WORKING TOGETHER

Gender Analysis in Agriculture

Editors

Hilary Sims Feldstein
Susan V. Poats

VOLUME 2: Teaching Notes

KUMARIAN PRESS

PN-ABN-061
ISN 80411

Working Together

Gender Analysis in Agriculture

Volume 2
Teaching Notes

Editors

HILARY SIMS FELDSTEIN
AND SUSAN V. POATS

KUMARIAN PRESS

Dedication

These volumes are dedicated to our husbands and children who have given us unstinting emotional support and who have transcended roles defined by gender or age to give us the space and time to complete this work.

To Lew and Julio, and Sarah, Robert, Rushuma, and Nicholas

Copyright © 1989 Kumarian Press, Inc.
630 Oakwood Avenue, Suite 119, West Hartford, Connecticut, 06110-1529, USA
All rights reserved under International and Pan-American Copyright Conventions. No part of this book may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording or information storage and retrieval system, without prior written permission of the publishers.

First printing in the United States of America, 1990
94 93 92 91 90 5 4 3 2 1

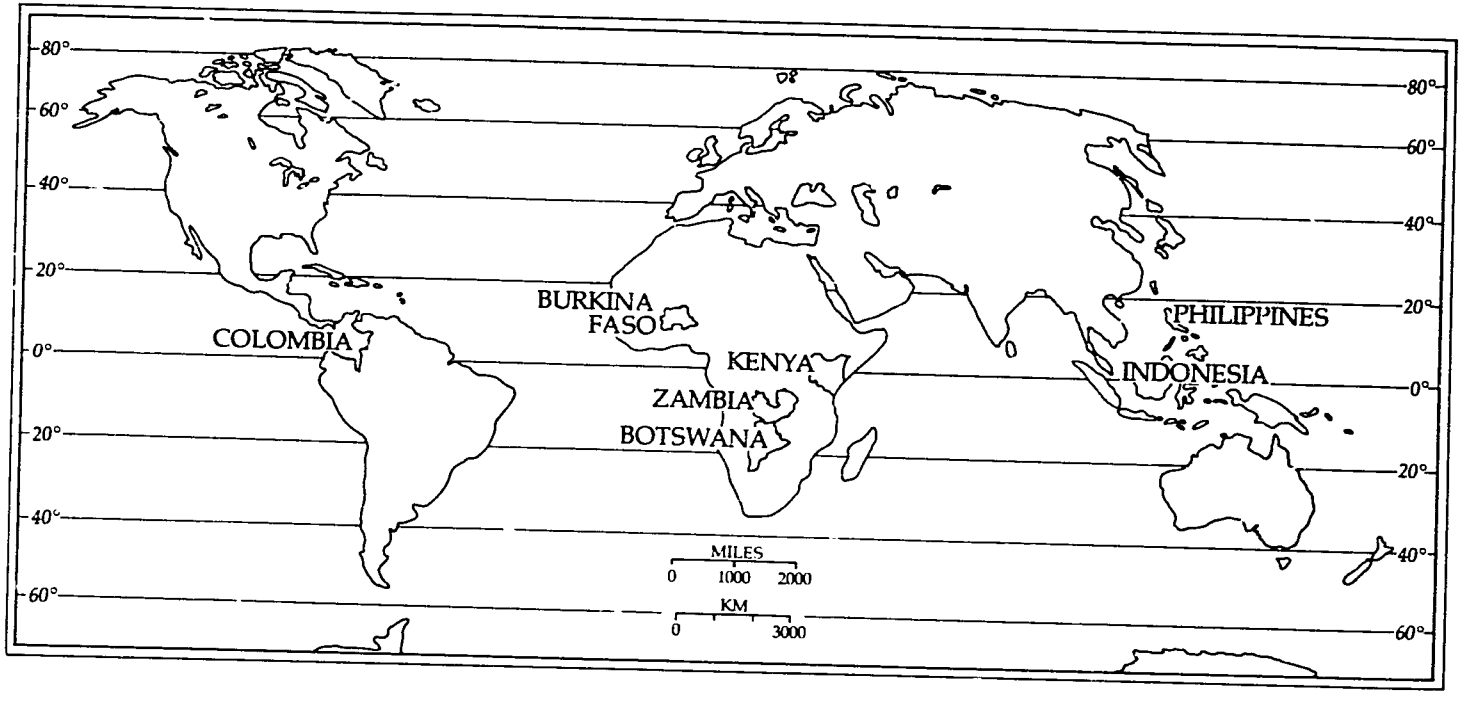
Cover design by Marilyn Penrod
Figures by Paloma Ibarra
Edited by Erica Swanson
Proofread by Ruth M. Wilson

Phototypeset by Johnson Publishing Company

Library of Congress Cataloging-in-Publication Data

Working together : gender analysis in agriculture / edited by Hilary Sims Feldstein and Susan V. Poats.
p. cm. — (Library of management for development) (Kumarian Press case studies series)
Includes bibliographical references.
Contents: v. 1. Case studies — v. 2. Teaching notes.
ISBN 0-931816-58-0 (v. 1) — ISBN 0-931816-59-9 (v. 2)
1. Agricultural systems—Research—Case studies. 2. Women in agriculture—Research—Case studies. 3. Agricultural extension work—Case studies. 4. Farms, Small—Case studies. 5. Agricultural systems—Research—Developing countries—Case studies. 6. Women in agriculture—Research—Developing countries—Case studies. 7. Agricultural extension work—Developing countries—Case studies. 8. Farms, Small—Developing countries—Case studies. I. Series. II. Series: Kumarian Press case studies series.
S494.5.S95W65 1989 90-4287
630'.72—dc20 CIP

Working Together


80°
60°
40°
20°
0°
20°
40°
60°
COLOMBIA
BURKINA FASO
KENYA
ZAMBIA
BOTSWANA
PHILIPPINES
INDONESIA
MILES
0 1000 2000
KM
0 3000

Contents

Frontispiece *ii*

List of Figures *vii*
List of Tables *vii*
List of Appendices *x*

Introduction *Hilary Sims Feldstein and Susan V. Poats* 1

Chapter 1 Preparation for Teaching a Case 5

Chapter 2 **Botswana.** Farming Systems Research in a Drought Prone Environment, Central Region Farming Systems Research Project
Teaching Notes for Part 1 (Vol. 1, Chap. 3) 23
Part 2 Adaptations in Experimentation and Monitoring during the Fourth Season 40
Doyle C. Baker with Hilary Sims Feldstein
Teaching Notes for Part 2 52

Chapter 3 **Burkina Faso.** A Case Study of the Purdue University Farming Systems Project
Teaching Notes for Part 1 (Vol. 1, Chap. 4) 62
Part 2 Experimentation and Monitoring 81
Joseph G. Nagy, Herbert W. Ohm, and Sibiri Sawadogo
Teaching Notes for Part 2 94
Part 3 Evaluation, Modifications, Recommendations, and Dissemination 104
Joseph G. Nagy, Herbert W. Ohm, and Sibiri Sawadogo

Chapter 4 **Colombia.** Production and Consumption Aspects of Technology Testing in Pescador
Teaching Notes for Parts 1 and 2 (Vol. 1, Chap. 5) 126
Part 3 Findings and Future Research 142
Jacqueline A. Ashby

Chapter 5 Indonesia. Farm-based Research in the Tropsoils Project, Sitiung
Teaching Notes for Part 1 (Vol. 1, Chap. 6) 145
Part 2 Research in the Second and Third Year 160
Vickie A. Sigman, Carol J. Pierce Colfer, Kathleen Wilson, and Russell Yost

Chapter 6 Kenya. Agroforestry Extension and Research, A Case Study from Siaya District
Teaching Notes for Part 1 (Vol. 1, Chap. 7) 171
Teaching Notes for Part 2 (Vol. 1, Chap. 7) 183
Part 3 After Eighteen Months 194
Hilary Sims Feldstein, Dianne E. Rocheleau, and Louise E. Buck

Chapter 7 Philippines. Women in Rice Farming Systems, Crop-Livestock Project, Sta. Barbara, Pangasinan
Teaching Notes for Part 1 (Vol. 1, Chap. 8) 204
Part 2 The Second Season, Experimentation and Innovation after the Introduction of the Women's Component 219
Thelma R. Paris

Chapter 8 Zambia. Intrahousehold Dynamics and FSR/E in Zambia, a Case Study of Traditional Recommendation Domain 3 in Central Province
Teaching Notes for Part 1 (Vol. 1, Chap. 9) 226
Part 2 Description of the Farming System and Problems Identified 244
Charles Chabala and Robert N. Gichira

Contributors 255

List of Figures

Chapter 3 Burkina Faso
Figure 3-1 Gender-disaggregated Activity Calendar for the Mossi Plateau 70

Chapter 7 Philippines
Figure 7-1 Cropping Calendar before the WIRFS Survey 209
Figure 7-2 Cropping Calendar after the WIRFS Survey 217

Chapter 8 Zambia
Figure 8-1 Gender-disaggregated Activity Calendar for Mkushi District 235

List of Tables

Chapter 2 Botswana
Table 2-1 Characterizing the Environment 30
Table 2-2 Access and Control Analysis of Resources 31
Table 2-3 Activities Analysis 33
Table 2-4 Assessment of Tillage-planting Trials Compared to Traditional Practices 33
Table 2-5 Benefits of Different Tillage Practices (1) 35
Table 2-6 Benefits of Different Tillage Practices (2) 35
Table 2-7 Future Trials 37
Table 2-8 Economic Analysis of a Sole-cropping Trial 45
Table 2-9 Traditional Sorghum Production, 1985–86 46
Table 2-10 Effects of Plowing and Planting Methods and Phosphate on Yield for Four Environmental Groups 49
Table 2-11 Farmer-Implemented Double-Plowing Sorghum Trial, 1985–86 50
Table 2-12 Farmer Participation in Trials, Fourth Season 50

Chapter 3 Burkina Faso

Table 3-1	Activities Analysis: Time Use and Task Allocation	71
Table 3-2	Access and Control of Resources for Farm Production	72
Table 3-3	Incentives Analysis: Access and Control of Benefits	73
Table 3-4	Maize Tied-Ridge Trial on Compound Plots, 1982	83
Table 3-5	Gender Division of Labor Hours for Major Agricultural Activities in Communal Fields	85
Table 3-6	Economic Analysis of Farmer-Managed Trials of Millet with Volta Phosphate and Tied Ridges, 1983–84	88
Table 3-7	Economic Analysis of Farmer-Managed Trials of Sorghum with Fertilizer and Tied Ridges, 1983–84	90
Table 3-8	Percentage of Cultivated Land Area by Tenure Category, 1984	92
Table 3-9	Comparison by Gender and Age of Labor Force and Farm Operations on Communal Fields	97
Table 3-10	Access and Control of Resources in Sorghum Tied Ridges and Fertilization Trial	99
Table 3-11	Tied Ridging and Fertilization Effect on Work Load	100
Table 3-12	Labor and Cash Requirements for Tied Ridges and Fertilizer, Bangassé	101
Table 3-13	Whole-farm Modeling Analysis of Tied Ridging with Donkey Traction	108
Table 3-14	Effects of Animal Traction and of Three Methods of Tied Ridging	112
Table 3-15	Percent of Farmers Adopting Tied Ridges, Fertilizers, and New Varieties	114
Table 3-16	Average Hectares of Technology Adoption	116

Chapter 4 Colombia

Table 4-1	Research Objectives	133
Table 4-2	Assumptions	134
Table 4-3	Activities Analysis: Part 1	135
Table 4-4	Resources Analysis: Part 1	135
Table 4-5	Activities Analysis: Part 2	137
Table 4-6	Resources Analysis: Part 2	137

Table 4-7 Research Activities: Parts 1 and 2 138
Table 4-8 Findings from Participant Observation 140
Table 4-9 Recommendation Domains Related to Intrahousehold Variables 143

Chapter 5 Indonesia
Table 5-1 General Learnings from the First Fifteen Months 153
Table 5-2 Ethnic and Site Differences 154
Table 5-3 Activities Analysis 155
Table 5-4 Inclusion Analysis 158
Table 5-5 Selected Soil Chemical Analysis of the Fertility Treatments After Years 1 and 2 161
Table 5-6 Home Garden Area Planted to Food Crops 163

Chapter 6 Kenya
Table 6-1 Activities Analysis 176
Table 6-2 Resources Analysis 177
Table 6-3 Desirable Benefits 178
Table 6-4 Zone Differences 179
Table 6-5 Extension and Research Tasks 180
Table 6-6 Alley Cropping and Gender Questions 182
Table 6-7 Spaces for Trees 189
Table 6-8 Desirable Benefits from Agroforestry 190

Chapter 7 Philippines
Table 7-1 Access and Control Analysis of Resources 212
Table 7-2 Activities Analysis 213
Table 7-3 Access and Control Analysis of Benefits 215
Table 7-4 Agronomic Characteristics of Glutinous Rice Varieties 220
Table 7-5 Costs and Returns of Glutinous Rice Varieties 220

Chapter 8 Zambia
Table 8-1 ARPT Activities in TRD3 233
Table 8-2 Resources Analysis for TRD3 236
Table 8-3 Benefits Analysis for TRD3 237
Table 8-4 Sample Problem Clarification and Proposed Solutions for TRD3 240
Table 8-5 Estimated Revenues from Crops 242
Table 8-6 Estimated Revenues per Day of Labor 242
Table 8-7 Main Characteristics of Male- and Female-Headed Households in TRD3 248

Table 8-8 Statistics on Female-Headed Households in TRD3 249
Table 8-9 Comparison of Female-Headed Households in TRD3 250

List of Appendices

Chapter 1 Preparation for Teaching a Case
Appendix 1 Suggested Arrangements for Teaching a Case Study 19

Chapter 2 Botswana
Appendix 2-A Letter from the Field 55
Appendix 2-B Computations: Gender-disaggregated Costs and Benefits from Double Plowing and Row Planting after Early Plowing 57
Appendix 2-C More Comments from the Field 59

Chapter 3 Burkina Faso
Appendix 3-A Summary of 1982 FSU On-farm Researcher-Managed Trials 118
Appendix 3-B On-farm Farmer-Managed Trial, Volta Phosphate and Tied Ridges on Millet Fields 120
Appendix 3-C Summary of 1983 and 1984 On-farm Trials 122

Chapter 5 Indonesia
Appendix 5 Letter from Joan to a Colleague in the United States 167

Chapter 6 Kenya
Appendix 6-A Gender Implications of Recommended Practices: Mutumbu 198
Appendix 6-B Recommended Agroforestry Species and Their Uses: Second Season 200
Appendix 6-C Agroforestry Research Trials 201

Chapter 8 Zambia

Appendix 8-A Results of On-farm Trials: Effects of Lime on Groundnuts, Maize, and Sunflower 251

Appendix 8-B Results of On-farm Trials Exploratory Study of Planting Method and Fertilization 253

Introduction

HILARY SIMS FELDSTEIN AND SUSAN V. POATS

The objective of this volume is to provide assistance in the analysis and teaching of the seven case studies included in *Working Together* Volume 1. This volume also includes the second and third parts to the Botswana, Burkina Faso, Indonesia, Kenya, Philippines, and Zambia case studies. All but one of the cases have been used in a training setting. The cases have been taught at the Gender Roles and Farming Systems Research and Extension Conference (University of Florida); a CIMMYT (International Maize and Wheat Improvement Center) East and Southern Africa Economics Program Networkshop in Zambia; the Women and Rice Farming Systems Network Workshop at the International Rice Research Institute, Philippines; the Farming Systems Support Project training courses in the Gambia; and the International Research Development Centre in Ottawa. They have also been used for teaching at the University of Florida, Iowa State University, and Virginia Polytechnic Institute and are part of the continuing work of the Gender and Agriculture Project.[1]

In testing and training with the cases we have received invaluable assistance from Mary Anderson and Catherine Overholt of the Collaborative for Development Action.[2] They have given unstintingly of their time, experience, and good humor in helping us learn how to organize for and "deliver" the teaching of a case. Mary Anderson helped prepare a team of us for our first teaching of the Zambia case at the Gender Roles Conference in 1985. She and Catherine Overholt led a Training of Trainers course sponsored by the Women in Agriculture program at the University of Florida in 1987, which we both attended. And in 1988, with us as co-trainers, they led a Training of Trainers course in advance of the Farming Systems Research and Extension Symposium in Fayetteville, Arkansas. We have drawn heavily on their teachings in the preparation of our guidelines. We have also learned from three excellent trainers with the Training Resources Group, James McCaffrey, Ed Salt, and Wilma Gormley, whose ideas, filtered through our own experience, have also contributed to this volume.[3] Rosalie Norem, Kathleen Cloud, Mary Rojas, John Lichte, and Ruth Grosvner-Alsop have also shared with us their experiences in teaching these cases. Finally, we would like to thank the participants from the case training sessions of the last three years; their evaluations have helped immensely in the preparation of this volume.

Chapter 1 in this volume, "Preparation for Teaching a Case," discusses general principles concerning the use of case studies and provides conceptual and logistical guidelines in organizing oneself to teach with cases. This chapter should be helpful to any teacher or trainer organizing for his or her own discussion of the material.

The subsequent chapters cover teaching notes specific to each case in Volume 1. They draw heavily on our own teaching experiences and work with the cases. They include good nuggets we want to pass along, but they are not the only points to raise or ways to teach these cases. These cases are rich in material, and there are themes other than the ones we have highlighted which can be usefully drawn out. Except where noted the teaching notes were written by the editors.

For each of the seven cases, the first teaching note is organized in the following manner: synopsis of the case, use of the case, learning objectives, sample study questions, analysis of the case, and sample discussion questions. The discussion questions follow from one another and are organized around a teaching session of approximately an hour and a half. The discussion questions are sometimes supplemented with a short list of other questions or areas to consider. The teaching notes make many references to material in Volume 1, the data of the case. In preparing for the case, one will go back and forth between the case itself in Volume 1 and the notes in Volume 2. Following the teaching note, there will be the text of a subsequent section of the case for further discussion. This is particularly useful in a classroom setting or a long training session. For subsequent sections of a case, we have provided some suggestions about key points which could be brought out in discussion, but we have not prepared a synopsis, analysis, or specific discussion questions.

For those reading this volume who are trainers, we recommend first working through the case oneself, using the general guidelines provided in Chapter 1. This is a surer way to get the firm grasp of the material needed for teaching the case. The trainer may then go to our notes and modify his or her work as seems appropriate.

For those reading these cases on their own, we recommend that specific attention be paid to the case synopsis and the analysis of the case. Note, however, that not every point brought out in the discussion questions is included in the analysis, so for greater depth we recommend reading the discussion questions as well.

As each case unfolds and is analyzed according to the conceptual framework, it becomes a working demonstration of how gender analysis contributes to a better understanding of farmer decision-making and, consequently, to improved focus and design of agricultural research and extension.

NOTES

1. Gender and Agriculture Project
   Hilary Sims Feldstein
   RFD 1, Box 821
   Hancock, NH 03449 USA

   and

   Susan V. Poats
   FUNDAGRO/CIAT
   Casilla 219 Suc. 16 C.E.Q.
   Quito, Ecuador

2. Mary B. Anderson and Catherine Overholt
   Collaborative for Development Action
   26 Walker Street
   Cambridge, MA 02138

3. Training Resources Group
   1021 Prince Street
   Alexandria, VA 22314

Chapter 1

Preparation for Teaching a Case

HILARY SIMS FELDSTEIN AND SUSAN V. POATS

CONTENTS

General Guidelines
Format for Teaching with Case Studies
Role of Trainer/Discussion Leader
Preparation for Teaching a Case
Details
Guidelines to the Specific Cases
Notes
References

Appendix 1 Suggested Arrangements for Teaching a Case Study

GENERAL GUIDELINES

Case studies are a form of experiential learning. As we have stated in Chapter 2 of *Working Together* Volume 1, research shows that adult learners learn best when they have an experience with relevant material rather than when they passively listen to a lecture. The learning comes from processing the experiential material (i.e. the observations and analysis of the specific situation), and then drawing out from that processing general principles or observations and applying those to one's own situation. The experience these cases present is of being immersed in the data and decisions of a particular research situation. In training with cases, a trainer or facilitator will assist that learning by helping participants understand and analyze the information and examine possible decisions. The learning will be enhanced when the trainer draws out from working through the particular case general principles about the applicability of gender analysis.

Previous Page Blank

Finally, with an individual case, or toward the end of training with several cases, a trainer can help participants examine and plan for the application of the general learnings to their own research or institutional situation.

To guide the processing and generalized learning from cases, trainers need to prepare well. They should be clear about their learning objectives, very familiar with the case material, and have ready a series of questions with which to guide discussion.

Learning Objectives

The overall learning objectives of the case studies are to convey an understanding of the concepts of gender analysis as presented in the conceptual framework, and their use in practice. It is important to separate those points—which are didactic, explicit, up front—from the outcomes of the discussions and the decisions participants may make. The point of discussion generated by analysis of a case is not that there is one right answer. Various options and opinions will be expressed. What option to pick, what research should receive priority, how to organize an on-farm trial will be decided differently by different researchers or research groups and by different participants. With gender-sensitive information or analysis, the farming system and research options are better defined, but researchers may legitimately differ in their conclusions. Within the analysis of the case and the discussion of the options lies the juice of the case method, but its ultimate outcome should not be considered a foregone, preset conclusion.

In determining which case to use or how to prepare for the teaching of a particular case, trainers should think about what specific learning objectives they have for the participants: What "aha" experience does the trainer want the participants to have? What learning should participants be taking back to their own work? These learning objectives should be kept in mind throughout the preparation process.

For each specific case, we have posed a set of four or five learning objectives. These objectives are reflected in the study questions and, more directly, in the discussion questions. They should also be reflected, as much as possible, in a trainer's summation of the discussion. In preparing for one's own discussion, checking the alignment between learning objectives, study questions, discussion questions, and likely summation helps check for thoroughness of thinking through the discussion possibilities of the case.

Questions

Two sets of questions accompany cases. First is a set of study questions given to participants along with the case. The point of study questions is

to direct people to particular parts of the case or aspects of the material. The study questions and the conceptual framework help people begin to organize and process the information in the case. Study questions are not test questions. Study groups may use them to organize their own discussions, but they are not expected to present reports responding to the questions. A trainer should feel free to emphasize different points or to make up his or her own study questions, or if time is short to direct participants to particular sections of a case.

Discussion questions are the questions used by the facilitator to move discussion by the larger group along and to make sure all aspects of a case are covered. As discussed below, many of these are prepared ahead of time. Sample study questions and discussion questions are provided for each case.

FORMAT FOR TEACHING WITH CASE STUDIES

The format for using a case study is intended to give trainees the opportunity to go through the material several times in different environments. Basically this involves self-study, working through the material in small, unstructured discussion groups, and working through the material with the whole group, in plenary, in which the discussion is facilitated by a trainer. Specifically, the format breaks down as follows:

1. The introduction to the case method and the case materials and any other relevant background materials
2. Self-study by the participants
3. Small group discussion
4. Plenary discussion under the leadership of a trainer
5. Evaluation
6. Discussion of follow-up activities relevant to the organization for whom training is conducted

The time, room, and materials requirements for teaching case studies are laid out in Appendix 1. The components of the format are described below.

Introduction of Case Materials

The case materials are introduced preferably the evening before the first case is to be taught. We have used this time to introduce general concepts

of gender and agriculture, to go over the conceptual framework (*Working Together* Vol. 1, Chap. 1), and to introduce participants to the case method (Chap. 2) and to what they should expect. If we haven't done so earlier, we direct people to the conceptual framework, the introduction to the case study method, and the specific case. We also hand out study questions, emphasizing that they, along with the conceptual framework, are helpful guides for organizing the material.

A general discussion of gender and agriculture can be drawn from the conceptual framework (*Working Together* Vol. 1, Chap. 1), from Cloud (1985, 1988), Poats et al. (1988), Feldstein et al. (1989), or from the trainer's own experience. We have often reinforced the general point about women and gender in agriculture with a movie or a slide show which gives visual evidence of women's importance in crop and livestock production.[1]

A visual layout of the categories for analysis suggested by the conceptual framework is also helpful. This can be done with blackboard, flip chart, or visual overheads. A trainer should emphasize that what is being asked is *who*. Who does what? And with reference to the cropping calendar, who does what *when*? Also, who is doing what other activities (household, off-farm) at any time of the year? Who invests or can invest resources into crop or livestock production? Who will benefit from specific enterprises? Who is included at each stage of research and implementation? The questions reinforce the point that gender is not an amorphous mass of information, but is amenable to being organized into categories useful for understanding farm production.

To help participants prepare the case, the trainer should point out the guidelines for studying a case given in *Working Together* Volume 1, Chapter 2. The trainer should also lay out the training timetable, the room arrangements and purposes for small group discussions, and the expectations for the plenary discussion. Participants need to be reminded there is no lecture and that they are all expected to engage in discussion. It is important to state up front that information will sometimes be incomplete and that the situation described may seem too narrow a slice of life. Participants should recognize that this is often true in real-life decision-making situations, and particularly true of field-based on-farm research, where the luxury of having all the information is rare.

Self-study

Trainers should allow ample time for self-study. For the first case, this includes time for reading the conceptual framework as well as for the case itself. How much time is required will depend on participants' familiarity with English, the time available in the overall training program, and a re-

alistic assessment of distractions. We prefer to hand out materials the night before and begin the first full day with small group discussions. However, where the schedule is tight and distractions are very strong, it may be better to build self-study right into the day.

Study Group Discussion

Study group discussion is the springboard for discussing the case with the larger group of participants. Working in a small group of four to five is an excellent way for participants to try out ideas generated by self-study and to consider and reconsider the evidence in the case. Critical thinking involves testing ideas with colleagues and, for many, the small study group discussion is a less threatening way to begin that process if it is an unfamiliar one in a training or workshop situation. We prefer to give no directions to the study groups other than to say that they are not expected to make a report (see below for exceptions). It is the participants' opportunity for an enriched studying of the case, to massage or work through the material on an experimental basis. To maximize participant involvement we suggest study groups be limited to no more than six.

After the groups have a chance to start their own discussion, the trainer will find it useful to move often from group to group, sitting in for a while to hear what is going on. Trainers should never participate, except occasionally to clear up a misunderstanding. The point is to listen and learn something more about the participants and the level at which they are grasping the content. Sometimes one hears an important point useful for the plenary discussion.

Plenary Discussion

The plenary discussion is the opportunity for a collective discussion of the evidence and analysis of the case. It is led by a trainer who acts as a discussion leader or facilitator, assuring that everyone's voice is heard and that the relevant points are discussed in the time available. The notes below are focused primarily on the trainer's preparation for leading the plenary discussion.

Evaluation

We have found participant evaluation of the case studies very valuable in thinking through our use of the cases and the unfolding of the plenary discussion. Where time permits, evaluation has been done by returning to small groups and posing a question on which they do report, and by discussing these reports in plenary. Alternatively and more usually, we have

provided written forms and led a discussion of both case content and the whole delivery process (introduction, study questions, study groups, plenary, etc.).

Application and Follow-up Activities

Asking participants to relate the learnings from the case study training to their own activities or institution is valuable in at least three ways. First it reinforces the learnings from having practiced gender analysis, linking them directly to the participants' own situations. One way of drawing this out is in small group discussions and reports or in a general discussion. Another possibility is having participants fill out a written form full of application questions (What would one do? How would help be sought? etc.) which they keep.

A second benefit is the transfer of insights and learnings to the participants' institution. This is particularly true when participants are all from one institution. Questions can be directed to what the institution can do to enhance the inclusion of gender analysis and a report can be made by the trainers on the advice from the participants. Finally, considering the applications of gender analysis to the participants' own work and institutions provides a natural point of closure.

ROLE OF TRAINER/DISCUSSION LEADER

The main task of the trainer is to guide discussion within the time frame available to cover the critical elements. The trainer's responsibilities include the following:

1. Raising the critical issues

2. Ensuring that all the information eligible for consideration is considered

3. Helping people undertake organization of the data using the conceptual framework

4. Helping people assess the research opportunities and decisions about future work according to that analysis

5. Facilitating an exchange of views assessing alternative decisions based on the analysis

6. Summarizing the discussion, drawing out or emphasizing the general principles or learnings concerning the use of gender analysis as an analytic tool in agricultural research and development

In our experience, case method is most effective in transferring the notion and skills of gender analysis when trainers refrain from telling participants what their opinion is, what a right answer is. In a sense, the process of thinking and discussing takes precedence over the message. Case study trainers should visualize themselves as discussion leaders rather than as college lecturers. It is important that trainers make the discussion environment comfortable for participants so that they do not feel at risk in venturing an idea. A discussion leader must be very well prepared in the substance and learning objectives of the case in order to keep the discussion on course, but open and flexible enough to tolerate diverse points of view.

PREPARATION FOR TEACHING A CASE

We cannot emphasize enough the value of preparing carefully for training with case studies. As a trainer you should know the material well, be clear about the critical issues to be discussed, and manage the limited time available. What follows is a list of steps we take in preparing to teach.

Before Teaching

1. Read the case thoroughly. This means reading it many times over and marking it up—with highlighter, notes, underlining—in order to identify major points and sources of information.

2. Determine areas for discussion. This will be affected by *(a)* the learning objectives, *(b)* the material in the case, *(c)* the nature of the group being trained, and *(d)* institutional demands. The teaching notes we have provided for each case do suggest learning objectives and study questions, but you or your institution may have other ones. In most plenary sessions, only two or three major points may be addressed, so consideration of what areas have the highest priority is also important. For each area likely to be discussed, identify the important points from the case and the supporting evidence. What are the points which you will want to put on the blackboard?

3. Organize the discussion points. What leads to what? Is there a logical order? How do the discussion points relate to the learning objectives? How can you create linkages between different points. Are there abstract or generalizing questions generated by the case which can be usefully dis-

cussed? Identify topic areas. Plan a sequence of discussion. Most discussions start with information-seeking questions, insuring everyone is using the same basic information. They then move on to analysis, to the identification of constraints or research opportunities, and to discussion and decisions about next steps in the project. Plan alternatives in case the discussion goes very fast or other interesting areas capture people's attention.

4. Plan time management. Most plenary discussions run between an hour and fifteen minutes to an hour and forty-five minutes. Plan how much time should be devoted to getting out the basic information and analysis and exploring the decisions or consequences. Make visible notes to yourself which give the time allowed for each topic area and find a way to monitor yourself on this while teaching.

5. Plan transitions. Prepare questions or linking statements which move you from one area of discussion to the next.

6. Plan the use of the board. The blackboard or its substitute provide a visual way of keeping track of the discussion, a reminder of what has been said. The analysis put on the board becomes a reference for later consideration of research possibilities and the design or consequences of improved technologies. We recommend a minimum of three large blackboards (see Appendix 1). Plan how many can be put up and where. Set up areas so linkages can be demonstrated by drawing with chalk from one section to another or by moving from one area to the next. The tables included with the teaching notes are illustrations of boards which might be created, though the boards themselves would include more shorthand than we have used in the tables.

7. Prepare a summary. Have ready some closing remarks which underline how using gender analysis contributes to improved research or extension. Draw on examples from the discussion. While the content of discussion will differ from case to case and between different teachings of the same case, there will be illustrations of the application of findings from gender analysis to decisions about future steps. The summary should reflect the original learning objectives (e.g., "We have seen how activities analysis helps us determine who should be involved in experimentaion with new fertilization practices"). The summary may also include what actually happened next in the case and a handout based on materials in this volume.

At the Training Site

The space, time, and materials requirements for teaching a case are given in Appendix 1. Once at the site, check out the room and blackboard arrangements and do what you can to make them conducive to a lively exchange of ideas. Three other areas of preparation are learning about the participants, selecting study groups, and making name tags.

1. Learning about the participants. If you are not working with your own colleagues or students, ask your hosts about the participants. Knowing their areas of expertise and their biases (pro and con) can help prepare you for drawing on their strengths and anticipating resistance. Take advantage of other opportunities before the case study (informal get-togethers, other workshop presentations, etc.) to learn more about the participants. In some situations gender is still a loaded topic. Learning about participants in advance will help you explode the land mines before they explode on you.

2. Selecting study groups. Ideally discussion groups mirror the representation of the large group. That is, they should include a mix of disciplines, genders, positions (seniority), area expertise, and, possibly, attitudes towards gender analysis. Problem solving and the breakdown of disciplinary biases will be enhanced by the mix of disciplines.

3. Making name cards. Make name cards to be placed in front of each participant at the table. Make sure the name you want to call people by is large enough to be seen from where you are standing.

Finally, enjoy yourself. The process works! We have found that the experience, energy, and ideas brought to each case session by the training participants is thoughtful, stimulating, and engaging.

DETAILS

Calendaring. It is very important in farming systems research and extension to recognize the *when* as well as the *who*. In land-rich, labor-scarce areas, conflict or potential conflict between tasks is an important element for farmer decision-making. The utility of a calendar in any particular case depends on the complexity and overlap of the system. We have found it particularly useful in the Burkina Faso and Zambia cases.

After several experiments, we have found the most efficient way to deal with disaggregating a calendar by gender is to preset the calendar on a board. This can be made ahead of time on flip-chart paper (four pieces taped together make enough space to draw the whole calendar), or on a separate movable black or white board that is turned away from the participants until the time to display it. Alternatively, the calendar can be preset on an overhead transparency.[2] Whatever the medium, it is useful to construct the calendar with the activities but leave off the gender indications. For the figures in the text, these are symbolically indicated. On the board, these can be highlighted better with different colors. It is possible to generate the calendar through questions to the participants; however, this takes a lot of time and most participants will have already generated some sort of calendar on their own and will have augmented it during the small group discussion. Having it already framed allows for participants to add missing information which you may have left out on purpose. For ex-

ample, you may wish to leave out the reproduction and maintenance activities and then elicit these following the discussion of the cropping and livestock activities. It takes about five to ten minutes to elicit the gender information and place it on the calendar. A calendar gives a very nice visual record of the roles of men and women in production and shows where the labor bottlenecks are.

When this exercise is completed, you have a calendar in which the activity load by gender and by season is clearly illustrated. This becomes a reference against which to assess the addition or subtraction of specific tasks or the changes in the timing of tasks. What conflicts do such changes relieve or create for the gender in question? Look, for example, at the Burkina Faso and Zambia teaching notes.

If the case is going to be used over several sessions, make a provision to save the calendar for reference throughout.

Study questions and study groups. The study questions are intended to help participants work their way through the material both on their own and in study groups. These questions are usually not identical to the learning objectives or to the discussion questions, but they do suggest areas which will be explored in the larger group session. Sample study questions have been included with the cases in *Working Together*, Volume 1.

In using unstructured nonreporting groups, we have usually left it to them to set an agenda for discussion, and other times told them specifically to use the study questions as a basis of discussion. We favor leaving it open, but we recognize that some groups may need some structure to get going.

Some trainers are more familiar with a format in which small groups report their discussions to the larger group. We generally do not use this format, preferring to think of the small study groups as just that: opportunities for further study of the material with colleagues. This keeps everyone on the alert for the plenary session. It also permits more small groups and makes each person's participation more likely.

Reporting would work well in an exercise in developing an on-farm trial. One method would be to give each group one of the suggested experiments from the first discussion of the case and have them develop a trial. They would be guided by Worksheet 1–6 (*Working Together*, Vol. 1, Chap. 1), making clear the gender implications of each aspect of an on-farm trial. During plenary, only one or two trials could be presented and other participants would comment on those.

Missing information. In every case there is desirable, but missing information. This is true to life and certainly true for each project. It can be a source of frustration to participants. One way to handle this is to start a list on one side of a board for information which is still needed.

This list can be considered later when discussing further research to be done and in designing how it will be done.

Sometimes information is presented in a different style or with greater inconsistencies than a participant is used to. The trainer should recognize the problem, agree if it is disconcerting, and go on, stressing that this is material from actual cases, from what was actually available to the research team.

Use of experts. Often there will be an expert in economic or agronomic analysis who will do further computations associated with a case. Do not worry if you have not done that, but ask the expert to state the results of the computations (out loud, not at the board) and then ask how it relates to the discussion. Move on from that point back into the discussion. Draw on the expert as one would in any interdisciplinary setting. Another kind of expertise comes from people familiar with the country or the specific project. In some cases their expertise can be helpful; in others it prejudges the case and you may have to remind the expert and the participants that you are working with the information available to the project.

Unmovable time constraints. When less than the recommended time is available for the discussion, there are several time-saving possibilities: (1) prepare a short lecture setting the stage and drawing out the initial points of the case, (2) preset all or most of the activities, resources, and benefits profiles which you are planning to use and have people examine and correct or finish them. In other words, if you have to take shortcuts, do it on the information side, leaving as much time as possible for analysis and discussion of alternatives with reference to that analysis.

Sending out material in advance. This is often suggested as a way to save time during a workshop. If you have information on who the participants are ahead of time, this can be done; but don't count on participants reading the material. It is better to make a specific time for reading during the workshop.

Handouts. John Lichte[2] suggests giving participants blank handouts for the analysis of activities, resources, and benefits in order that they better understand the nature of the "tools" for gender analysis. For discussing the activities calendar, he gives a handout with a preset calendar without any indication of gender. Then while he is filling in the gender variables in discussion, they can follow along with their own calendars. He supplies red pencils to facilitate this. By having the participants generate the gender roles and place them on their own calendars, they reinforce the learning of the use of the tool, and at the same time have a completed example to carry away with them. Blank handouts of the resources and

benefits analysis or forms for doing problem identification can also be provided. John argues that use of the same forms for several cases reinforces the learning and application of the tools to the "real" work of the participants. Though the same or similar worksheets are included in the conceptual framework (*Working Together* Vol. 1, Chap. 1), often participants are reluctant to fill these in and thus end up not using them in their analysis of the case studies. Handouts are somehow easier to write on.

Neither of the editors has yet tried this, but think in many situations this is a good device, particularly where only one case is to be taught. One drawback is the possibility that participants will spend more time filling out the charts than thinking actively about the issues and participating in the discussion. Whether or not to use handouts should be determined by a careful analysis of the time available for training, the learning styles of the participants, and the culture of the institutions within which they work.

Technical notes. Volume 1 includes several technical notes which may have value beyond the cases to which they are attached. These are Soil Science Overview (Appendix 6-A), General Information on Forages (Appendix 6-D) and Agroforestry Practices (Appendix 7-A).

Selection of cases. How many and which cases to use will depend on the learning objectives and time available. Ideally, three cases are used. Most participants begin to understand both the framework and case method with the first case. With subsequent cases familiarity with the method and the addition of new, comparative material and perspectives makes for a richer, more analytic discussion. Additional cases demonstrate vividly the power of the framework across environments. They illustrate that though the question is the same at each site—"who"—the answers differ. What is important is to ask the question. The first (or only) case used should be one in which the elements of the gender analysis framework—activities, resources, and benefits analyses—are clearly drawn out (see guidelines below). With subsequent cases, the trainer may move more quickly through the laying out of the framework and concentrate more on its implications for project decisions, generalizations about its use, and its application to participants' own work.

GUIDELINES TO THE SPECIFIC CASES

Botswana. This is a technically oriented case, best suited for a participant group which includes technical scientists and which has some experience in agriculture. It may be a difficult first case, but it would be an excellent second one. The case has good material on female-headed households and a wealth of information on farm resources and decision making. An

economic analysis has gender implications, and it is possible to start the case with an analysis of an on-farm trial, working back to analyze the system. The case also has implications for policy. It includes crops and livestock. Adequate time for reading is absolutely necessary because the case material is dense and much of the information is contained in tables.

Burkina Faso. This is a fairly technical case and one which lends itself to being spread over several sessions so that the material can be worked several times. Trainers should have taught other cases before and should be wary of getting bogged down in technical detail. There is much detail, so time should be allowed for reading the case carefully. The case includes crops and livestock. Calendaring and issues relating to land as a resource are also important elements. Part 3 (in Vol. 2) sets up a discussion of the dissemination of the most promising alternatives.

Colombia. The Colombia case is an example of a farming systems approach with a single commodity, beans. It is an excellent first case, especially for technical scientists. Laboratory scientists will find useful applications because the case revolves around breeding varieties and crop improvements. The case is useful for looking at methodologies for on-farm research and gender analysis, farmer participation, and the role of social scientists on an agricultural research team. It also addresses consumption issues.

Indonesia. This case illustrates on-farm research with a thematic focus: soils in a transmigration site. It is good for looking at gender and other differentiating variables among the farming population. It is not a good first case, but would make a good second or third. A high level of technical knowledge is not necessary. It is an excellent case for looking at methodologies for on-farm research, particularly farmer participation and time allocation studies, and at interdisciplinary research.

Kenya. This agroforestry case uses a farming systems approach. It is based on an explicit link between extension and research and includes elements on women's groups, the landscape, team dynamics or interaction, and an explicitly qualitative, farmer-participatory approach. It could be used in conjunction with the more technical cases for a later comparison between the nature and methods of collecting data. The issue of inclusion can also be discussed nicely with this case.

Philippines. The Philippines case study illustrates the value of gender analysis in an essentially joint system. This is a good first case which includes both crop and livestock elements. It also has a good activities and benefits analysis. The study describes the introduction of gender con-

cerns into an ongoing project and the adaptation of existing methodology. It also includes a consideration of postharvest processing and of differentiating variables other than gender.

Zambia. This is an excellent first case, especially for illustrating the value of a gender-disaggregated activities calendar. The study covers a whole farming system and has data for carefully laying out activities, resources, and benefits profiles. With these profiles, alternative suggestions about constraints and possible solutions can be screened as to their gender implications and decisions about priorities and design.

NOTES

1. A slide show developed in conjunction with this project is *Invisible Women: Gender and Household Analysis in Agricultural Research and Extension* by Susan V. Poats. It can be ordered from The Gender and Agriculture Project, RFD 1, Box 821, Hancock, New Hampshire, 03449.

2. A fellow trainer, John Lichte, has taught the Zambia case study using an overhead projector and transparencies for the calendar and the listing of problems and recommendations. Showing gender responsibility for activities with an overhead and various colored pens is quite easy and quick. The overhead projector can stay on with the calendar projected on wall while the analysis moves to other "blackboard" spaces.

REFERENCES

Christensen, C. Roland with Abby J. Hansen. 1987. *Teaching and the Case Method.* Boston: Harvard Business School.

Christensen, C. Roland, with Abby J. Hansen and James F. Moore. 1987. *Instructor's Guide.* Boston: Harvard Business School.

Cloud, Kathleen. 1985. Women's Productivity in Agricultural Systems: Considerations for Project Design. In *Gender Roles in Development Projects: A Case Book,* edited by Catherine Overholt, Mary B. Anderson, Kathleen Cloud, and James E. Austin. West Hartford, Conn.: Kumarian Press Inc.

———. 1988. A Teaching Module on Women and Agriculture: Household Level Analysis. Draft prepared for The International Workshop on Women, Households and Development: Building a Data Base. Champaign-Urbana: University of Illinois.

Feldstein, Hilary Sims, Cornelia Butler-Flora, and Susan V. Poats. 1989. The Gender Variable in Agricultural Research. Report 225e. Prepared for the Women in Development Unit, International Development Research Centre. Ottawa, Canada.

McCaffrey, James A. 1986. Independent Effectiveness: A Reconsideration of Cross-Cultural Orientation and Training. *International Journal of Intercultural Relations.* 10: 159–178.

Poats, Susan V., Marianne Schmink, and Anita Spring. 1988. Linking FSR/E and Gender: An Introduction. In *Gender Issues in Farming Systems Research and Extension,* edited by Susan V. Poats, Marianne Schmink, and Anita Spring. Boulder: Westview Press.

Appendix 1: Suggested Arrangements for Teaching a Case Study

The following are not a rigid set of guidelines, but do indicate, based on our experience, what is generally required in terms of time, space, and materials to conduct a case study workshop. It is intended for both planning and as the basis for negotiation about variations.

Ideally, a training workshop on gender analysis consists of three case study sessions with ample time to introduce the subject and work in small groups and plenary on particular issues of interest to participants. The group work will vary, but at a minimum it would include suggestions about applications to one's own research or, in the case of a sponsor, suggestions about the "next or desirable steps" to be taken for the further incorporation of gender analysis into the work of the sponsoring institution. The three sessions might be devoted to three different cases, to the unfolding over time of one specific case, or to some mix of the two. As part of a more extensive conference or workshop, one or two case studies might be used and tied into other material. The timing guidelines below are for using one case study.

TIMING AND FORMAT

Introduction. The trainer should prepare a one-hour introduction to be presented, preferably the night before. It should include an introduction to gender analysis and its importance; an introduction to the case study method, a guide to the materials, assignments to small groups; the logistics of the workshop; and a film or slide show. The materials handed out include the conceptual framework, the case study, study questions, and small group assignments. The introductory session is followed nicely by an informal reception at which people can begin to get acquainted.

Self-study. Overnight; if workshop meets within one day, at least 1 hour for the conceptual framework and 1 hour for the text of the case. A set of study questions accompanies the materials to help participants focus on particular aspects of the case.

