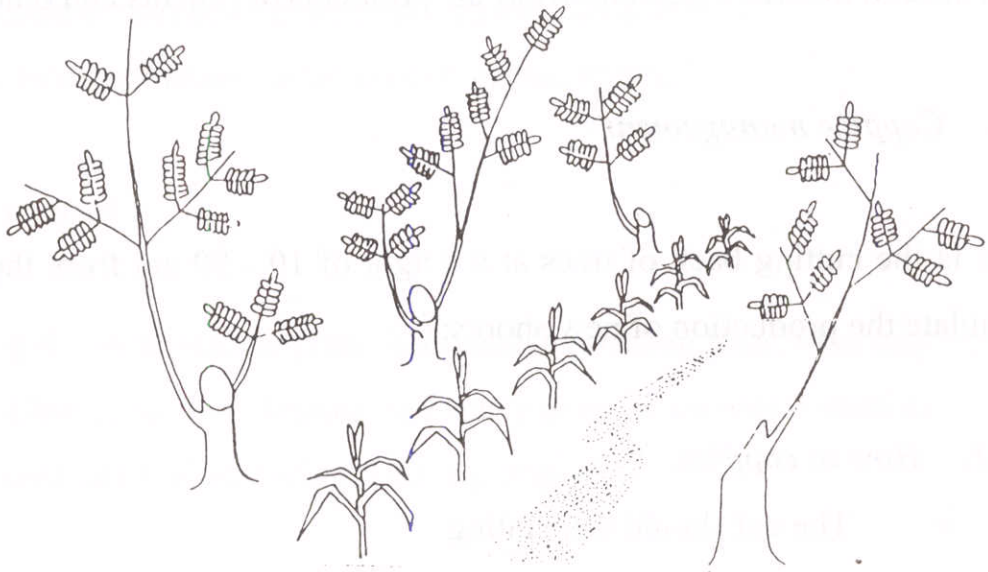


Fig. 7.3. Tree coppicing management to stimulate the production of new shoots

7.8.2. *Pollarding*

This is the cutting back of the crown of the tree at a height of at least 2 m. The crown of the tree is either pruned extensively or entirely removed. The objective of pollarding is to harvest the branches and leaves for fuelwood, fodder, or other biomass to stimulate the growth of new, well formed productive crown and to reduce negative shading effects on the adjacent crops.

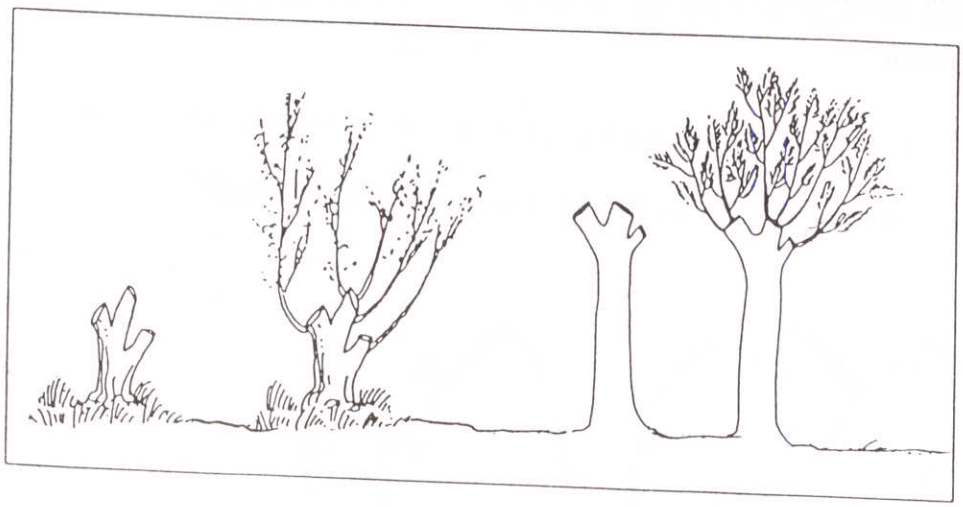


Fig. 7.4. How pollarding is done.

7.8.3. *Pruning*

Side pruning

This is the removal of branches from the tree to:-

- Reduce shade on agricultural crops
- Harvest the branches for fodder, fuel wood etc.
- Produce straight, knot-free poles for sawn timber

This can be done before planting the crop or during the cropping season when trees have a shading effect on the crops.