Small groups. 1½ hours; a little less time after the first case

The larger group is broken up into groups of four or five. Without structure or input from the trainers, members of the small groups go over

the case material and study questions. This gives individuals an opportunity to try out ideas, compare notes, etc. The group is *not* expected to report. It is merely an opportunity to work through the material again in dialogue with others.

Plenary. 1¼ to 1½ hours

The whole group meets, preferably around a large U-shaped set of tables, and discusses the case with the assistance of a trainer.

If more than one case is used, the pattern of self-study, small groups, and plenary repeats itself.

Additional

Evaluation: 10 minutes for written; ½ hour for oral, led by trainer

Recommendations for institution/sponsor: 45 minutes in small group; 1 hour in plenary

Two or three questions are set by the trainer. In this case, groups are expected to make a joint response to the questions.

ROOM AND EQUIPMENT REQUIREMENTS

One large room. The introduction and plenary sessions will require a room which is large enough for the entire group to sit around the outside of a U-shaped set of tables. A shallow U, where the distance between the trainer and participants is less, is preferable to a deeper U. This allows easier interchange between the trainer and the participants and between the participants themselves as well as making it easier to read the board.

Four to five breakout rooms. The breakout rooms can be small, for four to six people. Depending on the size of the large room, it could provide breakout space for one or two small groups.

Blackboards. The most important item for a trainer teaching by case method is the physical space to lay out the analysis generated in the plenary discussion so that all participants can see it. We and many other case method trainers have found that blackboards are the best medium for laying out the analysis and generally recommend that at least three large blackboards (five feet by three feet) or the equivalent are necessary. Erasable surfaces are best. Colored chalk is useful for making distinctions by gender or other variables in the analysis. In Zambia, local manufacturers made blackboards very cheaply which they put on stands. It is becoming more frequent to find whiteboards at the institutions where training is taking place. These are excellent because the writing is very visible and a variety of erasable colors can be used. Where blackboards are un-

available, a trainer may try affixing newsprint paper to the walls. We find flip charts too small to hold the analysis; however, they are very useful for small group work, eliciting lists during plenary, or as extra space in case the other boards become too full. Makeshift boards may be constructed out of sheets of flip-chart paper taped together. Some trainers find that judicious use of transparencies and an overhead projector works well (see Note 2, above).

Audiovisual. A slide or slide-tape projector or a movie projector and screen will be needed, depending on what is going to be shown.

Miscellaneous. Trainers will also need sturdy paper and markers for making name cards to be put in front of each individual. Name cards should be made by the trainers themselves to ensure that the names can be seen. Other needed supplies are colored chalk (or markers) and erasers and a table in front of the room for the trainer's materials.

Chapter 2

Botswana

Farming Systems Research in a Drought Prone Environment, Central Region Farming Systems Research Project

CONTENTS

Teaching Notes for Part 1: First Three Seasons of Research (in *Working Together* Vol.1, Chap. 3)

Part 2 Adaptations in Experimentation and Monitoring during the Fourth Season

Teaching Notes for Part 2

Appendix 2-A Letter from the Field
Appendix 2-B Computations, Gender-disaggregated Costs and Benefits from Double Plowing and Row Planting after Early Plowing
Appendix 2-C More Comments from the Field

This case and teaching notes were prepared as a basis for discussion rather than as an illustration of either effective or ineffective handling of a project.

Teaching Notes for Botswana: Part 1 First Three Seasons of Research

CASE SYNOPSIS

The Central Region of Botswana is characterized by poor soils, erratic rainfall, and low yields of crops, principally sorghum. Predominant income activities are livestock and wages, often from absent household members who send remittances. Farming is the main activity of only 25 percent of the rural population. The Government of Botswana's interest in improving agricultural productivity is related to its desire to increase national production, reduce imports, generate employment, and increase equity in rural areas. Nearly 40 percent of the households are female headed and most farming is done by women. Though there is a history of government-sponsored agricultural research and extension, little has been developed which is promising and few farmers follow any extension recommendations.

Part 1 of the case study (*Working Together* Vol. 1, Chap. 3) lays out a summary of three years of farming systems research in the Central Region carried out during a period of severe drought. Two parallel lines of research were undertaken: (1) experimentation focusing on plowing and planting alternatives to the traditional system as a means of improving plant stands and yields and (2) extensive resource monitoring and special studies designed to provide a whole farm system diagnosis for identifying other possible lines of inquiry. Initial research domains are based on type of traction (tractor, oxen, donkey) and access to traction (control or dependent).

Experimentation with plowing and planting suggests two promising improvements: double plowing and row planting following early plowing. Combined results of the experiments and economic analyses of both alternatives are included in the text. Results of other experimentation and a farmer workshop are reported in summary form.

Resource monitoring and subject surveys are reported with results disaggregated by criteria additional to that of the research domains: sex of head of household and whether rich or poor, as defined by cattle ownership. Survey results are reported for household composition, assets, labor activities, livestock practices, sources and uses of income, and perceptions concerning decision making.

USE OF THE CASE

The Botswana case is designed for use with a technically oriented group of participants. At least a substantial minority should be familiar with farming systems and agricultural research terminology and practices. Emphasis should be put on the need to know the text and tables well in order to discuss the case.

LEARNING OBJECTIVES

1. To analyze activities and resources used in farm production by men and women and different types of households in the Central Region in Botswana

2. To interpret the technical, economic, and sociological fit of two promising interventions and assess their differential effects on different individuals and types of households

3. To determine appropriate research which will benefit female heads of households and women farmers

4. To discuss the purposes for research domains and evaluate the relevance of different research domains

5. To recommend research priorities and means of working with farmers to increase farmer participation

STUDY QUESTIONS

1. How do the resources and activities of women and men differ in Botswana?

2. Evaluate the potential benefits and the sociological fit of the plowing and planting trials.

3. How do the categories of female-headed households and women farmers fit with the definition and concept of research domains as used by the CRT?

4. What should be the priority research activities in the next season? What are the objectives and who would benefit?

ANALYSIS OF THE CASE

The two main points to be made by this case are (1) how to treat, for diagnostic purposes, the category of female-headed households, particularly in the context of defining research domains, and (2) the differential effect of (*a*) double plowing (BDP) and (*b*) row planting after early plowing (RPEP) on men and women (according to task) and on male- and female-headed households. It is a rich case with a number of other possibilities for discussion concerning future research priorities, policy recommendations, and increasing farmer participation.

The constraints under which farming is done in Central Province are formidable: poor soils, erratic rainfall, male out-migration, better income opportunities in cattle and wage labor when available. Farming and experimentation are made even more difficult by the onset of a drought throughout most of the CRT's project period. The purpose of the project is to suggest improvements in technology for increasing agricultural productivity in order to increase national production, reduce imports, generate employment, and increase equity in rural areas. Prior work in agricultural research has focused on plowing and planting, and it is there where the CRT initially focuses its efforts. The original research domains established by the CRT are defined by kinds of draft (donkey, oxen, tractor) and access to draft. As stated in the case, when the drought takes hold, these domains dissolve in the face of a sizable shift to hiring tractor for tillage and the breakdown of other draft access arrangements. Type of draft is difficult to track. Despite these difficulties, some promise is shown with two plowing and planting arrangements—double plowing and row planting after early plowing.

Simultaneously, an extensive resource-monitoring effort is undertaken in order to further understand the farming system and subsets within it. Female-headed households had already received considerable attention in earlier research in Botswana leading the CRT to include that category for collecting and disaggregating information. They also included the number of cattle owned (in two categories, from zero to fifteen and more than fifteen) as a proxy for wealth.

The extensive monitoring and subject surveys provide a wealth of data which indicate differences according to sex of head of household, poverty, and access to draft. These are analyzed in *Working Together* Volume 1, Tables 3-1 through 3-7. Among the most salient differences are those of task (Table 3-2), control of and kinds of resources (Tables 3-1, 3-3, and 3-6), and decision making (Table 3-7). It is interesting to note that, when Table 3-1 is compared to Table 3-2 (both use the same sample of twenty-seven households), despite the relatively smaller percentage of women in most households, the hours put in by women are much greater. This is principally because of household maintenance, but also it

is true of agriculture. Note that according to footnote *a*, Table 3-2, the hours spent in bird scaring (principally a women's activity) are not recorded in the overall hours because "much of the time is inactive." As an expenditure of energy, those hours might be minimal; but as protection of necessary production and an opportunity cost to alternative activities, the hours are important and need to be considered in planning any activities which compete at that time of year.

There is an evolution in the way the CRT uses the concept of research domains. At first the team defines traction-based research domains and then selects representative farmers from each research domain to participate in trials. After it becomes apparent that double plowing and row planting are not feasible for draft-dependent households, the team begins using research domains to target specific interventions to specific types of households. For instance, the plowing and planting trials are continued with those farmers who have control of draft, and, eventually, the team expands the notion of targeting to include gender within households (testing of legume varieties with women farmers whether spouses or heads of household) and even targeting to particular soil situations. The experimental program represented two approaches to research domains. One view holds that interventions should be selected and then targeted to appropriate research domains, that is, selecting as trial farmers those who are interested in or already have the resources for the proposed change. The other view is that research domains should be based on farmers' circumstances and then interventions selected to meet the needs of farmers in different research domains. The difference is important. One approach takes technological options as a given and then targets, regardless of which farmers are helped, while the other puts the emphasis on seeking technologies to help different types of farmers. Both ways of identifying researchable problems and trial farmers have advantages and disadvantages and can be the basis of a class discussion.

Gender analysis initially receives attention in the consideration of female-headed households as a research domain. The evidence in the case suggests that in the Central Region other categories have more validity. Female-headed households are poorer, have fewer resources and less output than male-headed households (Tables 3-1, 3-3, and 3-4). However, in most instances, they are not the most disadvantaged in terms of resources for production. That falls to the draft-dependent households which include both male- and female-headed households. In fact, some female-headed households do control draft and are among the well-to-do. As a unit of analysis, draft dependency may be more useful than is sex of head of household in defining a relatively homogeneous set of farmers with characteristics relevant to improvements in crop production One could argue that when trials are designed for any particular category (e.g. draft dependent, rich or poor, etc.) it would be useful to include a proportion-

ate number of female-headed households to see whether further differences are picked up in the monitoring and evaluation of trials.

The case affirms the value of collecting information on the basis of sex of head of household as an early diagnostic activity to determine whether, in any project, it has validity as a separate research domain. For instance, Table 3-6 shows that male- and female-headed households have different sources of cash. Given the dependency on cash for hiring traction of draft-dependent households, changes in beer production or sales, livestock markets, or opportunities for wage employment would differentially effect different groups' ability to engage in optimal agricultural production. Expenditure on grain, meal, and food are about the same, but female-headed households spend more on wages which includes hiring for traction.

Gender analysis also enters through intrahousehold, gender-specific analyses of labor use (Table 3-2), control of resources, and decision making (Table 3-7). Male dominance concerning livestock (when to start plowing, when to plant vis-à-vis the rains, and whether animals are fit) is affirmed, but there is female dominance (from heads and spouses) with respect to how much seed to plant and when to weed. There are also gender differences in the perceived benefits and harms from farming system changes.

The case reports the results of sorghum plowing and planting trials in terms of yields and plant stands and in terms of an economic analysis. By disaggregating the economic analysis of the two most promising alternatives, one sees that men and women would be differentially affected by the improved technology. Double plowing (Table 3-9) requires more plowing (male labor or cash for hire) and harvesting (female labor) and a reduction in time for weeding (female labor). Overall there is a considerable increase in labor for men, a small one (though seasonally different) for women. Will men put in this extra effort? The row planting after early plowing strategy (Table 3-10) has different effects. Since men do row planting, their labor is increased, while women's is reduced (though we do not know by what amount). Women's labor in harvesting is increased. The net gain from overall operations is minimal. Again, the incentive for extra work by men is extremely limited. A gender-disaggregated analysis of these trials is illustrated in Appendix 2-B in this volume.

The circumstances of draft-dependent and female-headed households suggests that the plowing and planting schemes will not be particularly beneficial to them, and alternatives should be explored to increase at least the subsistence production of other food crops. Women's role in planting and seed selection suggests that any experiments which include a planting component and variety trials should be directed toward women.

Many of the findings of both the resource monitoring and subject surveys and the technical monitoring and trials had implications for government policies and programs; for instance: (*a*) the circumstances under which changes in practices or support systems would most likely lead to increased

resource productivity, (*b*) which sets of practices were most relevant for which sets of households, and (*c*) which households and people within households were most likely to benefit or be hurt by existing or anticipated government programs. An overriding question was how this program fit into the Ministry of Agriculture's original objectives of increasing national food production and improving equity. One can argue that it is important to put more resources in terms of researchers and experimentation on the double plowing experiments and improved step technologies which could improve productivity of the better-off farmers and make a contribution to national food production. On the other hand, such an approach does not meet equity objectives. Trials on activities such as thinning, replanting, and sole-cropping of other food crops hold more promise for poorer households.

The distinction between female heads of household and women farmers as categories for analysis is an important point in this case. Researchers sometimes think they have covered women if they have looked at female-headed households. This case study demonstrates that these categories are not identical and which is appropriate depends on the question being asked.

The collection and disaggregation of data by gender, poverty, and access to traction provide the CRT with information which challenges some of the project's initial assumptions (that women and female-headed households would automatically benefit from any improved technologies). The information also makes clearer the possible conflict between objectives (equity and national production) and provides improved understanding of different potential target groups for new technologies for improved production.

In this case, there is perhaps more social science data available than originally planned because the low amount of trials activity due to drought made more team resources available. In farming systems and other agricultural research projects, social science input is often given short shrift. This case study makes the point that such data can bring to the attention of researchers significant differences between groups of farmers with respect to their ability and interest in undertaking specific innovations. It makes clearer who will benefit from specific research, whose problems are not being addressed, and what additional researchable problems deserve consideration by the search team.

The case author's comments on the gender implications of this case are included in this volume as Appendix 2-A to the teaching plan. This would be a good handout for the trainer to give to the students after teaching the class.

DISCUSSION QUESTIONS

The teaching notes for this case take participants through activities and resources analysis before assessing the Central Region team's (CRT's) pro-

gram of experimentation. An alternative plan, discussed below, starts with an analysis of the plowing and planting trials and leads from these into gender analysis. If Part 2 (Vol. 2) is taught, discussion question 6 could be omitted.

1. What are the objectives of this project? Are they conflicting? compatible? What were the objectives concerning women?

A number of objectives may be drawn out. The objectives of the Government of Botswana in the agricultural sector are *(a)* generating employment opportunities, *(b)* reducing dependency on food imports, and *(c)* reducing household dependency on government resource transfers. The CRT objectives emphasize improving production in order to contribute to *(a)* equity and *(b)* national food independence, and *(c)* in order to develop on-farm research methods. Other objectives may include technology generation and working with resource-poor farmers. With respect to women, the case study states that because 40 percent of the households were female headed and most farmers were women, it was assumed women would benefit.

2. How would you characterize the environment in which this team is working?

This is a technically complicated case. It may be useful to begin by ensuring that trainees have a good grasp of the setting and of the key technical problems. (See Table 2-1 in this volume.)

Discussion should bring out the main points—the drought prone environment; agriculture as second to other sources of income; the erratic rainfall; and sorghum as the staple grain crop and the focus of earlier research.

Additional Questions: What do we know about the interaction of rainfall and crop production? This provides an opportunity to discuss the concepts of earliness in the season and timeliness vis-à-vis a given rain, and how this affects plant establishment, growth, and yield. The critical point to make here is that, since earliness affects yields, control over traction in order to do timely plowing is important.

3. The above discussion leads directly into questions about access and control of resources. Traction can be listed. What are other important resources for farm production in the Central Region? Who has access? Who has control?

The point of this question is principally to bring out the fact that there are specific resources required for production and that these are not available equally to all farmers though they share the same ecological conditions. Note that sometimes the dichotomy is between male adults and female adults; other times it is dependent on who is the head of the household. (See Table 2-2 in this volume.)

Table 2-1

Characterizing the Environment

Ecology	Farming System	Subsistence Elements	Cash Elements
Poor and variable soils Erratic rainfall	Mechanized traction Low inputs Not major activity Inequity of reources, esp. access to draft 40% FHH Female-headed, poor, & dependent HHs all do poorly Involved in the cash economy	Food for home consumption Insufficient home production Own draft animals Animals for milk, meat Land allocated, not sold, rented	Livestock sales Dependent on remittances Beer sales Purchase of sorghum, maize, tea, etc. Cost of hiring tractor

Key: FHH = female-headed households; HH = households

Additional Question: What units of analysis did the researcher use to investigate the resource base and flows of the farming system? At a minimum, answering this question insures that everyone is clear about the different categories established by Dean: male- and female-headed households, rich and poor, draft control and draft dependent. It is also a good

Table 2-2

Access and Control Analysis of Resources

	Access	Control	Least Well-off	Exchanges
Traction	MA>FHH	MA	DD	For labor between households Cooperative arrangements Long term borrowing Riskiness and cost of using tractors
Labor	MA, FA, FHH	MA, FHH	Poor HH	No cooperative work parties Exchanges between relatives provide assistance
Hired labor	MA, FHH		Poor HH	
Farm equip.	MA, FA	MA, FHH	Poor HH	
Land	MA, FA	MA?	?	Sometimes borrowed (Though HH sizes are similar, different hectarages are plowed (Tables 2-1 and 2-4))
Wage labor	MA, FA		Poor HH	
Cash			FHH	
Remittances	MA, FA			
Credit				
Formal	MA>FA			
Informal	FA			
Livestock	MA			
Agric. prod.	MA, FHH			
Beer brew.	MA, FA			
Wages	MA>FA			

Key: MA = male adult; MC = male child; FA = female adult; FC = female child; FHH = female head of household; DD = draft dependent; Poor HH = poorer households, fewer than 15 cattle; > = more than; < = less than.

base for discussing later the relative merits of setting up research along these lines. Were these the appropriate categories? How were they useful? How would they differ in other environments?

Additional Question: As people suggest resources and name who has access and control, ask: Is this the group with the least access or control? Here one can pull out the fact that female-headed households are often disadvantaged compared to male-headed households, but among the categories used they are not necessarily the most disadvantaged. One way to pull this out is to set up a third column, "least well-off." Table 2-2 sets out these three columns and a fourth column on exchanges and/or comments which you may want to elicit. An important point here is that the most critical resources are control of traction and/or cash. Farmers who are draft controlling face very different circumstances from those who are not. This will foreshadow the later discussion about the appropriateness for different groups of the research being carried out by the CRT.

4. What are the principal activities in farm households and who does them?

This leads into an activities analysis. (See Table 2-3 in this volume.) Not a great deal of time should be spent on this, but it is important that the distinction between men plowing and women planting, weeding, and harvesting be made as well as acknowledging the contribution women make to overall household maintenance. This also provides an opportunity to note that not all tasks are sharply dichotomized; for instance, men do some weeding and women do some livestock tending.

Since each year of the project has been one of drought, it is difficult to calendar the activities and determine whether there are actual labor bottlenecks and whose labor is affected. Note also the high amount of joint decision-making according to the decision-making survey, implying jointness rather than entirely separate spheres of activity.

Additional Questions: Once the board is laid out, ask how the activity patterns would be affected if there were more rains. Plant stands would increase, but so would weeding, bird scaring, harvesting, and threshing. What are the implications for labor availability?

5. The results of the plowing and planting trials are reported in Tables 3-8, 3-9, and 3-10 (*Working Together* Vol. 1). What are they? How promising are they for the farmers of the Central Region? Let's look first at the technical criteria. What are they? What do they show?

After three seasons of trials, four of the experimental treatments show yields higher than the control, of which the highest are planting by broadcast on a second plowing and row planting after early plowing (Table 3-8). Technically are either a promising technology? Tables 3-9 and 3-10 present yield comparisons. Table 2-4 in this volume (assessment of plow-

ing and planting trials versus traditional practice) illustrates how this might be shown on the board.

Additional Questions: What about economic feasibility? What are the tradeoffs? Table 3-9 in Volume 1 compares double plowing with single plowing one hectare and two hectares. The table shows that double

Table 2-3

Activities Analysis

	Male		Female
Livestock			
Herd	MA, MC[a]		Some
Milk	MA		
Plow	MC, MA		
Plant			
Broadcast	MA	<	FA
Row plant	MA		
Weed			FA
Harvest/thresh			FA
Field maintenance	MA		
Beer brew/sell			FA
Wage employment	MA		FA
Household maintenance			
Firewood	MA	<	FA
Water			FA
Cook/wash			FA[a]
Construct/repair			FA

Key: MA = male adult; MC = male child; FA = female adult; < = less than.
[a]Major time-consuming activity

Table 2-4

Assessment of Tillage-planting Trials
Compared to Traditional Practices

	BDP		RPEP	
	1 ha	2 ha	1 ha	2 ha
Technical	+	–	+	–
Economic	+	+?	+	?
With hired traction	–	+?	+	+
Sociological				
Men	–	–	–	+
Women	–	+	–	+

Key: BDP = broadcast double plowing; RPEP = row planting early plowing; + = improvement over traditional practice; – = less desirable than traditional practice; ? = benefit/cost not easily determined.

plowing is economically superior for one hectare, but if choosing between double plowing one hectare and single plowing two hectares, the choice is much narrower. A similar analysis for row planting after early plowing is shown in Table 3-10.

Additional Question: What do these two analyses tell you about the suitability of these innovations? This draws out the question for which farmers these techniques are appropriate, echoing the CRT conclusion that changes in plowing and planting are most appropriate for those who own traction. Row planting after early plowing is economically beneficial even for those who hire traction. (See Table 2-4 in this volume.) This leads into the next question.

Additional Questions: Will farmers find these practices attractive? What is the sociological fit of these proposed operations? Who gains and who loses? Here you need to draw attention to the different tasks involved in the operations—asking "who does what?"—and referring to the activities analysis on the board (Table 2-3). From this one could lead into a quick analysis such as in Tables 2-5 and 2-6 (benefits of different tillage practices). The analysis in turn leads to the completion of Table 2-4.

Using Tables 3-9 and 3-10 from *Working Together* Volume 1, the extra labor requirements (costs = "–") and savings (benefits = "+") can be disaggregated as shown here in Tables 2-5 and 2-6. A more precise analysis in pula and hours is shown in Appendix 2-B of this chapter.

When double plowing is compared to single plowing of one hectare, more labor is required of both men and women, but particularly of men (Table 2-5). The question is whether the increase in sorghum yields is sufficient incentive for them to increase their labor. For those who must hire traction, including predominantly female-headed households, there is a loss. When double plowing of one hectare is compared to single plowing of two hectares, there is substantial gain to women in terms of reduced weeding. Net gain in yields is marginal and male labor is increased, therefore it is not likely to be adopted by male-headed households.

When row planting after early plowing is compared to broadcast single plowing of one hectare, additional labor is required from men since men do row planting with traction (Table 2-6). Women's labor is slightly increased. In this case is there sufficient incentive for men to take on this extra activity? In a comparison of row planting after early plowing of one hectare to broadcast single plowing two hectares, men's labor time is slightly reduced if row planting after early plowing is chosen over broadcast single plowing, with no loss of income. Women work somewhat less using row planting after early plowing, and at a different season than previously. Under more favorable climatic conditions, this different distribution of activities might be important. Whether it is accepted or not is probably a joint decision in male-headed households.

This exercise demonstrates that technical and economic analysis,

Table 2-5

Benefits of Different Tillage Practices (1)

Double Plowing (BDP) vs. Single Plowing (BSP) One Hectare	MA	FA
Weeding		+
BSP harvesting		+
Second plowing	–	
BDP harvesting		–
Overall	–	–
Net gain from operations: Pula 19.97		

Double Plowing One Hectare (BDP) vs. Single Plowing (BSP) Two Hectares	MA	FA
Weeding		+
BSP harvesting 2 hectares	+	+
Second plowing	–	
BDP harvesting		–
Overall	–	+
Net gain from operations: Pula 3.16		

Key: MA = male adult; FA = female adult; + = benefit, i.e. reduced labor time; – = cost, i.e. increased labor requirement.

Table 2-6

Benefits of Different Tillage Practices (2)

Row Planting after Early Plowing (RPEP) vs. Single Plowing and Broadcasting (BSP) One Hectare	MA	FA
BSP harvesting		+
Planting	–	
RPEP harvesting		–
Overall	–	–
Net gain from operations: Pula 24.27		

Row Planting after Early Plowing (RPEP) One Hectare vs. Single Plowing and Broadcasting (BSP) Two Hectares	MA	FA
Second plowing	+	
Weeding second plot		+
BSP harvesting 2 hectares		+
Planting	–	
RPEP harvesting		–
Overall	+	+
Net gain from operations: Pula 0.97		

Key: MA = male adult; FA = female adult; + = benefit, i.e. reduced labor time; – = cost, i.e. increased labor requirement.

Note: This analysis does not take into account women's labor reduction because planting shifts to men.

without disaggregating the data by gender, does not give a full picture of the opportunity costs and benefits of the introduction of new techniques. Clearly there are different pluses and minuses for men, for women, and for female-headed and male-headed households. Who would benefit from and who would accept this new technology can be drawn out from and discussed by the class.

6. Let's look more carefully at the female heads of households and women farmers. How well has the intrahousehold or gender perspective been included in CRT's research? (Note: If you are using Part 2 of this case, this discussion could be held off until then. Move directly to discussion question 7.)

Among the positive steps taken by the CRT are the following:

- Gender-disaggregated data in the resource-monitoring surveys
- Women usually interviewed in the resource-monitoring surveys
- Household types, including female-headed households, used in farmer selection for some trials and in analysis of survey data
- Interhousehold linkages used as a topic of a subject survey
- Several trials designed with reference to female activities (weed monitoring, sole cropping of secondary crops) though not related to major system changes
- Disaggregation of labor data
- Questions specifically to male heads, female heads, and female spouses on roles in decision making

It is interesting to note that an abundance of social science data has been collected and disaggregated by several critical categories to see if any are pertinent to the definition of farmer problems or possibilities of new technologies. Areas of difficulty remain, principally, the continuing focus by the technical scientists on the plowing and planting operations which favor male-headed and richer households.

7. Let's turn to the concept of research domains. What is a research domain? How is it being used by the CRT? What are the conflicting views about how it should be defined or used?

Additional Question: How do the categories of female heads of households or women farmers fit with the concept of research domains?

This allows the trainees to look at the concept of research or recommendation domains, how they are defined and how they are used. The CRT has used two approaches: (1) defining a homogeneous group of farmers and then discovering their constraints and identifying researchable problems versus (2) beginning with a promising innovation and defining the target group which has the resources or interest in that innovation. This latter strategy is what evolved out of the plowing and planting trial. There are no right answers, but it is a fruitful area for discussion and for extension to more abstract questions such as what people would do as they go into a new environment with a farming systems research approach.

8. As the outside review team, what research priorities would you recommend for the next season? This question can come more directly out of the previous discussion, asking directly what research activities should be undertaken which will clearly benefit women farmers or female heads of households.

Here you might list suggestions from the trainees, drawing out who would benefit, as for example in Table 2-7. There are two main areas of discussion: (1) ensuring that any proposed trial is screened against whose

Table 2-7

Future Trials

	Who Contributes Activities/Resources?	Who Benefits?
Dissemination of double plowing	MA—plow	Draft-controlling households
	M/FHH—cash,draft FA—less weeding	M/FHH from crop
Dissemination of row planting after early plowing (RPEP)	MA—more planting labor	MA or FHH
Steps-in-technology trial	M/FHH—cash	
Sole cropping of other food crops		
Plant thinning		
Replanting		
Vegetable gardens		
Livestock improvements, etc.		

Key: MA = male adult; FA = female adult; FHH = female-headed household.

resources are required and who benefits, drawing out the different categories of farmers in the system, and (2) trying to focus on trials which would particularly benefit women farmers.

9. How can farmer input or participation be increased in the CRT program? (Note: If Part 2 of the case study is used, discussion of this question can be held off until then. See teaching possibilities for Part 2 question 4.)

This question can lead directly from the discussion of research domains and groupings of farmers (see discussion question 7) or from the list of suggested trials. The example of the farmer workshop conducted by the CRT plus the information on group activities recorded in the special subject surveys can be discussed. Should groups be continued? What should be the criteria for groups? How should they be organized? How should farmer interest be maintained? How many resources should there be for farmer-generated versus researcher-generated ideas? According to farmers' statements about their priorities and problems, too much emphasis was given to plowing and planting research during the first three seasons. This can lead into a discussion of problems identified by farmers or a general discussion of how such groups would work and would or would not be beneficial to the project.

An Alternative Approach

Another way to discuss this case would be to begin the discussion with an evaluation of the plowing and planting trials and move from there into gender analysis. Briefly, such a discussion might follow this pattern:

1. As above, question 1. Objectives of the project and objectives concerning women.

2. As above, question 2. Characterize the environment.

3. As above, question 5. Results of plowing and planting trials.

Using this plan, as you begin to discuss the sociological fit, you need to draw attention to the different tasks—asking "who does what?"—and begin putting them on the board. This leads to a partial activities analysis and the beginning of a board like Table 2-3.

4. We can see that paying attention to who does what can tell us something about how farmers might view these trials. What else do we know about what men and women do?

This leads to more information for the activities analysis (Table 2-3).

Additional Question: What about resources? This will bring out some of the elements shown in Table 2-2 and can lead into a discussion of the

different ways in which data was disaggregated. One should point out the differences between females who are heads of households and those who are spouses in male-headed households.

From here the discussion could lead in either of two directions: (1) a discussion of the methodology, such as the different categories for disaggregation, where they lead in terms of research or recommendation domains, the value of such information, and the ways used to obtain it; (2) a discussion of what experimentation might be appropriate for farmers without control of traction. Participants should consider the nonleverage interventions already being tried. What else might be tried? What arrangements might be made to adapt row planting after early plowing to non-draft-controlling farmers?

ADDITIONAL POSSIBILITIES TO CONSIDER

1. Should the resource-monitoring and subject surveys be continued? If so, with what objectives?

2. What are the implications for an extension service of having different recommendation domains based on resource constraints, soil conditions, and different people within households? What are the tradeoffs between homogeneity and heterogeneity and practicality?

3. Bring out more clearly the possible conflict between the technical scientists and social scientists in terms of objectives, priorities for research, and likely acceptability of results. Who is the audience for this research? Farmers, government, consumers, researchers, disciplines? Related to this is the question of what is a tangible result (concrete, highly specific research findings versus farmer interest and use).

4. Using some of the suggestions for future trials generated by the discussion, have participants, on their own and then in small groups, design a particular trial. In designing such a trial, several questions should be addressed. How would you set it up? Which farmers would you choose? What data would you collect? How would you evaluate this trial? Again, stress the *who*.

Botswana: Part 2
Adaptations in Experimentation and Monitoring During the Fourth Season

DOYLE C. BAKER WITH HILARY SIMS FELDSTEIN

The fourth season passed quickly for Dean Curtis. With a small formal survey program, Dean and his colleagues spent most of their time on trials and in informal interaction with farmers. Even though the trials program was again affected by poor rainfall, Dean felt more satisfaction than he had in prior seasons. He directly worked with farmers, discussing solutions to their problems and helping them evaluate new production practices.

It was now almost time for the team to prepare a new work plan. As his last assignment for the CRT, Dean was asked to prepare a report which summarized the team's activities during the fourth season, highlighted major findings, and identified important issues for the new CRT team members to consider when preparing the next work plan. Below is the report that Dean prepared.

CRT ACTIVITIES AND FINDINGS, 1985–86

During the fourth year, the emphasis on investigating many household types gave way to a less distinct subdivision of the farming population into two categories: (1) households that had the resources and interest to implement the multiple-tillage operations and (2) households that faced resource constraints, but that might benefit from additional employment opportunities in arable production. Hand-planting and thinning trials were designed for farmers who lacked access to draft.

Three farmer groups were set up to create an informal, "farmer-first"[1] format for discussing farmers' problems and situations and facilitating trials management. One particular objective in creating farmer groups was to make sure there was access to the views of women and representatives of poorer households. Even if poorer households were not able to imple-

ment as many trials, participation in group discussions allowed an input into the technology screening process.

Researcher-implemented trials were expanded. The technical scientists decided that researcher-implemented trials had proven to be the most successful format for experimentation directed at evaluating technical outcomes.

As a counterbalance, the extent of farmer management in most testing stage trials on plowing and planting practices and sole planting of secondary crops was increased. An attempt was made to closely target all interventions being examined, taking into account traction access, gender-specific production roles, and hypotheses about technology by environment interactions. The number of farmers participating in each trial was increased in order to better evaluate technology by environment interactions, improve the economic analysis, and enable farmer assessment surveys.

TRACTION USE STUDIES

Cart Owners Survey

Because of the multilocation settlement pattern, substantial amounts of time were spent transporting people, household goods, fuelwood, and water. Much of the time spent transporting fuelwood and water was done by women. Lack of transport was responsible for delays in planting and for premature abandonment of fields.

The cart survey of forty-six cart-owning households showed that many of the carts were not in good shape but the repair costs to keep them running were quite minimal. The main use of carts was for transporting goods, firewood, and water. Most carts were used on a regular basis. There was little hiring-out of carts. All of the owners said that the carts helped their households and many said they would buy newer carts if carts were included in the Arable Land Development Program (ALDEP). Nearly all thought that carts should be included in ALDEP so other households could buy carts.

Tractor Owners Survey

Tractor hire had become the main source of traction during the drought and many farmers complained that they were unable to hire tractors when they wanted. As more and more households tried to hire tractors, the problems faced by draft-dependent households had increased.

A tractor owner survey was administered to twenty-four tractor owners. The most obvious finding of the research on tractors was that they were tremendously underutilized. The main reason was that most of them

were in poor condition, so breakdowns occurred frequently. Some of the tractors were not in working condition for months at a time. The tractors were primarily used for plowing. Tractors were used only infrequently for trips to and from the lands, and for collecting fuelwood and water. Contracting-out services were done less often than had been anticipated.

FARMER GROUPS

The main objectives in forming farmer groups were to identify factors affecting farmers' willingness to modify practices and to facilitate interaction about changes in practices. Formation of the groups represented an institutional experiment. Prior on-farm experiments carried out through individual farmers had failed to stimulate community interest. In addition, the focus of most trials had been on plowing and planting systems and, as a result, had involved a disproportionate number of male-headed and richer households. It was hoped that formation of farmer groups would create additional community interest and would broaden the base of farmers involved in on-farm research.

Organization and Management

As part of the institutional experiment, the team decided to create different types of groups in the different villages. In Makwate, a large heterogeneous group was formed. Half the members comprised females from poor households while the other members came from various types of households involved in past CRT experiments. In Shoshong, the group was based on active and interested farmers who had adequate resources for farming but were not particularly wealthy. Most participating households were comprised of small conjugal units, and both spouses were encouraged to attend meetings. In Makoro, a third village added to the CRT program, the group involved just females and most were from female-headed households. In addition, nearly half of the members also served on the local Village Development Committee. Two of the groups had ten members, while the one in Makwate had twenty-one members. Most of the individuals attending meetings were females.

Farmer group meetings were held once a month, though attendance often dropped during the cropping season. Meetings generally consisted of three sets of discussions. The first was a review of the farmers' circumstances and problems since the prior meeting. The second was a discussion of trials implementation (during the early part of the season) and intermediate trial outcomes (during the later part of the season). The final part of each meeting consisted of a discussion of existing government

programs and how farmers might take advantage of the programs. Several procedures were followed to increase the likelihood of success:

1. The groups were focused on well-identified problems which were recognized by the farmers themselves as being problems. These included *(a)* delays in plowing and planting caused by lack of draft control, *(b)* gaps and uneven stands, *(c)* labor problems at weeding and harvesting, *(d)* making the best use of scarce seed for secondary crops, and *(e)* high plant populations with a lack of labor for thinning.

2. Both seed and advice were given to farmers to provide personal incentives for group membership.

3. Open discussions of problems and trials implementation created peer pressure to be more active. Start-of-season meetings were held to get farmer input into trial designs.

4. Regular meeting dates were set to reduce the chance that farmers would forget about meetings.

5. Meeting agendas were prepared to keep discussion focused, and farmer leadership was encouraged.

6. Each farmer participated in one or more trials which served as a focal point for farmer involvement in the groups.

7. Farmers were taken on midseason and end-of-season field visits so they could compare their relative progress.

Experimentation

Trials of particular interest to farmers or for which the CRT wanted farmer evaluation were carried out with the farmer groups. There were two main categories of trials: sole cropping, involving several crop varieties, and postestablishment stand management. The group meetings led to three modified formats during the season: one for a hand-planting trial, one involving thinning, and one involving monitoring of delayed emergence.

Sole planting of crop varieties trial. As a follow-on to the previous cropping comparison trial, farmer group members were given seed and advice on when to plant two to six high-valued crops/varieties in small sole-cropped plots. The varieties were jugo bean, mung bean, Sri Lanka cowpea, ER-7 cowpea, Kep maize, and Sellie groundnuts. The CRT

recommended that small plots be grown because (1) the potential labor conflicts between sorghum and secondary crops could be minimized and (2) small plots would be sufficient to meet the limited demand for secondary crops. The trial was completely farmer managed and implemented. Measurements included plot size, seeding rate, labor inputs, stand establishment, and yields.

The farmers encountered many problems. The late start of the rains prevented many farmers from planting jugo beans or groundnuts. Plant establishment for most crops was less than had been hoped for. Even when reasonable establishment was achieved, insect pests, heat, drought, disease, and wild animal damage destroyed most plots. An economic analysis of the results is presented in Table 2-8. For comparison, an economic analysis of traditional sorghum production is presented in Table 2-9.

Overall, the farmers said they liked to grow secondary crops because of their high sale value, even if they could be grown only in small quantities. They did not like the long growing season of the groundnuts because of inflexibility in the timing of planting and susceptibility to pests during the long growing season. Hilling groundnuts was identified as a labor time problem.

At the end of the season every farmer, when asked, said that the problems encountered in growing sole crops were no more severe or were less severe than when the crops were intercropped. Most farmers further noted some advantages in growing sole plantings, particularly with respect to the timing of planting, site selection, and harvesting labor.

Superimposed thinning trial. Farmers were asked to identify parts of their field where they felt the stands were too high. By targeting thinning to the areas where the plant response could be expected to be the greatest, the CRT hoped to address one of the major objections farmers had to thinning. Women had complained that they just did not have time to thin their entire field because of the time required for weeding. The CRT hypothesized that a targeted thinning operation would have a higher return to labor than a generalized weeding operation. Therefore, thinning could be substituted for weeding, even if no additional time was available.

Four adjacent plots in the identified areas were pegged and one of each paired plot (chosen randomly) was thinned. Eight comparisons were implemented. Unfortunately, most plots were not thinned enough or were not thinned early enough. Discussions in the farmer groups revealed that this was because the day-to-day timing of postestablishment activities was affected by heat, rainfall, and soil moisture. For example, the farmers said that it was not a good practice to thin when the soils were dry because one might remove plants which could best survive drought and because the roots of the remaining plants could be disturbed. The average time required for thinning was 39.5 hours per hectare.

Table 2-8

Economic Analysis of a Sole-cropping Trial

	Jugo Bean	Mung Bean	Sri Lanka Cowpea	ER-7 Cowpea	KEP Maize	Sellie Ground-nuts
Number of plots	15	16	20	27	26	10
Stand establishment						
Plants/ha x 1,000	14.4	5.7	10.2	19.0	3.4	21.7
Plots weeded (%)	73	19	75	41	27	70
Plots harvested (%)	67	27	63	46	4	71
Yield (kgs/ha)						
All plots	48.3	4.6	40.1	25.0	3.5	35.6
Harvested plots	58.0	17.2	63.5	54.2	90.4	49.9
Economic analysis						
Output value (P/ha)						
BAMB prices[a]	17.87	1.89	15.64	11.75	0.88	21.00
Local trade prices[b]	108.68	7.18	62.56	39.00	2.10	71.20
Imputed variable costs (P/ha)						
Seed						
BAMB	3.00	5.49	2.26	3.15	2.80	8.38
Local trade	18.23	20.90	9.05	10.45	6.72	28.40
Plowing						
Own donkeys[c]	11.70	11.70	11.70	11.70	11.70	11.70
Hired tractor[d]	50.00	50.00	50.00	50.00	50.00	50.00
Postplant labor[e]	25.73	2.93	15.24	9.77	1.18	22.00
Gross margin						
Per hectare						
Own donkeys	53.02	-28.35	26.57	7.08	-17.50	9.10
Hired tractor	14.72	-66.65	-11.73	-31.22	-55.80	-29.20
Per hour						
Own donkeys	0.92	-0.36	0.75	0.51	-0.14	0.48
Local	0.60	-8.28	0.09	-0.83	-17.62	-0.12

[a]BAMB (Botswana Agricultural Marketing Board) prices (Pula/kg) for Mahalapye for the 1986 harvest, as follows: jugo beans—0.37; mung bean (price for tepary)—0.41; Sri Lanka—0.39; ER-7 (price for Blackeye)—0.47; KEP—0.25; shelled groundnuts—0.59.
[b]Local trader prices based on 1985 regional survey, as follows: jugo beans—2.25; mung bean, Sri Lanka, and ER-7 (price for cowpeas)—1.56; KEP—0.60; groundnuts—2.00.
[c]Plowing labor standardized to two workers.
[d]Government plowing rate which has established the standard private rate.
[e]Postplanting labor includes weeding, harvesting, and threshing.

Table 2-9

Traditional Sorghum Production, 1985–86[a]

Outcomes	
Yield, harvested plots (kg/ha)	89.50
Output value	
Local trade prices[b] (P/ha)	34.91
Imputed variable costs	
Seed[c]	2.34
Plowing[d]	50.00
Weeding[e]	7.52
Harvesting[f]	6.80
Gross margin[g]	
Per hectare	-31.75
Per hour	-0.64

[a]Single plow/plant.
[b]Local prices for sorghum are 39 t/kg.
[c]Seeding rate 6 kg/ha.
[d]Standard government plowing hire rate (P 50/ha).
[e]Average weeding time 19.8 hours valued at 38 t/hr.
[f]Based on harvesting and threshing rate of 5 kg/ha (17.9 hours).
[g]All computations based on local prices.

Hand-planting trial. Gap filling was a potential intervention for the females in households which were unable to increase production by plowing a larger area or which, because of a lack of control of the timing of plowing, obtained irregular plant establishment. The objective of the hand-planting trial was to evaluate the returns to labor from hand gap-filling parts of failed fields using a lightweight, free seed-drop hand planter. Farmers expressed interest in trying millet as well as sorghum and for dry planting as well as wet planting.

This was a researcher-managed, researcher-implemented trial. Farmer group members were asked to identify fields where plant stands were poor or negligible. On these fields researchers planted millet (Serere 6A) and sorghum (65-D) in paired plots (one hundred square meters each), with two repetitions. On some fields, the main plots were split into dry- versus wet-planting subplots. Four sites had the wet and dry comparison and nine additional sites were planted on wet soil moisture.

The average planting time was only 10.2 hours per hectare. Acceptable stands were achieved. Dry plantings established significantly better than wet plantings. Establishment was better on more sandy soils. Establishment, where it was good, was heavy and yields might have been increased through thinning.

Due to the late planting followed by drought, plant development was poor and yields were low, particularly for 65-D. Using local grain prices (39 thebes per kilogram), the average returns to labor across all sites were

P 2.18 per hour for Serere 6A and P 0.27 for 65-D (taking into account planting and harvesting labor and the value of seed).

Evaluation

The farmer group experiment was generally successful, although not all problems were resolved. The group discussions were particularly helpful in clarifying the instructions for trials and in creating pressure to implement trials. Weeding and pest control were considered by many farmers to be more important problems than stand establishment. The discussions of general farming problems were less satisfying to both staff and group members because most problems had no identifiable solution. For example, there were severe insect pest attacks but a spraying intervention was neither technically nor economically feasible. The main problem encountered was the drought, which led to the failure of most trials. Particularly in Makwate, there was little planting and this made it difficult to sustain interest in farming systems activities.

The two smaller and more homogeneous groups in Shoshong and Makoro worked out much better. There was a higher rate of successful trial implementation and there were more vigorous discussions. The discussions clarified for the technical scientists some of the factors affecting the acceptability of an intervention, even though fewer numbers were generated than is the case with formal trial approaches.

Women attended the group meetings more regularly than men and were more active in the trials. Men tended to dominate discussions in which they were involved, but often were satisfied to sit back and wait for a topic on which they felt they had relatively greater expertise. The women were more prone to talk about their problems and to seek advice while the males often did not want to be seen as complaining. The most animated discussions took place when farmers interacted on the basis of differing personal experiences.

Group members were asked to assess the trials and the group meetings. Every member of each group said that he or she wanted to be a member of the group during the next season. Also, all of the members said they understood the instructions for the trials. All but two members said they felt they could talk about their problems at the meetings. These two, both in the large Makwate group, said they were too embarrassed. All but one member said it was useful to hear about the problems of other farmers. That member was the poorest member of the Makoro group and was unable to plow until late in the season. The problems of other farmers did not seem to serve in comparison. The CRT has some concern about whether and how new farmers might be included next season.