7.8.4. *How pruning is carried out*

- Pruning should be done at an inclining angle in order to allow water to drain from the cut end of the branch or stem therefore reduce the possibility of fungal attack
- The branches should be 2- 3 cm from the main stem
- Pruning should start from below and then move upwards
- The green leaves may be incorporated into the soil to add organic matter

Fig. 7.5. Side prunning of shrubs and trees

7.8.5. *Root pruning*

In cases where trees are planted in association with crops, it may be necessary to carry out root pruning

Be sure to root prune where trees are not under drought or physical stress.

7.8.6. *How to root prune*

- Dig a narrow 1 m deep trench at about 1 m from the base of the tree trunk
- Severe the exposed roots with a sharp implement
- After pruning return the soil to cover the trench

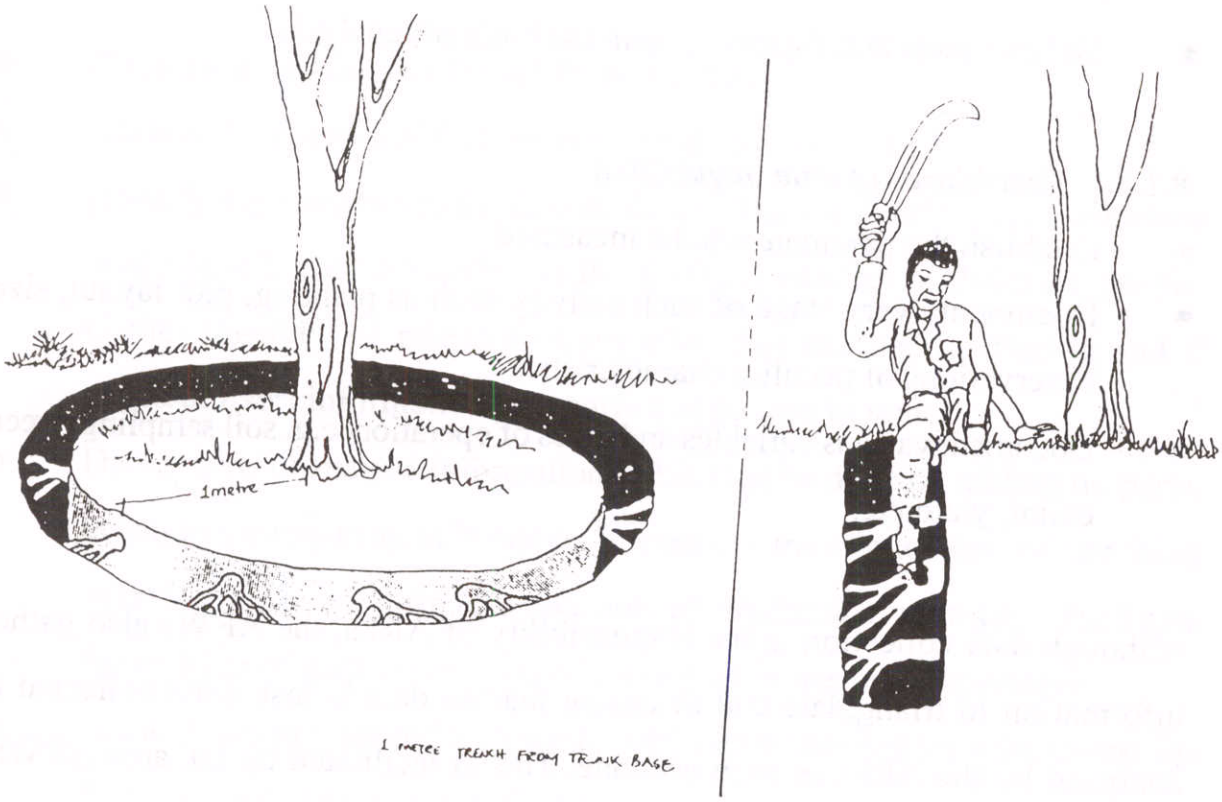


Fig. 7.6. Lateral root pruning.

8

DATA ACQUISITION, ANALYSIS, INTERPRETATION AND PRESENTATION

8.1. *Data acquisition*

Data recording is costly and it is preferable to limit data to those that are useful.