ADDITIONAL EXPERIMENTATION

Two additional researcher-managed and -implemented design trials were carried out in the fourth season, and a farmer-implemented double-plowing trial was carried out with draft-controlling households.

Steps-in-technology trial. The researcher-implemented trial designed to provide a factorial evaluation of six tillage-planting operations and phosphate, first implemented in the third season, was repeated on five fields and in four soil environments in the fourth season. The results showed that double plowing and row planting (with and without early plowing) both gave significant grain yields over traditional broadcasting. Row planting after early plowing is a weed prone system with a high percentage of weed cover (15 percent versus 2.4-4.0 percent for other treatments). An analysis of results by soil types showed a significant treatment by environment interaction. The most significant results to early plowing and phosphate were obtained at environments with the highest total water-holding capacity and with dry conditions immediately following planting. Results for traditional practice, double plowing, and row planting after early plowing are shown in Table 2-10.

Water conservation systems trial. This trial was part of a collaborative effort within the Department of Agricultural Research (DAR) to evaluate several systems designed to conserve water including row planting and minimum till and strip systems. Weed cover (percent), weeding labor (hours), percent field emergence, percent flowering, average plant height and grain yield were recorded. Strip systems produced smaller, fewer, and less flowering plants and weed problems became quite severe. Minimum tillage systems with chiseling, subsoiling, and/or row planting showed some promise, though four times as much weeding was required than with the traditional system (9.9 hours per hectare versus 36 hours per hectare).

Double-plowing sorghum trial. The double-plowing trial was targeted to draft-controlling households and to specific soil and weed environments. The purpose of this trial was to determine site conditions that would favor the recommendation of double plowing. Important site characteristics included soil texture, weed levels, and plowing history. Each comparison consisted of one traditional and one double-plowed plot, broadcast-planted on the same day. Two to three meetings with trial participants were held in each village to discuss trial design and implementation problems. Implementation of the double-plowing treatment, even on a small plot basis, proved difficult in a drought season. An overview of the outcomes is reported in Table 2-11. Participation in the farmer group trial and double-plowing trials is reported in Table 2-12.

Table 2-10

Effects of Plowing and Planting Methods[a] and Phosphate on Yield for Four Environmental Groups

Environmental Group[b]	Phosphate TRT[c]	Tillage-planting Method[a] BSP	BDP	RPEP	Mean[d]
		kg/ha			
A	Without P	500.4	870.6	926.5	712.6
	With P	628.2	1,198.5	1,252.0	931.9
	Mean	564.3	1,034.5	1,089.2	—
Standard error of mean = 157.75 and 38.91 for tillage-planting and phosphate comparisons, respectively.					
B	Without P	405.6	293.3	347.7	413.7
	With P	345.7	309.5	444.6	402.3
	Mean	376.1	301.4	396.2	—
Standard error of mean = 31.40 and n.s. for tillage-planting and phosphate comparisons, respectively.					
C	Without P	547.0	588.5	257.3	501.1
	With P	843.5	775.0	428.0	903.1
	Mean	695.3	681.8	342.7	—
Standard error of mean = 169.3 and 116.4 for tillage-planting and phosphate comparisons, respectively.					
D	Without P	82.7	146.3	130.7	113.4
	With P	81.1	131.7	208.2	140.4
	Mean	81.9	139.0	169.4	—
Standard error of mean = n.s. and 8.95 for tillage-planting and phosphate comparisons, respectively.					

[a]The three plowing and planting methods are BSP broadcast/single plowing; BDP, Early plowing plus broadcast/second plowing on later date; and RPEP, Row planting after early plowing. The other treatments were single plowing and row planting on a single day, single plowing plus seed-bed preparation and row planting on single day, and early plowing plus seed-bed preparation and row planting on a later date.

[b]*Environmental group A:* Deep to moderately deep soils with high total water-holding capacity and with a rainfall pattern favorable for response to early tillage (i.e. good preplanting rain with dry conditions immediately following). 3 sites x 2 repetitions per site.
Environmental group B: Shallow soils with low total water-holding capacity and with a rainfall pattern that would be favorable for response to early tillage. 3 sites x 2 repetitions per site.
Environmental group C: Moderately deep soil with high total water-holding capacity but with a rainfall pattern not favorable for response to early tillage. 1 site x 2 repetitions per site.
Environmental group D: Rainfall pattern consists of marginal moisture at planting followed by dry conditions resulting in delayed emergence. 2 sites x 2 repetitions per site.

[c]Phosphate treatment comparisons include the DAFS recommendation of 20 units P/ha applied broadcast before plowing and a 0 units P/ha check.

[d]Mean is the mean of all six treatments described under footnote *a*.

Table 2-11

Farmer-Implemented Double-plowing Sorghum Trial, 1985–86 *(N=31)*

	Total or Average
Crop response	
Avg. grain yield (kg/ha) (s.e.= 12.71)	
Traditional	89.5
Double plow	173.7
Avg. field emergence (%) (s.e.= 0.96)	
Traditional	17.1
Double plow	17.3
Weed control	
Avg. weed cover (%) (s.e.= 0.64)	
Traditional	5.3
Double plow	4.0
Avg. weeding time (hr/ha) (s.e.= 3.11)	
Traditional	24.6
Double plow	15.2

Table 2-12

Farmer Participation in Trials, Fourth Season

	Sex of Head		Cattle Assets		Draft Access			Contact
	M	F	0–15	>15	C	D	Total	Farmer
Sole planting[a]	21	19	23	17	20	20	40	Female
Thinning[b]	2	3	2	3	4	1	5	Female
Hand planting[b]	7	6	7	6	7	6	13	Female
Double plowing[b]	35	8	—	—	37	6	43	Male
Row planting[c]	14	0	—	—	14	0	14	Male

Key: M = male; F = female; C = control; D = dependent.
[a]Farmer-managed, farmer-implemented trial.
[b]Researcher-managed, researcher-implemented trial.
[c]Researcher-managed, farmer-implemented trial.

At the end of his report, Dean attached some additional observations reflecting concerns about future priorities.

OBSERVATIONS

We have experimented with a number of methodologies for acquiring information and for stratifying the farmers of the Central Region. In our earlier research, we distinguished several categories of farmers, but all those distinctions may no longer be necessary. We also have found that informal interactions through farmer field days and farmer groups have been as useful as formal surveys in providing insight into the farming system and perhaps should be given more weight in subsequent work.

Not all of what we have learned in the past four years can be found in our survey and trial findings. We have observed several issues which are likely to affect the future activities of the CRT. First, there are several important trends taking place in Botswana, including the growing importance of tractors and donkeys relative to oxen, the rapid pace of fencing and associated opportunities for intensified production, the growing labor constraints, the increasing gap between poorer and richer households, the changes in family structure and authority, the aging of the farming population, the increasing reliance on purchased inputs and food supplies, and the declining importance of agriculture for rural households. Second, many of the popular assistance programs are too expensive and have not had their desired impact. It may be that policy makers need advice on trends and policy issues as much as farmers needed advice on new production practices. Third, many practices which have been examined by the team are closely related to existing extension recommendations. It may be that a lack of knowledge and experience with alternative practices is as much a constraint on change as is a lack of proven advantage.

NOTE

1. The approach proposed by Dean is with reference to Robert Chambers and Janice Jiggins, *Agricultural Research for Resource Poor Farmers: A Parsimonious Paradigm*, Discussion Paper 220 (Sussex: Institute of Development Studies, 1986).

Teaching Notes for Botswana: Part 2 Adaptations in Experimentation and Monitoring During the Fourth Season

CASE SYNOPSIS

Part 2 covers the fourth year of experimentation by the CRT in Botswana. There was a shift in the subdivisions of the farming population from the original six research domains (based on type of and access to draft) and six types of households (sex of head, rich or poor, draft access) to two categories—those who had resources to engage in proposed tillage-planting operations and those who had severe resource constraints but could still benefit from increases in agricultural production.

For the better-off farmers, there was a continuation of the plowing and planting trials including one which was farmer managed and implemented. For the farmers with more resource constraints, the CRT formed farmer groups and focused on operations such as hand planting and thinning which could be carried out without draft. Trials on the sole cropping of varieties other than sorghum—beans, cowpeas, maize, and groundnuts—were also carried out with farmer groups.

Resource-monitoring surveys ceased and the principal surveys reported for the fourth season covered cart ownership, in order to understand access to transport, and tractor ownership, in order to determine tractor utilization by owners and hirers. The formation and organization of the farmer groups is described.

ANALYSIS OF THE CASE

The important points relating to gender in this case study are as follows:

1. The description of the farmer groups as a prototype for experimentation and for later extension activities and as a means of successfully reaching female and poorer farmers. The case reports that the farmer groups, especially small ones, worked well to enlist farmer interest in experimentation, farmer ideas on priorities, and farmer feedback on trials implementation and results. The farmer groups seemed an effective way of reaching female farmers. Overall, the groups improved farmer collaboration.

2. The explicit attention paid to female heads of household and female spouses in the selection of farmer collaborators for specific trials. As shown in Table 2-12 earlier, female-headed households numbered close to 50 percent in the trials conducted with the farmer groups. Likewise, the issues addressed by those trials—high-value food crops other than sorghum, and postestablishment practices which did not depend on traction—were ones which had a reasonable chance of being implemented by female farmers. The hand-planting trials showed that, compared with an opportunity cost of thirty-eight thebes per hour, hand gap-filling could be profitable with Serere millet, but not with sorghum. These trials were carried on simultaneously with those which met the needs of better-off farmers. (See also discussion question 6 in teaching notes to Part 1.)

3. The attention to women's labor constraints in the cart survey. This survey explicitly addressed the time spent by women in gathering fuelwood and water as well as the delays in planting due to lack of transport. The survey provided evidence for consideration of the inclusion of carts in the government assistance program, ALDEP.

4. Further consideration of the proposed plowing and planting in the light of gender roles. As the author points out in Appendix 2-C, the extra labor for the proposed plowing and planting falls principally on men, and the use of this method could release women's labor for improved postestablishment practices. This is again a demonstration of innovations which are technically feasible, but for which farmer acceptance will be severely limited because of the relatively little perceived benefit by the person who will have to contribute the most additional labor.

5. The consideration of the policy implications of the findings on resource constraints and female-headed households as they relate to potential improvements in agricultural production. Draft access seems the most useful category for defining farmer target groups with respect to improvements in arable production.

Another point which can be discussed here is the issue of tradeoffs between national production goals and the goal to reduce food imports and increase equity. Emphasis on the former would favor more experimentation with and resources for improved plowing and planting and the addition of inputs, though only a few farmers have the interest and resources to adopt them. Emphasis on the latter would favor further experimentation for resource-poor farmers, who are largely but not exclusively female-headed households. This would include a focus on the subsistence production of poorer households to see if improvements in their production of sorghum, under more limited circumstances, or of other food crops would be a contribution to reducing dependency on government transfers and, by extension, food imports. There are different interests at stake here—production scientists, government policy makers, etc.—and tradeoffs between equity and efficiency objectives. Such a discussion is an

excellent opportunity for different views to be expressed and argued. There is no one right answer.

TEACHING POSSIBILITIES TO CONSIDER

1. On the basis of trials conducted over all four seasons, are there any innovations which will demonstrably improve production and are ready to be disseminated to farmers? What? Why? Who will be the acceptors and what are the incentives and disincentives towards adoption?

2. Evaluate the involvement of male farmers and female farmers in this project. To what activities of the research did they contribute? What were the pluses and minuses of their involvement? What were the lessons to be learned? (See also discussion question 6 in teaching notes to Part 1.)

3. What form of monitoring should be used in future CRT work? Should the farmer groups be continued? On what basis?

4. How was farmer input and participation different in year four compared to the first three years? What further steps can be taken to increase farmer participation? (See also discussion question 9 in teaching notes to Part 1.)

5. Note the shift in farmer-researcher roles in trials management and implementation; from exclusive use of researcher-managed, farmer-implemented trials during the first two years, to a combination of researcher-managed, researcher-implemented trials and farmer-managed, farmer-implemented trials (through the farmer groups) in years three and four. Why did this shift take place? What are the different objectives and demands of working with farmers in these three different contexts?

6. How have the CRT activities fit with with the Government of Botswana's original objectives for the project? An important lesson is that the original assumption that women would benefit from any new technologies because they make up a high percentage of the farmers is not reliable. Benefits to women as a target group will depend on their circumstances—as heads of households or as spouses, and whether rich or poor.

Appendix 2-A: Letter from the Field

DOYLE C. BAKER

With respect to technology development research, a problem with either a gender or a cattle subdivision is that there is not a clear relationship with agricultural production performance. In other parts of the country (and in other studies) it has been assumed that gender is related through a shortage of male labor, and cattle assets are related via access to traction. However, both linkages are suspect—at least in the Central Region. My analysis of the demographic data do not support the belief that the gender structure of female-headed households is significantly different from that of male-headed households (except of course the presence of a male head). Moreover, female-headed households which have assets and therefore the money to hire traction or to gain labor through draft exchange do not necessarily have to have male labor. In this part of the country, a majority of households have been plowing with hired tractors lately, so the need for cattle or male labor is becoming less and less.

In contrast, there is much agronomic evidence that the number of days spent plowing and planting, and the timing of those days relative to rains, is the dominant determinant of cropping outcomes. The evidence is also clear that traction control is significantly related to the number of days of plowing and the timeliness of plowing (over the seasons and with respect to individual rains). Therefore, the traction subdivision has a clear relationship to the relevance of interventions to improve crop production. Equally important, the government can be confident that interventions designed to help draft-dependent households will in fact help impoverished households.

Therefore, I now feel that policymakers should concentrate on an asset subdivision while technical scientists set up research domains based on traction control. If both are done, the problems of poor female-headed households will be better addressed since no unsupportable assumptions will be required (e.g. all female-headed households are poor, households without cattle cannot plow, female-headed households cannot gain the male labor necessary for crop production, etc.).

The major implication is not that gender of household head is unimportant. In fact, one could reasonably argue that poor female-headed households are the most important target group among the entire population and should receive the top priority in planning. Rather the issue is the utility of different subdivisions when developing targeting strategies

for program planning and technology development. I would argue that, in the Botswana case, female-headed households will benefit the most if the other subdivisions are used. If for no other reasons, a political economy perspective would indicate that technical scientists will more readily respond to a directive to target based on the control of plowing resources, and policymakers will respond most readily to cattle subdivision. In my experience, for the most part, male scientists and policymakers reject the notion of targeting female-headed households.

The second issue I have been pondering lately pushes me into exactly the opposite direction of the above with respect to gender issues. I believe the issue of intrahousehold gender equity needs to receive much more attention than it has received.

In a simplistic agricultural economist view of the world, increases in production can come via expanding the area cultivated (extensification) or by intensifying land use (and thereby increasing yields). In Botswana, farmers have traditionally relied on the first strategy—reflecting their early shift to animal traction.

There are two basic limitations to a land extensification strategy: (1) erratic rains prevent adequate plowing in many seasons; and (2) in seasons with good rains, plowing is limited by the hours required for hand weeding the area plowed and planted. The land intensification strategy has been constrained by a prevailing impression that the marginal returns are too low and uncertain relative to other alternatives. The CRT research has shed light on these limitations.

Even in drought seasons, most farmers waste several opportunities to plow and plant. For example, early season rains could be used to plow without planting. Our research has shown (over five seasons of trials) that the addition of a "sole-plowing" tillage operation increases yields on average by 75 percent. Our research also shows that even with single plowing, farmers need not avoid planting just because the soil is drying, because there is substantial delayed emergence. While the production potential of such plots is low, it is certainly above unplanted plots.

In brief, if men are willing to work, they should be able to plow all their fields in every season. Our data support this view in the sense that several households have managed to plow all their fields during drought.

This leads to the more important extensification issue of a weeding labor constraint. There are two obvious solutions to this problem. One is to add the sole-plowing tillage operation mentioned above. This not only increases yields, it reduces weed burdens and can greatly reduce the requirements for weeding. During the last season, weeding labor time was cut by 50 percent due to the extra tillage operation. The second option is to adopt row planting and mechanical interrow cultivation as a substitute system for traditional broadcast planting and plowing and hand weeding. The row-planting system tends to increase yields as well as reduce total

labor requirements. In fact, our data show that the total time required for both row planting and interrow cultivating a hectare is about half that required for hand weeding a hectare.

The big catch with either system is that men must work harder. Specifically, women benefit from either modified system more than men lose. This is even clearer if one values female-weeding labor higher than male labor since the former is the most constrained household resource.

Appendix 2-B: Computations Gender-disaggregated Costs and Benefits from Double Plowing and Row Planting after Early Planting

Table 2-B.1

Double Plowing (BDP) vs. Single Plowing (BSP) One Hectare

	MA	FA	MA	FA
	Pula		hrs	
Weeding		(3.57)		(9.4)
BSP harvesting		(8.90)		(23.4)
Second plowing	+9.04		+23.7	
BDP harvesting		+15.04		+39.6
Additional (reduced) labor requirements	+9.04	+2.06	+23.7	+6.8
Net gain from operations: Pula 19.97				

Key: MA = male adult; FA = female adult.

Implications: More labor is required of both men and women, but particularly of men. The question is whether the increase in sorghum yields is sufficient incentive for them. For those who must hire traction, including predominantly female-headed households, there is a loss.

Table 2-B.2

Double Plowing (BDP) One Hectare vs.
Single Plowing (BSP) Two Hectares

	MA	FA	MA	FA
	—— Pula ——		—— hrs ——	
Weeding		(12.46)		(32.8)
BSP harvesting 2 Hectares		(18.46)		(48.5)
Second plowing	+9.04		+23.7	
BDP harvesting		+15.04		+39.6
Additional (reduced) labor requirements	+9.04	(15.88)	+23.7	(57.6)
Net gain from operations: Pula 3.16				

Key: MA = male adult; FA = female adult.

Implications: There is a substantial gain to women in terms of reduced weeding. The net gain in yields is marginal and male labor is increased, therefore it is not likely to be adopted by male-headed households.

Table 2-B.3

Row Planting after Early Plowing (RPEP) vs. Single
Plowing and Broadcasting (BSP) One Hectare

	MA	FA	MA	FA
	—— Pula ——		—— hrs ——	
BSP harvesting 2 hectares		(4.45)		(11.7)
Planting	+6.08		+16.0	
RPEP harvesting		+7.64		+20.1
Additional (reduced) labor requirements	+6.08	+3.19	+16.0	+8.4
Net gain from operations: Pula 24.27				

Key: MA = male adult; FA = female adult.

Implications: This practice requires additional labor from men for row planting and somewhat less additional labor from women for harvesting. Also, not indicated, is women's labor saving because men do planting.

Table 2–B.4

Row Planting after Early Plowing (RPEP) one Hectare vs. Single Plowing and Broadcasting (BSP) Two Hectares

	MA	FA	MA	FA
	Pula		hrs	
Second plowing	(9.04)		(23.7)	
Weeding second plot		(8.89)		(23.4)
BSP harvesting 2 hectares		(9.23)		(24.3)
Planting	+6.08		+16.0	
RPEP harvesting		+7.64		+20.1
Additional (reduced) labor requirements	(2.96)	(10.48)	(7.7)	(27.6)
Net gain from operations: Pula 0.97				

Key: MA = male adult; FA = female adult.

Implications: In this comparison, men's labor time is slightly reduced if RPEP is chosen over BSP, with no loss of income. Women work less using RPEP and at a different time during the season. Under more favorable climatic conditions, this different distribution of activities might be more important.

Appendix 2-C: More Comments From the Field

DOYLE C. BAKER

The gender battle extends to the land intensification strategies tested and discussed in Part 2. The CRT has tentatively identified two reliable avenues to intensification. The first entitles investments in high-potential sites. Although we have only been following this line of investigation for two seasons, the research suggests that farmers can profitably invest in further developing the production potential of these sites; that is, if they are plowed twice and receive twenty units of phosphorus per hectare. Such investments are too risky when done across entire fields, but are worthwhile on appropriately selected sites. Also promising, but untested, is the addition of manure and the incorporation of stover and contour plowing.

The catch with all the above is that increased investment involves tillage operations. The question is then, will men work harder in arable production if it is clearly demonstrated that the household will benefit?

A complementary strategy for reliable intensification is labor investments in postestablishment stand management, returns to hand-planting labor invested in gap filling (which exceed the urban minimum wage rate by 200–300 percent), and thinning. Women generally do these operations. However, women face a weeding labor constraint.

There are three ways around this constraint. First, if plowing begins earlier and extends to later in the season, weeding labor requirements can be spread over two to three more months. This would allow women to combine gap filling and thinning with their weeding operation. Second, if men assume total responsibility for plowing, rather than primary responsibility, then women can be hand gap-filling and thinning early planted plots while the men are continuing with plowing. Third, and most important, if men begin double plowing or row planting, then the requirements for hand weeding can be greatly reduced and women will have the time for thinning and gap filling. Again, all the alternatives for improvement require that men be willing to assume a greater share of the labor burden required to sustain the household.

In brief, I believe we are beginning to understand how arable production can be substantially increased in Botswana even under drought conditions. But every option depends on an implicit battle between the sexes. Unless a way can be found to convince Batswana men that they are exploiting women (along with cattle and diamonds) in order to have an easier life than their own labor product justifies, there is relatively little that can be done. This issue is so important in Botswana that the debates regarding gender of household head pale in comparison.

Chapter 3

Burkina Faso

A Case Study of the Purdue University Farming Systems Project

CONTENTS

Teaching Notes for Part 1: Country and Project Background (in *Working Together* Vol. 1, Chap. 4)

Part 2 Experimentation and Monitoring
Analysis of Diagnostic Information
First-Year Campaign, 1982
Second- and Third-Year Campaigns, 1983 and 1984
Study Questions
References

Teaching Notes for Part 2

Part 3 Evaluation, Modifications, Recommendations, and Dissemination
Evaluation Criteria
Evaluation of Farmer-Managed Trials
Development of a Mechanical Ridge Tier (MRT)
Recommendations, Conclusions, and Dissemination
Study Questions
Notes

Appendix 3-A Summary of 1982 FSU On-farm Researcher-Managed Trials
Appendix 3-B On-farm Farmer-Managed Trial, Volta Phosphate and Tied Ridges on Millet Fields
Appendix 3-C Summary of 1983 and 1984 On-farm Trials

This case and teaching notes were prepared as a basis for discussion rather than as an illustration of either effective or ineffective handling of a project.

Teaching Notes for Burkina Faso: Part 1 Country and Project Background

CASE SYNOPSIS

Burkina Faso is a land-locked country which suffers from poor soils and limited, erratic rainfall. The government is committed to improving the agricultural sector and has set in place a variety of parastatal organizations and agreements with international and regional agricultural research institutions to assist in this effort. The background of the country and the institutions serving the agricultural sector are described in *Working Together* Volume 1, Appendices 4-A and 4-B.

The farming systems research described in the case is a collaborative effort between SAFGRAD and Purdue University. To do the research, the team selected three villages in different agroecological zones having different characteristics with respect to size of holdings, household size, and access to animals for traction. The villages are Bangassé, Diapangou, and Nedogo. After a census was conducted, the heads of household from a sample chosen in each village were interviewed with a diagnostic questionnaire. The results of that diagnosis and other data collected by the project are reported in the case: household characteristics, cropping patterns, crop husbandry, beer making, food preparation, land tenure, and use of labor. Farmers were also asked to identify their goals and objectives, the factors affecting cropping and marketing decisions, their production constraints, and their access to credit.

The team looked at what was available from the region's research stations. These included (1) changes in cultivation practices (i.e. improved patterns of planting and weeding and a water retention technique, tied ridging); (2) fertilization using the available 14-23-15 fertilizer in combination with urea and local phosphate; and (3) varietal improvements in cowpeas, maize, and sorghum. At the close of the case, the team is faced with the task of planning a research program based on their diagnosis of the farming system and the most promising technologies.

USE OF THE CASE

This case is especially suited to a technically oriented group or to a multidisciplinary group of participants. It is one of the longest cases and requires ample time to read and study. It is best used in a long training course or academic class where it can serve for a number of exercises in addition to gender analysis. Trainers should use the Burkina Faso case after using another case. Participants should already have a basic knowledge of farming systems research and of trial design. This case would be good for social scientists interested in learning about the technical side of farming systems research.

The major areas for discussion of Part 1 are the determination of (1) recommendation or research domains, (2) production constraints, (3) priority problems, and (4) the design of experiments that will lead to a technology intervention that will diminish one or more of the constraints. Sufficient agronomic and socioeconomic data are available to focus in on specific agronomic experiments. Participants can also discuss the quality and appropriateness of the agronomic and socioeconomic diagnostic data and lay out plans for further surveys in the areas that they feel require additional information. Trainers should be on the alert for the possibility that technical scientists may get bogged down in the detail available and not pay attention to gender.

It is suggested that Part 1 of the case (*Working Together* Vol. 1) be taught in two sessions using the same text. The preparation for session 1, in individual study and in small group discussions, would be based on study questions A, below. During the plenary session the trainer would guide participants through the cropping calendar and activities analysis, and the resources and incentives profiles. That section would end with problem definition and suggestions for research for the coming year. At the close of the session, study questions B would be handed out.

Session 2 would begin with small group discussion, this time working specifically on the design of a field trial and the collection of relevant socioeconomic data. During the plenary session, the group would analyze one or two proposed field trials according to the intrahousehold analysis done earlier and would collaborate on specifying what additional socioeconomic and intrahousehold information is desirable and how it is aquired.

Note: Some people confuse communal land and compound land. Communal land is land farmed for the benefit of a traditional household, usually a male head of household, his wife or wives, and their young children. Often adult sons and their wives and children are included. The decision-making authority for communal land or fields rests with the head of household; these fields might be located near or distant from the homestead. Compound land is the land including and adjacent to the homesteads. It is a specific location, but use rights and decision making might be divided among several individuals.

LEARNING OBJECTIVES

1. To disaggregate by gender and age the principal activities, resources, and benefits of agricultural (including livestock), household, and other production

2. To analyze the agronomic and socioeconomic data to determine research domains, production constraints, priority problems, and research possibilities

3. To design a field trial and related socioeconomic research activities and monitoring mechanisms

STUDY QUESTIONS

Study Questions A

1. What and when are the agricultural, livestock, and other production activities carried on during the year and who does them?

2. What factors affect men's and women's access to and control of resources for production? What factors affect men's and women's access to and control of benefits from production?

3. What are the constraints and priority problems faced by farmers when attempting to increase agricultural production? What technological interventions might be considered?

Study Questions B

The following study questions build upon the analysis undertaken in session 1, below.

1. List the possible technological interventions and associated field trials or experiments that you might want to consider in designing a field program. Define the domain (region, types of farmers and individuals, etc.) in which you will work, the time frame, and the method of organizing the program, i.e. the sequencing of researcher-managed and farmer-managed trials.

2. Using the information available in Part 1 (*Working Together* Vol. 1), design a field trial for an intervention or set of interventions which look promising.

a) Develop it further into a protocol that could be given to the field staff. Specify related agronomic data (i.e., rainfall, planting dates) and socioeconomic data that you would gather, the research domain and the target group, and how and when you would monitor the field plots. Include a partial economic budget if possible indicating likely returns and the breakeven point.

b) Specify what new tasks will have to be performed because of the technological intervention and speculate on what might be the changes in the gender division of labor of the intervention chosen. What new resources will be required and who will have access and control over them? What is the incentive structure (i.e., who gets the revenues)? Provide a way to monitor the above developments.

c) Describe what criteria you will use to judge whether or not the intervention should be recommended for extension.

3. What additional agronomic and socioeconomic information would you collect in the next and subsequent year's campaigns?

Note: In giving these questions, you may want to refer to Worksheet 1-6 (*Working Together* Vol. 1, Chap. 1) as an outline of a protocol, so that students have a standard format for reporting their designs.

ANALYSIS OF THE CASE

Burkina Faso is a resource-poor country with very limited economic opportunities. Agriculture is the dominant sector and improvements in this sector will reach the lives of most of the people in Burkina Faso. Food security, the balance of payments deficit, and a large and increasing population given the resource base are major problems that must be faced by Burkina Faso.

One of the main themes of this case is the exploration of the access to and control of resources and how this leads to the control of revenues from labor or other enterprises undertaken by men and women. For this research, the definition of a household unit was "a group of people who came under the direction of one person," the headman, usually an elderly man "who controlled the resources of the group and made the final production and consumption decision." In this farming system the hierarchy of decision making in two crucial areas, land and labor, is dominated by the headman.

Land is not owned in the Mossi plateau, but people have tenure to land by virtue of different rights: customary, individual, and borrowed. Tradition and social custom dictate that land for use in cultivation is assigned by the headman or senior male who sets aside the best land for communal fields upon which are grown the main cereal crops—millet, sorghum, and maize. Junior men, women, and teenage children are assigned personal plots upon which they cultivate a mix of subsistence and cash crops, those crops such as groundnuts and bambara nuts which are used for both home consumption and sale. Women do not inherit land and their rights to fields for cultivation come through their husbands, accompanied by the obligation to provide one meal a day for their immediate household during the dry season. The personal plots of women and children are rotated every one or two years; those of men may be held for longer and become the base of their own extended holding. Land can also be classified according to its soil fertility and capacity for water retention, such as compound land, sorghum land, and millet land.

Production from communal fields is given priority. From these fields comes a major share of a household's subsistence. The headman commands the labor of all under him for work on these plots. People are then free to work on personal plots, but women and children also work on the husband's holding. Women and children work on their own fields after they have met these obligations, and the requirements of household maintenance (food preparation and fetching of fuel and water). Senior wives have more autonomy, lower requirements for work on communal fields, and more time for their own production. One's command of one's own labor and family labor for one's own account activities depends on where one is in the hierarchy.

The case does not provide information on what the rules or areas for negotiation are concerning the command of labor by the headman or by husbands of their wives' labor. Is there a maximum? How much is negotiable? Are there reciprocal obligations or payments and what conditions them?[1]

Even modern institutions echo tradition and social custom: access to purchased inputs through the credit system does not favor women or men who are not heads of households.

The primary incentive for production is survival; production of enough for year-round subsistence. Only half the farmers in one village, Diapangou, consider price and cash an incentive. In general the need for cash, as reported by the heads of households surveyed, is for taxes, medical assistance, clothing for family in return for the labor given, and gifts to facilitate the arranging of marriages. Men control the revenues from production on personal plots, livestock (also a use of cash as savings or wealth), crafts, and some commerce. Women control the products from their personal fields, including what is sold, and the revenues from beer making (which may be regulated) and small-scale commerce.

A woman's decisions about what to plant and how to manage her personal fields is affected by a number of factors. First is the obligation to contribute toward the household food supply, which is met by planting about one-third of her holdings to staples and another third to maize and relish crops. The final third is usually devoted to peanuts or bambara nuts which are used for consumption and sale. Second is the quality of the land which she is given, how appropriate it is for different crops, and how long she is likely to have it. Third is the availability of her own and her children's labor, given the many other demands for her time. Fourth are alternative opportunities such as in beer making and small-scale commerce. As indicated above, the room for making autonomous decisions expands over time.

Men's decisions about what to plant and how to manage their fields, including communal fields, depends on their position in the hierarchy. This determines the amount, rotation, and quality of their personal fields and the amount of labor they can command for common production. Communal fields are planted to meet the compound's needs for adequate food supply.

Though the three research villages differ somewhat in what they grow, their use of animals, their demographics, and their position on the subsistence-cash continuum, their problems are very similar: poor degraded soils, lack of moisture, and labor constraints. The land constraint is the absence of good sorghum land with sufficient fertility and water retention characteristics for reliable sorghum production. Poorer, millet land is too risky for the production of sorghum, the preferred crop. The time with the greatest labor constraint is the period of first weeding of sorghum and millet which overlaps with the planting of maize and groundnuts and is also the period of lowered human and animal productivity because of food shortages. The competing demands for labor at this season are not just between crops, but between fields: communal fields, men's personal fields, and women's personal fields. Finding low-cost solutions to these problems is the task of the Purdue Farming Systems Unit (FSU/SAFGRAD) team.

In order to plan the next year's on-farm research, the FSU team must consider what technologies hold the most promise and with what groups or research domains to work. There are a limited number of technical possibilities from work already done on research stations. These can be screened as to their technical feasibility, economic viability, and likely fit with this farming system. Intrahousehold analysis provides assistance in examining specific technologies and experiments for their likely effects.

The analysis suggests that crosscutting the agroecological criteria of soil fertility and the capacity for water retention are fields which, though they may be planted to the same crops, are operated under different resource constraints with respect to labor and with different objectives. There are

communal fields, men's fields, and women's fields. A solution appropriate for communal fields may not be cost effective or appropriate for personal fields, especially if it calls for more labor. The greater labor demands may reduce the time available for work on individual plots; or if there are customary rules about how much labor can be commanded by the headman, the extra labor required for the communal fields may not be forthcoming. On the other hand, labor-saving technology would benefit both men and women, leaving more time available for their own production.

In considering improved varieties—for improved yields or a shorter growing cycle—the researchers need to consider the end use of the crop and its acceptability by those, predominantly women, who make it into *tôt*, beer, or sauce. With cowpeas, both grain and leaves are important products. Applying gender analysis is also useful in identifying who specifically is affected by a change in activity or resource use. In the case of planting and weeding, men, women, and children all participate and all should be included in learning new techniques and assessing their utility. Changes in land preparation would probably affect mostly men; changes in harvest practices would affect men for the initial cutting and stacking, women for cutting the panicle.

The team's own analysis can be found in this chapter, in Part 2 of the case.

DISCUSSION QUESTIONS

Discussion questions are presented for two sessions. The first session focuses on gender analysis in the diagnosis of the farming system and examination of research possibilities. The second concentrates on the design of a research program and on-farm trials, taking gender analysis into account.

Session 1

Note: If you are unsure of the audience's experience with farming systems or technology development, we would recommend a short initial lecture giving a synopsis of the case, the context for experimentation, and a review of tied ridges and other available technologies.

1. Where are we? What is this project about? What are the objectives? Who is carrying out this project?

These opening questions set the stage for further discussion. It is important that everyone is clear about the circumstances under which the FSU team is working. These may be listed on the board and are useful as a reference point in later consideration of what is or is not appropriate or

feasible research. The team is working in a resource-poor environment with little in the way of off-the-shelf technologies. Though there is government support for agriculture, within the area where they are working the infrastructure for providing inputs and extension is weak. They have specific objectives: to identify production constraints, identify appropriate technologies, develop a multidisciplinary research method, and identify elements of the method used in Burkina Faso which can be transferred to national agricultural systems.

2. What goods and services are produced? Who produces them and when?

The first task for participants is the construction and/or disaggregation of an activities calendar. To do this, the participants will need to refer to Figure 4-2 and Tables 4-5 and 4-10 of *Working Together* Volume 1. The purpose is to combine the information on crop production (Figure 4-2) with livestock and household production, etc., and to assign gender for each enterprise or task. Note also the times of greatest labor constraint from Table 4-10.

A gender-disaggregated calendar of activities for this region includes crop and livestock production, household production, and off-farm wage labor (Figure 3-1). Because a central issue in this case is seasonal labor constraints it is important to discuss the activities while using the calendar and it is important that all activities be included. (See the notes on using a calendar in chapter 1 of this volume.)

What is immediately evident, and verified by the comments of the heads of household surveyed, is the labor constraint during June and July when the first and second weeding of sorghum and millet (staple, subsistence crops) compete with the planting and later weeding of maize and groundnuts (a source of cash). This can be identified and put under a new heading, "resource constraints," for later discussion.

A second form of displaying an activities analysis (Table 3-1) does not capture seasonality. It does include some notes which may be helpful in discussion.

3. What are the resources available for production? Who controls them? Who has access to them?

These questions get at the heart of the application of gender and intrahousehold analysis to this system. A profile of the access and control of resources for this area shows that senior men control most of the resources, especially land and labor (Table 3-2). What was not evident in the activities analysis but is evident here is that the labor available for different fields varies as does an individual's control over his or her own labor. This and the availability and quality of land are important discussion points. Differential access to credit for purchased inputs should also be noted in the discussion.

Figure 3-1

Gender-disaggregated Activity Calendar for the Mossi Plateau

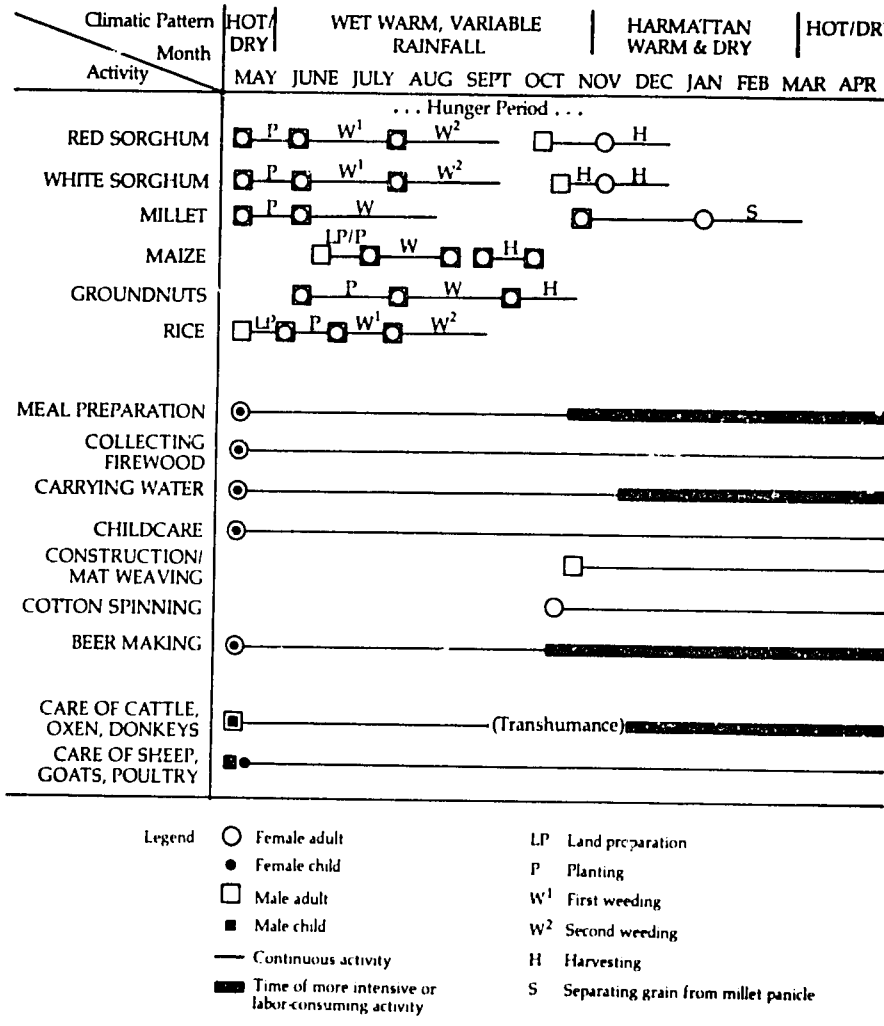


Table 3-1

Activities Analysis: Time Use and Task Allocation

Production of Goods and Services	Males	Females	Notes
Subsistence crops			
Maize	MA	FA	Maize is near compound
Millet	MA	FA	Communal fields
Sorghum, red & white	MA	FA	
Relish crops	MA	FA	
Cash crops			
Peanuts	MA, MC	FA, FC	On individual fields
Bambara nuts		FA	
Cowpeas	MA	FA	Intercropped with grains
Animals			
Small animal care	MC	FC	High death rate, little vaccination
Livestock work	MA, MC		Nov.–May transhumance
Poultry	?	FA	
Tasks			
Land preparation	MA		Traction for some farmers, but animals often weak
Planting & harvesting	MA, MC	FA, FC	Shared
Harvesting & stooking	MA		
Panicle cutting		FA	
Construction & fence building	MA		
Weaving mats	MA		
Pottery & other crafts	?		
Cotton spinning		FA	
Commerce	Large	Small	
Beer brewing		FA	Sometimes rotated in villages
Off-farm wage labor	MA		
Human capital production			
Food preparation		FA, FC	
Child care		FA, FC	
Water		FA	
Fuel		FA	
Building maintenance	MA		
Other			

Key: MA = male adult; FA = female adult; MC = male child; FC = female child.

Table 3-2

Access and Control of Resources for Farm Production

Resources	Access	Control	Notes
Land			
Communal	FA	SrMA	Higher quality
Individual right	MA, FA MC, FC	SrMA, MA	FA, MC, FC, shift frequently; MA longer rotations
Borrowed	MA, FA	MA	Cultivation rights only
Compound		MA	
Labor			
Family labor		SrMA, MA	
Own labor	FA	MA>FA	SrFA more autonomous
Capital goods			
Dabas (hoes)	MA, FA	?	
Animal traction units	MA		Stratifying variable/income
Cattle		MA	Wealth food insurance
Donkeys		MA	
Oxen		MA	
Small ruminants	FA	MA>FA	FA needs husband's permission to sell
Poultry	FA	FA	
Inputs			
Seed	?	?	
Fertilizer		MA	
Manure		MA	
Fodder	?	?	
Agricultural credit			
Formal		MA	5.5%; often not available
Informal	?	?	200–250%
Inputs credit		MA	Often late or unavailable
Markets/transport	MA, FA		
Cash	MA, FA	MA>FA	
Fuel for wood	FA	MA	Owner of land/not borrower
Sorghum for beer			
for consumption	FA	MA	Access to common fields
for cash	FA	FA	With cash

Key: MA = male adult; FA = female adult; SrMA = senior male adult; SrFA = senior female adult; > = more than; < = less than.

It is useful at this time for participants to recognize that differences relate not only to gender, but also to seniority. Senior women have more autonomy than do junior women. Junior men also have obligations to the headman which are reduced over time, and their long-range prospects for autonomy are greater than for any women.

4. What is actually produced by farmers in this system? Who controls the outputs? Who uses them?

Charting an access and control profile makes it clear that control over the two dominant resources—land and labor—gives control over their outputs or benefits (Table 3-3). Individuals do have control over the product of efforts on their own fields and in other income-generating activities. For women this is beer making and crafts. Cattle are a source of wealth for men.

The main incentive to produce, as stated by the household heads interviewed, is subsistence. As the FSU team suggests, this may be an obstacle to farmer interest in new technologies because lack of cash will make the purchase of desirable inputs unlikely.

Table 3-3

Incentives Analysis: Access and Control of Benefits

Products	Access	Control	Uses/Characteristics
Agricultural products			
Sorghum and millet grain			Stored; needed to last from Nov. to late Aug.; also used for beer
Communal	MA, FA	SrMA	
Individual		MA, FA	FA oblig. for 1 meal/day
Sorghum stalks	MA, FA		HH use and livestock feed
Relish crops		FA	
Cash crops, individual		MA, FA	Men oblig. for head tax, medicine, clothes, social oblig.
Cattle		MA	Wealth; draft; risk insurance
On-farm nonagricultural products			
Beer		SrMA, FA	
Craft enterprises		MA, FA	
Off-farm enterprises			
Wage labor	MA	SrMA?	

Key: MA = male adult; FA = female adult; MC = male child; FC = female child; SrMA = senior male adult; HH = household.

It is useful in this discussion to bring in the question of obligations associated with these outputs or benefits. For instance, the millet and sorghum produced in the communal fields are the main source of provisioning for the unit over which the headman has responsibility, including beer for household consumption. The production of women's fields also supplies a substantial amount of food for consumption at one meal a day for the dry season (approximately 25 percent). Both examples illustrate how obligations can affect decisions about how resources are used.

5. What are the factors affecting the pattern of gender roles?

The text attributes this pattern to tradition and social custom, a web of rights and responsibilities based on a unit larger than the nuclear household. It may be useful to discuss two points: what may cause change and the role of the researchers as potential change agents. With a quarter of the nation's young men away for wage labor, there may be more de facto female-headed households, but as long as major decisions remain in the hands of a senior male, women's active decision-making continues to be in a relatively small sphere.

6. What are the major production constraints and priority problems for these three villages?

The identification of constraints and priority problems is an important step in the FSR/E process and is the foundation upon which a field campaign and technology intervention is based. A list of constraints and priority problems could include the following and be listed on the board.

Major constraints:

- Very low soil fertility, low soil water retention and poor rainfall distribution
- Labor shortages at the critical periods of planting and weeding (in particular, at first weeding) in the communal sorghum and millet fields and in the personal fields
- Present subsistence orientation for some of the farmers and the incentive system (work does not always match the benefits)
- The present land tenure system, which may prevent the fallowing of land in land-deficit villages for fear of losing the land
- Nonavailability of purchased inputs and new technologies and a credit system that is not accessible to all

Other constraints and priority problems:

- Continuing soil degradation and the breakdown of the traditional shifting cultivation practices

- The present land tenure system, which may not be conducive to the adoption of new technologies on land that is borrowed
- The farm management practice of burning fields
- The slow but continual deforestation of the land
- The yearly hungry period, when food reserves get very low and are often not sufficient for an adequate diet, thus producing negative effects on human and animal productivity
- Low crop yields and high mortality rates of animals and poultry
- Crop pests such as striga in sorghum, insects in cowpea, and potential disease problems (especially under intensification)
- Not being able to plough before planting to allow first rains to infiltrate soil (combination of soil properties and health of traction animals in this time period)
- Poor pastures and poor livestock feed especially during dry season

One to three of these constraints should be further developed, the problem refined, and possible technological solutions suggested. The proposed solutions can be examined against the activities, resources, and incentives profiles in order to consider appropriate domains, resource and labor constraints, and the selection of cooperating farmers.

You should note that most farmers emphasize their subsistence needs, yet there is evidence that animal and human productivity is lowered near the end of the season before the first maize is harvested. One approach would be to focus on improving food availability during the hunger season in order to improve human and animal health and thus overall productivity. This suggests a number of possibilities: increasing the yields of storable sorghum and millet and/or earlier and increased yields for maize. To increase the availability of sorghum one would focus on increasing fertilization and water retention (changes in management), decreasing susceptibility to striga (breeding and cultural practices), increasing its storability (breeding and management), and possibly breeding for higher-yielding varieties. A similar effort could be made for millet, especially in its storability. For earlier yields of maize, the focus might be on earlier varieties and on technologies which would permit earlier land preparation or which would reduce labor constraints at the planting period (which is simultaneous with sorghum and millet weeding and peanut planting).

As any specific problem or technology is examined, you should make reference to the activities and access and control analyses depicted on the board to suggest whose labor or resources might be affected or should be included in the experimentation. For instance, in looking at sorghum production for consumption, conditions of both communal fields and women's fields should be taken into account. Conditions may mean both differences in land quality and in labor availability. Taking time to walk through each proposal provides participants with the opportunity to look in detail at the implications of each suggestion.

To sum up this section, you should emphasize how the roles of men and women differ with respect to their contributions to and benefits from farm production and other activities. The analysis provides insight into how new technologies will affect those roles and their likely acceptability.

See also "Additional Possibilities to Consider" below, especially points 1–3.

Session 2

Given the constraints defined by the students in the previous session, the stage is now set to design a field program which includes agronomic experiments and socioeconomic data collection. Using study questions B, participants in individual study and small group discussions can prepare a proposed program of research and/or design a specific on-farm trial. Worksheet 1-6 from the conceptual framework (*Working Together* Vol. 1, Chap. 1) provides a guideline for designing an on-farm trial.

There are two general areas for discussion. One focuses on the overall research program, reviewing the equity and appropriateness of the proposed activities. A second line of investigation focuses on the specifics of a proposed on-farm trial. During a plenary session, probably only two or three proposals can be covered.

1. Given the problems and constraints discussed earlier, what do you propose for on-farm testing for the coming year?

Possible technologies to test might include the following:

- Tied ridging with and without traction with different crops, particularly sorghum, millet, and maize
- Fertilizer for sorghum
- Sorghum varieties for yield, and striga resistance
- Maize: shorter season varieties

- Maize: fertilizer response of new and traditional varieties

- Livestock improvement: management, fodders

Additional Questions: Whose fields or production activities will be affected by each of these areas of research? Here is where you should use the calendar and system as laid out in session 1. Take the proposed technology for testing and impose it on system. Play out what would happen. Talk about changes in labor, in the system, and the time constraints. What resources are actually available? What are the implications if you use tied ridges for instance? What happens to weeding? Who is affected? What about manual tying of ridges? What is the impact on other labor requirements? This is gender analysis at work. You should always go back to the analysis of the system to check the impact of technology.

In conclusion of this point, examine who benefits from the experimentation. This raises issues of equity and efficiency. If research is appropriate only to communal fields and requires more labor, what happens to production on personal plots which also contributes to the household food supply? Is there matching experimentation to save labor in another activity at the same time of year, or through a change in varieties, to shift it to a less competitive time?

2. Let us take a closer look at a proposal for a specific on-farm trial.

In the analysis of a proposed field trial, each aspect—selection of farmers, numbers and levels of treatments, placement of fields, changes in operations, etc.—should be examined against the framework in order to identify who does what and what resources and benefits are involved. When designing the field trial, students must identify the research domain and target group and specify how the field trials are to be monitored; for instance, at what stages should the crop be looked at and what data should be collected? The point of this discussion, including the additional questions listed below, is to help people examine their own assumptions about the availability of labor and resources and the incentives for farmers to change what they do.

Additional Question: What changes in activities or resource use will result from this technology?

The objective of this question is to make the participants think about or speculate whether and how the technology they propose changes gender roles. What new tasks are to be performed and what may be the change in the gender division of labor? What new resources are required and who will have access to and control over these resources? What is the incentive structure, i.e., who gets the returns? There are two aspects to these questions: (1) a screening for likely acceptability and for the person-specific costs and benefits of the proposed change, and (2) identifying

whose roles are affected so that those persons are included in any training, in the receipt of inputs, and in the assessing of proposed changes.

3. By what criteria should the trials be evaluated? How will the team evaluate the technical feasibility, economic viability, and technological fit of an experimental technology?

This question is designed to start students thinking of how they are to judge whether or not the intervention should be recommended. The question will prepare them for Part 2 of this chapter, in which they will be asked to analyze an experiment. For each category a list should be made of related data that would be gathered such as temperature, rainfall, soil information, and socioeconomic data.

Additional Question: How would you assess whether this technology fits with labor availability during the cropping year and with the goals and objectives of the farmers? If not already suggested in the discussion, this questions broadens assessment beyond strictly production criteria. Suggestions for monitoring changes in gender roles and labor availability should be made and discussed.

If the point does not emerge from participants' comments, attention should be drawn to the assessment of new varieties by those who use them postharvest: for *tôt*, for beer, for livestock feed, for house construction.

4. What additional diagnostic information would be useful to the project? How might it be gathered along with or parallel to the field trials?

Among the kinds of information to be considered might be the following:

- The utility of collecting further information on women's perceptions of goals, obligations, and risks with respect to their own production
- Establishing levels of actual and desirable food consumption during the hunger period in order to calculate desirable increases in sorghum and millet production
- Soil samples
- Entomology studies, including local knowledge
- Survey of forages
- More information on field sizes by gender
- Further land tenure studies to see if borrowed land is an impediment

- An understanding of the formal or informal rules governing labor allocation between different kinds of fields
- Marketing studies
- Livestock and animal traction related studies
- Credit studies and technology adoption monitoring surveys

The point of this question is to round out the research agenda and to identify those unanswered questions which have a direct bearing on farmers' decision-making about agricultural production.

ADDITIONAL POSSIBILITIES TO CONSIDER

1. What research or recommendation domains would provide an appropriate basis for on-farm testing? There are agroecological differences based on soil fertility and water retention; there are differences between villages in their use of draft, their preferred crops, and their incentives for production; there are differences between fields in terms of labor availability; and there are differences between men and women in the demands on their own time. A discussion of the pros and cons or of ways of applying each set of criteria in defining the research agenda would help participants identify and assess assumptions about homogeneity underlying any set.

2. Let's summarize the circumstances of women producers in this system. As discussed in the analysis of the case above, a woman provides labor to communal, her husband's, and her own fields; her own fields are the source of food for the family and her own cash. Her decisions about allocating time or what to plant are conditioned by the other demands on her time.

3. What additional information on gender roles or other socioeconomic factors would be useful to the project? This provides an opportunity for technical and social scientists to identify specific data which is useful to the technical scientists but is best obtained by the social scientists. It can be an useful exercise in task-focused rather than discipline-focused collaborative problem-solving.

4. Given a limited set of resources, which research should receive priority? In order to provide a reality base for discussion of the research possibilities and a tighter framework for assessing priorities, you can offer or elicit from participants the likely makeup of a farming systems team. This could include the number and disciplines of the professional staff and field assistants. Another factor to consider is a realistic time horizon.

For instance, for USAID financed projects a program should be feasible within a time frame of three to five years. International agricultural research centers (IARCs) using core funds may have a longer time horizon. National systems may have longer term commitment but more limited resources for a specific project.

Participants might also consider what arrangements to use in organizing the research. For example, FSU's method was organized around five villages conducting farmer-managed trials, researcher-managed trials, and socioeconomic studies that used the same farmers. There are various other methods. Ask about participatory research and how it would be organized to define or implement FSU's experimental program. Some FSR/E programs only use researcher-managed trials; in others, on-farm trials and socioeconomic studies do not take place in the same village.

NOTE

1. There are excellent discussions of this for other areas in West Africa in the following references: Mary Burfisher and Nadine Horenstein, *Sex Roles in the Nigerian Tiv Farm Household*, Women's Roles and Gender Differences in Development: Cases for Planners, no. 2 (West Hartford, Conn.: Kumarian Press, Inc., 1985); Cecilia Jackson, *The Kano River Irrigation Project*, Women's Roles and Gender Differences in Development: Cases for Planners, no. 4 (West Hartford, Conn.: Kumarian Press, Inc., 1985); Christine Jones, "Bargaining Processes Among Members of Agricultural Production Units in North Cameroon," in *Understanding Africa's Rural Households and Farming Systems*, edited by Joyce Lewinger Moock (Boulder: Westview Press, 1986).

Burkina Faso: Part 2
Experimentation and Monitoring

JOSEPH G. NAGY, HERBERT W. OHM, AND SIBIRI SAWADOGO

ANALYSIS OF DIAGNOSTIC INFORMATION

Based on their review of the information gathered from the diagnostic phase, the FSU team listed the most pertinent points to consider in planning their next phase of research:

1. Farmers' goals and objectives are subsistence oriented and commercialization is at a low level. At present, the farmers are most concerned with the likelihood that their food consumption needs will be met, especially in the hungry period. The present incentive system that matches work and rewards may be a problem for technology adoption and may give rise to equity problems. The present land tenure system may inhibit traditional fallowing in land-deficit areas and also may not be conducive to the adoption of technologies on borrowed land.

2. Soils are of poor structure, low in fertility and organic matter, and have poor water infiltration properties. Population pressure in some areas is causing a breakdown of increased degradation of the soils. Little plant residue is left in the field for use in mulching and animal manures are finite in supply. There is a slow but continual deforestation of the land.

3. Rainfall is variable and unpredictable and combined with the properties of the soil leads to water retention and soil erosion problems. Effective ploughing before planting to allow first rains to infiltrate the soil is not feasible.

4. Farmers base their resource use decisions on soil quality, timeliness of rains, and their available labor supply. They plant less sorghum than they wish because of soil quality and water retention constraints that make sorghum a riskier crop to grow than millet. Peanuts are planted mainly to obtain cash for taxes, but more are not planted because they compete for labor used in millet production. Cereal-legume intercropping is widely practiced. Labor is a primary constraint during the planting and first weeding periods. Labor is less constraining during the second weeding period and the periods that follow.

5. Livestock feed and pastures are very poor, especially during the dry season, and there is a high mortality rate among animals and poultry.

6. Few available on-station-tested technologies exist and very few technologies have been tested on-farm. Some work has been done on variety improvement (sorghum and cowpea), soil fertility (Volta phosphate, 14–23–15, and urea), and soil water conservation (tied ridges). Striga is a major problem on sorghum, and cowpea disease and pest problems are increasing under intensification. Limited fertilizer availability and lack of access to credit are cited by farmers as problems (FSU/SAFGRAD 1983, 76; Lang et al. 1983, 8).

Given the physical and economic environment of Burkina Faso, the team characterized agricultural production as a low to intermediate input cropping system. With regard to the factors of production, land quality (a soil fertility problem) and the labor requirements at planting (in particular at first weeding) represented the most pressing constraints. The other critical constraint was water. If more water could be made available the expected returns to several other factors of production (land, labor, fertilizer) would be substantially increased.

Additional constraints to exploiting some types of technologies were the farmer subsistence orientation, the land tenure system, and the low level of commercialization combined with the nonavailability of some technologies such as fertilizers. Thus, in the initial stages of development, farmers would be expected to be interested only in technologies with low to moderate cash input requirements. The team agreed that, to the extent possible, noncash inputs such as labor should be exploited, remembering that there was some slack during and after second weeding. Given the major constraints, and their own mandate and technical expertise, the FSU team decided that the major focus would be on research which would provide technological interventions in the areas of soil fertility and water management of the major crops. The team agreed that agronomic improvements leading to increased water availability and improved soil fertility would complement varietal improvement research and was probably necessary before gains could be made in this area. This was a departure from the Green Revolution model, where the primary focus was on varietal improvement because of an existence of a more favorable physical and economic environment.

FIRST-YEAR CAMPAIGN, 1982

Field Trials

Since little off-station research work had been done, the FSU team decided to make the bulk of the field trial campaigns on-farm and re-

searcher-managed with only one on-farm farmer-managed trial. It was also the first opportunity to develop the methodology and learn how to conduct a full farmer-managed trial. The program focused its major efforts on soil fertility and water management. Research trials were also conducted on some new varieties and on intercropping within the on-farm environment. Given the continuing deterioration of the soil and the limited supply of local organic matter, commercial fertilizers were incorporated in the field trails. For most of the trials, the SOFITEX mixture of 14–23–15 was used along with urea (to increase nitrogen) because of their availability in the country. The water management technique of tied ridging was also incorporated into the field trials. Since water was a primary constraint, it was hypothesized that the combination of tied ridging and commercial fertilization would allow economic returns to low fertilizer levels so as to meet the requirement of using low-level cash inputs. The use of the local rock phosphate (VP1) was also incorporated into some of the trials because of its availability and lower cost.

A summary of the protocols and results of the on-farm researcher-managed trials is presented in Appendix 3-A. The analysis of yield data for experiment 3 on tied ridging in maize plantings is given in Table 3-4. All the trials were conducted on communal field sites and the labor for all the researcher-managed trials was done manually by the FSU field staff. The average rainfall in millimeters during the cropping season (May to October) in 1982 at Bangassé, Diapangou, and Nedogo was 494, 719, and 583 respectively.

In addition to the above researcher-managed trials, one on-farm farmer-managed trial was also conducted. The protocol for the farmer-

Table 3-4

Maize Tied Ridge Trial on Compound Plots, 1982

Factor	Yield
	kg/ha
Locations	
Bangassé 1	1,994
Diapangou 1	3,070
Diapangou 2	3,982
Nedogo 1	2,060
Nedogo 2	2,027
Treatments	
Traditional	2,220
Tied ridges before planting	2,911
Tied ridges 35 days after planting	2,749
LSD (.05) = 262 kg/ha	

Source: Adapted from FSU/SAFGRAD (1983), 59.

managed trial (Volta phosphate + urea + tied ridges on millet) is presented in Appendix 3-B. Farmers were selected at random.

Labor Data

Gender-disaggregated labor data (along with field areas and yields) were collected for various field operations on the twenty-five to thirty cooperating farmers' communal fields. Data was collected by farmer recall. The actual labor times represent the typical labor proportions of men, women, and children for sorghum and millet activities across the three villages (Table 3-5). Labor data for maize cultivation indicated a similar gender distribution to that of sorghum and millet.

Since tied ridging and fertilization are not traditional practices, labor times for both these operations were collected from the on-farm farmer-managed trial. The labor data for tied ridging and fertilization on the farmer-managed plots was collected on a weekly farmer-recall basis and showed a large variance. With the help of the field staff, the data was carefully screened. On the whole, for each village the gender division of labor for both fertilization and tied ridging was similar to that of planting and first weeding activities, respectively, as given in Table 3-5.

For the purpose of the economic analysis, man-hour equivalents were used instead of actual hours to obtain a composite or single labor unit and were determined using the following weights: one male hour (≥ 15 years) = 1, one female hour (≥ 15 years) = 0.75, and one child hour (< 15 years) = 0.5. The labor figures that were used in the analysis of on-farm, farmer-managed, tied-ridging millet trials were as follows: the mean man-hour equivalent labor required above weeding for tied ridging was set at 100, 75, and 75 hours per hectare for manual, donkey, and ox traction, respectively. Fertilizer application required 75 and 20 man-hour equivalent hours per hectare for application in the seed pocket and banding, respectively. The above labor hours represent the average time it would take farmers to construct tied ridges and apply fertilizer, and they represent labor that would be required above the traditional activities as given in Table 3-5.

Animal Traction

As part of the socioeconomic program, the junior economist on the FSU team also collected socioeconomic data in Nedogo and Diapangou for his Ph.D. thesis on animal traction (FSU/SAFGRAD 1983). The results from the animal traction study indicated that animal traction could lead to significant area expansion effects through increased weeding capability, especially at the first-weeding and late-planting peak labor period (Jaeger and Sanders

Table 3-5

Gender Division of Labor Hours for Major Agricultural Activities in Communal Fields

Labor Source	Soil Preparation			Planting	Replanting	First Weeding	Second Weeding
	Hand	Donkey	Ox				
	mean hrs/ha[a]						
Bangassé (77 millet fields)							
Men	0.16	2.81	—	16.72	1.90	48.94	45.25
Women	0.11	0.14	—	28.36	6.56	116.17	67.64
Children	0.08	2.42	—	5.27	1.37	30.25	19.89
Totals	0.35	5.37	—	50.35	9.83	195.36	132.78
Diapangou (millet and sorghum fields)							
Men	2.18	2.93	11.82	16.60	0.94	44.78	32.26
Women	26.94	1.80	1.69	50.31	6.92	77.96	70.84
Children	48.86	3.03	—	15.63	0.88	59.72	24.49
Totals	77.98	7.76	—	82.54	8.74	182.46	127.59
Nedogo (22 sorghum fields)							
Men	—	—	—	10.15	4.64	59.4	52.76
Women	—	—	—	22.69	9.23	108.6	100.70
Children	—	—	—	4.66	3.04	28.06	24.40
Totals				37.50	16.91	196.06	177.86

Source: Unpublished FSU labor data collected during the 1982 agricultural season using the sample cooperator farmers in each village.
[a]Actual labor hours

1985). Increased yields from the use of animal traction had been observed, but the yields were usually small and the use of animal traction is a debated issue in the literature. To be profitable, animal traction utilization rates must be high (at least thirty days per year), yet there is a learning curve for both the animal and the farmer which initially impedes a high rate of use. Favorable internal rates of return can be achieved by higher utilization rates through expanding the number of field operations mechanized and by shorter learning curves. However, in spite of possible high rates of return, animal traction adoption rates were low primarily because of the low utilization rates and long learning curves. Problems of obtaining high utilization rates stemmed from the small-sized farms, an inappropriate and incomplete set of equipment, poor animal health, and poor management skills. Shorter learning curves were not obtained because there was little farmer or animal training through extension and because there was

not a well-developed market for trained draft animals. To date animal traction can be characterized as land using (extensive).

Farmers' Views

At the end of the harvest period, all the farmer cooperators were questioned about what they thought of the technologies. Farmers in general were pleased with the results of experiments 3 and 5 (Appendix 3-A), but the question of fertilizer and labor availability did arise. Farmers were not impressed with either the variety trials or the VPI trial. Farmers reiterated that they would prefer to grow more sorghum yet consistently pointed to production risk as the reason for not planting more sorghum. Farmers again said that they did not plant more peanuts because of the labor competition with the millet crop. The yield data from farmers' fields indicated that the mean yields of sorghum and peanuts would provide farmers with more revenue per hectare than millet. But yield variance comparisons over all sorghum and peanut fields as compared to all millet fields indicated that a significantly greater risk was associated with the production of sorghum and peanuts than was associated with millet (FSU/SAFGRAD 1983, 20). There is also the land constraint that keeps sorghum hectarage lower than desired, and farmers know from experience that sorghum grown on millet land is very risky. The question of labor availability was brought up at the annual SAFGRAD meetings.

SECOND- AND THIRD-YEAR CAMPAIGNS, 1983 AND 1984

For the 1983 and 1984 campaigns, two more villages were added to the program: Dissankuy, just off the Mossi plateau and 120 kilometers north of Bobo-Diolasso, a land-abundant area with an equal number of manual and ox traction farmers; Poedogo, just on the Mossi plateau and 130 kilometers southeast of Ouagadougou, where almost all farmers use donkey traction. Both villages are in the 800–900 millimeter rainfall range and have more potential and a lower production risk than the original three sites. The addition of these two sites gave an increased representation of farming systems in Burkina Faso. Rainfall in the villages of Bangassé, Nedogo, Poedogo, Dissankuy, and Diapangou was 574, 670, 770, 666, and 668 millimeters in 1983, and 514, 452, 633, 675, and 458 millimeters in 1984, respectively.

Field Trials

The 1983 and 1984 researcher-managed trials followed the lead of the 1982 campaign while making some changes in the program. The 1982 maize trial with tied ridges (experiment 3, Appendix 3-A) was conducted in Dissankuy in 1983, resulting in significant yield increases for the treatments (1) tied ridging before planting and (2) tied ridging thirty to thirty-

five days after planting. The 1982 experiments 4 and 5 were repeated in both 1983 and 1984, giving similar results to those obtained in 1982. A summary of the 1983 and 1984 researcher-managed trials are presented in Appendix 3-C.

The 1983 and 1984 farmer-managed trials included a repeat of the VP1-on-millet trial using the same treatments and same plots as in 1982 (Table 3-6). The objective was to determine the economic returns from a continued and cumulative application of VP1 over several years. The results from the trials at Diapangou are not presented because farmers did not follow the protocol.

A farmer-managed sorghum trial was conducted on the basis of the 1982 researcher-managed trial (experiment 5), which showed a yield increase of 193 percent when fertilizer and tied ridges were constructed thirty to thirty-five days after planting. The trial was conducted on medium to good sorghum land at Bangassé (twenty-five farmers with manual tillage) and Nedogo (twenty-five farmers with manual tillage and twenty-five farmers with donkey and ox tillage), with tied ridges and 14–23–15 and urea application. The experiment was conducted at Dissankuy for the first time in 1984. In the other three villages, treatments were assigned to the same plots in 1984 as in 1983. At Bangassé and Dissankuy, the experimental design was a randomized complete block with farmers' fields as replications. At Nedogo and Diapangou, the experimental design was a split plot with main plots (types of traction) arranged in a completely randomized design, and treatments were the subplots. The protocol is similar to the VP1 experiment and Table 3-7 gives the treatments and the results for selected sites for 1983 and 1984.

In the economic analyses (Tables 3-6 and 3-7), net returns are calculated without considering the carry-over effect of fertilizer from one year to the next. The amount of fertilizer carry-over varies with rainfall and type of fertilizer and, as yet, the amount of carry-over has not been studied in detail. Assuming that 25 percent of the value of 14–23–15 and urea and 75 percent of the value of VP1 is carried over each year with an opportunity cost of 15 percent, calculations indicate that the economic relationships among the treatments and any arguments made on the basis of the information in Tables 3-6 and 3-7 would still hold.

The results of the researcher-managed maize trial in 1982 (experiment 3, Appendix 3-A) led to conducting a farmer-managed maize trial in 1983 and 1984. A summary of the maize trial and other 1984 on-farm farmer-managed trials not mentioned in the text is presented in Appendix 3-C.

Farmer Surveys

The major findings in 1982 led researchers to focus on soil fertility (required use of fertilizer) and water management, keeping in mind that

Table 3-6

Economic Analysis of Farmer-Managed Trials of Millet with Volta Phosphate and Tied Ridges, 1983–84

	Treatments[a]				
	C	TR	TR. F	2F	F
Nedogo: Manual traction, 1984 *(N=11)*					
Grain yield (kg/ha)[b]	107	238	349	228	195
Yield gain above control (kg/ha)	—	131	242	121	88
Gain in net revenue (FCFA)[c]	—	12,052	16,029	2,209	1,861
Return/hr of additional labor (FCFA)[d]	—	121	75	29	16
Farmers who would have lost cash (%)	—	0	0	55	55
Nedogo: Manual traction, 1983 *(N=10)*					
Grain yield (kg/ha)	346	360	373	331	338
Yield gain above control (kg/ha)	—	14	27	–15	–8
Gain in net revenue (FCFA)	—	1,288	–3,752	–10,303	–6,972
Return/hr of additional labor (FCFA)	—	13	—	—	—
Farmers who would have lost cash (%)	—	0	75	88	88
Nedogo: Donkey traction, 1983 *(N=11)*					
Grain yield (kg/ha)	354	410	483	407	370
Yield gain above control (kg/ha)	—	56	129	53	16
Gain in net revenue (FCFA)	—	5,152	5,633	–4,047	–4,764
Return/hr of additional labor (FCFA)	—	69	30	—	—
Farmers who would have lost cash (%)	—	0	36	70	80

Bangassé: Manual traction, 1984 *(N=17)*					
Grain yield (kg/ha)	220	283	469	251	273
Yield gain above control (kg/ha)	—	63	249	31	53
Gain in net revenue (FCFA)	—	5,796	16,673	–6,071	–1,360
Return/hr of additional labor (FCFA)	—	58	78	—	—
Farmers who would have lost cash (%)	—	0	6	59	59
Bangassé: Manual traction, 1983 *(N=12)*					
Grain yield (kg/ha)	218	237	319	204	202
Yield gain above control (kg/ha)	—	19	101	–14	–16
Gain in net revenue (FCFA)	—	1,748	3,057	–10,211	–7,708
Return/hr of additional labor (FCFA)	—	17	14	—	—
Farmers who would have lost cash (%)	—	0	31	86	80

Source: Adapted from Ohm et al. (1985b) and Lang et al. (1984).

[a]C = control (no tied ridges or fertilizer); TR = tied ridges constructed at second weeding; F = 100 kg/ha Volta phosphate applied in the seed pocket and urea applied in pockets 10–15 cm from seed pockets at first weeding; 2F = 200 kg/ha Volta phosphate and 50 kg/ha urea applied together in a pocket 10–15 cm from seed pocket at first weeding.

[b]The standard error of the difference between two means and the coefficient of variation (in parentheses) are for Nedogo 1984 continuing through to Bangassé 1983: 28.0 (32), 44.2 (27), 35.6 (21), and 40.3 (39), respectively.

[c]Net revenue = yield gain x grain price (92 FCFA/kg) minus fertilizer cost (25 FCFA/kg for Volta phosphate, and 66 FCFA/kg for urea). Includes interest charge for six months at rate of 15%.

[d]Net revenue/additional labor of tied ridging and fertilizer application. Manual traction requires 100 hours of additional labor/ha for tied ridging. Fertilizer application requires 115 additional hr/ha for F, and 75 additional hr/ha for 2F.

Table 3-7

Economic Analysis of Farmer-Managed Trials of Sorghum with Fertilizer and Tied Ridges, 1983–84

	Treatments[a]			
	C	TR	F	TR, F
Nedogo: Manual traction, 1984 *(N=11)*				
Grain yield (kg/ha)[b]	157	416	431	652
Yield gain above control (kg/ha)	—	259	274	495
Gain in net revenue (FCFA)[c]	—	23,892	13,275	33,607
Return/hr of additional labor (FCFA)[d]	—	238	140	172
Farmers who would have lost cash (%)	—	0	27	9
Nedogo: Manual traction, 1983 *(N=18)*				
Grain yield (kg/ha)	430	484	547	851
Yield gain above control (kg/ha)	—	54	117	421
Gain in net revenue (FCFA)	—	3,510	-2,285	17,475
Return/hr of additional labor, (FCFA)	—	35	—	90
Farmers who would have lost cash (%)	—	0	66	0
Diapangou: Donkey traction, 1984 *(N=19)*				
Grain yield (kg/ha)	498	688	849	1,133
Yield gain above control (kg/ha)	—	190	351	635
Gain in net revenue (FCFA)	—	17,480	20,359	46,487
Return/hr of additional labor (FCFA)	—	233	214	273
Farmers who would have lost cash (%)	—	0	21	0
Bangassé: Manual traction, 1984 *(N=12)*				
Grain yield (kg/ha)	293	456	616	944
Yield gain above control (kg/ha)	—	163	323	651
Gain in net revenue (FCFA)	—	14,996	17,783	49,959
Return/hr of additional labor (FCFA)	—	150	187	246
Farmers who would have lost cash (%)	—	0	8	17

Source: Adapted from Ohm et al. (1985b) and Lang et al (1984). Similar results were obtained at three other sites in Burkina Faso.

[a]C = control (no tied ridges or fertilizer); TR = tied ridges constructed one month after seeding; F = 100 kg/ha 14–23–15 two weeks after seeding plus 50 kg/ha urea one month after seeding.

[b]The standard error of the difference between two treatment means and the coefficient of variation (in parentheses) are for Nedogo manual traction through Diapangou ox traction: 175.1 (.), 63.4 (44), 45.6 (18), and 46.8 (18) respectively.

[c]Net revenue = yield gain x grain price (92 FCFA/kg) minus fertilizer cost; (78 FCFA/kg for 14–23–15 and 66 FCFA/kg for urea). Includes interest charge for six months at rate of 15%.

[d]Net revenue/additional labor of tied ridging and fertilizer application. Manual, donkey, and ox traction require 100, 75, and 75 hours of additional labor/ha for tied ridging respectively. Fertilizer application requires 95 additional hr/ha.

farmers were risk-averse and subsistence-oriented and therefore hesitated to purchase inputs such as fertilizer. In view of these findings, the major socioeconomic research objectives for the 1983 campaign were (1) to identify factors explaining farmer well-being (grain consumption per capita) and (2) to identify factors explaining the commercial behavior of farmers (grain sales and cash cropping). A farmer's wealth in livestock holdings and the amount of grain consumption, grain sales, and cash cropping area were considered the key indicators of the ability to reinvest earnings in the farm enterprise. It was important to know the factors that influence these indicators in order to help identify the farmers most likely to accept or reject technologies requiring cash inputs.

To meet the above objectives, the researchers surveyed each village (thirty households per village) to collect data on demographic and resource endowment data, cropping behavior, farmers' performance with respect to revenues, sales, and assets, risk perceptions, and technical production coefficients. Monthly interviews on stocks, transactions, and consumption were collected. Monthly variable-theme interviews were also conducted. One interview focused on nonagricultural sources of revenue. Other variable theme interviews included characteristics of farmer seed varieties (reported to plant breeders), marketing practices, and the awareness of market prices. A further study to identify goals and objectives of farmers and farmers' principal problems was conducted. Additional investigations into the labor times of tied ridging and fertilization in general confirmed the labor times used for the 1982 budgets.

The single variable consistently found to be a major factor in explaining grain consumption per capita (farmer well-being) was the number of hectares per capita, which was associated with an increase in grain consumption of six to twenty-four kilograms per month. Cash cropping was also directly and consistently related to the number of total hectares per capita managed by the household. Interseasonal analysis indicated that grain sales were more closely related to grain in storage than to available hectares per capita, but the acquisition of grain for storage was, in the long run, also a function of land per capita. Per capita grain consumption was greater too in villages that exhibited a higher number of cattle per capita (Lang et al. 1984).

Land Tenure and Credit Studies

In 1984, the FSU team conducted a land tenure study and a study of formal and informal credit on the basis of the previous socioeconomic studies and diagnostic information indicating that security of land tenure and availability of credit were important issues in technology adoption. In the case of land tenure, access to land in terms of its security of tenure might be important when farmers were deciding to adopt intensive agri-

cultural technologies that upgrade the quality of the land. Fertilizers (especially VP1) and water management techniques such as tied ridging improve the soil and have a residual effect for several years to come. Table 3-8 presents the percentage of cultivated land area by tenure category for the five FSU villages. Four tenure categories were delineated. The nonborrowed land in category I and the borrowed land in category II comprised the highest security of land tenure. The land in these two categories reflected future long-term usage by the farmers who presently farmed the land. The security of land tenure in categories III and IV (which usually required a rental fee) was much less than that of categories I and II. The possibility existed that the land could be taken away from the farmers in the latter two categories. The results indicated that, with the exception of Dissankuy, a large proportion of the land had security of tenure. However, the larger proportion of borrowed land in Dissankuy had not stopped cotton growers from obtaining credit for fertilizer (Ohm et al. 1985a).

The land tenure survey also questioned land lenders on the kinds of improvements they would allow on land they lent to nonkinsman land-borrowers (i.e., tenure category III and IV). Fifty to seventy percent of land lenders would not allow the planting of trees for fruit, fuelwood, windbreaks or live fences. Ninety percent said that they would allow the use of animal enclosures, anti-erosion ditches (tied ridges, diguettes), and VP1 on the land that they lent (Ohm et al. 1985a).

Given the results of the first three seasons of on-farm trials and the new information from the socioeconomic studies, the FSU team needed to assess the on-farm research and determine the research program for the following year.

Table 3-8

Percentage of Cultivated Land Area by Tenure Category, 1984

Tenure Category[a]	Bangassé	Diapangou	Nedogo	Poedogo	Dissankuy
I	62.8	81.8	54.0	64.8	19.3
II	7.0	6.9	25.4	26.1	0.0
III	15.7	11.3	17.6	2.6	35.0
IV	14.5	0.0	3.0	6.5	45.7
Totals	100.0	100.0	100.0	100.0	100.0

Source: Ohm et al. (1985a) 91.

[a]Category I includes nonborrowed land that has been passed from parents, immediate family, members of the household, extended family and friends. Category II includes land that has been borrowed from parents or immediate family. Category III includes land that had been borrowed from members of the household, friends and relations other than parents or direct family members. Category IV includes land obtained through the *chef de terre* or village chief.

STUDY QUESTIONS

1. At the end of three years of trials what new technologies tested by the FSU team hold most promise for these communities and why? Which should have further or modified testing? Which can be recommended for farmer practices?

2. What additional information has been learned about men's and women's roles in this farming system?

3. Evaluate the farmer-managed sorghum trial with tied ridges and fertilization taking into account technical feasibility, profitability and risk, and the fit of the proposed technologies into the farming system in terms of resource availability, labor patterns, and incentives. What are the additional resources required and incentives for different family members? What is the effect of animal traction?

4. Using Bangassé as an example, what are the cash and labor requirements for adapting these technologies to junior men's and women's personal fields? Is this technology feasible for these domains? What additional information would be useful for testing the feasibility?

5. Would you recommend further on-farm testing of the sorghum and millet trial with tied ridging? Are there any modifications that you would like to make to the two trials in the next season?

REFERENCES

FSU/SAFGRAD. 1983. *FSU/SAFGRAD 1983 Annual Report*. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Jaeger, William K., and John H. Sanders. 1985. Profitability of Animal Traction: Field Study in Burkina Faso. In *Proceedings: Appropriate Technologies for Farmers in Semi-arid West Africa*, edited by Herbert W. Ohm and Joseph G. Nagy. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Lang, Mahlon G., Ronald P. Cantrell, and John H. Sanders. 1983. Identifying Farm Level Constraints and Evaluating New Technology in Upper Volta. Staff Paper. West Lafayette, Ind.: Department of Agricultural Economics, Purdue University.

Lang, Mahlon G., Ronald P. Cantrell, Herbert W. Ohm, and Sibiri Sawadogo. 1984. *FSU/SAFGRAD 1983 Annual Report*. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Ohm, Herbert W., Joseph G. Nagy, and Christopher R. Pardy. 1985a. *FSU/SAFGRAD 1984 Annual Report*. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Ohm, Herbert W., Joseph G. Nagy, and Sibiri Sawadogo. 1985b. Complementary Effects of Tied Ridging and Fertilization with Cultivation by Manual and Donkey and Ox Traction. In *Proceedings: Appropriate Technologies for Farmers in Semi-arid West Africa*, edited by Herbert W. Ohm and Joseph G. Nagy. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Teaching Notes for Burkina Faso: Part 2 Experimentation and Monitoring

CASE SYNOPSIS

Part 2 of the case presents the FSU analysis of the information collected during the diagnostic period and its identification of critical constraints and the few available technologies developed at research stations. The team decided to focus on soil fertility and water retention using low levels of inputs.

An extensive set of researcher-managed trials is carried out during the first campaign. These include varietal trials, intercropping, tied ridging alone and with fertilizer, and fertilizer using locally available SOFITEX (14–23–15), urea, and Volta phosphate (VP1). The treatments and results are summarized in Appendix 3-A. Yield information on one of the most promising trials, tied ridging on maize planting, is reported in Table 3-4. One farmer-managed trial is carried out which combines fertilization with VP1 and urea with tied ridging. The protocol is presented in Appendix 3-B.

Three socioeconomic studies are undertaken: (1) gender-disaggregated labor data collection on various operations on farmers' communal fields (Table 3-5); (2) gender-disaggregated labor data collection on tied ridging and fertilization on the farmer-managed trial plots (on a weekly recall basis); and (3) a study of the potential for using animal traction. All farmer cooperators were asked their views of the trials carried on that year.

For the second and third years, two villages with a more favorable resource base were added to the program. During these two years, additional researcher-managed and farmer-managed field trials were carried out. The most promising results continue to be with tied ridging, alone or in combination with fertilization. An economic analysis of three years of the farmer-managed VP1 and tied ridge trial (Table 3-6) and of a farmer-managed sorghum tied ridge and fertilizer trial with 14–23–15 and urea (Table 3-7) are presented. The 14–23–15 and urea combination, which requires separate applications, is more promising than the longer-acting VP1.

Concern with farmers' capacity and incentives to adopt new technology led to a series of variable theme surveys trying to get at factors which explained farmer well-being (grain consumption per capita) and commercial behavior (grain sales and cash cropping). Discussions with farmers

about their objectives and problems continued as did study of labor times of tied ridging and fertilization. In order to better understand farmers' sense of security about their land, a further study of land tenure was undertaken. The proportion of land held in four kinds of tenure are reported in Table 3-8. A study of formal and informal credit was also undertaken.

At the end of the third campaign, the FSU was evaluating the technologies which had been tested and deciding on the suitability of these technologies for local conditions. What needed further investigation? What could be recommended to farmers?

LEARNING OBJECTIVES

1. To evaluate a series of trials for their agronomic and economic implications

2. To examine the fit between new technologies and the existing system including availability of resources, labor, and incentives

3. To provide examples of economic analysis of agronomic trials

4. To examine the implications of new technologies for women

STUDY QUESTIONS

1. At the end of three years of trials what new technologies tested by the FSU team hold most promise for these communities and why? Which should have further or modified testing? Which can be recommended for farmer practices?

2. What additional information has been learned about men's and women's roles in this farming system?

3. Evaluate the farmer-managed sorghum trial with tied ridges and fertilization taking into account technical feasibility, profitability and risk, and the fit of the proposed technologies into the farming system in terms of resource availability, labor patterns, and incentives. What are the additional resources required and incentives for different family members? What is the effect of animal traction?

4. Using Bangassé as an example, what are the cash and labor requirements for adapting these technologies to junior men's and

women's personal fields? Is this technology feasible for these domains? What additional information would be useful for testing the feasibility?

5. Would you recommend further on-farm testing of the sorghum and millet trial with tied ridging? Are there any modifications that you would like to make to the two trials in the next season?

ANALYSIS OF THE CASE

There are several useful findings from the on-farm trials conducted by the FSU. In a series of varietal trials with cowpeas, maize, and white and red sorghum, local varieties outperformed research station varieties with or without the addition of tied ridging and fertilizer. Intercropping trials were generally inconclusive except for a trial where millet did well in association with cowpeas. Several fertilization programs were tried using different combinations and timing of 14–23–15, urea, and VP1. Results were mixed, with the 14–23–15 and urea applied at first and second weeding, respectively, generally showing promise. Greater improvement was shown when fertilization was combined with tied ridging. The generally favorable yield results from both manual and traction tied ridging with and without fertilizer confirmed the FSU's original hypothesis that improvements in water retention would improve yields and the benefits from other inputs or new varieites.

To improve their understanding of the distribution of labor in field operations on communal lands, the FSU team quantified the time spent on each operation and disaggregated the labor according to sex and age. The numbers are reported in hours per hectare in Table 3-5. All the hours in the shared tasks of planting and weeding are totaled, converted to percentages, and compared with the percentage distribution of men, women, and children for each village (Table 3-9). What the table makes clear is that while men and women both do planting and weeding, their share of those operations is not proportionate to their numbers. Nor are women excluded completely from land preparation with animals, though their numbers are small. There are two points of significance here. First, women's contributions to communal holdings is substantial, well over 50 percent of the work in most cases. The implication is that the ability to command women's labor for communal fields is quite strong. The second point is that a small study to quantify labor inputs provided important data and insights which would not be gained by simply recognizing that tasks are shared. As we shall see below, the flexibility between sexes for

Table 3-9

Comparison by Gender and Age of Labor Force and Farm Operations on Communal Fields

	Active Workers[a] per Household	Total Active Workers	Planting[b] and Weeding	Contributions to Planting and Weeding
		%	hr/ha	%
Bangassé				
Men	2.13	36.9	112.81	29.1
Women	2.24	38.8	218.73	56.3
Children	1.40	24.3	56.76	14.6
Totals	5.77	100.0	388.30	100.0
Diapangou				
Men	2.10	28.9	94.58	23.6
Women	2.63	36.2	206.03	51.3
Children	2.53	34.8	100.73	25.1
Totals	7.26	99.9	401.34	100.0
Nedogo				
Men	2.03	37.9	127.00	29.6
Women	2.80	52.3	241.20	56.3
Children	0.53	9	60.16	14.0
Totals	5.36	100.1	428.36	99.9

[a]Table 4-2, Vol. 1
[b]Table 3-5, shared tasks of planting, replanting, first weeding, and second weeding

these tasks seems limited; and this quantitative data is useful in assessing the likely spread of these innovations. Note that the case does not describe the methodology for farmer recall (frequency? which farmer?).

Analysis of Farmer-Managed Sorghum Trials with Tied Ridges and Fertilization

Tied ridging provides a boost in yields in almost all cases. The economic analysis of the farmer-managed sorghum trials shows substantial returns to combined tied ridging at the second weeding and fertilization applying 100 kilograms per hectare 14–23–15 at first weeding and 50 kilograms per hectare urea at the second weeding. Tied ridging alone brings returns well above the standard wage rate of 30 FCFA per hour. Without tied ridging, fertilization carries with it a greater economic risk. However, tied ridging and fertilization both require substantial increases in labor at the time of year when labor is already constrained, during the first and second weedings of millet and sorghum.

The information from the case can be used to analyze the farmer-managed sorghum trials with tied ridges and fertilization according to the framework, looking at (1) the benefits from improved technologies and who benefits, (2) the resources required for new technologies, principally labor and cash, and who has access to or control of those resources, and (3) how the technologies fit or affect existing activity patterns. In terms of benefits, the increases in yields on communal fields will go initially to meet the subsistence needs of the household. The determination of the use of extra yields—distribution for consumption or for sale—is made by the headman. When crops from personal fields are sold, cash goes to the person whose field it is by ownership or assignment. Thus the benefits from increased yields using tied ridges and fertilization are theoretically available to anyone. An increase in sorghum production on women's fields, in addition to meeting their obligation to contribute to the food supply, could provide the raw material for beer making, a source of cash.

When one looks at resources (Table 3-10), it can be seen that male heads of household have greater access to and/or control over the necessary resources for making the changes required: specifically they have a call on family labor for communal fields, are members of associations through which credit is available, and, through their control over land and labor, can produce more crops. Those with animals have an even greater advantage in terms of the amount of land which can be cultivated. Therefore benefits from the tied ridging and fertilization technology are likely to accrue principally to male heads of households who have access to and control of the resources necessary to use it.

In terms of activities (Table 3-11), the increased labor required affects men, women, and children. The team's economic analysis is based on "male equivalent hours" (ME hours). The weighting of labor is based on the assumption that while men's and women's productivity, holding everything constant, may be equal, women are more likely to be interrupted to care for a child at the back or near at hand.[1] In the FSU/SAFGRAD project men's labor was weighted at 1.0, women's at 0.75, and children's at 0.5.

The one hundred hours for tied ridging (TR) and ninety-five hours for fertilization (F) are reported in male equivalent hours (ME hours) and therefore do not correctly state the actual number of hours allocated by men, women, and children to carry out these operations. When male equivalent hours are translated back into actual hours spent, women pick up a share of the new activity larger than their proportion in the active work force (Table 3-11).

The household heads interviewed stated that adopting tied ridging and fertilization still ran up against a labor constraint because the timing of the operation corresponded to the heaviest period of weeding and planting. In terms of efficiency, the head of household will allocate family

Table 3-10

Access and Control of Resources in Sorghum Tied Ridges and Fertilization Trial

Resources	Access	Control	Notes
Own labor	All	SrMA>JrMA/FA	Primacy given to communal fields w/ greater autonomy for senior wives and older junior men
Family labor	MA>JrMA/FA	SrMA>JrMA/FA	Same as above
Cash for fertilizer	MA & ?	SrMA, MA, FA	Others with cash income theoretically have some available depending on actual income and other expenditure responsibilities
Credit for fertilizer	MA	SrMA	Credit associations apparently limited to male heads of household; access of others dependent on relationship with him
Animal traction	?	MA	Differentiated by village and by income level
Land			
Secure (cat. I & II)	All?	MA	Generally 75% of all land or over; exception Dissankuy
Borrowed from			
Nonfamily	MA	MA	53% in Dissankuy
Chef de Terre	MA?	MA	45% in Dissankuy
Instruction from FSU/ORD	MA		For cooperating farmers

Key: SrMA = senior male adult; MA = male adult; JrMA = junior male adult; FA = female adult; C = child; > = more than.

labor available to himself in terms of his greatest benefits. Calculations for the additional hours required are on a per-hectare basis. According to the information in Part 1 of the case, communal fields are larger than that. Using Tables 4-2 and 4-6 in Volume 1, the average hectarage in communal fields in Bangassé is 1.16 hectares.