8.1.2. *Objectives of data acquisition*

- To systematically document all findings/observations in trial and control plots
- To have facts and figures to form the basis for analysis

8.1.3. *Procedures of data acquisition*

- Establish the parameters to be measured
- Document every stage of each activity such as planting, plot layout, size observations of peculiar characteristics
- Document various variables and dates of operation e.g. soil sampling, weed count, yield etc.

Although data collection is the responsibility of ARFs, the ARWs also gather information to triangulate and to ensure that no data is lost. Data collected is analyzed by the ARFs in each ecozone. This is facilitated by the area ARWS, guided by senior technical staff (STS) and researchers.

8.2. *Data analysis and presentation*

8.2.1. *Objectives of data analysis*

- Help arrive at research results
- Facilitate participatory research
- Facilitate the identification of further researchable issues for on-station and adaptive research
- Facilitate the presentation of data in a simplified manner so as to be understood by local community

8.2.2. *Procedures of data analysis and presentation*

- Convene a meeting for the ARFs in the area
- Review the questions/objectives of the data collected
- Identify key parameters for data analysis. The mechanism of information analysis will vary according to the thinking process of different people. Gather together all relevant information that has been collected and if necessary sort information into parts that belong together
- Decide how to analyze information. This may be done by adding up parts, averaging, comparing information to examine the relationship of one thing to another. Analysis can also take note of similarities, contrasts. Facilitate the ranking of parameters according to preference and importance
- Use any ranking method to come up with recommended techniques/species
- Analyze quantitative and qualitative information. Quantitative information can be done by use of tally and summary sheets qualitative information can be analyzed by using comparative drawings.

Fig. 8.1. Data Analysis by farmers

8.3. *Data presentation*

- Present data to the community and other stake holders. The results should be presented in a way that is understandable to people for whom they are meant.

The way the results are presented will depend on the kind of information collected, resources available and the tools used for the information gathering.

Qualitative results are more easily presented in visual from such as tables, graphs while qualitative results (descriptions) can make use of dramas, stories and case studies.

8.3.1. *Some guidelines for presenting results*

- Results should be interesting
- Results should be understandable, convincing, participatory
- Results should be presented in a form appropriate to the audience

The first data presentation is done in Barazas (local chiefs meeting) and in group meetings. The process is facilitated by ARF, extensionists and ARWs. It is then synthesized and refined and made scientifically sound for presentation to multi-disciplinary team comprising of representatives from line ministries, research bodies and other NGOs involved in agroforestry extension.

NOTE:

Tally sheets can be used for production scores, such as survival scores and nursery sales (see Table 3 below). It is important to think what information when paired will answer the questions originally asked. This method is especially important where the literacy is low.

Table 3. An example of a tally sheet

Household	A	B	C	D	E	F
Number of people in household	4	7	6	5	3	8
Land farmed	1	3.2	1.3	1	2.5	1.5
Livestock Cows	2	5	4	6	3	9
Goats	6	9	10	5	15	20
Number of trees planted	20	90	150	230	56	75

Note:- Information from each household is filled downward

Averages are calculated by adding horizontally and divinding by the number of households

To show information individually in order to see clearly the difference between each piece of information, a summary sheet such as the one illustrated in Table 4 below can be used. These are very useful for analyzing information from interviews.

Table 4. An example of a summary sheet

Trees planted	Niche where planted			
	Woodlot	Boundary	Home garden	Fodderbank
Leucaena				
Eucalyptus				
Markamia				
Grevillea				


HELLO, IT
IS NICE TO SEE
YOU AGAIN.

9

DEVELOPMENT AND DISSEMINATION OF EXTENSION MESSAGES

After the analysis and validation of the tried technologies, extension messages are developed for extension staff for use during farmer training and adoption thereafter.

9.1. *The goal of extension process*

- To enable people to use developed skills, knowledge and information to improve their quality of life
- Enhance the rate of adoption of technologies from research trials and
- Facilitate easy extension communication

In developing extension messages two criteria are considered

- The first is the role the methods play in adoption process. This involves awareness, interest, evaluation, trial and adoption or rejection.
- The second criteria is the number of audience a method in targeting. The methods include mass media which include radio, newspapers, television, newsletters. The methods are suitable for creating awareness and interest during adoption process.