The issue is not only one of extra labor, but its timing. Additional labor

Table 3-11

Tied Ridging (TR) and Fertilization (F)
Effect on Work Load

Activities	Male Adults	Female Adults	Children	Totals
Bangassé: Manual traction				
Active workers[a] (N=)	2.13	2.24	1.40	5.77
Active workers (%)	37.00	39.00	24.00	100.00
TR at ME hours[b]	32.40	57.60	10.00	100.00
TR at actual hours[c]	32.40	76.80	20.00	129.20
Actual hr 2nd weeding[d]	45.25	67.64	19.89	132.78
F at ME hours[e]	38.85	49.50	6.65	95.00
F at actual hours[c]	38.85	66.00	13.30	118.15
Nedogo: Manual traction				
Active workers[a] (N=)	2.03	2.80	0.53	5.36
Active workers (%)	38.00	52.00	10.00	100.00
TR at ME hours[f]	38.40	52.60	9.00	100.00
TR at actual hours[c]	38.40	70.13	18.00	126.53
TR at actual hours (%)	30.30	55.50	14.30	100.00
F at ME hours[f]	32.68	54.82	7.50	95.00
F at actual hours[c]	32.68	73.09	15.00	120.77
F at actual hours (%)	27.10	60.50	12.40	100.00
Nedogo: Animal traction				
TR at ME hours[f,g]	28.80	39.45	6.75	75.00
TR at actual hours[c]	28.80	52.60	13.50	94.90
F at actual hours (%)	30.30	55.40	14.20	99.00

[a]Table 4-2, Vol. 1.
[b]ME hours = male equivalent hours. Actual hours of men, women, and children at first weeding were converted to ME hours by multiplying by 1.0, 0.75, and 0.5 respectively.
[c]ME hours were divided by 1.0, 0.75, and 0.5 respectively to get actual hours in the field.
[d]Table 3-5.
[e]Percentages were derived by same process as (b) using planting hours (Table 3-5) as the base. Since F takes 95 hours, the percentages were multiplied by 0.95.
[f]Percentages were derived by same process as (b) using Nedogo as base.
[g]Since TR with animal traction takes 75 hours, the percentages were multiplied by 0.75.

is required at planting to incorporate the fertilizer and at second weeding to do the tied ridges. This creates a new labor constraint at the second weeding of cereals which is the same period as the first weeding of peanuts. This may limit the area of peanuts that women and, to a lesser extent, junior men, are able to cultivate. The rules or payments associated with a man's or a headman's command of his family's labor are not known, so it is difficult to anticipate whether and how widely the new technology is likely to be accepted. Its acceptance will depend on the degree to which the labor of junior members of an extended household, especially women, can be commanded for extra work on the communal fields. This may be at the

expense of other sources of family welfare, such as women's production of cereals and relishes and cash earnings from peanuts and beer making.

Even if time availability remains the same, can junior men (who can command wives' labor) and women add on the time necessary to make these improvements in management? Using the figures for Bangassé from the tables in *Working Together* Volume 1, Table 3-12 provides estimates of the labor and cash investments required for the fields of junior males and women.

Table 3-12

Labor and Cash Requirements for Tied Ridges and Fertilizer, Bangassé

	Junior Men	Women
Fields		
Percent of field[a]	31.00 %	12.00 %
Actual of 2.15[b]	0.67 ha	0.26 ha
Labor		
Hours for TR[c]	86.60 hr	33.60 hr
Hours for F[d]	79.20 hr	30.70 hr
Total additional hours	165.80 hr	64.30 hr
Cash for sorghum		
SOFITEX (14–23–15)	5,226 FCFA	2,028 FCFA
Urea[f]	2,211 FCFA	754 FCFA
Total cash needed	7,437 FCFA	2,782 FCFA
Income estimates for sorghum[g]		
TR alone	10,703 FCFA	4,153 FCFA
F alone	21,208 FCFA	8,230 FCFA
TR and F, combined	42,754 FCFA	16,587 FCFA
Cash for millet		
VP1[h]	1,675 FCFA	650 FCFA
Urea[f]	2,211 FCFA	754 FCFA
Total cash	3,886 FCFA	1,404 FCFA
Income estimates for millet[i]		
TR alone	2,238 FCFA	868 FCFA
F alone	758 FCFA	294 FCFA
TR and F, combined	8,278 FCFA	3,212 FCFA

[a]From Table 4-6, Vol. 1.
[b]Average hectares per household, Bangassé, Table 4-2, Vol. 1.
[c]Actual hr/ha for TR 129.2 x actual hectarage.
[d]Actual hr/ha for F 118.15 x actual hectarage.
[e]78 FCFA/kg at 100 kg/ha x actual hectarage.
[f]66 FCFA/kg at 50 kg/ha x actual hectarage.
[g]Figures from Table 3-7 for sorghum trials at Bangassé. Increases in yield x 98 FCFA x actual hectarage.
[h]25 FCFA/kg at 100 kg/ha.
[i]From Table 3-6. Average yield over control for 1983–84, Bangassé, manual traction x 92 FCFA/kg.

In addition to time, women's interest in using these improvements on their own fields will be affected by other factors. An incentive to improving production comes from the necessity to supply part of the family foodstuffs. A second factor will be the quality of the lands and the women's security in it. The FSU survey indicated that, except in Dissankuy, land is held fairly securely. But this applies to land tenure or holding by men, not land use. A woman's security in a particular piece of land is at the discretion of her husband and/or the headman. Annual or biannual rotation is common and would be a disincentive to any long-term investment. Tied ridges in sandy soil requires more upkeep, also a disincentive. Given these constraints and the unavailability of cheaper credit, adoption of improvements by women for their own fields seems unlikely.

DISCUSSION POSSIBILITIES TO CONSIDER

In addition to the study questions already suggested, there are several avenues which might be explored in a discussion of Part 2.

1. The methodological justifications and implications of using male equivalent hours. Such weighting overlooks the opportunity costs of a woman's time, the actual hours involved in tasks done by men and women, and samples only two variables—gender and age—to differentiate productivity when there are many other variables to consider such as nutritional status and the nature and complexity of the task. The advantages and disadvantages of this approach for predicting farmer acceptability can be drawn out in discussion.

2. The implications for men and women of programs for introducing or improving animal traction. In many agricultural development projects the introduction of animal traction and/or mechanization is focused strictly on men. There is some evidence in the case study that some women do land preparation, although whether or not they use animal traction is unclear. This is a useful question for discussing how researchers' own biases and traditional views may preclude the possibility of women as well as men being trained to handle animals. Access to this training and to animals could have a beneficial effect on their work load.

3. An assessment of farmer participation in the whole research program. Using Worksheet 5 from the conceptual framework (*Working Together* Vol. 1, Chap. 1), one can identify which farmers were included and which were not. What are the implications of who was and was not included? What steps might be taken to broaden participation?

4. Given the satisfactory technical results from tied ridging and fertilization, how could this technology be extended to farmers? Identify different recommendation domains and develop a strategy for gaining farmer

interest. What problems remain to be solved? In this discussion, it is important to distinguish between decision makers who control resources and those who do the task.

5. The potential for increased stratification in terms of production for subsistence and sale between those who do and those who do not have animals for traction.

INTRODUCTION TO PART 3

Part 3 of the case is a detailed discussion of the evaluation, modifications, recommendations, and dissemination of new technologies by the FSU and its collaborating institutions. It can be summarized by a trainer or otherwise made available to participants. It also can be handed out as the basis for additional discussion. In this case, a discussion on dissemination might wait until that section has been read.

NOTE

1. William K. Jaeger, as part of his doctoral dissertation, discusses several variables affecting productivity. He then employs a linear programming model, using data from this project, to assess actual productivity for specific tasks by gender as measured by area covered in a fixed time period, and he uses this to determine weighting for his analysis. See W. K. Jaeger, "Agricultural Mechanization: The Economics of Animal Traction in Burkina Faso" (Ph.D. diss., Stanford University, 1984).

Burkina Faso: Part 3
Evaluation, Modifications, Recommendations, and Dissemination

JOSEPH G. NAGY, HERBERT W. OHM, AND SIBIRI SAWADOGO

At the end of 1984, the FSU team evaluated the trials conducted during the previous three years, paying particular attention to the on-farm farmer-managed trial of sorghum with tied ridges and fertilization and with manual and animal traction. They also undertook a further trial designed to test improvements in tied ridging by the use of a mechanical ridge tier. The following reports their 1984 and 1985 evaluations.[1]

EVALUATION CRITERIA

The criteria for the evaluation of the two principal technology interventions that FSU worked with (tied ridging and fertilization) were (1) technical feasibility, (2) profitability and risk, (3) the fit of the technology within the farming systems (Sanders and Roth 1985), and (4) intrahousehold and interhousehold considerations (McKee 1986). The first criteria involved answering the question: Is the technology agronomically or technically superior to existing farmer practices? The agronomists used both the statistical tools of analysis of variance to determine yield superiority and their technical skills in identifying problems of plant stress, diseases, pests, and the like. The remaining three criteria were primarily evaluated by socioeconomic personnel but included input from the agronomist and feedback from the farmer cooperators. Simple budgeting analysis was used for the second criteria to indicate the profitability of the technologies. The percentage of farmers who would have lost cash from any of the treatments was used as an indicator of risk.[2]

With respect to the third criteria of fit, given that the technology was technically and economically feasible, the team needed to establish whether there were other constraints that held back the use of the technology, such as land (quality, quantity, tenure), labor availability, credit, management ability, and farmers' goals and objectives. The information used for evaluating technology with respect to the third criteria came from the

socioeconomic surveys and the monitoring of cooperator farmers. Along with this information, whole farm modeling in the form of linear programming was also used to facilitate the answering of the question of fit.[3]

Linear programming was used to add to the information of the simple budgeting of costs and returns from criteria 2. Simple budgets are the minimum requirement of an economic evaluation of new technology; however, they are limited in two ways (Roth et al. 1986). First, the explicit values of land and labor in Burkina Faso are unknown and when used are generally included in an ad hoc manner. Second, the budgeting analyses are partial, hence they ignore the substitutability of inputs on the farm and how they are allocated based on the fixed endowments and implied prices of resources within a whole farm context. Linear programming helps to predict the substitutability of inputs under the limits imposed by constraints. The research questions for the linear programming farm model were (1) Will the new technologies be adopted (given the assumptions of the model farms)? (2) What will be their income effect? and (3) What will be the most pressing production constraints preventing adoption? (Sanders and Roth 1985).

Although the technology might be technically feasible and profitable and fit into the farming system using the household labor supply as a single quantity, further questions were asked concerning fit given intrahousehold dynamics: (1) If there are new tasks to be performed, is there a change in the division of labor (gender or age group) such that a heavier labor burden is carried by one of these groups? And does this affect acceptability of new technologies? (2) If new resources are required, are some people denied or do they have limited access to or control over these new resources? And does this, in turn, have implications for the efficiency of production, income distribution, or change in status? (3) What is the incentive structure, i.e., do participants using the new technology receive a share in the returns? Apart from the equity considerations, the answers to the three questions could also give information as to the acceptability of the technology intervention within or between households.

EVALUATION OF FARMER-MANAGED TRIALS

Sorghum with Tied Ridges and Fertilization

Technical feasibility. The relative responses of sorghum yield to the four treatments were consistent across the four locations over the two years. Selected results are shown in Table 3-7. Treatments consisting of tied ridges to reduce surface runoff of rainfall and fertilization to ameliorate the low fertility resulted in increased levels of sorghum yield. The analysis of variance indicated that when tied ridges were combined with fertilizer, statistically significant yield increases over the control were

recorded at all locations for both years.[4] No differences in disease and pest levels were observed among the treatments. Yields of sorghum were generally higher with animal traction than with manual traction.

The team concluded that the use of tied ridges alone or of fertilizer alone (at the treatment levels) could result in superior yields, but, when used in combination, the sorghum yields were substantially larger. Further, tied ridges might not be suitable in the more sandy soils and should only be recommended in areas with soils that do not wash away as easily.

Profitability and risk. The partial budget analysis for 1983 and 1984 (Table 3-7) showed that, for the mean yield increases at all locations over the two years with the exception of Nedogo manual tillage (treatment F), the return per hour for labor to construct tied ridges and/or to apply fertilizer was positive. In most cases the return was substantially above the standard wage of 30 FCFA per hour. With respect to farmers' risk of losing their cash outlay, the treatment using fertilizer alone was moderately risky and some farmers at each location would have lost cash. The use of tied ridges in combination with fertilizer substantially reduced the farmers' risk of losing cash as opposed to using fertilizer alone. Because tied ridging uses household labor, the tied ridging treatment did not carry the risk of losing a cash outlay. However, this option resulted in substantially fewer net returns when compared to the tied ridging and fertilization combination, and, although this practice controls erosion, it cannot solve the low soil-fertility problem. Using fertilizer at unsubsidized prices would reduce returns and increase farmer risk.

Again the team concluded that only in combination did the two technologies provide a substantial net return and yield a return per hour of additional labor at a level of risk which might be acceptable to farmers fearful of losing their cash outlay. Given the positive and large net returns and the low levels of risk exhibited from the combination of fertilizer and tied ridges, the team's next step was to look at the fit of this technology package within a whole farm context, as stated in criteria 3.

Technology fit.

1. *Linear programming model.* Linear programming was used to analyze the technology interventions within a whole farm context. Three models were constructed representing the three types of tillage practices on the Mossi plateau: manual tillage, donkey traction, and ox traction. The technology interventions of tied ridging and fertilization were incorporated into the models. The alternative of modeling fertilizer alone was not considered because of the high risk of losing the cash outlay as indicated under criteria 2. Tied ridging and fertilization were options on the two types of sorghum land and on the millet lands, and tied ridging alone was made an option for maize on compound land. On-farm researcher-

managed trials for maize indicated a significant maize yield response from tied ridges alone but little additional response when fertilizer was added in combination with tied ridges on compound land (Lang et al. 1984). Results of ox and donkey traction were similar and are shown only for the donkey traction model, given the option of using the two technologies in combination and not separately (Table 3-13).

The results of the manual tillage model indicated that the hectarage devoted to the technologies would be very low. The labor constraint and the lower yields associated with manual traction precluded a significant area from being devoted to the two technologies. When the alternative of tied ridging alone is modeled, the lower yields associated with this technology as compared to the yields when tied ridging is used in combination with fertilization precluded a significant hectarage from being brought into the solution.

In Table 3-13, columns 1 and 2 compare the results of the donkey traction model under traditional management practices with tied ridging (ridged with donkeys but tied by hand) and fertilization.[5] The results indicate that the new technologies would not completely displace the total hectarage under traditional management practices because of the labor constraint. The opportunity cost of labor for tied ridging was 350 FCFA. Total per capita cereal production and net farm income per worker both increased with tied ridging and fertilization.

The model was run with several tied-ridging labor times to examine the sensitivity of the results and to take into consideration the fact that labor times vary from farmer to farmer. The results indicated that farmers with the management ability to construct tied ridges using the least amount of labor time would obtain a significantly higher net return. Those farmers who took longer to construct tied ridges would apply the technologies to a smaller hectarage.

The model was also run with unsubsidized fertilizer prices (130 FCFA per kilogram for 14–23–15 and 120 FCFA per kilogram for urea). The revenue from the increase in yields resulting from the use of tied ridging and fertilization is still large enough to make the use of the technology profitable at the unsubsidized fertilizer prices. Thus, it is still the labor constraint that holds back the use of the technology package and not the price of fertilizer.[6] The use of tied ridges and fertilizer has shown that an improvement in the physical environment would increase yields from local sorghum varieties. This sets the stage for plant breeding within this improved environment. The conclusions to be drawn from the linear programming model are that the two technologies can fit into the production system of animal traction farmers but that a labor constraint still prevents the technologies from being adopted on all the hectarage. The results also indicate that manual tillage farmers would adopt the technologies to a lesser extent than would animal traction farmers.

Table 3-13

Whole-Farm Modeling Analysis of Tied Ridging with Donkey Traction

	Treatments[a,b,c]			
	(1) TM	(2) TR-Manual	(3) MRT-1	(4) MRT-2
Total area cultivated (ha)	5.5	5.6	5.5	5.6
Maize				
Traditional	0.20	—	—	—
Tied ridges	—	0.20	0.15	0.15
Red Sorghum				
Traditional	0.60	—	—	—
Tied ridges	—	0.60	0.60	0.68
White Sorghum				
Traditional	0.80	0.70	--	—
Tied ridges	—	0.10	0.95	0.80
Millet				
Traditional	3.18	3.15	1.88	3.18
Tied ridges	—	—	1.27	0.05
Peanuts	0.76	0.86	0.71	0.79
Total cereals production (kg)				
Per household	2,103	2,436	2,737	2,651
Per resident[d]	150	174	196	189
Net farm income[e] (000's FCFA)				
Per household	215.3	246.2	262.2	253.5
Per worker[f]	30.8	35.2	37.5	36.2

Source: Nagy et al. (1985).

Key: TM = traditional management; TR-Manual = manual tying of ridges at second weeding; MRT-1 = ridge tying at second weeding (one pass); MRT-2 = ridge tying at first and second weedings (two passes).

[a]Treatments (2), (3), and (4) each received 100 kg/ha 14–23–15 and 50 kg/ha urea.

[b]Labor requirements over TM; TR-Manual, 75 male equivalent (ME) hr/ha; MRT-1, 2 ME hr/ha for one pass; MRT-2, 20 ME hr/ha for two passes.

[c]Yield estimates in kg/ha for traditional practices and the technological interventions of fertilization and tied ridges in combination are as follows: maize, not fertilized (1,090–1,730), red sorghum (672–1,236), white sorghum (472–913), and millet (320–660); 1985 fertilizer and grain prices were used.

[d]Based on 14 residents/household.

[e]Annualized cost of 4,400 FCFA for tied-ridging machine subtracted in columns 3 and 4.

[f]Based on 7 active workers/household.

2. *Survey information and farmer views.* The diagnostic survey indicated that farmers (both borrowers and lenders) might be reluctant to use certain technological innovations on land borrowed from nonkinsman. The land-tenure survey indicated that, with the exception of Dissankuy, land borrowed by nonkinsman without tenure security ranged from 10 to 30 percent (Table 3-8). Ninety percent of the lenders of such land said that they would allow tied ridges and fertilizer use on their land and did not see the use of these two technological interventions as a threat to their maintaining the land. Farmers who borrowed land in the Dissankuy area already were using fertilizers and other purchased inputs. Thus the present land-tenure system might not be an overriding factor in the adoption of the two technologies. However, the present subsistence goals and objectives of many of the farmers may be another constraint to technology adoption. The linear programming model may only represent a small portion of the farmers at present.

3. *Labor requirements.* Under traditional cultivation, men, women, and children were involved in planting and in first and second weeding. The technology interventions of constructing tied ridges and using fertilizer required additional labor. The labor data collected during the field campaign indicated that the gender distribution of labor with the introduction of tied ridges and fertilizer did not appreciably change. However the additional labor must be pulled from other tasks or leisure and/or there must be a rearrangement of tasks to fit the labor profiles. Labor, to a large degree, is controlled by the household head who has priority on labor for use on the communal fields. The extent to which labor for the two technologies would be taken away from other tasks (women's household work or beer making) or from work on personal fields (especially women's fields, which are responsible for one daily meal in the dry season) requires further study and monitoring.

4. *Cash and credit.* The technological intervention of fertilization requires a cash outlay and the fertilizer is often bought through credit. The limited access to credit for fertilizer might preclude the use of fertilizer alone or in combination with tied ridges on both men's and women's personal fields. The degree to which other economic and social features constituted barriers to entry into village credit groups required further study.

5. *Benefits.* The main output from the technology intervention is increased agricultural output which may be used for consumption or marketed The household heads who control the resources of production on the main fields also control the output. Other members of the household might benefit indirectly through increased consumption or cash income, but this depends on the distribution of the new production. Whether the increased output would be distributed as in the past according to the current goals and objectives of the household, or whether it would benefit only a small minority of the family, remains unknown.

Changes in distribution of income between households might occur from the adoption of the technology interventions. The linear programming results indicated that animal traction farmers would adopt the technologies to a greater degree than would manual tillage farmers primarily because of the labor constraint. However, manual tillage farmers might adopt the technologies on a smaller hectarage. Income distribution changes might also occur if all households did not have access to credit.

Millet with Volta Phosphate (VP1) and Tied Ridges

Technical feasibility. The response of millet yield to the treatments was inconsistent across the two locations and the three years (Table 3-6, 1983 and 1984 only). Statistically significant yield differences were found in several instances and the conclusion drawn was that a yield superiority could be obtained with VP1 and tied ridging, but only after a year or two of the application of the VP1 because of its slow release.

Profitability and risk. The partial budget analysis (Table 3-6) shows that even with mean yield increases and with 50 percent subsidized VP1 prices, only in 1984 was there a robust gain in net revenue and a return per hour to the additional labor required. Though the risk of farmers losing their cash outlay for VP1 decreased over time as more fertilizer was applied, increasing the available phosphate to the plant, profits would not be shown until the third and later years. Thus unsubsidized prices would make VP1 even less attractive.

Technology fit. The higher risk and lower profitability indicated little hectarage is likely to be devoted to the two technologies. Labor, cash and other resources, and incentives are similar to those described for sorghum. Even if VP1 is profitable after several years of application, farmers see the immediate difference between 14–23–15 plus urea and VP1 and make their own judgment.

DEVELOPMENT OF A MECHANICAL RIDGE TIER (MRT)

The linear programming model results, the questionnaire on the adoption of technology, and farmer interviews throughout the three years of field trials clearly show that, if the labor requirement for fertilizer application and the construction of tied ridging could be decreased, more hectarage would be devoted to the technologies. This had been communicated to the component researchers as early as the end of the 1982 agricultural season. Beginning in 1983, a Peace Corps volunteer with the International Institute for Tropical Agriculture (IITA) started work on a prototype mechanical device to tie the ridges (Wright and Rodriguez 1985).

The mechanical ridge tier (MRT) is attached to an animal-drawn cultivator and either ties the ridges as they are made (one-pass method) or ties the ridges after the fields have been ridged, by making a second pass with the MRT attached to the cultivator with a smaller sweep (two-pass method). When oxen are used, the ridging and tying with the MRT can be done at the same time. Donkeys can do both operations but only if they are managed well, are healthy and in good condition, and if the soil is loose or moist.

With FSU and IITA/SAFGRAD collaboration, the MRT was part of the 1985 national on-farm field program of the Institut Burkinabe de Recherches Agronomiques et Zootechniques (IBRAZ) (Nagy et al. 1986). The objectives of the MRT field campaign were threefold: (1) to obtain and compare yield and other agronomic data of the MRT to flat cultivation and to animal traction ridges tied by hand, (2) to assess the economic profitability and labor demands of the MRT, and (3) to obtain technical data about the MRT and question farmers about the operation of the MRT.

The experimental design for the on-farm farmer-managed trials was a split-plot with whole plots (types of traction) arranged in a completely randomized design and treatments were subplots. The treatments and results are shown in Table 3-14. Farmers managed and carried out the experiments and were responsible for all labor inputs. Fertilizer was supplied to the farmers. Prior to harvest, all parcels were evaluated for the general conditions of the crop. Farmers harvested all parcels and the field staff weighed the harvest.

Labor inputs associated with the MRT were obtained by farmer recall. Ridging and tying with the MRT at the same time (one pass) with donkey traction adds only one to three actual hours per hectare of time over that of ridging alone. One pass with ox traction only requires on average one hour more than ridging alone with oxen. If the donkey cannot do the operation in one pass, the additional time it takes to make the second pass to tie the ridges takes on average 10 hours per hectare. With two people usually working the donkey, the man-hour equivalent on average is 20 hours per hectare. In the trials, urea was banded and covered by the ridges at second weeding instead of being put into pockets, thus decreasing the labor requirement from 75 man-hours per hectare to 20 man-hours per hectare.

Weather was generally favorable except for a dry spell at the time of peak flowering which severely reduced maize yield. Maize, sorghum, and millet yields, respectively, were estimated by the field staff to be 60 percent, 100 percent, and 100 percent of normal.

Technical feasibility. On average, the ties made with the MRT were about 13 centimeters high whereas the ties made manually in association

Table 3-14

Effects of Animal Traction and of Three Methods of Tied Ridging *(N=14)*[a]

Treatments[b]	Mean Grain Yield
	kg/ha
Traction-MRT[c]	
Donkey	920.5
Ox	882.6
SE[d]	71.6
Tied-ridging methods[e]	
Control (treatment 1)[f]	740.0
TR-Manual (treatment 2)[g]	954.4
MRT-1 (treatment 3)[h]	927.5
MRT-2 (treatment 4)[i]	875.6
SE	62.8
CV%	19.0

Source: Nagy et al. (1986).
[a]The number of farmers' fields (replications) on which the experiment was grown—seven farmers with donkey, and seven farmers with ox traction, Nedogo, 1985.
[b]Local varieties of sorghum were used.
[c]Comparing the mechanical tying of ridges by donkey traction with the mechanical tying of ridges with ox traction.
[d]Standard error of the difference between two treatment means.
[e]Fertilizer application of 100 kg/ha 14–23–15 in a band 10–15 cm from the rows of sorghum 2–3 weeks after planting, and 50 kg/ha urea applied in a band 10–15 cm from the rows of sorghum 6–8 weeks after planting was applied to all treatments.
[f]Flat cultivation without tied ridges.
[g]Manually tying the ridges made by animal traction 6–8 weeks after planting.
[h]Mechanically tying the ridges 6–8 weeks after planting.
[i]Mechanically tying the ridges 2–3 weeks after planting, and again at 6–8 weeks after planting.

with ridging by animal traction were about 15 centimeters in height and had a broader base. All three tied-ridging treatments resulted in significant yield increases over the control (Table 3-14). Given the distribution and timeliness of the rains, the yields of the tied-ridging treatments were not dramatically higher than the yield of the control. However, earlier trials had indicated that where less or untimely rainfall is received, treatments having ridges tied by hand out-yielded the fertilizer-only treatments.

The lower yields observed in the two treatments using the MRT may be the result of root pruning or damage caused to the plants by the MRT. Higher ties of the manually constructed tied ridges also may have allowed more water to accumulate during a rain thus creating a larger moisture reserve.

Profitability. Simple budget analysis indicated that the MRT was profitable (Nagy et al. 1986). The linear programming model results using

the MRT at second weeding are presented in Table 3-13. Column 3 presents the results when two passes are required. Column 4 presents the results when only one pass is used to ridge and tie and show that a greater proportion of millet land was devoted to the technologies.

Technology fit.

1. *Labor.* The MRT is a labor-saving technology and decreases the labor time needed to tie ridges from 50 to 75 man-hours per hectare by hand, when ridges have already been made with animal traction, to 20 man-hours per hectare using the MRT in one pass. This does change the gender distribution of labor. While women ordinarily would provide 40–60 percent of the labor to construct tied ridges by hand, the operation of the animal-traction MRT is almost exclusively done by men. With increased yields, more time would be required at harvest by both men and women. This fits within the system as the harvest period is very flexible and not a peak labor-demand period.

2. *Credit and other resources.* There is a problem with access to the MRT as well as to the fertilizer in terms of credit arrangements that may preclude its purchase and use on the personal fields of women and nonhousehold head men. Also, using the MRT requires animal traction units and the skills to work with them. What is not known is the extent to which animal traction units and equipment or services are available to nonowners, including wives, kinsmen, or nonkinsmen, and on what basis.

3. *Benefits.* Since the MRT is dependent on animal traction and only about 10–15 percent of farmers use animal traction on the Mossi plateau, tied ridging will take place to a greater extent on animal traction farms relative to manual tillage farms. However, the MRT may make animal traction more profitable and thus more practical for adoption by present manual tillage farmers. By using the MRT in combination with fertilizer, animal traction could be land augmenting with increased production obtained from increased yields per hectare.

4. *Farmers' views.* A survey of technology adoption by FSU cooperator farmers was conducted at the end of the 1984 campaign (Ohm et al. 1985a, 105). The objective of the survey was to determine the extent to which FSU cooperator farmers adopted the technologies of tied ridging, fertilization, and new plant varieties on their own fields (Tables 3-15 and 3-16). The extension of technologies to farmers at large was the responsibility of the National Extension Service, and FSU worked closely with the Organisme Regional de Développment (ORD) of each village, giving them a summary of research results at the end of each year. All the FSU on-farm trials provided a demonstration effect and added to the programs provided by the local extension service. Farmers commented that the primary reason for not constructing more tied ridges was the lack of sufficient labor. Not having the cash or not being able to obtain credit were their primary rea-

sons for not using more fertilizer. Farmers were generally hesitant about trying new plant varieties until they could give them a good appraisal—either on someone else's field or on a demonstration plot.

RECOMMENDATIONS, CONCLUSIONS, AND DISSEMINATION

Recommendations and Conclusions

The water retention and soil fertility research results indicated that the combination of tied ridging and fertilization (14–23–15) is profitable and at a level of risk low enough that many farmers may adopt the technology. There continue to be constraints on using fertilizer alone because of the risk of losing cash. The combination of tied ridging and fertilization is also constrained by the shortage of labor. Before farmers will adopt the water retention and soil fertility technologies on a large scale, several issues must be dealt with. The following recommendations and conclusions are presented to deal with some of these issues.

Table 3-15

Percent of Farmers Adopting Tied Ridges (TR), Fertilizers, and New Varieties

Village	Years[a]	Number of Farmers	Percent of Farmers Adopting		
			TR	Fertilizer	Varieties
Bangassé	3	53	23	0	0
Diapangou	3	61	25	8	8
Nedogo	5	69	25	10	10
Poedogo	2	27	4	33	41
Dissankuy	2	60	2	97[b]	0

Source: Ohm et al. (1985b) 71.
[a]Number of years FSU in village; 1984 was the first year for farmer-managed trials at Poedogo and Dissankuy.
[b]The figures relate only to land sown to cotton. Small amounts of fertilizers are used on cereals.

Table 3-16

Average Hectares of Technology Adoption

	Bangassé	Diapangou	Nedogo	Poedogo	Dissankuy
Tied ridges	0.03	0.18	0.32	0.11	0.03
Fertilizer	—	0.34	0.46	3.00	3.00
Varieties	—	0.04	0.33	0.12	—

Source: Ohm et al. (1985b) 71.

The labor constraint. Although still in the design and research stage, the MRT presented the possibility of substantially decreasing the time involved in constructing tied ridges. This land-augmenting device could make animal traction more profitable and increase the use of animal traction in Burkina Faso. Using the MRT, however, would still require animal traction programs on a large scale to train animals and farmers in the management and maintenance of the animals and to make animals, equipment, and credit available as indicated by the animal traction study. These programs must also be aimed at all groups within the household. Animal health and nutrition, particularly during the hunger period when need for traction is greatest, would also bear further study.

There is also the possibility of decreasing the labor requirements of fertilization by using a formulation with a higher nitrogen content than the SOFITEX 14–23–15 mixture, which was developed for cotton and not cereals, thus eliminating the need for a separate application of urea. The formulation of one fertilizer with sufficient nitrogen (cost implications require study) would substantially reduce labor requirements.

Fertilizer. The local rock phosphates VP1 and UV5 do not perform as well as 14–23–15 in terms of increased yield of profitability and they were not readily accepted by farmers. Further research is needed to improve rock phosphate fertilizer and to characterize soils for concentrations of a broad range of nutrient elements essential for crop growth. The institutional problems of fertilizer and credit availability also require attention.

Plant breeding. On-farm farmer-managed trials have shown that the use of an intermediate level of inputs such as tied ridging and moderate levels of fertilizer is feasible and can be profitable using local varieties. Thus, it is within this intermediate input level environment that screening for better plant varieties would have the most immediate payoff.

With the recommendation of tied ridging and fertilization comes the caution that the technologies have the potential to skew income distribution. Those with access to credit and animal traction will be the most likely adoptors. Not all members within the household nor all households have equal access, and programs were required in the credit and animal traction areas to make access more readily available to all. Also, tied ridges will not work well in all soils, and other water retention methods such as diguettes and soil tillage practices by themselves or in combination with tied ridges need to be further researched as to their appropriateness in various soil zones.

Technology Dissemination

The above specific recommendations were made at SAFGRAD meetings and were made known to the component researchers and the accelerated

crop production officers (ACPOs) within the SAFGRAD program. Annual meetings with the extension people in several ORDs that were reviewing FSU's findings were carried out. Through meetings by SAFGRAD and FSU with the national agricultural research institutions (IBRAZ in particular) the findings were passed on to the host government.

STUDY QUESTIONS

1. Assess the MRT for its technological fit into the system.
2. There are promising results from tied ridging alone and with fertilization, and with the MRT. What would you recommend? To what recommendation domains? What would you do to encourage adoption?

NOTES

1. A complete overview of the policy issues, suggestions, and implications of the work done by the FSU and other researchers is in Nagy, Sanders, and Ohm (1988).
2. It would be more appropriate to measure risk in terms of a time-series variance (i.e. over many years) than a cross-sectional variance (i.e. over many farmers in one year) as used here. Three years of experimental data make it difficult to undertake a time-series risk analysis. However, some information is gained from the cross-sectional analysis. For a treatment of time-series risk analysis, see Anderson et al. (1977).
3. Briefly, the linear programming model has the option of performing tillage operations under one of three types of tillage practices: manual, donkey, or ox. A farmer possesses four types of resources: land of various qualities, family labor, animal traction (if not a totally manual operation) and modern inputs. Land is divided into four types: high fertility compound land, two types of sorghum land with one having better fertility and water retention capability, and lower quality millet land. Stocks and flows of labor are disaggregated into weekly time periods to capture the critical labor constraints at planting and weeding. Information on the technical aspects of the tied ridging and fertilization technologies from the on-farm trials and socioeconomic surveys are included in the linear programming model. The model indicates the extent to which the new technology is adopted and indicates the constraints within the production system that hold the technology from further adoption.
4. Other criteria that could be considered especially if new varieties had been included in the treatments are seedling establishment, yield stability, and yield component analysis (Matlon 1985).
5. The basic structure and data of the model is outlined in Roth et al. (1986). The traditional management yields in kilograms per hectare and those obtained under the technology options in the donkey traction model are maize on compound land (1090 to 1730); red sorghum on high quality sorghum land (672 to 1236); white sorghum on lower quality sorghum land (472 to 913); and millet on poorer quality millet land (320 to 660). The yields are based on FSU field trial data (Lang et al. 1983; Ohm et al. 1985a).
6. It is important to mention that the linear programming model as it is used here does not take risk into consideration. Farmers with a low risk aversion may do exactly as the results of the linear programming model suggest, while farmers that exhibit a higher risk aversion may cut back on the amount of fertilizer used.

REFERENCES

Anderson, J. R., J. L. Dillon, and B. Hardaker. 1977. *Agricultural Decision Analysis.* Ames, Iowa: Iowa State University Press.

Lang, Mahlon G., Ronald P. Cantrell, and John H. Sanders. 1983. Identifying Farm Level Constraints and Evaluating New Technology in Upper Volta. Staff Paper. West Lafayette, Ind.: Department of Agricultural Economics, Purdue University.

Lang, Mahlon G., Ronald P. Cantrell, Herbert W. Ohm, and Sibiri Sawadogo. 1984. *FSU/SAFGRAD 1983 Annual Report.* West Lafayette, Ind.: International Program in Agriculture, Purdue University.

Matlon, Peter J. 1985. A Critical Review of Objectives, Methods and Progress to Date in Sorghum and Millet Improvement: A Case Study of ICRISAT/Burkina Faso. In *Proceedings: Appropriate Technologies for Farmers in Semi-arid West Africa,* edited by Herbert W. Ohm and Joseph G. Nagy. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

McKee, Katharine. 1986. Methodological Challenges in Analyzing the Household in Farming Systems Research: Intra-household Resource Allocation. In *Proceedings of the Kansas State University's 1983 Farming Systems Symposium,* edited by C. Butler-Flora. Manhattan, Kans.: Kansas State University.

Joseph G., Herbert W. Ohm, Linda L. Ames, and L. D. Schaber. 1986. Analysis of the IITA/SAFGRAD Mechanical Ridge Tier. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Nagy, Joseph G., John H. Sanders, and Herbert W. Ohm. 1988. Cereal Technology Interventions for West Africa Semi-Tropics. *Agricultural Economics* 2: 197–208. Amsterdam: Elsevier Science Publishers.

Ohm, Herbert W., Joseph G. Nagy, and Christopher R. Pardy. 1985a. *FSU/SAFGRAD 1984 Annual Report.* West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Ohm, Herbert W., Joseph G. Nagy, and Sibiri Sawadogo. 1985b. Complementary Effects of Tied Ridging and Fertilization with Cultivation by Manual and Donkey and Ox Traction. In *Proceedings: Appropriate Technologies for Farmers in Semi-arid West Africa,* edited by Herbert W. Ohm and Joseph G. Nagy. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Roth, Michael, Phil Abbot, John H. Sanders, and Lance McKenzie. 1986. An Application of Whole-farm Modeling to New Technology Evaluation, Central Mossi Plateau, Burkina Faso. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Sanders, John H., and Michael Roth. 1985. The Development and Evaluation of New Systems of Agricultural Production: Some Field Model Results from Burkina Faso for Tied Ridges and Fertilization. In *Proceedings: Appropriate Technologies for Farmers in Semi-arid West Africa,* edited by Herbert. W. Ohm and Joseph G. Nagy. West Lafayette, Ind.: International Programs in Agriculture, Purdue University.

Wright J., and M. Rodriguez. 1985. *"Trap" Project. Tied-ridging with Animal Power: End of Project Report.* Maize Agronomy Program. IITA/SAFGRAD, no. 39. Ouagadougou, Burkina Faso: USAID.

Appendix 3-A: Summary of 1982 FSU On-farm Researcher-Managed Trials

1. *Millet-legume intercropping trial.* Randomized complete block, two locations per village, four replications per location on medium to good sorghum land. *Treatments:* (1) Mung bean with millet, (2) local cowpea with millet, (3) cowpea SUVITA-2 with millet, (4) cowpea TVx 3236 with millet, (5) millet. All the new cowpea varieties are determinate flowering and have an upright growth habit while the local varieties are indeterminate flowering and rampant. Plots are 3.6 m x 8 m, 66,700 plants/ha of millet, 16,675 plants/ha of legumes. *Results:* Lost experiment at Diapangou due to drought and at Nedogo due to thrips and drought. Only one location at Bangassé was harvested; the other lost to poor millet stands. Local cowpea varieties superior to other entries.

2. *Legume (cowpea) variety trial.* Randomized complete block, two locations per village, four replications per location on good to medium sorghum land. *Treatments:* (1) Local cowpea, (2) cowpea KN-1, (3) cowpea SUVITA-2, (4) cowpea TVx 3236, (5) cowpea TVx 1999, (6) cowpea Mongue, (7) bambara nut, (8) peanuts, (9) mung bean, (10) soybean. Plots are 3.2 m x 8 m, 60,000 plants/ha. Three sprayings of 12 gm Active Ingredient (AI) /ha Decis insecticide. *Results:* In general, local cowpea performed equally well at all locations with improved varieties. Cowpea prices and insecticide cost indicate that farmers would lose money.

3. *Maize tied-ridges trial on compound land.* Randomized block, two locations per village, three replications per location. *Treatments:* (1) Traditional management (TM), (2) tied ridges (TR) before planting, (3) TR 30–35 days after planting. Plots are 3.2 m x 8 m, 60,000 plants/ha. *Results:* See Table 3-4.

4. *Maize tied-ridge trial on medium to good sorghum land.* Split plot, main plots were fertilizer application and subplots TR. Diapangou and Nedogo, two locations per village, four replications. *Treatments:* (1) TM, (2) TM plus fertilization (F)—100 kg/ha SOFITEX (14–23–15) in seed pocket plus 50 kg/ha urea banded at first weeding, (3) TR before planting, (4) TR before planting plus F, (5) TR at 30–35 days, (6) TR at 30–35 days plus F. Plots are 4.8 m x 8 m, 60,000 plants/ha. *Results:* TR and TR plus F treatments nonsignificant; F treatment significant at one location.

5. *Sorghum tied-ridge and fertilizer trials on sorghum land.* Split plot, main plots fertilizer application and subplots TR. Two locations per vil-

lage, four replications. *Treatments:* Same as experiment 4. Plots are 4.8 m x 8 m, 66,700 plants/ha. *Results:* Yield responses to both F and TR significant. Over all locations, F + TR yield was 744 kg/ha more than the TM yield and was profitable for the farmer.

6. *VP1 trial on millet and sorghum.* Randomized complete block, two locations per village: one sorghum (on sorghum land) and one millet (on millet land). *Treatments:* (1) TM, (2) 50 kg/ha in seed pocket, (3) 100 kg/ha in seed pocket, (4) 200 kg/ha in seed pocket, (5) 50 kg/ha banded, (6) 100 kg/ha banded, (7) 200 kg/ha banded, (8) 200 kg/ha broadcasted, (9) 400 kg/ha broadcasted. All treatments received 50 kg/ha urea side dress at first weeding. Plots are 4.8 m x 8 m, 66,700 plants/ha. *Results:* Sorghum yield response nonsignificant. Mixed results for millet showing significant yield differences for one location only.

7. *Maize variety and fertilizer trials on compound land.* Split plot with main plots improved varieties and subplots fertilizer. Two locations per village with four replications. *Treatments:* Two levels of fertilizer—(1) zero and (2) 100 kg/ha 14–23–15 in seed pocket plus 50 kg/ha urea side dress at first weeding. At Nedogo, varieties were local, UST 42, and Pool 16. At Bangassé and Diapangou, the varieties were local, SAFITA-104, and SAFITA-2. Plots are 4.8 m x 7 m, 66,000 plants/ha. *Results:* At Nedogo, no significant difference due to fertilizer; UST 42 performed significantly worse than Pool 16 and local. At Diapangou and Bangassé, no significant differences between fertilizer treatments or varieties (FSU/SAFGRAD 1983).

Appendix 3-B: On-farm Farmer-Managed Trial Volta Phosphate and Tied Ridges on Millet Ridges

TRIAL PROTOCOL

1. Objective
   To evaluate the agronomic characteristics and the economic benefit of VP1 fertilizer in association with tied ridges

2. Experimental Plan
   a. *Villages*

Bangassé	Thirty large millet fields (manual)
Diapangou	Thirty large millet fields (animal traction)
Nedogo	Thirty large millet fields (manual)

   b. *Treatments*
   Plot sizes are to be approximately 0.15 ha with all plots in the same field of equal size; treatments will b randomly assigned to plots in each field (randomized complete block with farmers' fields as replications).

Designation	*Description*
80 (Black)	Traditional management practices without tied ridges or fertilizer
81 (Yellow)	Tied ridges constructed at second weeding (6–8 weeks after planting); without fertilizer
82 (Green)	100 kg/ha VP1 applied in the seed pocket; 50 kg/ha urea applied in pockets 10–15 cm from seed pockets at first weeding (3–4 weeks after planting); tied ridges constructed at second weeding
83 (Blue)	200 kg/ha VP1 and 50 kg/ha urea applied together in a pocket 10–15 cm from seed pockets at first weeding
84 (Red)	100 kg/ha VP1 applied in the seed pocket; 50 kg/ha urea applied in pockets 10–15 cm from seed pockets at first weeding; without tied ridges

3. Method

a. *Soil Preparation*

Measure and stake all plots with designated colors.

b. *Planting*

Plant millet in the traditional manner where manual tillage is practiced. Plant millet in rows where animal traction is practiced.

Treatments

82 (Green) — Apply 100 kg/ha VP1 in the seed pocket

84 (Red) — Apply 100 kg/ha VP1 in the seed pocket

c. *First Weeding*

Do first weeding 3–4 weeks after planting.

Treatments

82 (Green) and 84 (Red) — Apply 50 kg/ha urea in pockets 10–15 cm from seed pockets at first weeding. *Cover urea with soil immediately!*

Treatment

83 (Blue) — Apply 200 kg/ha VP1 and 50 kg/ha urea together in a pocket 10–15 cm from seed pockets at first weeding. *Cover fertilizer with soil immediately!*

d. *Second Weeding*

Do second weeding 6-8 weeks after planting.

Treatments

81 (Yellow) — Construct tied ridges at second weeding.

82 (Green) — Construct tied ridges at second weeding.

e. *Harvest*

Harvest and weigh the grain from each plot separately. Record the unthreshed and threshed weights for a sample from each plot. Because farmers may harvest the trial over a period of days, communicate well with each farmer so the total yield for each plot is taken into account.

f. *Observations and Data to be Collected*

Rainfall (amount, dates)

Select plot sites, measure plot for each farmer-managed trial

Date of planting

Emergence, percent (transplant if necessary for certain experiments)

Thin seedling population

Plant height at certain dates

Dates of:	Weeding	Fertilizing
	Application of insecticides (cowpeas)	Tied ridging
	Flowering	Maturity
	Harvest	

Degree of lodging

Yield

Miscellaneous relevent notes depending on conditions and season

The professional staff worked alongside the technical staff as needed to ensure that data were measured correctly. The FSU staff advised farmers regularly to ensure that farmers carried out the management of their plots correctly and on time.

Appendix 3-C: Summary of 1983 and 1984 On-farm Trials

RESEARCHER-MANAGED TRIALS

1. *1983 maize-cowpea association.* Randomized complete block, two locations per village, four replications on compound land. *Treatments:* (1) Local maize, local cowpea with traditional management (TM), (2) local maize, local cowpea with 200 kg/ha 14–23–15 plus 50 kg/ha urea, (3) SAFITA-2 and TVx 3236 with TM, (4) SAFITA-2 and TVx 3236 with fertilizer as in treatment 2. *Results:* Maize only harvested at Dissankuy and Nedogo locations, other trials abandoned because of drought. At Nedogo, local variety yield more than double the yield of SAFITA-2 under both traditional and improved management. At Dissankuy, only SAFITA-2 with improved management (treatment 3) significantly greater than other three treatments.

2. *1983 sorghum with tied ridges and mulch.* Randomized complete block with four blocks of eight treatment combinations. Two locations at Nedogo and Dissankuy and one location at Bangassé. *Treatments:* (1) Control, (2) tied ridges (TR) on.y, (3) 2.5 t/ha mulch, (4) 5 t/ha mulch, (5) 10 t/ha mulch, (6) TR with 2.5 t/ha mulch, (7) TR with 5 t/ha mulch, (8) TR with 10 t/ha mulch. *Results:* Inconsistant results. One location at Nedogo indicated TR plus mulch had significant yield differences over the control. Mulch treatments did not out-yield the control at any of the locations.

3. *1983 cowpea variety trial.* Split plot, dates of seeding were whole plots (5 July and 9 August), and variety and TR treatments were the subplots. One location at Dissankuy. *Treatments:* (1) Local variety plus TM, (2) local variety plus TR, (3) TVx 3236 plus TM, (4) TVx 3236 plus TR, (5) KN-1 plus TM, (6) KN-1 plus TR, (7) SUVITA-2 plus TM, (8)SUVITA-2 plus TR. All plots sprayed (one liter per hectare) at budding and again 10 days after budding with Thiodan. *Results:* Average plot yields at early seeding date significantly greater than yields from later seeding date plots. No significant yield differences among the eight treatment combinations when averaged over the two seeding dates. Under TM, local variety out-

performed improved varieties. Under TR, local variety performed as well as improved varieties.

4. *1983 millet and cowpea association.* Randomized complete block with four replications. Two locations at Dissankuy and one at Bangassé. *Treatments:* (1) Millet (31,250 plants/ha), (2) millet (31,250) and local cowpeas (7,800), (3) millet (31,250) and local cowpeas (31,250), (4) millet (62,500) and local cowpeas (62,500), (5) millet (31,250) and TVx 3236 (62,500), (6) millet (31,250) and TVx 3236 (31,250), (7) millet (62,500) and TVx 3236 (62,500). Millet and cowpea planted on same date. Sprayed as in experiment 3 above. *Results:* Treatment effect not significant for millet. Cowpea yields increased with increased densities. At the three population densities, local cowpea yield greater than TVx 3236. Yields of millet in association tended to be higher than millet-pure stand yields.

5. *1984 response of sorghum and millet to fertilizers.* Randomized complete block, four replications, one location at each village. Local millet and sorghum mixture at Diapangou, 82S50 white sorghum (ICRISAT) grown at other four villages. *Treatments:* (1) Control, (2) TR, (3) TR with 100 kg/ha VP1 in seed pocket, (4) TR with 100 kg/ha UV5 (partially acidified Volta rock phosphate) in seed pocket, (5) TR with 50 kg/ha urea banded one month after planting, (6) TR with 100 kg/ha 14–23–15 banded at planting, (7) TR with 200 kg/ha 14–23–15 as in treatment 6, (8) TR with 100 kg/ha VP1 as in treatment 3 plus 50 kg/ha urea as in treatment 5, (9) TR with 100 kg/ha UV5 as in treatment 4 plus 50 kg/ha urea as in treatment 5, (10) TR with 200 kg/ha UV5 as in treatment 4 plus 100 kg/ha urea as in treatment 5, (11) TR with 100 kg/ha VP1 plus 50 kg/ha urea in seed pocket one week after planting. *Results:* Poedogo site not harvested because of late planting. Good response to 14–23–15 across all sites. Responses to VP1 and UV5 very inconsistent.

6. *1984 sorghum and millet fertilized with manure.* Split-plot with whole plots (zero or 50 kg/ha urea in pockets one month after seeding) arranged in a completely randomized design with manure treatments as subplots. TR constructed on all plots prior to planting. 82S50 sorghum grown in Nedogo and Dissankuy and local millet at Bangassé and Diapangou. *Subplot Treatments:* (1) Control, (2) 3.1 t/ha manure in seed pocket below seed, (3) 3.1 t/ha manure 10–15 cm from seed pocket at planting, (4) 3.1 t/ha manure plus 100 kg/ha UV5 in seed pocket below seed. *Results:* Significant response to urea only at Nedogo and Bangassé. Response to manure plus UV5 inconsistent across villages. Manure alone did not result in significant yield increases.

7. *1984 early-maturity white sorghum variety trial.* Randomized complete block with four blocks conducted at Nedogo. *Treatments:* (1) Kanfiagui (local Diapangou variety), (2) Kanfiagui with 100 kg/ha 14–23–15 banded two weeks after planting plus 50 kg/ha urea in pockets 10–15 cm from seed pocket one month after planting, (3) 82S50 (ICRISAT variety),

(4) 82S50 with fertilizer as in treatment 2. *Results:* Kanfiagui produced significantly more grain than 82S50 under fertilization and nonfertilization (Lang et al. 1984; Ohm et al. 1985a).

FARMER-MANAGED TRIALS

1. *1983 and 1984 effects of tied ridges on maize.* Randomized complete block with farmers fields as replications at each of the five villages. The experiment was conducted in 1984 for the first time at Poedogo and Dissankuy. Twenty-five farmers at each village, local variety on compound land. *Treatments:* (1) Control, (2) TR at second weeding. *Results:* TR treatment gave significantly greater yields than control over both years. Returns to the additional labor for TR construction ranged from 62 to 339 FCFA/hr in 1983 and from 155 to 888 FCFA/hr in 1984.

2. *1984 performance of millet and sorghum on millet land.* Randomized complete block, farmers fields as replications at Nedogo (25 donkey), Bangassé (25 manual) and Dissankuy (25 ox). Objective to find if improved management can agronomically and economically be used to grow sorghum on the poorer millet land. *Treatments:* (1) Local millet on millet land with TM, (2) local millet on millet land with 100 kg/ha 14–23–15 banded two weeks after seeding plus 50 kg/ha urea in pockets one month after planting and TR six to eight weeks after planting, (3) local sorghum on millet land with fertilization and TR as in treatment 2. *Results:* Millet and sorghum yield not significantly different but both have a significantly greater yield than the control. Millet with improved management out-performed both the control and the sorghum treatments in economic return. A higher percent of farmers would have lost cash if they grew sorghum as in treatment 3 relative to growing millet as in treatment 2. Major problem with sorghum seedling establishment under drought stress. A subset of six Nedogo farmers with good seed establishment indicated that sorghum could compete economically with millet on millet land. The seedling establishment problem was communicated to the on-station researchers.

3. *1984 red sorghum variety trial.* Randomized complete block, farmers (25) in Poedogo were replications. *Treatments:* (1) Local red sorghum, (2) local red sorghum with improved management practices as in experiment 2, treatment 2 above, (3) Framida (ICRISAT) red sorghum, (4) Framida with improved management practices as in treatment 2. *Results:* Both Framida and local variety responded to improved management, but yield of local variety greater than Framida (contrary to 1983 ICRISAT trials). Problem with spittlebug and sorghum midge in Framida. Both men and women were asked about Framida. They preferred the taste, grinding ease and the large kernels of Framida as compared to the local variety (Lang et al. 1984; Ohm et al. 1985a).

Chapter 4

Colombia

Production and Consumption Aspects of Technology Testing in Pescador

CONTENTS

Teaching Notes for Part 1: Initial Diagnosis and Planning ***and Part 2:*** Experimentation, Ongoing Diagnostic Research, and Evaluation (in *Working Together* Vol. 1, Chap. 5)

Part 3 Findings and Future Research

This case and teaching notes were prepared as a basis for discussion rather than as an illustration of either effective or ineffective handling of a project.

Teaching Notes for Colombia
Part 1: Initial Diagnosis and Planning
Part 2: Experimentation, Ongoing Diagnostic Research, and Evaluation

CASE SYNOPSIS

This case covers the initial eight months of an on-farm testing project for varietal and fertilization technology components in a farming system in Pescador, Colombia. The first cycle of diagnostic experimentation and evaluation research conducted by the project is presented.

Part 1 of the case (*Working Together* Vol. 1, Chap. 5) provides background information on the composition of the research team for the project, their objectives and disciplinary points of view in setting up the diagnostic phase of research, and the information they generated to design the experimentation phase. The team's focus on crop production aspects of the farming system is highlighted as well as the way in which this influenced the methodology for data collection in the diagnostic phase. The emergence of different gender-related criteria for selecting technological components to be included in farm trials is shown. Part 1 closes with a discussion of how the researchers defined recommendation domains and what components should be included in the on-farm experimentation.

Part 2 of the case (also in *Working Together* Vol. 1, Chap. 5) discusses experimentation and monitoring and shows the design of on-farm experiments that address the team's objectives. The need for further diagnostic research and new methodology is identified, focusing on women's contribution to managing related production and consumption activities in the farming systems.

The team then describes how the information from additional diagnostic research influenced the evaluation methodology to include consumer evaluations with women. Further evaluation following the on-farm trials led to the discovery of the relevance of age-related as well as gender-related differences in preference structures affecting technology adoption, and the importance of situating these variables in the context of the domestic life-cycle of the farm family.

USE OF THE CASE

This case may be taught in one or two sections. Together the two parts present the process of discovering the relevance of intrahousehold vari-

ables to the objectives, methodologies, and findings during the first eight months of a research project, as experienced by the researchers. Part 1 presents what was known at the end of the initial diagnostic phase by the participants in the project; Part 2 provides new information which threw light on past assumptions or interpretations of data and caused the researchers to adapt their methodology and concepts to take intrahousehold variables into account.

Discussing the case in two parts provides an opportunity for an exercise in trial design and for a more specific discussion of how the researchers' analysis of gender-related activities and resources changed over the course of the project. At least one hour for reading time and time for additional small group discussions should be allowed between the plenary discussion of the two parts. An outline for teaching the case with the sections discussed separately is presented in Plan A.

When Parts 1 and 2 are taken together, the focus is on the shift in researcher's assumptions which resulted in changes in research activities, in evaluation criteria, and in the definition of research domains. An outline for teaching the case with the sections combined is presented in Plan B.

LEARNING OBJECTIVES

1. To identify and reconcile the research interests of a multidisciplinary team

2. To determine the preference structures relating to bean production and apply those structures to the design and evaluation of on-farm experimentation (optional)

3. To examine a series of research activities with respect to the inclusion of farmers and users and the utility of the data generated

4. To illustrate how the methodology for diagnostic research had to be adapted to include multiple members of the farm household

5. To show how the results of the new diagnostic methodology fed into the design of the evaluation which could tap multidimensional criteria for acceptance of the technology, reflecting different gender- and age-related roles and preferences in the farm household

6. To illustrate the relevance for farming systems research to conceptualize the activities, resources, and incentives of different members of the farm household and thus identify the potential clients for the adoption of new technology

STUDY QUESTIONS

Part 1

1. What are the objectives of the research?

2. What is known about men's and women's roles with respect to bean production in Pescador?

3. What are the different kinds of beans grown in Pescador? What are the cultivation practices associated with them and what are their uses?

4. What should be the main components of an experimental program in February in terms of *(a)* varieties, *(b)* fertilizer use, and *(c)* farmer management? How can farmer participation be maximized? What further research would be useful at this phase?

4. (alternate) Develop an on-farm experimental program for beans. Consider the trial objectives, the group of farmers to which it is directed, treatments and levels for each trial, selection criteria for co-operators, and data to be collected for evaluation purposes. What additional research should be done?

Part 2

1. What was learned about incentive structures in bean production? Household resource control? Household preferences for bean varieties?

2. What research activities were actually undertaken during the project? Where were they located? What are the strengths and weaknesses of each activity?

3. What should the research team recommend to small farmers? To the government of Colombia? To similar research institutions?

Parts 1 and 2 Combined

1. What are the objectives of the research?

2. What is known about men's and women's roles with respect to bean production in Pescador?

3. What are the social and economic factors which influence farm production activities?

4. What are the strengths and weaknesses of the research design?

5. What should the research team recommend to small farmers? To the government of Colombia? To similar research institutions?

ANALYSIS OF THE CASE[1]

Part 1: Initial Diagnosis

This section lays out the objectives and assumptions of the researchers and their criteria for evaluating the new technology in the diagnostic stage of their research. The initial diagnostic activities and these objectives and criteria provide the basis for the experimental design and the development of new diagnostic research. It is important to appreciate the multiple objectives reflected by the different disciplines, which included methodology development as well as testing component technology (bean varieties, fertilizers).

The focus on soils criteria for selecting the site for on-farm testing must be appreciated in relation to the soil scientist's objective of evaluating a fertilizer technology that requires acid soils low in phosphorus (P) (see Table 5-3 and Figure 5-2, *Working Together* Vol. 1). This leads to an understanding of why the diagnostic research described in the remainder of this section already had a focus on the production aspects of evaluating the proposed technologies.

The researchers' concern with market acceptability of bean grain types for selecting the varieties to be included in the on-farm testing program (see Tables 5-4 and 5-5, *Working Together* Vol. 1) needs to be understood in relation to their perception of the urban population as the eventual consumers of beans produced in CIAT's target region, and their perception that farmers would select varieties exclusively in terms of their marketability. Note that researchers assumed that these urban consumer preferences, which were already known, could be generalized for the rural population.

As a result of the commodity and input-oriented approach, the project selected a site with acid soils low in phosphorus, where the fertilizer technology was expected to have an impact on bean yields, but where beans were not a major cash crop (because soils were infertile and yields low). The consequent dual role of beans in the farming system, for market and for home consumption, did not attract much attention initially among researchers. Yet this important fact emerges at the end of Part 1

upon the discovery that women's perception of a bean variety as desirable for home consumption purposes influenced farmers' initial selection of acceptable grain types.

While cursory information on the sexual division of labor was obtained, it was utilized primarily to make the decision of whom to interview. The focus on production aspects of evaluating bean varieties meant that male farmers who carried out all these activities were identified as the relevant informants. The focus on production aspects of testing the technology also meant that the male head of household, the farmer, was perceived as the significant decision-maker. As a result, farmer participation in the identification of technical components for inclusion in the trials, also an important objective of the project, was conceptualized in terms of the participation of male farmers in evaluating production aspects of the bean crop.

It is important to note that the participation of male farmers in this respect added to the information provided earlier by the survey. It enabled researchers to identify innovative production strategies which represented possible objectives for experimentation. It was the unexpected and serendipitous favorable rating given BAT-1297 which led to the reanalysis of the interview data and the recognition by researchers that the participation of women might be important.

Part 2: Experimentation, Ongoing Diagnostic Research, and Evaluation

Note the way in which the researchers' uncertainty about which varieties to include or exclude, due to the questions raised about the possible bias of only asking men to evaluate the varieties, led to the inclusion of a large number of treatments to be evaluated in the exploratory trial (Table 5-11, *Working Together* Vol. 1). This resulted in a tradeoff between scientific objectives incorporated in the design of a fairly complex exploratory trial and the objective of obtaining farmer participation, incorporated in a superimposed trial design focused on varietal evaluation. Note how these difficulties in identifying which treatments (especially varieties) to include in the trials resulted from the incomplete diagnostic research presented in Part 1, in particular the incomplete assessment of production versus consumption objectives of different members of the farm household.

Note also the continuing focus of the project on evaluating aspects of the technology with the participation of male farmers. The experimentation was launched before a new diagnostic methodology was developed and carried out to find out what relevance an input by women might have for the project's methodology. Earlier, the priority given to rapid results led to an informal survey interviewing farmers in the field, thus screening out women as informants for diagnostic research.

An important point to appreciate is the use of participant observation methodology in the women's work place (the kitchen), which showed women participating in a much broader spectrum of production activities than previously was realized. Participant observation also illustrated how important the preparation of laborers' meals by women was to the production activities carried out by men.

The social scientists identified the preparation of field laborers' meals as a key economic contribution of women to the farming system. The importance of beans to a woman's ability to manage the costs of provisioning field laborers indicated an area where women's preferences for bean grain type might operate powerfully on the selection of varieties. Women's involvement in managing cash flow also indicated an area where decisions about expenditures on fertilizers and their profitability might be influenced by women. The social scientists concluded that the ultimate adoption of the technology being evaluated in field trials with the men might also depend on evaluations performed by women.

The second section of Part 2 presents the process by which the researchers having incorporated gender differences into their evaluation methodology, obtained results from the evaluations of the farm trials, the evaluation of the consumption aspects of the varieties, and the results of their follow-up evaluation. These were clarified by taking age-related and family structure variables into account when interpreting differences in expressed preference. The results of the analysis of variance showed that, under traditional or minimum input management of pests and disease, fertilizer accounted for 45 percent of bean yield variation, and varieties accounted for 12 percent. Under innovative or high-input management the order of the results was reversed: varieties accounted for 42 percent of total yield variation, while fertilizer accounted for 28 percent. These results confirmed the farmer strategies identified by the initial diagnostic activities. Farmers using traditional management relied heavily on fertilizers, while innovative managers of the bean crop were experimenting with the effects of a reduced investment in fertilizer complemented by more intensive pest and disease management.

When women evaluated cooking characteristics of the varieties, a different order of preference emerged from that identified in the postharvest evaluations conducted with the men, which had considered exclusively yield, profitability, and marketability. In the evaluation with women, three varieties including BAT-1297 were preferred to A-36, the variety ranked highest by the men.

The follow-up study suggested to the researchers that evaluation of the varieties by women was proving influential in the dissemination of seed material after the trials. It appeared that women who were responsible for managing household consumption in the nuclear or extended family were influential in establishing preferences for varieties that directly

addressed consumption rather than market-oriented objectives. However, women who were junior members of an extended household did not have this same responsibility or set of preferences. Indeed, the preferences of young women in an extended household had more in common with those of young men, often their husbands, with a focus on the marketing aspects of bean varietal selection.

On the basis of this analysis, it is possible to classify different social groups with preference structures in the community which could be related to potential acceptability of the different varieties, and so provide newly defined recommendation domains as guidelines for further evaluation of new technology: (1) young adult men and women in early life-cycle positions in the extended family, (2) male heads of household of nuclear or extended families, and (3) women in later life-cycle positions with responsibility for managing household consumption in the nuclear or extended family. The redefined recommendation domains shown in Table 4-9 (in Part 3 of this chapter) were incorporated into the project as a basis for selecting participants in on-farm trials and in the evaluation of the consumption qualities of the new varieties in the coming planting season.

In closing, it is important to highlight how the diagnostic research by the social scientists was an iterative process which interacted with different stages in the agronomic farm trials. Note also the tradeoffs between conducting diagnostic, in-depth case studies and participant observation before planting farm trials, or before getting out to the field and planting on-farm trials right at the beginning of a project. To what extent did this diagnostic research derive focus from the fact of having the technology out in the community, so that intrahousehold preference structures became apparent? Note that the sociologist was probably a woman and therefore able to do an important piece of diagnostic research through participant observation. This case covers only one planting season or approximately eight months of on-farm research. To what extent could these preference structures have been identified using rapid rural assessment or survey approaches to then provide focus for planting on-farm trials?

DISCUSSION QUESTIONS

Plan A describes a teaching plan for parts 1 and 2 used separately. In using Plan A, make reference to Worksheet 1-6 (*Working Together* Vol. 1) as a format for trial design. Plan B is for teaching Parts 1 and 2 together and draws on particular questions from Plan A.[2]

Plan A: Part 1

1. What are the objectives? Is this a shared goal? Is the goal commonly developed? Are there other research objectives?

The first responses are likely to be "participatory research" and "better bean varieties." This set of questions allows the diverse set of objectives of the researchers to be drawn out and put on the board as illustrated in Table 4-1. It may be useful to ask participants to evaluate how important the information on access to resources, labor allocation, family composition, or other household variables was to the perceived interests of the researchers.

There is a need to emphasize that this is a project involved in technology development. In a group of workshop participants dominated by anthropologists and sociologists, there may be a lot of critical comments about the lack of detailed sociological and gender-disaggregated data before any decisions were made by the research team. Suggestions for research which "should have been done" can be listed separately on the board. (See also discussion under question 2, Part B below.)

2. As they begin the diagnostic surveys, what are the research team's initial assumptions about bean production in Pescador?

There are a number of assumptions which underlie the approach of the researchers to understanding beans in the farming system (see Table 4-2).

Additional Question: What did the researchers learn on the first diagnostic survey which challenged their assumptions? Use stars on the developed board to note where this has happened.

3. One of the assumptions is that men produce crops and are the decision makers. Let's look at activities and resources. What is known about gender roles and gender-related preferences?

This is an opportunity to open up activities and resources analyses and write on the board a short and rough list of what is known at this time. At this stage, very little is known and is represented by Tables 4-3 (activities) and 4-4 (resources). The view is that men do all the agricultural tasks mentioned and women are exclusively in the domestic domain with no role in production. There is mention of the subsistence fields where maize and climbing beans are intercropped, without a clear indication of who tends to them. In discussing fertilizer and pesticide activities, draw out that there ap-

Table 4-1

Research Objectives

Breeder	Agronomist	Economist	Soil Scientist	Social Scientist
High-yielding variety, type	Crop management techniques	Preferences Price Costs of production	Fertility response Soil quality	Farmer participation Community response Gender issues

Table 4-2

Assumptions

Farmer interest
Willingness to participate
Yield is important
Need for imported/new bean varieties
Preference for big pink bean
Bean quality related to size, color, yield, price
Time constraint
With farmer participation, researchers will get it right and farmers will adopt
Farmer, male, is the decision maker because he is doing the planting
Market importance
Household preference equals market preference
Farmer need for cash
Division of labor: men farm, women housekeep
All income through males
All farms are the same
All households have the same priorities

pear to be two sets of practices: those of traditional farmers and those of innovative farmers. You might illustrate this with superscripts as in Table 4-3.

4. Have participant(s) present one field trial or one set of field trials organized according to Worksheet 1-6 (*Working Together* Vol. 1, Chap. 1) as a basis for discussion.

Prepare the class in advance for the possibility of a cold call (without warning) on this and for the fact that not all plans will be presented. Have a cold call on each element of a trial design as described in Worksheet 1-6. As objectives for each experiment are being described, ask how the potential adopters (or recommendation domains) for the technology are being defined. After each person states his or her plan for a specific element of a trial, put that on the board and have other comments and discussion. Add comments to the board. It is important as each element is discussed to ask *who* is involved and to relate that to the assumptions or to the findings after the diagnostic activities.

Additional Questions: Which bean varieties should be included? How should fertilizer treatments be included? Which bean cropping system (climbing beans intercropped with maize or monocropped bush beans) should be given priority? Who are the relevant participants for testing? How adequate was the diagnostic research, particularly the gender-related data for determining relevant participants?

5. What additional or parallel diagnostic work could be done?

This is an opportunity to explore whether or not participants are satisfied with the recommendation domains already suggested by the re-

Table 4-3

Activities Analysis: Part 1[a]

	Exclusively or Mainly		Shared by
	Male	Female	Both Sexes
Agricultural			
Purchase agricultural inputs	M		
Land preparation	M		
Planting	M		
Weeding	M		
Fertilization	M[I,T]		
Pest management	M[I,T]		
Harvesting	M		
Domestic			
Housework		F	
Meal preparation		F	
Child care		F	

Key: M = male; F = female; I = innovative farmer; T = traditional farmer.
[a]Derived from text, Part 1 (Vol. 1, Chap. 6).

Table 4-4

Resources Analysis: Part 1[a]

	Access	Control
Land	MA	MA
Labor		
Own	MA	MA
Family	MA	MA
Chemical fertilizer	MA	MA
Chicken manure	MA	MA
Sprays	MA	MA
Cash	MA	MA

Key: MA = male adult.
[a]Derived from text, Part 1 (Vol. 1, Chap. 5).

searchers and whether there is additional information which would be useful in defining all the desirable criteria for bean varieties and fertilizer management. Additional information might include the different uses to which climbing beans and monocropped beans are put in the system, the factors affecting the choices of innovative and traditional farmers.

Summary. Here you want to stress the point that the researchers' assumptions about the men as the decision makers might have led to a miscalculation concerning what varieties to test. If it has not already come out in the discussion concerning additional diagnostic research, it could

be pointed out that women seem to have some influence over decisions about bean varieties which bears further investigation—and this is what they did.

Have the trainees read Part 2 of the case study (*Working Together* Vol. 1, Chap. 5). At least one hour of reading time plus time for small group discussions should be allowed between the plenary sessions on Parts 1 and 2.

Plan A: Part 2

Preset the activities and resources boards which were derived from the previous discussion. This can be carried over from the session before or redrawn and reordered to make the information more clear.

1. What has been learned about the activities and preferences of men and women in Pescador as they relate to bean production?

Refer to Tables 4-5 and 4-6 and write up on the board what information the participants volunteer. Here it is important to bring out the fact that hired labor is an important resource and that paying with meals rather than with cash is an economic advantage; in other words, women's labor in preparing meals is an economic cash-saving activity and an inducement to hire and hold better labor. Thus women's preferences for beans as the main ingredient in the stew is important in deciding what beans to plant. Similarly this discussion should bring out that younger women are different from their mothers in that they are more actively engaged in crop production. They may farm their own fields or hire labor to do the farming.

2. To get to this understanding of the farming system and the preferences affecting the choice of bean varieties, the project has undertaken a number of research activities. What are they? What were their strengths and weaknesses?

Refer to Table 4-7. Be sure and draw out questions of *who* was involved and where the activity took place. This helps to demonstrate how understanding who is interviewed and knowing the location of research affect the information gathered. You probably will not be able to get to all of them. The important points to be made are the openness of the team to reinterpret the data, to listen to the requirements of each other's disciplines and research agenda, and to seek information from more than one household member. The team was also flexible in undertaking additional innovative diagnostic work to get information on specific questions and in designing on-farm experiments which incorporated both researchers' and farmers' interests.

Additional Question: What does the emphasis on rapid results from diagnostic research imply when diagnosis requires attention to intrahouse-

Table 4-5

Activities Analysis: Part 2[a]

	Exclusively or Mainly		Shared by
	Male	Female	Both Sexes
Agricultural			
Purchase agricultural inputs	M		
Land preparation	M		
Planting	M	*F*	
Weeding	M		
Fertilization	M[I,T]		
Pest management	M[I,T]		
Harvesting	M		
Postharvest process	*M*	*F*	
Seed selection			*B*
Care of vegetable garden		*F*	
Domestic			
Housework		F	
Meal preparation			
Family		F	
Laborers		*F*	
Child care		F	
Weekly marketing	*M*		
Cash management (housekeeping)			*B*

Key: M = male; F = female; B = Both; I = innovative farmer; T = traditional farmer.
[a]Items added from the text in Part 2 (*Working Together* Vol. 1, Chap. 5) are in italics.

Table 4-6

Resources Analysis: Part 2[a]

	Access		Control	
Land				
Own	MA	*FA*	MA	*FA*
Rented	*MA*	*FA*	*MA*	*FA*
Labor				
Own	MA		MA	
Hired	*MA*	*FA*	*MA*	*FA*
Family	MA		MA	
Chemical fertilizer	MA	*FA*	MA	*FA*
Chicken manure	MA	*FA*	MA	*FA*
Sprays	MA	*FA*	MA	*FA*
Cash	MA	*FA*	MA	*FA*
Stew ingredients	*MA*	*FA*	*MA*	*FA*

Key: MA = male adult; FA = female adult.
[a]Items added from the text in Part 2 (*Working Together* Vol. 1, Chap. 5) are in italics.

Table 4-7

Research Activities: Parts 1 and 2

Strengths		Weaknesses
	Initial diagnosis	
+	Interdisciplinary	
+	Interactive setting	
+	Use of existing data	
	Nothing on family structure	–
	Survey of 40 households	
+	Production practices	
	Nothing on uses	–
	Nonrecognition of hired labor	–
	Focus on fertilizer practices	–
	Innovative farmer survey	
+	Reality check	
	One group of farmers	–
+	Seeking farmer experimenters	
	Assumptions about decision maker	–
	Reanalysis of beans grown	
+	Rethinking old data w/new insights	
	Participant observation	
+	Consumption criteria and uses	
+	Timely collection of data	
+	Additional information on farming system	
	On-farm trials	
+	Restricted complicated trial to 2	
+	Maximized farmer involvement in other trials	
	Included young M & F innovators?	–
	Did not include subsistence fields or huerta	–
+	Farmer evaluations of field	
	C/B analysis and farmer preferences	
+	Real market prices	
+	Farmers' views	
+	Recorded characteristics of respondents	
	Consumption evaluation	
+	Included food preparation and use	
+	Included community	
+	Included women's views	
	Follow-up survey	
+	Reality check on household decisions	
	Planted in which fields?	–
	Asked men only?	–

Key: M = male; F = female; C/B = cost/benefit analysis.

hold variables (such as decision making) which are not readily measurable by a survey? Be sure to make connections back to the informal survey approach and to the priority given to rapid results from interviewing farmers in the field, mentioned in Part 1, and how this screened out women as informants for the diagnostic research. This might bring out the importance of learning about family composition and responsibilities in the early diagnosis, perhaps discovering sooner the age as well as gender differentiation in preference groups.

There may be considerable discussion with pros and cons on this. For instance, with respect to the innovator farmer survey, pluses are often accorded to "seeking out farmer experimenters," "getting large number, not just one or two," and "innovators were identified by other farmers." However, questions or minuses result when there is a question of whether this biases the sample to resource-rich farmers or to initial informants' friends.

There are several alternative approaches to discussing the research activities. One is to focus on a particular activity and the new information gained. For an example based on the participant observation, see Table 4-8. Another is to take each stage—diagnosis, experimentation, etc.—and play that against Worksheet 1-5 (*Working Together* Vol. 1) of the conceptual framework on "inclusion," discussing as it is filled out the gains and losses of particular "inclusions" or "exclusions."

If additional social science research was suggested (see discussion question 1, Part 1 above), these suggestions could be evaluated. How would each method contribute directly to technology development? How cost effective and compatible with the needs of technical scientists are the suggested methods compared with the research activities of the sociologist?

Additional Question: What gender are the researchers? Any clues?

It is fairly clear that the sociologist is a woman given the seeming ease of participant observation. There are several associated questions. Without her awareness of women and of the consumption questions, would anyone else have addressed these questions? Could a male researcher have found the same information? How? This can be a takeoff point for a more general discussion of the role of women, of social scientists, and of gender analysis and training to an FSR/E team.

3. The purpose of this research was to clarify for researchers farmer preferences and likely adoption of new varieties. What are the relevant farmer preference groups (recommendation domains, target groups) and what are their characteristics? (See Table 4-9 in Part 3, following.)

Additional Questions: How might these different preference groups have been identified a priori? How would this affect the selection of farmers for farmer-managed trials? For the location of trials (commercial bean plots versus subsistence garden plots)? For different combinations of factors (varieties, levels of pest and disease control, and fertility management)?

Table 4-8

Findings from Participant Observation

Women control consumption
Beans pay for labor
Paid labor holds young in community
Comparison advantage to good cooks
Beans substitute for meat
Meals ensure more reliable labor
Women farm garden areas
Women influence production decisions
Women influence decisions on allocation of children's time: school vs. farm
Young women can get credit
Are interested in innovation
Perceive income as partnership
Can absorb more risk

Another alternative would be start with "What are farmers' preferences?" and use the answers to lead into the definition of different preference groups.

4. What recommendations could be made to small farmers? To the government of Colombia? To other agricultural research institutions? What recommendations could be made for further research?

Plan B: Parts 1 and 2 Combined

The discussion questions for using Parts 1 and 2 together are drawn from the questions in Plan A, as follows:

1. As in Plan A, Part 1, question 1, researcher objectives.

2. As in Plan A, Part 1, question 2, initial assumptions.

3. As in Plan A, Part 2, question 2, strengths and weaknesses of research activities.

4. As in Plan A, Part 2, question 3, recommendation domains.

An alternate approach. An alternate way to combine Parts 1 and 2 is for the trainer to summarize and frame the information in Part 1 and then go back and add to it from questions and discussion based on Part 2.

Summary. Emphasize how the original assumptions set up the original research agenda, with emphasis on crop production aspects and pref-

erences for market-type beans. Further diagnostic research led to the understanding of other gender- and age-related criteria for looking at preference groups and for determining the acceptability of innovations in bean production and utilization.

ADDITIONAL POSSIBILITIES TO CONSIDER

1. Examine the implications for other crop-specific breeding programs such as rice textures and maize meal.

2. Explore questions about young women farmers and how they fit into the overall farming system.

3. Discuss of the methodologies used by this team, looking at the different kinds of information generated from questioning, informal interviews, and participant observation.

4. Examine the interdisciplinary nature of the team, in particular the role of the social scientist and the role of a woman on the team.

NOTES

1. This section was written by Jaqueline A. Ashby.

2. These teaching plans draw heavily on the original teaching of this case by Catherine Overholt in 1987.

Colombia: Part 3
Findings and Future Research

JACQUELINE A. ASHBY

The research team incorporated gender differences into their evaluation methodology. The results of their evaluations of the farm trials and consumption aspects of the varieties as well as the results of their follow-up evaluation were clarified by taking age-related and family structure variables into account when interpreting differences in expressed preference. It appeared that women who were responsible for managing household consumption in the nuclear or extended family were influential in establishing preferences for varieties that directly addressed consumption rather than market-oriented objectives. Women who were junior members of an extended household did not have this same responsibility or set of preferences. Indeed, the preferences of young women in an extended household had more in common with those of young men, often their husbands, who focused on the marketing aspects of bean varietal selection.

On the basis of this analysis, it was possible to classify different social groups with preference structures in the community which could be related to potential acceptability of the different varieties, and so provide newly defined recommendation domains as guidelines for further evaluation of new technology:

- Young adult men and women in early life-cycle positions in the extended family
- Male heads of household of nuclear or extended families
- Women in later life-cycle positions with responsibility for managing household consumption in the nuclear or extended family

The redefined recommendation domains shown in Table 4-9 were incorporated into the project as a basis for selecting participants in the on-farm trials and in the evaluation of consumption qualities of new bean varieties in the coming planting season.

Table 4-9

Recommendation Domains Related to Intrahousehold Variables

Position in Domestic Life Cycle and Family Structure	Group Characteristics	Criteria for Acceptability of New Technology
Early life cycle in extended family	Single men and women, or young couples (innovative farmers)	Extra-local marketability High input using May be risk taking
Early life cycle in nuclear family	Men (innovative farmers)	Local market acceptability High input using Low risk
Late life cycle head of extended family	Men (traditional farmers)	Local market acceptability Low input disease High fertilizer responsive Low risk
Early life cycle in nuclear family or late life cycle, head of extended family	Women (farm housewives)	Advantageous for meals prepared for household and hired labor Suitable for home garden production

BAT-1297 continued to show promise in the field and CIAT began testing its market acceptability. The 1985 CIAT Annual Report states:

> BAT 1297 has consistently obtained superior yields in regional trials conducted with FEDECAFE and its performance in commercial production was also confirmed this year. However, despite an acceptable color, the variety's small seed size was expected to lead to a substantial price discount compared to other commercial varieties, and even prevent commercial acceptability.
>
> In a test market program the supermarket chain MERCALDAS sold BAT 1297 in Manizales at prices 20–35% lower than the cheapest alternative bean in the market. In the study period of July 1985, BAT 1297 was the biggest selling bean, taking a 37% market share. This suggests that a low priced bean can penetrate the market, even when it does not meet traditional concepts of market requirements. Obviously, the viability of such a strategy depends on the relative proportions of productivity increase versus price discount. In this particular case, the cost-of-production study indicated that even at the lower end of the price range tried in the test marketing, BAT 1297 would be quite profitable for most growers.

Chapter 5

Indonesia
Farm-based Research in the Tropsoils Project, Sitiung

CONTENTS

Teaching Notes for Part 1: Diagnosis and First-year Experimentation (in *Working Together* Vol. 1, Chap. 6)

Part 2 Research in the Second and Third Years
Trials with Collaborator Farmers, Aur Jaya
Forage Trials
Home Gardens
Indigenous Knowledge: Minang
Notes

Appendix 5 Letter from Joan to a Colleague in the United States

This case and teaching notes were prepared as a basis for discussion rather than as an illustration of either effective or ineffective handling of a project.

Teaching Notes for Indonesia: Part 1 Diagnosis and First-Year Experimentation

CASE SYNOPSIS

The Tropsoils case is set in Sitiung, a transmigration site in western Sumatra. This is an area where the Indonesian government is transferring volunteer families from the overcrowded island of Java. Most of the population, a mixture of Javanese and Sundanese, is from Java – here small landholdings are intensively farmed. At Sitiung, transmigrants are given relatively large plots (one hectare of uplands; one-quarter hectare around the house; and in some cases one hectare of irrigated paddy). Though there is abundant rainfall, the soil is infertile and highly acidic, typical of tropical forest areas, and has been further damaged by the practice of bulldozing the early settlement areas. About 10 percent of the transmigration land is set aside for the Minang, an ethnic group indigenous to the area and more used to extensive farming practices, substantially different from those of the transmigrants.

Initial background of the site is given, drawn from prior reports and the team's own *sondeo*. Four research activities and their results are described: a collaborative farmers' trial, a one-year time allocation study, an exploratory trial on forages and grasses, and a short study on income and food practices.

The collaborative farmers' trial is exploratory, to learn more about farmers' practices as well as the prospects for improved soil management in the upland fields, *ladang*. The process of working with farmers, the design and changes in the trial, and the first year's results are reported. The time allocation study is designed to provide information on who does what at two key sites. A summary of the method and the resulting frequencies of observations, disaggregated by gender, are reported and compared. The rationale and preliminary experimentation on forage legumes is described. The food practices and income study is based on one month's research and includes twenty-four-hour recall on diet and a year's recall on income and its sources. Consumption practices are described and the sources of income are reported.

Because the case focuses on soil management, it includes short technical notes on soil science, particularly as it applies to Sitiung, and on the

rationale and kind of experimentation done on forage legumes and grasses.

USE OF THE CASE

The Sitiung case provides a good opportunity for trainees to work with information from a time allocation study. Appendix 6-C (*Working Together* Vol. 1) gives actual frequencies reported by gender and by site of each kind of activity recorded.The endnote describes the formula for translating frequencies into hours per day. The frequencies reported in Appendix 6-C are in discrete bits with some grouping (such as work in *ladang*, work in home garden) indicated by spacing. Participants should be encouraged to scan the data to identify groupings or differences (between men and women or between sites) which "stand out." The case also provides an opportunity to discuss three themes related to gender or intrahousehold dynamics and FSR/E: (1) the makeup and objectives of the teams; in this case, a project focused on soils, (2) collaboration with farmers in design and evaluation of on-farm experimentation, and (3) ethnic differences.

LEARNING OBJECTIVES

1. To characterize women's and men's roles and ethnic differences in production

2. To assess research methodologies used by the Tropsoils team

3. To identify promising research opportunities for improving soil management and productivity, specify the target group or recommendation domain, and evaluate them with respect to men's and women's roles

4. To propose a strategy for the greater involvement of women farmers

STUDY QUESTIONS

1. What are the roles of men and women in Sitiung?

2. There are three primary types of land use in Sitiung. What are the products of each of these systems and what are the uses of this output?

3. What are the factors influencing crop production practices in Sitiung?

4. What problems and/or opportunities for improving agricultural production and family life in Sitiung can be identified so far? Propose some promising research possibilities and identify to whom they are targeted.

5. Evaluate the involvement of men and women farmers in the Tropsoils project during the first fifteen months. What strategies might increase the involvement of women farmers? How does this fit with the project's objectives?

ANALYSIS OF THE CASE

This case presents two challenges: (1) the relevance of gender and interhousehold analysis to a very technically oriented research team whose main focus is soil management and (2) how such analysis can be integrated into the team's work. There are three areas in which information on gender and intrahousehold aspects of the farming system are relevant:

1. The recognition of different kinds of farming systems, as defined by different types of fields within this area, with particular attention to the often-overlooked home garden

2. Evidence of the role of women as well as men in agricultural production

3. Evidence of ethnic differences in cultural practices

The purpose of the Tropsoils project is to find principles of soil management which will increase productivity at the same time land is conserved and improved. The need for understanding farmer circumstances and decision making is explicitly recognized in the inclusion of a farming system specialist, an anthropologist, and in the avowed intention of the team to work collaboratively with farmers. The question of the role of women is introduced immediately by the anthropologist, but initial information is scanty.

Though the Tropsoils project works throughout the transmigration area, the case focuses on two sites: Piruko, in Sitiung I, which was settled by a homogeneous population, all Javanese from a particular village on Java, and which has been settled on cleared land for eight years; and Aur

Jaya, in Sitiung V, which has a mixed population and has been newly settled, with recently cleared homesteads and upland fields. In both settlements, land title is given to the head of household which in all but 7 percent of the cases is male.

Evidence on the different types of farming systems—*sawah*, *ladang*, and home gardens—is evident from the beginning in the kind of land given to transmigrants (*sawah* available only to Sitiung I residents) and from the *sondeo*. The focus of the Tropsoils team is exclusively on the *ladang* fields, common to all sites. Evidence on the importance of the home garden comes from the time allocation study (TAS), which shows that both men and women spend considerable time in the home garden. In the collaborator trial, farmers choose crops (peanuts and chilies) which have been growing successfully in the home garden, indicating a desire for an increased production of those crops. This is reinforced with the finding from the income and food practices study that the home garden provides a significant proportion of agricultural production for consumption *and sale*. The peanuts do well; the chilies do not. One of the questions to be addressed by the team in their planning for the next season's research is whether and how to treat the home gardens.

Initially there is very little information on gender roles. The farming systems specialist, a woman anthropologist with previous experience in Indonesia, suspects women are involved in agricultural production, but early evidence from the *sondeo* is thin. The *sondeo* report mentions food processing. The primary data for examining gender roles comes from the TAS. The percent of frequency of observation for three main categories—reproduction, production, and leisure (Fig. 6-2, *Working Together* Vol. 1)—demonstrates that both men and women participate in productive activity with men doing more, women do the bulk of the reproductive activity, and men have more leisure. The relative time spent on different kinds of productive activity demonstrates big differences between the sites and between men's and women's time allocation (Fig. 6-3, *Working Together* Vol. 1). In Piruko, men do more on the *sawah* and *ladang* and off-farm labor; women work in both and have the major responsibility for planting and weeding. Women do more on the home garden (but men work there also), and both spend a lot of time collecting grasses for and caring for livestock. Women are also primarily responsible for selling at the market. In Aur Jaya, which lacks both *sawah* and livestock, men do more in the *ladang*, off farm, and other activities (generally land preparation and collecting and selling wood from the forest); women and men share equally in work on the home garden.

Women seem to predominate in planting. There is evidence from the collaborator trials that they are responsible for planting corn, and their noninvolvement in the designing of or instructions for corn planting in that trial may have contributed to poor corn yields. The anthropologist

tried to get women involved in the collaborator trials, but they had "other responsibilities."

The evidence of women's involvement in agriculture and the negative results from their noninvolvement in the corn planting during the collaborator trials suggest that greater inclusion of women and attention to their roles by the Tropsoils team would be beneficial to the research. There are several possibilities. Further research could include working on home gardens where women are more active. Because of their roles in processing food for sale and marketing, researchers should learn their criteria for varietal preferences and specifications. These are both substantive areas of interest to questions of soil management (home gardens) and increases in family welfare (decisions about sales versus consumption), and ones where the team more naturally may reach women who seem "too busy" or reluctant to become involved with public activity as represented by the researchers. One might also raise questions about the makeup of the team (one woman with many responsibilities) and the problem of language barriers.