Group methods include meetings, group discussions and demonstration. These methods are suitable for providing trial and evaluation opportunities during adoption process.

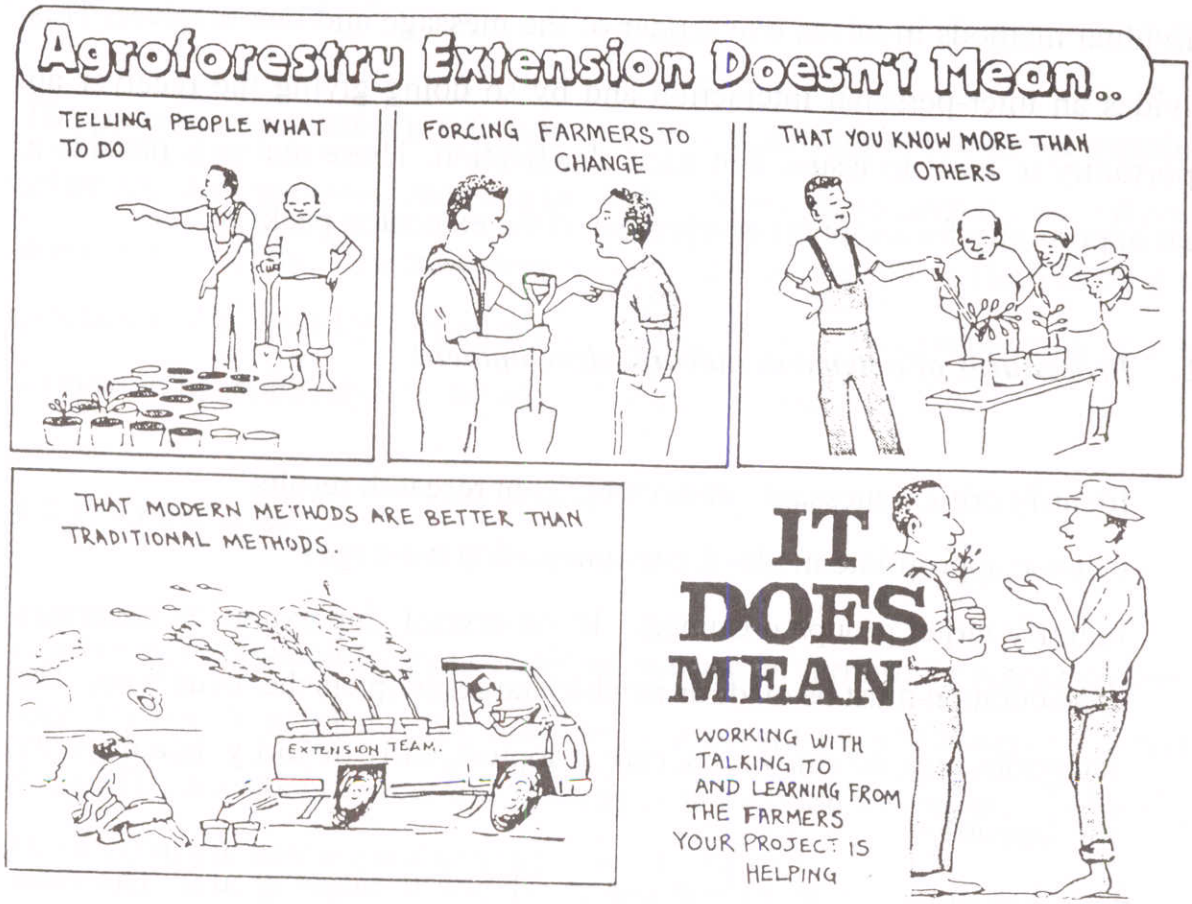


Fig. 9.1. The meaning of extension

Individual methods involves one sender of the message and one receiver. This provides an inter-personal interaction and by so doing giving the receiver an opportunity to react to issues that need clarification. These methods provide a great opportunity for adoption or rejection of the extension package.