Ethnic differences in cropping practices are perhaps more significant than gender differences in understanding farm decision-making in Sitiung and in providing guidance to the researchers about workable solutions in this particular environment. There are basically two groups, the transmigrants from Java who can be further subdivided between the Sundanese and the Javanese, and the indigenous Minang. Not surprisingly, the transmigrants, who come from intensive systems on little land, have quite different practices from the Minang who have farmed extensively in this upland area for a long time. Those differences as revealed to the researchers are shown in Table 5-2 (below). The Minang farm with perennials, have rubber trees on the upland fields (not allowed by the government program), and do not believe in hoeing. Perhaps more significantly, the food practices study shows them to be better off than the transmigrants, and, after one year with the collaborator trial, they leave the site. The implication is that they are living fairly successfully in this environment and do not feel the need for the government program or for innovations introduced by the research team. The *sondeo* report recognizes there may be something to learn here of use to the team, but in the first fifteen months, there is not much direct research done on the Minang system.

Another variable which affects research possibilities is the differences between the two sites. Sitiung I is older, homogeneous, more settled, has *sawah* and livestock, and has access to many off-farm and off-site income opportunities. Sitiung V is brand new, ethnically mixed, has newly cleared fields, lacks *sawah* and livestock, and has fewer off-farm possibilities.

An interesting aspect of this case is how soils management which is such an over-riding focus of the research is combined with a rolling design and considerable farmer participation in design. The researchers

show considerable flexibility in accommodating farmer suggestions at both the design and implementation stages. It is interesting to note that the farmers were quick to point out the risk they took in having a "control" plot under such unfamiliar and difficult conditions; a complaint to which the researchers responded imaginatively with an experiment with green leaf manure. This highlights some of the difficulty of conducting controlled experiments under transmigrant conditions where any practice (except of course those practiced by the indigenous groups) are, in essence, experimental. The forage trials work, done in collaboration with CIAT, is more formal, but appears promising given the evidence that collecting fodder for animals is time consuming and the potential contribution of leguminous species to soil improvement.

After fifteen months on site, there are a number of findings which could be taken into account. Agricultural production is an important source of sustenance and income. This is as true of the home garden as of the *ladang* and *sawah* and is a key finding since home gardens are frequently ignored in agricultural development and farming systems projects as being a minor activity. In this case, they warrant further investigation as to their crops, their productivity, and the opportunities for improving production. In Sitiung I, keeping cattle is important and collecting feed is time consuming. This suggests the value of continuing the forage tests with cattle feed production as well as improvements in soil fertility being evaluated. At both sites, women are active in agricultural production and their noninvolvement in tasks for which they are responsible, such as corn planting, undermines the success of experiments. Little is known about the Minang who have lived in this environment for a long time; perhaps something could be learned from them. The researchers were concerned with nutrition and it appeared from their study that diets are marginal, with a lower-than-desirable intake of vegetables and fruits. However, the competition over use of output—for sale or consumption—is also clear. As long as cash needs are high, productivity needs to be increased considerably in order to accommodate improved nutrition through home consumption as well as sale. The team has done a good job of including farmers in the design of trials and in doing so has learned something about ethnic differences in crop preferences and cultivation practices.

This points to possible future work which would focus more on the home garden in terms of soil management practices and their relationship to productivity and overall household production. The Minang, who live successfully in this environment, should be studied for agricultural practices which could be extended to or adopted by the transmigrants. The TAS provides some insight into differences in task, but it is not crop specific. In planning future experiments, information on exactly who does what and special efforts to involve actual task doers in any specific activ-

ity would be useful. For instance, since women dominate marketing and food processing, they should be included in evaluating the characteristics of any new varieties introduced. Forage gatherers, men and women and children, should be included in evaluating promising species as to their fit with "cut and carry" management.

The case ends with the tension between the disciplinary (soils) driven and practical, farmer-oriented approach as an issue for the team to resolve in planning the following year's research.

DISCUSSION QUESTIONS

1. What are the objectives of this project? What kind of a project is it?

The important point here is that this is a soils management project—the objectives and the team are slanted to look at soils questions. Soil management will predominate, but it is set in a broader framework. The objective of improved soil management is targeted toward preserving land quality and increasing family income and welfare. The project is also intended to uncover "principles which will enable resource-poor farmers to adopt soil management practices," and thus explicitly states the need to understand farmers' interests.

2. Who are the researchers in this project? What research activities are covered by this case?

The researchers are principally soil scientists and agronomists. The only full-time social scientist is the farming systems specialist, a female anthropologist. Nutritionists are there for a short time. The following lists the studies undertaken and those who performed them:

- The *sondeo* (all team members)
- The collaborator farmer trial (soil scientists and the anthropologist)
- The time allocation study (anthropologist)
- Forage trials (agronomist)
- The income and food practices study (anthropologist and short-term nutritionist)

3. What are the important variables defining the farming practices or systems in Sitiung?

Briefly, they are the sites themselves; soils and topography, and the different early treatment of the soils; variable rainy seasons; ethnic differ-

ences (Javanese, Sundanese, Minang); the kinds of fields available (*ladang*, *sawah*, home garden); time of settlement; some differences in government services; and gender in terms of task or activity. It is important to emphasize that there are a number of variables of which gender is one.

4. The Tropsoils team started out with the collaborator farmer trial as a way to get to know both the soils and the farmers better. First, what was learned about the soils?

From Tables 6-1 (rice yields, cycle 1) and 6-2 (peanut yields, cycle 2) in Volume 1, it appears that the addition of lime has a better effect on yields than the other three treatments. The second introduced variable was hoeing or tilling versus no hoeing, which shows improved yields in all instances except liming. All three fertilizer treatments were significantly better than the control, confirming the farmers' impression that for them the control is a waste of time. Note that this site is new to the transmigrant farmers as well as to the researchers, so that the concept of a "farmer control" has little validity under these circumstances. Another finding is that a third cycle is not possible during the dry season in these fields.

Additional Question: What is learned about the farming system from this trial? Two types of answers may emerge: general points such as the poor quality of the soil, and indications of ethnic, and some gender, differences. This provides an opportunity to begin boards such as Table 5-1 on general points, Table 5-2 on ethnic differences, and Table 5-3 on gender-disaggregated activities analysis. For all three boards, fill in what is volunteered from the collaborative trial.

Additional Question: (or save for below) What do you think about the researcher-farmer interaction? This is an opportunity to discuss the participatory mode, the flexibility of the researchers, the difficulty of getting women to participate, the problems with farmer selection, and the tradeoff with getting things going.

5. Let's go back to the original *sondeo*. What did that indicate about ethnic differences? About gender?

Continue drawing ideas from participants and putting them up on appropriate boards.

Additional Question: What about the TAS? What does that tell us about what men and women do at the transmigration sites? Is there any information on ethnic differences?

A long list is available to trainees because of the list of activities recorded for the TAS in Appendix 6-C (*Working Together* Vol. 1). See the notes on the TAS under "Use of the Case," above. To encourage discussion of general categories refer to Figure 6-3 (*Working Together* Vol. 1) for different productive categories and to Figure 6-2 (*Working Together* Vol. 1) for reproductive and leisure categories. You can also ask whether

Table 5-1

General Learnings from the First Fifteen Months

Collaborator farmers' trial
Poor soil, not good for vegetables
Interest in vegetables
Two crops only
Hoeing increases yields
Sondeo
Three kinds of fields
Site differences
Cassava grows well; not liked
Some legumes, corn
Home garden—includes cash crops
Cattle—older settlements
Pests—various
Little extension
Time allocation study
Importance of off-farm labor
Importance of home garden
Forage trials
Cattle feed +
Soil fertility +
Income and food practices study
Marginal nutrition
Agricultural production ca 1/3 income
20–50% sold
Home garden 30–60% of agricultural production

Key: + = positive results or benefits.

there are any gender-specific tasks. What is important here is to get out the fact that there are differences between Sitiung I and V in terms of what is done (Sitiung I has cattle, *sawah;* Sitiung V puts more into home gardens), and that women are active in agricultural production in addition to reproductive activities. They work in all the agricultural enterprises and are particularly important in the home garden. In Sitiung I, men, women, and children find feed for cattle, a time-consuming operation.

It is important that the chart include off-farm labor available to women and men, but predominantly to men, and reproductive or household maintenance activity where women put in the bulk of their time. Their cumulative percentage for both production and reproduction is greater than men's (subtract leisure from total).

Note that while the TAS gives extensive information on gender differences, the information reported here does not show ethnic differences. One can surmise that there were no sharp differences between the Sundanese and Javanese with the small sample and that the Minang were

Table 5-2

Ethnic and Site Differences

	Transmigrant	Minang
Collaborator farmers' trial		
Farmers	S = 2/5, J = 2/5	1/5
Hoeing	Clean = bare	Not at all
Vegetables	S - chilies J - peanuts	?
Macuna bean	J - only	
Second year participation	Continues	Leave
Sondeo		
Sawah	Sit. I only	Have some by river
Fertilizer	Use, higher yields	Do not use, lower yields
Home garden	Mixed vegetables and food crops and fruit trees	Perennials
Cattle	Sit. I only J - security	Water buffalos
Rubber trees	None	Major activity
Time allocation study	—	—
Forage trials	J - Cut and carry pref. erect type	Graze
Income and food practices	S - more greens J - less	Better off nutritionally than J, S

Key: S = Sundanese; J = Javanese; Sit. I = Sitiung I.

hardly represented, if at all, since they seem to have left Sitiung V during the second year. Whatever the reasons, the TAS as presented does not provide information on ethnic differences.

Additional Questions: Continue filling in all three boards with information from the forage trials and income and food practices survey. Examples are shown in Tables 5-1, 5-2, and 5-3.

6. This is a fairly comprehensive view of a complex system. Given what has been learned in the first fifteen months, what research and other efforts should the Tropsoils project undertake next year?

There are several promising leads to follow. As each, or any other, is volunteered, make reference on the boards to who is affected or why the research may be promising. Or put up a whole list and then examine one or two with respect to what is known from the profiles on the board. The point is to use the gender and ethnic analysis of existing information to screen or shed light on research alternatives.

Table 5-3

Activities Analysis

	Male		Female	Notes
Collaborator farmers' trial				
Ladang	MA	>	FA	
Planting corn			FA	Left out
Sondeo				
Home production			FA	
Time allocation study				
Sawah	MA	>	FA	Sit. I only
Plowing, hoeing	MA			Sit. I only
Planting, weeding			FA	Sit. I only
Ladang	MA	>	FA	
Planting	MA (I)		FA (V)	
Hoeing	MA			
Shelling			FA	Postharvest seed selections
Home gardens	MA	<	FA	Sit. I
	MA	<	FA	Sit. V
Planting			FA	
Hoeing	MA			
Harvesting			FA	
Livestock	MA		FA	Sit. I only
Off-farm	MA	>	FA	More in Sit. I
Sell at market			FA	Sit. I only
HH maintenance/ reproduction	MA	<	FA	
Child care	MA	<	FA	
Leisure	MA	>	FA	More in Sit. V
Forage trials	—		—	Farmer interest
Income and food practices	—		—	Home garden more diverse; production sold

Key: MA = male adult; FA = female adult; I = Sitiung I; V = Sitiung V; > = more than; < = less than.

a) Make a closer examination of Minang system for practices and crops applicable to the transmigrant sites.

b) Continue the collaborator farmer trials with particular attention to transmigrant reactions to use of green leaf manure and mulch possibilities. Given their Java-induced admiration of hoeing and bare soil, there is an interesting conflict over a traditional practice now inappropriate for new soil conditions.

c) Continue efforts to involve women in trials in the *ladang*, particularly with respect to seed selection and planting.

d) Continue forage trials in Sitiung I with involvement of men, women, and children in evaluating forage portability. This may also be useful for improving soil fertility in Sitiung V in anticipation of the later introduction of cattle.

e) Perform additional research on the home garden including a study of what is grown and soil management practices. Carry out trials on practices which would improve yields so that households can increase both consumption and sales. This would provide an opportunity for closer collaboration with women as well.

f) Explore pest control problems.

g) Make a further study of marketing and decision making as they apply to the consumption and sale of agricultural produce. Women are predominant in this area, so a special effort would be needed to have researchers who can break through the women's reluctance to become involved with the project.

7. What should receive priority? Why?

This provides an opportunity for participants to weigh the pros and cons of each research possibility. If not volunteered by the participants, the trainer should bring in several considerations, as in the following:

a) The original objectives which include soil management and improvements in family welfare.

b) The tension between the academic, discipline-driven objectives of some team members and part of the review team versus the more practical farming-systems-oriented approach of other team members.

c) Team composition: the dominance of soil scientists and agronomists and the possibilities for actual collaboration in experimentation versus separately tracked research activities. For instance, how integrated will the TAS results be in designing future work? There is collaboration between scientists on the collaborative farmers trial, but what about the other trials and research?

Particularly important is discussing the home garden as a potential focus for research, drawing out why it is important, the pros and cons of working there, and what else needs to be known. How does this fit in with a soil management perspective? The arguments in its favor are that it is another system of soil management, that it is an important component of the farm family income, and that it may improve the nutrition of the family. An open discussion of the home garden possibility allows a group to come to grips with the widely held preconception that home gardens are, at best, a marginal part of a farming system.

ADDITIONAL POSSIBILITIES TO CONSIDER

1. Evaluate the participation of farmers, men and women, in the research undertaken by the team so far. This may be laid out on the board as in Table 5-4. The team has done a good job of reaching out to farmers in a collaborative fashion, particularly in the design and implementation of the collaborative farmers trial. It is important to bring out how little women have been involved, despite the avowed interest by some of the team members to do so. The TAS, the collaborator trials, and the income and food practices study all suggest the importance of women to the farming system. But efforts to include them, such as the explicit invitation to the meetings with collaborating farmers to design the trial, were not successful.

This is an excellent opportunity to discuss the relevance of gender analysis in improving the soils management goals of the project and in getting at the efficiency and equity issues. The home garden, women's specific agricultural production tasks, and their role in marketing all point to certain areas where attention to what women do will benefit the design of future research. Participants should also discuss why the project was not able to retain the interest of the Minang farmers.

2. Discuss what might be built into future work which would have a greater likelihood of including women in planning and evaluating experiments. The discussion may first focus on impediments to women's participation. They seem to be shyer, leaving public negotiation to the men. Many of them do not speak the Indonesian national language. They are working hard, with less free time than their husbands.

Several ideas for improving their involvement come to mind: (1) working on home gardens is specifically a possibility since it is near to the home where many of their other activities are carried out, and women both work as much or more than men in the garden and sell the product; (2) choosing a person from each language community who also speaks Indonesian to facilitate communication between the team and those who work on home gardens, particularly women; (3) having separate meetings

Table 5-4

Inclusion Analysis

	Who was Included?	Decision makers	Criteria/Mechanism Notes
Sondeo	MA, FA?	RMA, RFA	No info. on selection Short, four days, five sites
Collaborator farmers' trial			
Selection	MA	RMA, RFA, MA	Selected community leaders who selected others
Design	MA	RMA, RFA, MA	Women invited, but didn't come Short meetings to discuss design Good farmer role in decision making
Work	MA, FA	MA	Lack of women's involvement in discussions—poor corn planting
Time allocation study	All	RFA, RMA	Random Task by crop not identified
Forage trials	0	RMA	Exploratory trial on species viability
Income and food practices	80 families	RFA (2) RMA (1)	Two interviews, one midday (FA?); other evening Modified dietary recall Income questions about previous year

Key: MA = male adult; MC = male child; FA = female adult; FC = female child; RMA = male adult researcher; RFA = female adult researcher.

of men and women to discuss home garden production to see if they have different information and to give women the opportunity to talk independently; and (4) identifying women-dominated tasks and taking time to discuss with them any introduced procedures (such as with the corn planting).

3. Make a further examination of the TAS methodology and discuss how it can be used. The observations available as a result of the TAS provide the raw material from which to make certain hypotheses about who does what and when, which can be pursued in further work. With this

data, researchers can identify high-frequency activities which have potential for labor-saving or alternative technologies. In this case it was the home garden. Tasks where there are sharp gender differences, or where both participate, can be identified. For a women-centered strategy, those tasks identified as done exclusively or mainly by women could be the focus of further research. Similarly, site differences are made clear in terms of number of activities and the relative importance of each. For the anthropologist, the TAS provided the means of giving statistical information to her more technically oriented colleagues to back up the observation that women were engaged in agricultural production.

Participants could also compare the methods and nature of the information available from each of the research activities as to the nature of the data each produces and its relevance to decisions in farming systems research and extension.

USE OF PART 2

Part 2 is included to show the use the Tropsoils team made of the information learned during the first fifteen months. Work continues with the collaborative farmer trials and forage trials. Research and trials on the home garden are begun. By the third year, a study of the Minang is underway. This section may be copied or summarized for distribution to students at the conclusion of teaching a case or it may be used as the source of further discussion. If used for further discussion, the Appendix, Joan's letter, should be reserved for a final handout.

Possible Areas for Discussion

1. What elements from the Minang system can be incorporated into future work with the transmigrants?

2. The project has been unable to work collaboratively with women. What additional strategies might be employed? (See additional question 2, above.)

3. What research should receive priority in the coming year? Why? How would it be designed?

Indonesia: Part 2
Research in the Second and Third Years

VICKIE A. SIGMAN, CAROL J. PIERCE COLFER,
KATHLEEN WILSON, AND RUSSELL YOST

By the third year of the Tropsoils project there had been many personnel changes. Project activities continued and expanded. Exploratory trials with collaborating farmers continued in Aur Jaya; a second set of CIAT B Regional Trials on forage grasses and legumes was undertaken in Piruko; and research on home gardens was begun. A study was undertaken of the Minang farming system.

TRIALS WITH COLLABORATOR FARMERS, AUR JAYA

During the second year, the collaborator farmer trials had continued according to the plan drawn up at the end of the first year. The cropping pattern was for two cycles, rice followed by peanuts. The team monitored farmer practice in incorporating organic materials: green leaf manure at the beginning of the first cycle and rice straw residues during the second cycle.

First cycle. Four farmer treatments of the application of green leaf manure (GLM) on the control plots were observed: the GLM was (1) not used, (2) mulched, (3) mixed (broadcast over the soil surface and hoed in), and (4) buried in furrows similar to what a moldboard plow would do. Rice was then planted. Yield results indicated that burying the GLM was superior to other GLM treatments and to all the fertilizer treatments.

Second cycle. Following the rice harvest, the varying practices related to the management of rice straw residues were recorded: (1) burning, four farmers; (2) incorporating, two farmers; and (3) removing, seven farmers. These treatments were made across all plots within each farm, and not on selected treatments as with the previous tillage and GLM factors. Peanut yields indicated burning and incorporating rice straw were superior management treatments to removal. Burning combined with the government and lime fertilizer treatments gave the highest yields.

Peanut yields were also compared on the farmer GLM treatments. Mixing in and burying GLM were associated with peanut yields superior

to those for other treatments. The overall effects of the fertilizer treatments on the chemical analysis of the soil are shown in Table 5-5.

FORAGE TRIALS

The team decided to continue the forage trials. The TAS showed conclusive evidence of significant labor allocation to collecting grass for animal feed. There was an increasing conviction that farmers could not afford to provide significant chemical inputs; and there were the intriguing research results in Sitiung II suggesting that organic matter might substitute effectively for lime (and perhaps some nutrients as well). The team wanted to determine the most productive forages and to consider applications such as green manures and cover crops as well as animal feeds.

A researcher-managed experiment took place in Sitiung I, where farm family members passed daily in their search for grass for their animals. Farmer interest was obvious from the start. By June 1985, a number of farmers had asked for and had been given planting materials from the experiment.

HOME GARDENS

None of the team was hostile to Joan's interest in home gardens. They had come to recognize the significant differences in soil management there and they realized that women might be more likely to participate actively near home. Being on flatter terrain and closer to the home, such

Table 5-5

Selected Soil Chemical Analysis of the Fertility Treatments After Years 1 and 2 (Mean of All Farms)

Treatment	pH	Al+H	Ca+Mg	K	P	Acid Sat.
		—— cmol (+) L-1 ——			kg m-3	%
Year 1						
Control	4.5	1.9	1.7	.24	4	49
Government	4.4	2.2	1.4	.23	4	56
Rock Phosphate	4.5	1.8	1.7	.20	8	52
Lime–NPK	4.7	1.1	2.8	.20	6	28
Year 2						
Control	4.5	1.0	2.8	.31	3	25
Government	5.1	0.3	4.6	.32	5	6
Rock phosphate	4.7	0.8	3.4	.32	9	20
Lime–NPK	5.2	0.2	4.8	.34	7	4

Source: Wade et al. (1985b).

gardens had advantages from an experimental point of view (fewer pigs and monkeys, potential for more consistent weeding, less likelihood of theft of harvest). But no one really knew much about home gardens and how an experimental design could be fashioned that incorporated, or at least recognized, the complexity and diversity that seemed to exist. They seemed so complicated compared to the one, two, or three crops common on *ladangs* planted to field crops. More information was needed.

Ann, the wife of one of the new team members, had an enthusiastic interest in home gardens for their potential nutritional contribution. Her arrival spurred the team to action and resulted in three research efforts: a *sondeo*, an in-depth study of sample households, and an experiment using waste products as fertilizers.

Sondeo

This time the *sondeo* team had a better mix of disciplines and of gender, including an anthropologist, a nutritionist, an agronomist, soil scientists, and a social worker. The team found a great variety in management strategies on home gardens. Some transmigrant gardens had large areas planted to field crops. Others, like the Javanese prototype, were a complex, multistoried mixture of crops (medicinals, ornamentals, vegetables, roots, trees). Still others were virtually uncultivated. In Piruko, most had cattle and goats; not so in Aur Jaya. Many in both communities had fishponds and/or chickens.

Gardens in Minang villages included large expanses of hard, flat earth, with only tree crops and ornamentals growing. The Minang home gardens in Aur Jaya were full of tree crop seedlings and sugarcane (a crop that needs little care, since the Minang had moved back to their home village). None of the Minang had penned animals or fishponds in their home gardens.

Home Garden Characterization

This study involved eight families in Aur Jaya: four Javanese, three Sundanese and one Minang. Direct observation, structured interviews, and drop-in visits were used to gather data. An inventory of perennial and annual (food) crops was compiled for each home garden, maps were drawn to record the diversity of cropping patterns, and the garden areas specifically devoted to food crops were measured.

Findings. Pineapple, jackfruit, silk-cotton tree, coconut, and banana were ubiquitous border crops, supplemented in some cases by leguminous trees. Within these borders, farmers planted a number of perennial tree and food crops, with the most diverse garden containing twenty-eight species. Table 5-6 shows the area planted to food crops.

There had been a big change in home garden use between the first year of settlement and the third year. Earlier home gardens had been dominated by food crops (rice, maize, soybeans, cassava, and peanuts) which were used for family consumption to supplement the government subsidy. By 1986, tree crops were much more important. Although fruit from the home garden was eaten by children or was traded with neighbors, most food crops were sold or saved for seed. Vegetable production, other than cassava leaves and young jackfruit, was limited mainly to a few small patches of swamp cabbage, eggplant, and long green bean. Small plantings of spices, medicinal plants, and ornamentals were common. When asked about the role of the home garden, farmers emphasized its economic role. It was planted "for the future" and "for tree crops."[1]

Home Garden Trials

Two scientists initiated a collaborative trial on home gardens in Aur Jaya and Piruko. Joan was pleased that the team had begun to pay attention to the importance of involving women and attending to nutritional considerations. The major experimental thrust was to measure the effects of different sources of "waste" material on soil chemical and physical properties, and on horticultural crop production.

Methodology. The study was conducted with thirteen families, six Sundanese from Aur Jaya and seven Javanese from Piruko. The treatments

Table 5-6

Home Garden Area Planted to Food Crops

Crop/Farmer	A	B	C	D	E	F	G[a]	H
	Crop Area in m^2							
Soybean	2,104	1,488	945	1,800	1,456	157	0	258
Peanut	443	0	0	0	0	0	0	0
Corn	•	•	•	•	288	1,823	0	70
Cassava	•	•	260	•	•	0	0	0
Mung bean	0	0	0	0	0	0	0	630
Area unused (%)[b]	30	10	20	10	10	10	—	10
Total area[c]	1,783	1,339	956	1,620	1,570	1,782	—	910

Source: Evensen (1986).

•This crop was intercropped with soy or peanut; no individual measurement taken.

[a]No food crops grown.

[b]Percent of area not used. This is an estimate of the area within the measured food crop plots unplanted due to the presence of stumps or trees.

[c]Total area. This figure represents an estimation of the amount of home garden space planted to food crops. With the exception of farmer A, who has 3,200 m^2, all remaining farmers have a total of 2,500 m^2 available to them on their garden lot. Of this total, an estimated 400 m^2 is taken up by the family home, bathing area, and entrance/children's play area.

were (1) control; no fertilizer application, (2) 10 tons per hectare barnyard manure, (3) 10 tons per hectare compost, and (4) 100 kilograms urea per hectare, 125 kilograms per hectare Triple Super Phosphate (TSP), 125 kilograms per hectare KCl, and 80 kilograms per hectare kieserite ($MgSO_4$). Five of the thirteen gardens (those with fishponds) would have an additional treatment of 25 tons per hectare fishpond sediment (73 percent average water content on weight basis).

A farmer in each location was hired to prepare the compost, in order to ensure comparability between replications (or farmers). Green material (of unspecified composition) from nearby shrubs was interlayered with manure in a wooden box, mixed every two weeks, and used after three months.

Farmers chose to plant chilies and then bambara nuts, both crops with a good market price. The fertilizers required by the research design were supplied to the farmers. Farmer practices were then monitored. Labor and costs for each were recorded insofar as possible.

Unfortunately, the technicians responsible for dealing with the farmers were young, shy, and of a different ethnic group. They found it easier to deal with the men and somehow missed one of the primary objectives of the trial: to involve the women. The personnel crunch on the team precluded the kind of supervision needed.

Results. Technical evaluation showed that the control and fishpond treatments had the lowest yields for both crops. Manure, composting, and inorganic fertilizers showed significant results for chilies, and inorganic fertilizer produced the highest yield for bambara nuts. When subjected to cost-benefit analysis, the manure treatment gave the highest return in chili production followed by inorganic fertilizer. For bambara nuts, inorganic fertilizer was the most economical option.[2]

Farmers recognized the value of inorganic fertilizers, compost and manure. They accurately predicted the inordinate amount of physical labor required to use fishpond sediment, and suspected that it would not be much of an improvement over normal soil. In Aur Jaya, inorganic fertilizers were the most common type used (since there were no ruminants as yet). In Piruko, almost every family had ruminant livestock and manure was perhaps more commonly used than inorganic fertilizers. Piruko farmers felt that the availability of manure made the extra work of composting unnecessary.

INDIGENOUS KNOWLEDGE: MINANG

With Herb's departure at the end of the second year, Joan had become team leader. She decided that the time had come for a hard look at this other farming system that the team had not yet investigated, that of the indigenous Minang. Earlier studies had indicated ethnic differences in farm-

ing systems. It seemed logical that these people who were native to the area might know something of use to the team about soil management. The soil scientists agreed to help.

The predominant method used was participant observation of one village. This was supplemented by another time allocation study. The soil scientists took samples from indigenous soil types and identified plants. Joan also conducted two surveys, one on ownership of land and wealth and one on income, both disaggregated by sex.

The most important result was an understanding of the different approach the Minang had to land. Unlike the intensive system familiar to the transmigrants, the Minang had a seemingly unlimited supply of very poor tropical forest land, which they managed in an extensive manner. Their management often replicated the natural forest through layering of annual and perennial crops. Where the transmigrants pondered and planned about how to use this small plot or that, the Minang decided they'd like to plant some rubber, and went out looking for a suitable (and available) forested area to clear.

For the Minang, water availability, terrain, and stage of forest regrowth were important considerations in crop selection. The use of forested land could normally be arranged by appeal to matrilineal clan elders (the custodians of one's mother's, sisters', and daughters' land). Low-lying areas where water could be controlled were appropriate for paddy rice. Special purpose crops, such as chilies, bananas, bamboo, fruit trees, pandanus, and sago palm, were planted near the river on richer soil, confirmed to be more fertile by soil analysis.

The forested uplands were selected for cropping on the basis of their expected fertility (stage in the forest regeneration cycle) and, now, for their nearness to a road. In some cases, such fields were planted directly to tree crops. More frequently a newly cut field was reserved for a year or two of upland rice (a strictly subsistence crop, managed almost exclusively by women). Such fields were eventually planted to rubber and other more exotic tree crops. The field might later be interplanted with coffee, eventually culminating again in forest. Little clumps of vegetables were sometimes grown in these upland fields for an easily accessible food source while working in or guarding the fields.

At each stage of forest regrowth, the Minang harvest their produce. The year after the last rice crop is harvested the field has bananas and pineapples. As the brush grows up, the jackfruit and stinkbean begin to bear. By the time the rubber orchard qualifies as secondary forest, the rubber trees are bearing, along with miscellaneous wild crops.

Data from the ownership and income surveys show men's, women's, and joint ownership of the different kinds of fields. In this ethnic group matrilineal inheritance is the norm. Women own about three times as much hectarage as men, though even more fields are jointly owned.

Rice is a subsistence crop and reported to be sold only under the direst of emergencies. Joint ownership of rice fields is dominant (87 percent of the total hectares devoted to rice), as are joint rights to produce. Women own two and one-half times the amount of rubber hectarage as men, but they only get one-third the amount of income generated from rubber. This corresponds to the local practice of giving the land or tree owner one-third of the yield and the tapper two-thirds. Men tap more commonly than women. In terms of total agricultural income, men have much greater access to money than do women. Their efforts are focused on logging and rubber-related activities. Women have a much more diverse agricultural base and they earn more than men from each of the other individual crops.

Joan was pleased with the work done during the three years of the Tropsoils project, but was frustrated at the lack of involvement of women farmers (see Appendix 5). The time had come to prepare a set of recommendations for the new team concerning the continuation or initiation of research and the continuation of collaboration with farmers.

NOTES

1 A full report of this study is in Stacey Evenson, *Farmer Practice and Production Study —Characterization of Home Gardens in Aur Jaya (Sitiung V)*, Tropsoils Field Research Brief no. 32 (Bogor, Indonesia: Centre for Soil Research, 1986).

2. For the economic analysis, manure had an opportunity cost of Rp 100,000 plus the cost of application. If the total costs that vary are reduced to application costs, manure is more economical than inorganic fertilizer for both crops. A full discussion of this experiment can be found in Fahmuddin Agus, Carol J. Pierce Colfer, Stacy Evenson, and Sholeh, *Farmer and Crop Responses to Different Sources of Fertilizers: A Farmer Managed Study on Home Gardens*, Tropsoils Field Research Brief no. 34 (Bogor, Indonesia: Centre for Soil Research, 1987).

Appendix 5: Letter from Joan to a Colleague in the United States

Dear Susan,

It was so good to hear from you! Your questions about how the project was going brought up a welter of conflicting thoughts. In general it's going very well. I like the people I work with; although they hadn't thought a great deal about people issues, they have been open, and feel they're important. I've already told you how much I like living in Sitiung and working with Indonesians.

But I am really quite frustrated about the problem of trying to include women in the project. At first, I think I told you, I wasn't 100 percent sure women were involved in agriculture. Although they'd been very involved elsewhere in Indonesia where I worked before, I recognized that they might very well not be in this new location and with new ethnic groups. So I first started collecting data to determine whether they were involved or not in Sitiung. I wanted to be careful not to come on strong to involve women only to find them not very involved. Anyway, we worked collaboratively with twenty families on a day-to-day basis, that first year; and I did year-long, observational time-allocation studies in two communities. By the end of the year, it was completely clear that women were out there working in the fields, despite an occasional "ideal" statement that women ought to be housewives and shouldn't have to hoe.

We had tried from the start to get both husbands and wives from our cooperator family farmers to work with us, but had infinitely more luck with the men. I was only able to get one woman to come to one meeting once!

So we thought, well, maybe it's because (1) they don't go to formal meetings (no time), and (2) they do somewhat more work on the home gardens (from both observation and the TAS). We'll try a series of cooperator farmer activities on the home gardens. Meanwhile we'd also learned that a large portion of income came from home gardens, that much of the diversity in the diet came from home gardens and that organic fertilizers were more available on home gardens (where they kept their animals). To make a long story short, the concern for involving women basically fell out. My own responsibilities within the project had grown substantially over the years, and I had delegated this task to others with other priorities. I think one of the problems was that the technicians and scien-

tists who wound up working on that component were young, unmarried men—a bit shy with women.

In some cases, our researchers could communicate better with the men because of language. Men were more likely to speak Indonesian; whereas women often spoke only Javanese or only Sundanese. That was definitely true of our female American nutritionist; our male Minang soil scientist; and our American male fisheries specialist—all of whom helped on the home garden components.

Anyway, meanwhile, I was exploring other possibilities. Perhaps these people considered agriculture to be basically a male function with women just serving as laborers. This seemed quite unlikely to me, given my qualitative understanding of Indonesian approaches in general. But I thought I'd better make sure—preferably in the quantitative terms more acceptable to agricultural scientists. I did a Galileo (a multidimensional scaling technique designed to "map" people's perceptions of relevant concepts in a given sphere). We asked people about their views on people-soil interactions, basically. We asked equal numbers of men and women, and equal numbers among the three main ethnic groups there. Interviewers included two women and two men. Our initial expectation was corroborated 330 interviews later and after a complicated computer analysis in Honolulu. All three ethnic groups viewed men and women as quite similarly related to the concepts they considered relevant to the people-soil interface.

So why were we still having such a difficult time getting women involved?

Meanwhile, of course, we were under considerable pressure from USAID in Washington not to be doing any extension. There was almost a paranoia that we were trying to use research monies to do extension work. This inhibited us somewhat from going forward with the collaborator farmer work—which might in turn have been a more successful route to female involvement (though we did continue some of that work).

Our most recent effort has focused on trying to get at intrahousehold decision-making. We used the wife of one of our technicians (the technicians from Bogor have included only one woman, and although she is extremely competent in other areas, she is not naturally suited to work with villagers). Tania (the wife) interviewed four families with whom we were doing another collaborative experiment (every three days). She had an instrument asking about time use, division of labor by sex and by field, marketing and credit information, etc. She was also to do open-ended interviews, trying to get to know the farmers (both sexes), to gain a qualitative understanding of how decisions were made. In her study two of the families seemed to have a shared decision-making pattern about most things; one included a very dominant husband; and the other included a very dominant wife. This prompted us to seek additional help in this area.

We have now arranged for three female sociology students from Andalas University to come out for two months of field study on this topic.

But in my mind, I don't see the actual involvement I want to see happening. We have used female researchers. We have gained acceptance of the importance of women's participation by the agricultural scientists—both American and Indonesian. We can prove women's importance in agriculture till we're blue in the face. But until we can make some more progress involving women farmers in our work, we won't have done what needs to be done!

Do you have any ideas? Well, I'd better hush up on this, and get back to work. Hope all's well on the Mainland, and please do send me that paper you mentioned. I'd love to critique it.

Love,
Joan

Chapter 6

Kenya

Agroforestry Extension and Research, A Case Study from Siaya District

CONTENTS

Teaching Notes for Part 1: Planning (in *Working Together* Vol. 1, Chap. 7)

Teaching Notes for Part 2: The First Nine Months (in *Working Together* Vol. 1, Chap. 7)

Part 3 After Eighteen Months
Kefri Experiment
Markhamia and Sesbania Study

Appendix 6-A Gender Implications of Recommended Practices: Mutumbu
Appendix 6-B Recommended Agroforestry Species and Their Uses: Second Season
Appendix 6-C Agroforestry Research Trials

This case and teaching notes were prepared as a basis for discussion rather than as an illustration of either effective c ineffective handling of a project.

Teaching Notes for Kenya: Part 1 Planning

CASE SYNOPSIS

The first part of the Kenya agroforestry case is told by means of a discussion between Anna, who is responsible for planning a new agroforestry research and extension project, and David, a researcher from the International Council for Research on Agroforestry (ICRAF). The objectives of this project are to improve family welfare through planting trees, to combat deforestation, to determine what are appropriate agroforestry practices for farmers in Siaya, and to provide a model of a combined research and extension service for the Forest Department.

Agroforestry is becoming a promising and popular strategy for rural development. David reviews the principle elements which make up agroforestry: functions or uses of woody species, components or species, arrangements and location, and management practices. These are amplified in Appendix 7-A (*Working Together* Vol. 1). Examples show how these elements interact to produce different outcomes—products or services. The challenge of design is putting those elements together in a way which provides maximum benefit to farmers. But which farmers? As David and Anna discuss their experiences with ongoing research efforts, it becomes clear that access to and use of trees may be quite different for men and women and be different from one locality to another. Several examples of men's and women's activities in relationship to trees, particularly planned use of trees, are given.

The discussion covers the experiences of Anna, David, and their colleagues on several topics of interest in planning this project, including diagnosis and design, the technique developed by ICRAF to learn about farmers' systems and problems; work with self-help groups; farmers' concepts about trees; and the development of nurseries. After David leaves, Anna reviews what she knows about Siaya District. There is considerable agroecological variation in the district, ranging from the higher potential, but more densely populated northern section to the drier, lower potential lakeshore area in the south. Agroecological variation is echoed in differences in livelihood: two-season cropping, commercial tree use, and remittances from men employed away from home are characteristic of the north; fishing and livestock are combined with a single cropping season in the south. In both areas defor-

estation is a growing problem. Traditional agroforestry practices are observed and summarized. Because one objective is to develop an extension service, information on Kenya's other rural extension services is also given. The four kinds of groups with which CARE might work are described.

USE OF THE CASE

This case describes an extension-led model for technology development. The emphasis of Part 1 is on the application of gender analysis to concepts of agroforestry and to the planning of an extension and research project. Part 1 should be used alone with trainees who are new to agroforestry. In Part 2, they can apply its concepts to a specific project. The case is useful for the introduction of agroforestry principles and practices to non-agroforestry researchers, to extension workers who have not done research before, and more generally, to those interested in participatory approaches to research and rural development.

Technical scientists may be uncomfortable with the lack of the kind of data with which they are more familiar, for instance, more measurements and statistical analyses. One strategy for addressing their discomfort is to have them suggest what they need to know and how that fits into decision making about experimentation or recommendations.

LEARNING OBJECTIVES

1. To provide information on agroforestry practices and their functions in Kenya

2. To do gender analysis with respect to the management and benefits of trees

3. To specify the elements of a research and extension service and to plan for their selection and training

4. To devise a strategy and specific objectives for diagnosis with groups in Siaya District

5. To consider the gender implications of recommended agroforestry practices

STUDY QUESTIONS

1. What are the ways in which women's and men's roles and preferences are likely to influence the introduction of agroforestry practices or species?

2. How can the proposed project be designed to encourage access for or benefits to women?

3. What is an appropriate job description for extension field staff? What criteria should be used in choosing staff? What should be included in training?

ANALYSIS OF THE CASE

The main point of this case is the recognition that men and women may have quite different interests with respect to the introduction of agroforestry practices or the domestication of trees. Such differences vary between localities and they are discoverable. Achieving project objectives will depend on a diagnosis which reveals these differences and a design which takes into them into account. This case is unique in that research has been initiated by extension institutions. The Forest Department wants an improved extension service and more appropriate technologies to extend. CARE Kenya is a nongovernment organization extension-like service. There is, at the outset, a marked orientation toward farmer identification of constraints and desirable technologies.

Generally, planting and managing trees for specific purposes is a new concept to people in Kenya's rural areas. Until recently, trees have been nearby, easily accessible, a free resource. A rapidly increasing population, requiring more fuelwood and more cropland, and commercialization are contributing to rapid deforestation. There are fewer trees for any purpose and soil fertility is low. CARE's project, in collaboration with the Forest Department, is intended to forestall deforestation and improve farmers' welfare. The issues are which farmers? Whose objectives? and How can they be achieved?

The first area for consideration is the overall relationship between men and women and trees. Men predominate in traditional forestry with timber and commercial species, and in the past the Forest Department has provided those kinds of trees to men. In Kathama, women plant trees and more recently have learned about developing seedlings in nurseries. In western Kenya near the project site, women do not plant trees; men plant trees. However, some low-growing bushy varieties are considered bushes and exempt from that prohibition. While women need trees for a number of purposes, especially fuelwood, most tree activities have been directed towards men.

A second area of consideration is defining the desirable objectives for agroforestry practices. There are many possible benefits from trees: fuelwood, timber, charcoal, building materials, fodder for animals, food, medicines. In the Mazingira project, men knew more about timber and

building materials, women were concerned with fuelwood. In Kathama, researchers were interested in working with self-help groups, made up predominantly of women, to plant fuelwood and fodder trees for erosion control in gullies. However, the women members were more interested in nurseries to develop seedlings for their own homesteads. Similarly, researchers were interested in alley cropping for soil fertility, using the leaves of those trees for mulch. Both men and women took leaves from other areas, composting them for mulch, and used the alley spaces for fruit trees or used the leaves of the multipurpose trees for fodder. There is potential competition as to the use of cuttings (mulch or fodder), cuttings versus longer growth (for poles or timber), and the choice of species in a given space for fruit, fodder, or another product.

The differences between the northern and southern ends of the district suggest that men's and women's interests will vary by location. In the intensive system in the north, desirable objectives are likely to include commercial timber production in woodlots, fodder for cut and carry, improvements in soil fertility, and planting along fence lines or boundaries. Where men are absent for off-farm labor, the responsibility for these practices will fall to women. In the south, fuelwood for smoking fish and fences for controlling animals may be desired. There is potential conflict between fuelwood and fodder, but whether this is gender related isn't known without further investigation.

A third area of consideration is location. In Kathama, women have access to and can even plant in semipublic niches such as roadsides and gullies. Women are observed gathering in similar areas in Siaya. Men have woodlots, women do not; the implication is that access to land for planting trees is more limited for women than for men. This may be particularly true where land is registered to only the male head of household. Women's access to trees and their products may be greater than their access to land, but it is subject to conditions set by others.

Arrangements and components will be determined in large part by the desired benefits and the available locations. Many species have the potential for different purposes, but what is achieved will depend on the management practices. The question of whose trees and whose objectives is important. Growing for poles precludes cutting for fuel or fodder or mulch. A second question related to management is whose labor is required? In Kathama, some women finally rebelled at bringing water from great distance to raise seedlings for their husbands. In the CARE project, a question to be considered is who will raise seedlings and how will they be compensated? In any system of mulching or composting, who will be responsible for the extra labor? Another question related to labor is whether labor will be available in a timely fashion for cutting or pruning trees which are in alley-cropping arrangements to reduce shade on nearby crops.

Another set of considerations arises out of the complexity and location-specific nature of men's and women's interests in trees. In order to design appropriate agroforestry practices and supply the right species, the extension staff must be equipped to ask the right questions and ensure that women as well as men are consulted. Interviewing skills may be as important as technical know-how. This means first learning about agroforestry practices and possibilities and the implications for gender. It means learning to interview groups, where women are often more easily approached. It may mean negotiating arrangements that satisfy each household member when designing for individual farms. It means selecting women and men as extension officers. It means making explicit from the top down, that women as well as men are intended beneficiaries.

The project's plan of action includes research to determine what works in Siaya District. There are technical specifications to be determined for recommended practices and species. Here again awareness of gender roles may influence the design of the research and what is measured. For example, in alley cropping, are there different fields or different crops for men and women? Which species interact best with which crops? Are there conflicting uses for the species planted and do these affect the frequency of cutting, the shading of the crops, the availability of mulch for soil fertility, or, for that matter, which species is used? The fact that there are tolerated indigenous species suggests that they be included in the research program.

At this point in the case, there is not enough definitive information about women's and men's roles in Siaya District or at either end of the District, to make specific recommendations about practices, species, or research. The material presented, primarily through discussion by two local experts, suggests that gender considerations are important and that specific steps should be taken to ensure that they are included.

DISCUSSION QUESTIONS

1. What are the objectives of the CARE Kenya agroforestry project in Siaya?

The case states that the overall objective is to "improve rural welfare in Siaya District through tree planting." Associated with that is the focus of CARE on deforestation and providing fuelwood, the decision to work with groups, and an explicit concern for women. The Forest Department is interested in CARE developing a model for a research and extension service, to provide better advice to farmers. Another objective is to combine research with extension, to do research in order to determine what works best. It is important to list these on the board so the multiple objectives are clear.

Additional Questions: Who are the key actors? Are there conflicts between their objectives? In addition to CARE and the Forest Department, the Kenya Forestry Research Institute (KEFRI) has agreed to conduct agroforestry trials. ICRAF appears to be cooperating, at least informally, and for both these institutions the focus will be on the research. This presents an opportunity to discuss possible differences between the researchers, who often are focused on technical outcomes defined from the top down, and user perspectives.

2. What have Anna and David and their colleagues learned already about the relationship between agroforestry and gender in Kenya?

There are a number of ways in which gender roles have implications for agroforestry practices. What is known comes from experiences in districts other than Siaya. Nevertheless, it is useful to state and discuss what is known as a guideline for asking questions in Siaya. What is known from eslewhere may be laid out on the board as suggested in Tables 6-1 (activities), 6-2 (resources), and 6-3 (benefits).