9.2. *Procedures of extension message development*

- Identify critical messages emanating from research results
- Choose appropriate mode of communicating messages
- Identify target group/consumers. In contextualizing extension messages consideration must be made as to which target adopters the focus is on. The categories include innovators, early adopters, early majority, late majority and laggards.
- Develop messages as appropriate in relation to target group. The most appropriate method is the one that fully satisfies the intention of the communication process (create awareness, create interest, stimulate action, increase knowledge, change attitude and modify behavior).
- Present developed messages
- Adjust message as appropriate
- Disseminate messages

9.3. *Disseminating extension messages*

- The main objective is to transfer knowledge. The procedure will usually include the identification and organization for forum dissemination and the actual dissemination of the messages. Dissemination can be done through:-

9.3.1. *Demonstration*

This is meant to persuade a farmer to a new practice/innovation for sustained adoption. An effective demonstration is the one that is organized on the farmers farm and using the farmers resources as much as possible. The fact that the practice is successfully carried out by a neighbour builds confidence of other farmers in the applicability and adaptability of the practice

9.3.2. *Field days*

This is a day on which an area containing successful farming or other practice is open for people to visit. The purpose is to permit target farmers to observe personally, ask about successful farming practices and to create a situation in which informal learning and contacts can take place.

9.3.3. *Farm and home visit*

This is a very important tool in the monitoring and evaluation on how well the farmers are responding to the new skills and knowledge. Such visits also serve to strengthen the relationship between the extension agents and the farmer.

9.3.4. *Printed material*

These are economical and practical for storing information.

9.3.5. *Posters*

These are most commonly used sources support materials especially for awareness creation. These are usually hanged at public places where they make the public seek for additional information.

9.3.6. *Photographs*

These are exact visual recording of objects, people etc. They are potential aids especially in discussions. These can be shown to members of a community especially during farmer to farmer visits.

9.3.7. *Audio-visual aids*

This can be an effective way of sharing information and reinforcing specific technical information. Slide presentation should be brief, addressing a single theme at a time. The message contained should be locally relevant.

9.3.8. *Use of schools*

Schools are often seen as convenient focus for extension efforts since they are found almost everywhere. They are well organized and involve a high proportion of the population.

FURTHER READING

Beukeboom, H., Lai, C. K. and Otsuka, M. (1993). Report of the Regional Expert Consultation on Participatory Agroforestry and Silvofishery systems in Southeast Asia, 15-21 November Ho Chi City, Vietnam, Asia Pacific Agroforestry Network Report No.6, Bogor, 133 pp.

Chavangi, A. H. and Zimmermann, R. (1987). A guide to farm forestry in Kenya, Rural Afforestation Service Forest Department, Nairobi, 93 pp.

den Ban, A. W. and Hawkins, H. S. (1988). Agricultural Extension, John Wiley and Sons, New York, 328 pp.

F. A. O, (1989). Community Forestry Participatory Assessment, Monitoring and Evaluation, Community Forestry Note: 2 150 pp.

F. A. O, (1990). The community's toolbox: The Idea, Methods and Tools for Participatory Assessment, Monitoring and Evaluation in community, Forestry Community Forestry Field manual 2, F. A. O Regional wood energy development Bangkok, 146 pp.

Getahun, A. and Reshid, K. (1988). Agroforestry in Kenya: A field guide, Motif Creative Arts Limited, Nairobi, 59 pp.

Kerkhof, P. (1990). Agroforestry in Africa: A survey of projects experience (G. Foley and G. Barnard eds.) Panos Publications Ltd, London, 216 pp.

Kimwe, S. and Noordin, Q. (1994). Management and uses of Agroforestry Trees, Agroforestry Field Manual -KWAP, ETC Kenya Consultants B. V. Nairobi, 36 pp.

Raintree J. B., (1987). The state of the art of agroforestry diagnosis and design. *Agroforestry systems*, 9: 219-251.

Raintree J. B., (1987). D&D User's Manual: An Introduction to Agroforestry Diagnosis and Design, ICRAF, Nairobi, 100 pp.

Simute, S. (1992). Agroforestry Manual for extension workers with emphasis on small scale farmers in Eastern province, Zambia, Regional Soil Conservation Unit SIDA, Technical Handbook No: 2, Nairobi, 93 pp.

Tengnas, B. (1993). Guidelines on Agroforestry Extension Planning in Kenya Regional, Soil Conservation Unit Technical handbook No.3 71 pp.