Additional Question: Will the pattern in Siaya be the same as what is laid out here? What hints do we have? There aren't many specific hints, except the prohibition on women planting trees in an adjoining district and the tendency for the Forest Department to emphasize timber and commercial trees.

Additional Question: What differences are there between the higher and lower potential areas? What agroforestry practices might be most appealing to each and what are the gender implications? The salient points are summarized in Table 6-4. Working through the differences between the zones and their implications for people's livelihood and men's and

Table 6-1

Activities Analysis

	Females	Males
Planting trees	FA?	MA
Raising seedlings	FA (group)	MA
Carrying water	FA	
On-farm trials	? (group)	MA
Gathering fodder	FA	?
Cutting for timber		MA
Group activities	FA	?
Not known, but important: pruning, light coppicing gathering fruit, etc.		

Key: MA = male adult; FA = female adult.

Table 6-2

Resources Analysis

	Access	Control
Seed		
Wild	MA, FA	
Forest Department	MA, FA	
Seedlings		
Wild	MA, FA	
Forest Department	MA, FA	MA (FD personnel)
Other nurseries	MA, FA?	
Species		
Timber, commercial	MA	MA
Citrus	MA	MA
Noncitrus fruit	MA, FA?	MA?, FA?
Fuelwood, domestic	FA	MA?
Exotic multipurpose		
Mulch	MA	MA
Firewood	FA	MA?
Fodder	MA	
Land/spaces		
Private	MA, FA	MA, FA? (FHH?)
Public, semipublic	MA, FA	
Borders	MA, FA	MA
Traditional knowledge		
Timber, building	MA	MA
Fuelwood, domestic	FA	FA

Key: MA = male adult; FA = female adult; FD = Forest Department; FHH = female head of household.

women's roles provides another opportunity for trainees to apply gender analysis.

3. What are the tasks which this project must accomplish?

The tasks are outlined in Table 6-5. There are a number of different steps and each entails decisions about who is to be included as a source of information, as a project participant, as a receiver of project benefits.

Additional Question: What criteria should be used in selecting initial project participants? Several criteria are given in the case—working with groups, including women. Other criteria which should be discussed are the different zones and kinds of groups. Should they be existing or new groups? Should they have prior nursery experience? Should they be predominantly women? Are there technical requirements like enough land? Access to water? Room for a research or demonstration plot? Are the affiliations of the groups important? Chiefs? Churches? A variety of women's

Table 6-3

Desirable Benefits

	Females	Males	Implications
Timber		MA	
Charcoal	FA		
Fuelwood	FA		
Medicine	?		
Fodder	?	?	Who is owner or feeder?
Living fences	?	?	Whose area is being protected?
Mulch	FA	MA	Whose crop?
Soil fertility	?	?	Whose crop? Whose field?
Building materials	?	MA	
Fruit	FA	MA	Both domestic and commercial

Key: MA = male adult; FA = female adult.

groups? Schools? Participants can speculate about the advantages or disadvantages of each and what should be a proper mix. For instance, chief's groups have experience and are established, but have favored men's trees. Women's groups would reach a key group, but may have more organizational problems and they also may not include the most needy. One issue which might be discussed is the availability of water, the getting of which is usually a women's task. Should a group be excluded if water is not readily available? How might the project accommodate that? Should groups be willing to focus on fuelwood problems?

Additional Questions: Once groups are selected, how should nurseries be set up or improved? Who will do all the tasks associated with seedling development? Will they be paid or will it be a volunteer member's responsibility? What will happen to the seedlings developed? Will they go to members? How? Will they be sold for cash? Who will profit? If seedlings are given or sold to individuals, should field officers work with both husbands and wives on a farm?

4. To carry out these tasks, what skills should the extension workers have?

The extension workers are pivotal in implementing this project. They are the primary contact with farmers. By referring back to the list of tasks developed in question 3, participants can name a number of necessary skills. Both technical and people skills are required. First, they need to know the technical possibilities, tradeoffs, limits, and unknowns about various agroforestry practices. They need to be familiar with the available

Table 6-4

Zone Differences

Element	Higher Potential Zone		Lower Potential Zone	
	Description	Who?	Description	Who?
Population density	High		Low	
Tree patterns	Hedges, fencelines In compounds Stream banks Scattered in croplands		Woodlands Scattered in grazing land In compounds Scattered in croplands More trees but harsher environment	
Potential functions	Stickwood fodder	MA	Fuelwood for smoking fish	FA
	Timber, commercial	MA	Fodder for livestock	MA
	Cypress, eucalyptus in lots	MA		
	Implied soil fertility	MA?, FA?		
Land	Privatized, fenced County land Some semi-public Cattle, sheep, goats, wander		Open, much shared for grazing and gathering	
Possible agroforestry technologies	Alley cropping in crop land	MA?, FA?	Fencing to protect from animals	MA, FA
	Density suggests fencing and poles	MA?, FA?	Need for fuelwood for smoking fish	FA
			Possible conflict with fodder	MA

Key: MA = male adult; FA = female adult; FHH = female head of household.

Table 6-5

Extension and Research Tasks

Identify target group
Diagnose farming systems, problems, and constraints
Identify (male and female) farmer objectives, desired results
Select appropriate species and configurations
Supply seed
Establish or improve nurseries
Train group members to run nurseries (technical and bookkeeping)
Distribute seedlings grown in nurseries
Develop and test agroforestry practices
Identify individual farmer needs
Help (male and female) farmers design for own farms or spaces
Train in planting-out
Develop and train farmers in appropriate management for specific outcomes
Monitor activities and tree/crop performance for technical outcomes and farmer/participant judgements

species and their potential. They need to understand farming systems and the possible niches for tree plantings. They also need to know how to grow seedlings and manage a nursery operation.

People skills are required for various tasks—interviewing groups for diagnosis, including women participants, helping groups to organize their nurseries and distribution policies, communicating extension advice and training people in new skills, working in a balanced fashion with both men and women farmers in designing their on-farm practices. Again, this question allows participants to share their own experiences with extension and to generalize about the desirability of these skills in various extension settings. The issue of accessability to women is important. In Kenya, there are not the prohibitions against contact between men and women. But custom, habit, and familiarity have made it most common for men to be contacted and women to be ignored by extension and research. Special efforts may be required to overcome what is familiar and to make sure women are equal informants, participants, and beneficiaries.

Additional Question: What criteria should be used for selecting extension officers and what training should be given? This project must operate in the context of existing extension systems and the desire to create a model which will be adoptable by the Forest Department. This suggests certain minimal qualifications, such as postsecondary education and experience in agriculture. Beyond that, how much emphasis should be given to prior educational qualifications or experience? How much can be instilled through training? Should both men and women be hired? Should there be quotas? Are they likely to have equal qualifications? How important is it to model the inclusion of women? Again, this is an opportunity

for participants to reflect on their own knowledge of extension systems and of what makes people effective communicators and change agents, regardless of the technical specialty. The point to be made in this discussion is that people skills are important and should by training or prior experience be part of the qualifications for an extension officer.

ADDITIONAL POSSIBILITIES TO CONSIDER

1. What questions or elements should be included in group interviews in order to diagnose the farming system? This is an opportunity to specify all the factors, including gender roles, affecting the different elements of agroforestry—functions, locations, arrangements, enterprise interactions. What needs to be known about the assignment, timing, and responsibility for different activities? What resources are at issue? What are the desirable outputs? Consideration should also be given to furthering the understanding of the indigenous practices and species: What are they? How do they fit into the system? Into traditional knowledge? How can they be accommodated in technical specifications with respect to planned agroforestry arrangements or plantings?

2. Take a specific agroforestry practice—alley-cropping, living fences, etc.—and discuss the technical specifications as outlined in Appendix 7-A (*Working Together* Vol. 1). As each element is discussed, consider its possible implications for gender. What are the questions to ask when doing a diagnosis or when planning research? These are sketched out for alley-cropping in Table 6-6.

3. Introducing fuel-efficient cookstoves will be going on simultaneously with the CARE tree project. Should the extension of this technology be combined with the tree project? How would you go about it?

Table 6-6

Alley Cropping and Gender Questions

Elements of Agroforestry	Technical Specifications	Gender Implication
Functions or uses Soil fertility Tree products Mulch Fodder Fuelwood Other	Improved crop production. Rate of production.	Who determines priority use?
Location	Soil conditions. Water availability. Landscape niche, e.g. valley, slope.	Whose space? Availability for desired use? Private or public? Conditions? Distance from where product is used.
Arrangements	Spacing between crop rows; within row spacing; effect of each on crop production, tree production. Proportionality of species. Orientation to sun and crops.	Will differ according to whose field or crop is at issue.
Components, species Which crops? Which trees?	What characteristics are required? How well do the species achieve those benefits?	Determined by dominant decision-maker about field and tree functions. Access to and availability of desired species; are there cultural prohibitions?
Management	Effect of different cutting practices—frequency, kind of practice—on desired tree output, on fertility, on nearby crops (shade).	Who has responsibility for plant establishment? Who has harvest or cutting rights and what do they imply in terms of frequency and nature of cutting?
	Mulching: depth for fertility effects.	Whose labor is required?

Teaching Notes for Kenya: Part 2 The First Nine Months

CASE SYNOPSIS

The CARE project has been in operation in Siaya District for three months. David is now project manager. A staff has been hired and trained and nine groups have begun raising seedlings. Appendix 7-D (*Working Together* Vol. 1) gives the uses, management characteristics, growth rates, and geographical range of the species used in the nurseries during the first season. The groups have been interviewed about their farming systems, tree uses and preferences. David's colleague from ICRAF, Mary, has come to learn about the project and conduct group diagnostic interviews with the field officers.

The field officers were selected for their leadership abilities and prior work or education in agriculture. The training program was focused specifically on the task of providing agroforestry extension with a diagnostic, problem-solving approach and working collaboratively with farmers. They worked with nurseries of the Mazingira project, tried out interviewing groups in Machakos, met with different kinds of tree-growing groups, toured around Siaya District, and interviewed and helped select the nine target groups.

The field notes for interviews with two women's groups, Mutumbu, from the northern, higher potential zone, and Ginga, from the lakeshore, lower potential zone, are given in Appendix 7-E (*Working Together* Vol. 1). The characteristics of the seven groups, their most important problems, and the number of species named for different uses are reported in Appendix 7-F (*Working Together* Vol. 1). These summaries and the text indicate the differences in tree uses, perceived problems, and tree preferences between zones and between men and women. Women's roles in tree planting and decision making and their access to tree products are examined in David's summary of what he learned from group interviews and in conversations between Mary, the ICRAF researcher, Achola, a sociology graduate student, and Grace, a school teacher.

The case closes as David and his colleagues begin to plan for the first planting out of the CARE seedlings and to suggest what research should be undertaken by the project. Appendix 7-G (*Working Together* Vol. 1) gives the best-bet agroforestry technologies which CARE will be recommending to farmers when they plant out the seedlings.

USE OF THE CASE

Part 2 of the case requires some familiarity or comfort with the concepts of agroforestry, either through a previous session with Part 1 or trainees' own prior experience. The theme concerning extension with diagnosis carries through both parts. The material offered in this section allows considerable specificity in recommending or evaluating agroforestry technologies or planning further research using the species and recommended practices given in the case. It can also be taught, as discussed below, more in terms of general concepts.

LEARNING OBJECTIVES

1. To provide information on the training of extension workers as diagnosticians and on using group interviews for diagnosis

2. To evaluate the recommended agroforestry practices and species as to their benefits for men and women in Siaya District

3. To plan for the planting out of nursery-raised species and extension of agroforestry practices on-farm

4. To define a program of research for the next season

STUDY QUESTIONS

1. What steps were taken by the CARE project to facilitate the inclusion of women in this project?

2. Evaluate the recommended agroforestry practices and species for Mutumbu and/or Ginga. What are the implications for gender?

3. What are your recommendations for the distribution and planting out of seedlings from each nursery?

4. What agroforestry research should be recommended by the project?

ANALYSIS OF THE CASE

The evidence provided in Part 2 confirms the differences in men's and women's roles with respect to trees and that these differences vary with zonal and farming system differences. It provides an opportunity to do specific matching of men's and women's desires with species and arrangements (see below).

An important issue addressed by this section is the role of women in extension—as field officers and as recipients of benefits. CARE has taken a number of steps to ensure that women are a definite part of the project. One of the four field officers is a woman and care is taken to ensure her full equality on the team. The majority of the groups selected for the project's first season are women's groups, but not all. The two chief's groups have men, one exclusively. One of the women's groups, Odkoga, is fifty-fifty, men and women. Field officers were trained to interview groups and to look explicitly for the women's point of view—their expertise, their needs, their planting spaces.

In general, the planting spaces where women have full control over the trees are few. In most cases the permission of husbands or senior males is necessary for planting and harvesting. Planting is associated with men; harvesting of fruits, medicines, and fuelwood is associated with women. Commercial harvesting—timber, charcoal, poles—is associated with men. If women want to cut trees in any way which jeopardizes the trees' commercial uses, the permission of the men is needed. Nevertheless, Grace, the school teacher, testified that under conditions of modernization women are beginning to plant. Control of and access to trees is a system full of conditions where rights of access to a planted tree depends on where it is, who planted and cared for it, what is sought, and whether anyone senior or male has an alternative use for the tree. These conditions are location specific. For instance, women in Ginga have enough bargaining power that men would not transgress the women's right to harvest from trees which they planted, while in Kakamega, a nearby district, men completely control the use of the tree despite women's labor in tending it. An important point here is that the questions which include gender are the same; what differs from place to place may be the answers.

Desired uses for trees also differ. Interviews show that men and women are aware of each other's perceived need for tree products, but their priorities differ, as in Nyasanga and Udege where women voted for fuelwood and men voted for fodder. In the higher potential areas, women's role with respect to trees may be greater in the absence of wage-earning husbands, but the final say may rest with him and thus delay activity.

The most promising spaces available for women's planting are in their own compounds, along their boundaries, and, with some risk, in their own fields. The comments of Achola indicate women have access to a tree which they have planted and have continued to care for even if their homesteads or fields have moved. One of the conditions which may affect women's willingness to make a large investment in planting trees in fields is that fields may shift leaving access to trees more limited, if not by rules, then by distance. Management or continual harvesting may become more difficult and access rights may decline.

At this stage in the project, there are several areas where gender analysis has a bearing:

1. Decisions about who will get the seedlings produced by the groups. Should workers and/or nonworkers get the seedlings? In what proportion and for what purposes? For instance, using the project's specifications, it takes about four hundred seedlings to alley crop half a hectare. What happens on-farm with species women are given or choose for themselves? Should the project set quotas for distribution based on work or gender?

2. Whether to include "women's species," such as *Sesbania*, in the portfolio of the nursery for the next season. Other indigenous species should also be included. Is seed available? How is it best propagated? Who has that knowledge? Can the plantings of indigenous species be regularized and increased? What are their effects in different arrangements, i.e. in association with crops? The choice should include both fuelwood and fodder species with plans for the placement and configurations for each so that both men's and women's interests are served.

3. Whether to include women's as well as men's intentions in planting out the first seedlings. This is tricky and, as is said in the case, may require diplomacy in working with both partners. First, choices will be influenced by what seedlings are actually available; so if women pick species, they will already influence the outcome. Timber species are available and may be part of that package so that both men's and women's wishes are met. It may be advisable to visit when both partners are present, to acknowledge that women have brought a benefit (seedlings) and so that both can hear about the possibilities available or not available, the tradeoffs of different arrangements, and what management practices will produce the desired effect. Perhaps there should be time between an initial planning visit and the final decison about where to plant so that people can make their decisions privately.

4. Whether to include women's circumstances and spaces in the research agenda. An intention of the project is to experiment to determine what works best in Siaya District, looking for the technical specifications indicated in Appendix 7-D (*Working Together* Vol. 1). As in any on-farm experimentation, actual management possibilities may differ from what is optimum from a purely technical point of view. For example, if alley cropping is to be tried, it should be tried on both the farms where men are present and those where they are not. Are there differences in management, for instance timely pruning or coppicing of trees to let in light for the crops? Monitoring this should be part of the research design. Do women favor different crops in their fields? How do the associations work in those fields? The number and spacing of trees and crops in alley cropping will affect the amount of labor required for the planting as well as the effect on soil fertility; what is realistic under different farmer circumstances?

At this stage in the project, before seedlings are planted out, the technical specifications and profitability of different agroforestry practices are unknown. The project has gone with best bets from other similar areas. These best bets can be assessed as to their likely fit into the system and as to who is likely to benefit. This is done by taking each element of a recommendation—the arrangement and the species suggestions—and screening it against what is known about men's and women's spaces, access rights, and preferences. For example, of the four species recommended for woodlots *(Cassia, Grevillea, Eucalyptus, and Markhamia), Cassia* lends itself to coppicing small (i.e. being kept bushy) and is not considered a "men's" tree.

DISCUSSION QUESTIONS

There are several ways to approach the mixing and matching of arrangements and species with their implications for meeting the needs of men and women in Siaya District. What follows are guidelines for using the charts and information in the text to discuss specific arrangements.

1. To evaluate the current recommendations (Appendix 7-G, *Working Together* Vol. 1), each one can be examined as to its benefit(s), who benefits, and the implications for gender. For spaces and arrangements there is information from the resources analysis (see discussion question 2 below). For species, there is information in the species chart (Appendix 7-D, *Working Together* Vol. 1). To determine the implications of any species, one can look across the chart at *(a)* uses, to determine if there are competitive uses; *(b)* management, to determine if there are practices which could bias a tree toward one use or another; *(c)* growth habit, to determine if it easily grows back; and *(d)* zone, to determine likely agroecological fit. This is illustrated in Appendix 6-A (discussion question 4, below). This can be applied to an assessment of designs suggested by students and the basis of discussion about the merits and tradeoffs of various designs.

2. To design a recommendation, one could again start with spaces and functions, i.e. the needs to be met by the agroforestry practice. For instance, which spaces are more appropriate or accessible for women. Then look at species which would meet certain needs such as fruit, fuelwood, and fodder. The species need to be screened for competitive uses. If a particular use is most desirable (e.g. fuelwood), what can be done to reduce the competition for its other uses? Possibilities might include placement, early management such as coppicing, or use of species which are not highly desired for alternate commercial purposes. In other words, of all the species which might be grown in a given space, some may be screened out because of competitive uses unless space, access, and choice of use is clearly under women's control.

3. To design on-farm research of agroforestry practices, one would begin as with a recommendation, identifying desirable functions, spaces, arrangements, and species. The results of an agroforestry practice are due to complex interactions in relation to soil and to species responses to different kinds of cutting, shade, and sunlight, etc. The research is intended to get at the optimum technical specifications for spacing, species, management, and harvesting practices of trees and crops in different configurations. All of these elements have gender implications in terms of labor available for management, access to trees and products, and competition over desirable uses. In designing an experiment, one can use the charts to anticipate critical management questions and therefore note where researchers should observe and document actual management and harvesting, who does it, and who benefits from all the products.

Questions

1. Can women plant trees in Siaya?

This is an opportunity to examine the effect of modernization on people's traditional beliefs, particularly with respect to trees. Traditionally, women do not plant trees, though they do plant bushes such as *Sesbania*. This is changing. Even when they don't plant trees they use them for a whole range of benefits and they are doing the work in the nurseries.

Additional Question: How can CARE deal sensitively with a situation undergoing rapid change? Beliefs and norms may differ from actual practice. What an informant says people do may not be borne out by observation. Steps to ensure getting the best information include talking to a variety of people, making sure one talks to women as well as men, and observing carefully. The case nicely illustrates how interviews with knowledgeable informants can provide a wealth of insights into a farming system.

2. Where can trees be planted in Siaya District? What spaces are available and who controls them? What conditions are attached to planting or harvesting in any space?

A sample board and suggested discussion points on conditionality are illustrated in Table 6-7. In discussing where trees can be planted, one can distinguish between north and south as well as gender. It is important to discuss conditionality, that the rules are changing, that in different environments women's rights of access are different. Control and access are also affected by land adjudication, which has given legal title to men and has reduced the role of senior men and women's traditional protection where it existed. The spaces most favorable for women, such as boundary plantings and near their own homes, can be highlighted for later reference in discussing on-farm design.

Table 6-7

Spaces for Trees

Spaces	Access	Control	Conditions
Men's fields	MA	MA	
Women's fields	FA	MA>FA	Fields may move; if caring for them, one is still entitled to access, but the site is removed from current activities, so access may be difficult to maintain.
Near own house	FA	MA>FA	Depends on husband's permission; possible conflict over intended product, e.g. poles or fuelwood.
Own boundaries	FA	MA	Favored by both Mutumbu and Ginga groups. Again dependent on husband's permission and intended use and management.
Outside boundaries	FA	SrMA	Need permission for planting, but harvesting is generally all right.
Grazing lands (private)	FA?	MA	Dependent on owner's permission; need to use nonpalatable species or pollarding to preserve against animal grazing.
Grazing lands (public)	FA	SrMA	Same as above.
Woodlots	MA, FA?	MA	Usually used just for timber species; FA uses sometimes for fuelwood.

Key: MA = male adult; FA = female adult; SrMA = senior male adult or headman; > = more than.

3. What are women in Mutumbu interested in having trees provide? What about men?

Table 6-8 shows a sample board with notes on why certain outputs are desirable, and it lists conditions, such as associated crops, which need to be taken into account. In Nyasanga, there is open disagreement about priorities—fodder or fuel. Discussion of intended uses and the possibility of conflicting priorities serves to reinforce the point about male and female differences. It also can lead to a more abstract discussion of how re-

search and extension workers learn about and negotiate differences in preferences between different groups.

Additional Question: What about men and women in Ginga? Continue eliciting men's and women's preferences and asking how preferences in one zone differ from those in another.

4. Let's take Mutumbu women's group. We have the results of the project's interview with them. Let's evaluate the "best bets" agroforestry interventions for the higher potential zone (Appendix 7-G, *Working Together* Vol. 1). How will they work in Mutumbu? What about men and women?

Appendix 6-A illustrates an assessment of these agroforestry practices and species with respect to Mutumbu and to gender. A similar assessment can be done for Ginga. The most pressing need in Mutumbu is soil fertil-

Table 6-8

Desirable Benefits from Agroforestry

	MA	FA	Notes
Mutumbu			
Soil fertility	X	X	Key problem in the area and ranked third in importance in all problems; note that absence of husbands puts more crop production under women; main staple crop is maize.
Fuelwood		X	Much fuel, in the form of charcoal, is purchased; some interest in reducing that cost.
Fodder	?	X	Little grazing land; off-farm sources of fodder, but cattle considered important savings.
Poles	?	X	For cash.
Fruit trees		X	For cash.
Seedlings		X	For cash.
Ginga			
Fuelwood		X	High demand for smoking fish.
Fodder for cattle	X	X	Land squeeze implies decline in grazing land and it is listed as a key problem.
Poles	?	X	For cash.
Fruit		X	Home consumption or sale?
Soil fertility	?	?	Not mentioned in group interview except land squeeze; only one cropping season; sorghum grown for subsistence, cotton and maize for cash.

Key: MA = male adult; FA = female adult.

ity. Alley cropping is a promising solution, but much remains to be known about the effectiveness of different combinations, the uses to which alley trees are put, and the labor demands needed to maintain the alley cropping in a way that the trees do not compete with crops for water, sunlight, or space.

Additional Question: Are there other agroforestry practices or species which you would recommend? Why? This provides an opportunity for participants to identify other needs in Mutumbu, such as fruit trees and fuelwood, and to suggest solutions. Similarly, the presence of useful indigenous trees may be noted. These proposals can be examined in the same way as the recommended practices by referring to what is known about the species according to the charts.

One area which can be explored are questions concerning felt versus observed needs. For instance, fodder. The use of cattle for savings, the presence of ticks, and the limited private grazing land suggest the need for fodder, but it is not mentioned among the group's priorities. The same is true for fuelwood, one of CARE's priorities. Here again is an opportunity for participants to look at the role of change agents in using their priorities or observations as a basis for introducing change or further discussion.

As the implications of different species and arrangements are discussed, there will be obvious gaps in the information about how things will actually be used and regarding the possible arrangements and species which are not recommended in the first round. The interviews reveal that a number of indigenous species, such as *Sesbania, Markhamia,* and tamarind, are used regularly, but not much technical information is available. How do they compare with the introduced species? These can be listed and may provide the basis for discussing what kind of research should be done to find the optimum feasible agroforestry practices for the district.

5. What experimentation would you recommend to KEFRI?

   Several possible areas of discussion are listed below:

   a) Experimentation with initial recommendations, varying parameters to get optimum technical specifications

   b) Documentation of who does what and who benefits, the limits of labor availability for critical management

   c) Locus of experimentation, in demonstration plots close to the nurseries or actually on-farm

   d) Whether to do formal experiments, document farmer practices, or some combination

   e) Selection of on-farm experimental sites with regard for different farm constraints; for instance the absence of men in wage employment, or women's versus men's fields

   f) Experimentation with indigenous species to get technical specifications and more information on uses

Each of these is a fruitful area of discussion in looking at research objectives and methods, taking into consideration that men and women have different practices for and desired benefits from agroforestry possibilities. What is important during this discussion is to have the participants screen their proposals against the gender analysis and to be specific about what data would have to be collected to evaluate the project.

Additional Question: Design an agroforestry practice for a compound such as in Figure 7-3 (*Working Together* Vol. 1). Indicate all the data to be gathered, technical, economic, and gender related. Have participants assess and modify the design as needed. This is a more technically oriented exercise than the above.

Additional Question: What measures would you select for evaluating this project? The objective is improving rural welfare in Siaya. Suggestions for measuring that may vary considerably from counting the number of trees or introduced trees to increased precision on agroforestry specifications to measures of welfare benefits in terms of increased income or reduced costs.

6. What would you recommend to the field workers concerning the distribution of seedlings from the nurseries?

This question leads back to extension and the role of field officers as change agents in the community. One might begin by listing the potential recipients—workers (case indicates these are probably all women, except perhaps in the chief's groups), members of groups, husbands of group members, chiefs or church members for groups with those affiliations, the wider community. There are different uses for seedlings—selling for cash, planting by members in whatever way they wish, planting according to CARE priorities and recommendations. Who should make the decision? The CARE project manager? The field officers? Group members? There are no right answers. There are no wrong answers either, but a critical point in discussing women in development is the actual distribution of project resources of which seedlings certainly are one. Discussion allows participants to examine the implications of various strategies. Part 3 (which follows) describes the strategy actually used by the CARE field officers.

7. What strategies would you suggest to field officers as they begin to do on-farm diagnosis and design with group members?

The choices for on-farm design are limited by the species available (in type and number) and are influenced by CARE's "best bets" practices and its interest in fuelwood. There are established differences between men's and women's roles. How should the field officers go about helping farmers plan for the planting out of CARE seedlings? There are several on-farm factors to consider: the actual layout and soil conditions, existing trees and crops and their locations, access to other land, the specific needs of the farmers, the possible gender differences or complementaries.

Again there are no right answers, but the discussion allows participants to think out in detail and defend how they would carry their knowledge and social values to farmers, specifically how they would continue to ensure that women's needs be met.

USE OF PART 3

Part 3 of the Kenya case describes the growth of the CARE project and what the project actually did to resolve the questions raised by Part 2. It describes how seedlings were distributed, how field officers did on-farm diagnosis and design, the inclusion of new species in the CARE nurseries' portfolios, research undertaken by KEFRI, and research undertaken on two indigenous species, *Markhamia* and *Sesbania*. It can be used as a handout to students to see what actually happened, or as a basis for further consideration of agroforestry research and extension issues as they relate to gender roles.

Teaching Possibilities for Part 3

1. Examine the specific steps taken by the CARE project to maximize benefits to women participants. From reviewing what CARE did, participants can then discuss these steps at a more abstract level based on their own experience and on the constraints and opportunities offered them in other institutional settings. Note that CARE is a nongovernmental organization with outside funding and one of its mandates is to develop a model for the Kenya Forest Department. How much will transfer?

2. Compare the on-station experimentation and the on-farm documentation of current practices done by the Dutch researchers. From which was more learned? Which would assist in designing appropriate recommendations or research for Siaya? One exercise could be for participants to design research for the next season based on the new information in the case and these models.

3. Examine the methodological issues of how extension is or can be related to research and experimentation. Also examine the extension approach used by this project and its applicability to other situations, especially government service.

Kenya: Part 3
After Eighteen Months

HILARY SIMS FELDSTEIN, DIANNE E. ROCHLEAU,
AND LOUISE E. BUCK

A year and a half after the CARE project had begun work in Siaya, it had already expanded rapidly. The team had trained fifteen male and female extension workers to work directly with nurseries and individual farmers. The project was working with over eighty nurseries. During the year, 465,000 seedlings had been planted out, 150,000 direct seeded, and 25,000 trees established by cuttings. They were working with over one thousand farms and twenty-five school compounds; five hundred farms had been visited for individual D and D. There were over three hundred alley-cropping systems established, though some of them were very experimental. Some farmers had planted one long line of *Leucaenea* or *Markhamia* across the field to see what would happen. Because of the widespread interest, the project began providing assistance to more groups with fewer materials; nursery establishment costs were down to just about Ksh 1,000 per nursery. The team was receiving many requests for assistance and was faced with questions of how rapidly and with what structure to expand.

Some new diagnostic techniques had been developed. The extension workers were not as skilled as their predecessors at probing for local knowledge of tree uses and species. A visitor from the Kathama project had suggested giving groups a week or so to answer some of the decision questions, including species preferences and priority uses for trees. This approach had interesting results. After thinking over what they needed trees for and discussing a bit among themselves, the group members had come back the following week with much longer lists, including many indigenous species used by women for a variety of subsistence products. The team observed that shyer members were more likely to speak up and that husbands and wives worked together, privately, on lists of preferred species. As a result, in voting on preferences and priorities, the groups had presented more varied lists of tree species and types of products desired than in the first round of interviews. Also, people had begun to ask questions about how to get and grow more of the local species. A number of indigenous or other preferred trees had been introduced into the nurseries' portfolios (Appendix 6-B).

The interest of the farmers in the nurseries and the planting out of trees had allowed the team to dispense with the idea of nursery-located demonstration sites and instead to let farmer plantings serve as demonstrations. Decisions about who got seedlings had been left to the groups which worked out processes allowing for adequate numbers of seedlings for a good demonstration to one or two members, and an equitable sharing of the remaining seedlings to other members, with preference for those who had actively worked in the nurseries.

The team kept the goal of maximizing benefits to women participants clearly in mind. For instance, they taught nursery workers to pinch back *Cassia* and *Parkinsonia* at the early stages to make them bushier and better for fuelwood than for poles. The selection of the seedlings took place at the nursery, so those most active in nursery work, principally women, made the selections. Visits were made to half of the farm households to plan where the selected seedlings would be planted. Appointments were made specifically with the women, but if a husband was not absent the appointment was set for a time when the husband was there. If a decision could not be reached on the initial visit, time was allowed for private negotiation and the extension worker came back a week later. Follow-up interviews one month after planting showed that most households planted according to the agreed-upon plan. In three instances men had resisted certain species; and in three other men had put trees in woodlots.

The general conclusion of the team was that it was acceptable for women to raise seedlings, because it was a new activity which lent itself to groups and most groups were made up of women. It was not a sex-stereotyped activity. Once women had done the work of raising seedlings and choosing what to plant, women went ahead and planted them. They identified with trees, unless there were serious objections from their husbands. Generally, once trees were planted out, men became more supportive of their wives' nursery work.

During the year, several research projects were designed to better understand the technical variables associated with different components, or species, and arrangements. These were (1) an investigation of soil fertility under different alley-cropping arrangements carried out by KEFRI, (2) a study of farmer views of two trees commonly found in farmers' fields, *Markhamia* and *Sesbania*, and (3) a mulching experiment testing soil fertility of the leafy biomass from different species, carried out by two consultants.

KEFRI EXPERIMENT

In the months of April and May 1985, five research trials were set up in five different regions of Siaya District. The main objective was to investigate the suitability of agroforestry trees in sustaining soil fertility. The trees chosen for intercropping with food crops were those that had been

shown to improve soils and to harmonize with crops in other regions with similar climatic conditions. The design and results of this research are reported in Appendix 6-C.

MARKHAMIA AND SESBANIA STUDY

During 1985, two Dutch researchers studied the characteristics and uses of two species found frequently planted in farmers' fields—*Markhamia lutea* and *Sesbania sesban*. The objective of the study was to learn more about farmers' reasons for planting and/or leaving *Markhamia* and *Sesbania* in their fields and to investigate whether there was a contribution to soil fertility through mulching or directly through root rot. Such information would help to determine an optimal planting regime. The investigation included the following:

1. Observation of how the trees were planted in relation to crops

2. Yield measurements of crops over the season

3. Yield measurements of the tree (diameter, height, and depth of crown)
   a) When pruned and not pruned
   b) When scattered and in a hedgerow
   c) With different numbers of shoot

4. Soil samples around the trees

5. Interviews with men and women farmers with respect to
   a) methods of propagation
   b) uses

6. Mulching experiments

Markhamia lutea

Markhamia is a long-lived tree which is planted around the compounds as a boundary marker and for security. It is a source of building poles, fuelwood, timber, and other items. When a family moves and the old compound is turned into cropland, these trees are left and the maize is sown up to the stem of the tree. For hundreds of years, the trunk remains viable, producing two to four poles every two or three years.

In interviewing farmers, the investigators found that men and women gave different responses about the lives of the trees. Men often knew the

ages of trees because they had planted them. They knew how to manage the *Markhamia* in order to get good poles. Coppicing is considered a man's job, requiring heavy labor. Women were usually responsible for the crops next to the trees and used the leaves for dry-season fodder for their goats. If the tree was in a woman's plot, she knew the history of its cutting. Though she would actually prune the tree, she asked her husband how and when to prune it; he decided. Women cut out crooked poles to reduce competition for good poles. The crooked poles were sold for fuelwood as a source of income for school fees, for example.

Sesbania

Men were less informed about this tree than women. Women considered it a good fuelwood and were more often responsible for managing it. When the tree became old, it was cut and destumped and left to die. After it was dead it was pulled up. The investigators found that the nodules of this tree which had decomposed and released their fixed nitrogen after the tree was killed helped to fertilize the nearby soil. Women knew of this fertilizing effect because they observed better crop growth on the spot where the tree used to be. Some farmers therefore planted extra *Sesbania* in their fields.

Mulching Experiment

In the northern part of the district, the Dutch researchers carried out a small trial on the time for decomposition of mulch leaves. They compared *Markhamia* and *Sesbania* with *Cassia* and *Leucaenea*. Since more was known about the timing and nutrients of the last two species, they hoped to extrapolate additional information about the fertilizing capacity of the local trees. The investigation was carried on in the grounds of two schools with three replications each. *Leucaenea* broke down fastest and was eaten by termites. *Sesbania* was much slower to decompose and was not eaten. *Cassia* also was attacked by termites and decayed at the slowest rate. *Markhamia* was similar to *Sesbania* but sustained some termite damage. No clear conclusions could be drawn from these experiments because the termites fed on the leaves. It was observed that *Leucaena* and *Cassia* were preferred by the termites.

Appendix 6-A: Gender Implications of Recommended Practices: Mutumbu

Recommendation	Benefit	Who?	Gender Implications
Alley-cropping	Soil fertility	MA, FA	Which crops, whose fields?
Maize	Food, cash	MA, FA	Increased yields will depend on right species interaction; thinning or coppicing to remove shade.
Leucaena	Soil fertility	MA, FA	Depends on whose field, technical specifications not known.
	Fodder	MA, FA	May be competition between these uses; if used for fodder, needs to be protected from grazing cattle.
	Fuelwood	FA	Would supplement scarce fuel supplies, but possible competition for other uses.
	Mulch	MA, FA	Requires frequent cutting; is labor available?
Markhamia	Soil fertility	MA, FA	Tolerated in fields but actual interaction with crops not known. Alley cropping would be a new practice.
	Fuelwood[a] Timber poles?[a] Handicrafts[a]	FA MA ?	Considered a man's species so timber, poles likely to take precedence.
Gliricidia	Fuelwood	FA	
	Mulch	MA, FA	Depends on labor available.
	Fodder	MA, FA	Whose labor for cut and carry?
	Timber	MA	

Continued on next page

Appendix 6-A, *continued*

Recommendation	Benefit	Who?	Gender Implications
Spacing of trees and crops		MA?, FA?	Who plants? Effect on fertility and labor requirements for planting and pruning not known.
Fuelwood in woodlots	Fuelwood	FA?, MA	Question of women's access to woodlots (generally considered men's) or space for woodlots given pattern of moving women's fields.
Cassia	Fuelwood	FA	Poles and charcoal are competitive uses; fast growing. Can be coppiced and kept small for fuelwood.
Grevillea	Fuelwood	FA	Poles, timber, charcoal are competitive uses; poles are desirable for cash; alternate use is mulch which would contribute to soil fertility; medium growing.
Eucalyptus	Fuelwood	FA	Also considered a man's tree and valuable for timber and charcoal.
Markhamia	Fuelwood[a]	FA	Is used as fuelwood according to groups.
Hedges and windbreaks	Protection from wind	?	Depends on whose fields, compounds, etc. are being protected.
	Source of useful products	FA	Hedges or other boundaries near the homestead are more accessible for fruit, fuelwood, and perhaps fodder.
Grevillea	Various	?	See remarks above.
Cassia	Various	?	Neither species provides fodder and therefore would be good barrier to animals.

[a]Represents current uses by group; information comes from group interviews as Markhamia was not among the seedlings brought in by CARE.

Appendix 6-B: Recommended Agroforestry Species and Their Uses: Second Season

Added Species	Uses													Management Practices						Growth Habit			Agroecological Zone	
	Charcoal	Craftwood	Erosion control	Fencing	Fodder	Food	Fuelwood	Medicine	Mulch	Ornamental	Poles	Shade	Soil Fertility	Timber	Coppice, small	Coppice, large	Pollard	Prune	Full tree, renewable	Full tree, single harvest	Fast	Medium	Slow	North	South
Albizia coriaria	●	●					●				●	●	●	●				●		●		●		●	●
Carica papaya*						●		●											●		●			●	●
Citrus spp.*						●	●											●	●				●		
Erythrina spp.		●	●				●		●	●			●		●		●				●			●	
Ficus spp.					●	●			●			●							●		●			●	●
Mango*	●	●				●	●					●		●				●	●	●			●	●	●
Markhamia lutea	●	●					●	●	●		●	●		●		●		●		●	●			●	●
Sesbania sesban					●		●					●	●					●		●	●			●	●
Tamarindus indica	●	●				●	●	●	●			●		●				●	●	●			●		●

*Exotic and newly or recently introduced species

Appendix 6-C: Agroforestry Research Trials

Protocol

1. Intercropping Trials

Completely randomized block designs with three replications and four treatments (three tree species and a control) were used. Alley widths chosen were 4.25 m x 15 m. Spacing for the maize crop was 0.75 m x 0.3 m. Tree seedlings were spaced at 0.5 m along the row.

a) Three tree species—*Leucaena leucocephala, Markhamia lutea,* and *Gliricidia sepium*—were intercropped with maize in two plots located at Nyasanga and Abayo.

b) *Calliandra calothyrsus*, another new "miracle" multipurpose tree, was used as a substitute for *Gliricidia sepium* in Yala.

c) *Sesbania sesban* was used in place of *Gliricidia sepium* at the Bondo site.

d) Only two species were used at the North Siaya site: *Leucaena leucocephala* and *Markhamia lutea.*

2. One split-plot intercropping trial was used where alley widths were varied between 2.75 m x 15 m, 3.5 m x 15 m, and 4.25 m x 15 m using *Sesbania grandiflora* and *Markhamia lutea.* This trial was located at Nyasanga.

3. Fuelwood trials took place at three sites: Bondo, Abayo, and Nyasanga. Tree species used were *Cassia siamea, Grevillea robusta, Casuarina equisetifolia, Eucalyptus ssp.*, and *Markhamia lutea.*

4. Hedges or windbreaks were planted around the research plots using *Grevillea robusta* and *Cassia siamea.*

Planting

Research assistants who were involved with individual plots did the planting with the help of casual laborers. The bulk of the tree planting was done in mid-April and early May when soil moisture was adequate and tree seedlings were readily available. Maize planting was delayed by the unavailability of seed, but was still done in good time. *Gliricidia* cuttings and seedlings were not available in sufficient numbers for all the sites. Those available, especially cuttings, became highly susceptible to attack by termites soon after planting. About 40 percent of the cuttings were destroyed in Nyasanga. Other seedlings presented difficulties be-

cause they were not of good quality, having traveled a great distance or having been too long in the nurseries. These conditions resulted in poor establishment (especially of *Markhamia* in Nyasanga), stunting (from overpruning while being held in nurseries), and high susceptibility to termites (North Siaya).

Results

The main problem overall was termite damage. Because of the delay in planting, poor seedlings, and the termite damage, comparisons between species and between distances in row planting were inconclusive.

Chapter 7

Philippines

Women in Rice Farming Systems
Crop-Livestock Project, Sta. Barbara, Pangasinan

CONTENTS

Teaching Notes for Part 1: Benchmark Survey and the Introduction of the Women's Component (in *Working Together* Vol. 1, Chap. 8)

Part 2 The Second Season, Experimentation and Innovation after the Introduction of the Women's Component
- *Design and Experimentation*
- *Additional Activities*
- *Notes*
- *References*

This case and teaching notes were prepared as a basis for discussion rather than as an illustration of either effective or ineffective handling of a project.

Teaching Notes for Philippines: Part 1 Benchmark Survey and the Introduction of the Women's Component

CASE SYNOPSIS

The Sta. Barbara case describes two phases of a project: the initial research and decision making about experimentation by a farming systems crop-livestock team and the changes in the program once a women's component is introduced.

The Sta. Barbara project grew out of the interest of the Asian Rice Farming Systems Network (ARFSN) to sponsor crop-livestock research in rice systems using a farming systems approach. The collaboration is between departments at the International Rice Research Institute (IRRI), the Philippines Department of Agriculture, and the Institute of Animal Sciences (IAS) at the University of Los Baños (UPLB). The two sites selected near the town of Sta. Barbara were Malanay, an irrigated site whose irrigation system allows it two rice crops a year, and Carosucan, a rainfed site which can grow rice only during the rainy season The project began with a benchmark survey of a sample of households from each village. The results of the initial survey are described. The project focuses on livestock (specifically carabao and cattle), the addition of legumes to the rainfed system, and improved cultivars and practices for existing crops. On the basis of the constraints identified, on-station research, on-farm crop trials, on-farm crop-livestock feeding trials, and household record-keeping are begun. The on-farm crop trials include varietal trials (both sites), fertilizer trials (Malanay), new cropping patterns (Carosucan), use of insecticides (Carosucan), and new land preparation practices (Carosucan).The trials and the results after the first season are described in the text.

At the end of the second year, the Women in Rice Farming Systems Network (WIRFS) at IRRI began research at these sites in order to learn how women's concerns could be considered at various stages of technology development.To learn more about the farming system and particularly women's roles, the WIRFS researchers undertook a village census, a resurvey using a revised benchmark survey, informal questioning, participant observation, and focused interviews. The results of their research are reported in Appendices 8-B, 8-C, and 8-D (*Working Together* Vol. 1). The

findings include men's and women's activities in crop and livestock production, identification of additional income-generating enterprises, labor arrangements, and the means of access to the factors of production (land, livestock, credit, household technology, education, and income-generating activities). Information was also collected on nutrition and consumption. Additional research was done on sources of income and on glutinous rice production and processing. The WIRFS team presented their results to the crop-livestock team and together they began to plan the next year's program of research.

USE OF THE CASE

This is a very straightforward case filled with an abundance of information with which to do an activities analysis and an access and control of resources analysis. It would work well as a first or second case in a series. By using the cropping systems approach, which is a commonly accepted format for presentation in much of Asia, audiences there would feel at home with the material.

LEARNING OBJECTIVES

1. To examine the activities of men, women, and children in both a rainfed and an irrigated rice farming site in the Philippines

2. To determine who has access to and control of the benefits of production

3. To plan for appropriate crop-livestock research after the addition of the women's component

4. To evaluate the research methods used in this project to understand the farming system

STUDY QUESTIONS

1. What were the major findings of the Sta. Barbara crop-livestock team during the first year?

2. What was known about the activities and resources of men, women, and children after the research done by the WIRFS project?

3. What are the benefits of production and who has access and control?

4. What recommendations do you have for research for the next phase?

5. Evaluate the diagnostic research undertaken throughout the project.

ANALYSIS OF THE CASE

This is an excellent example of how a well-thought-out approach to women's issues as they relate to agricultural research yields significant information to benefit the whole project. During the first year of the crop-livestock project, the researchers focused on only the large animals: carabao and cattle. Their trials were directed to some real constraints: introduction of a successor crop to rice in the rainfed system, new varieties, exploration of fertilizer levels, and feeding trials for carabao and cattle. There were several promising results. In Carosucan, the rainfed site, some success was shown with making furrows with carabao rather than by tractor preparation of fields for mung beans (leaving more residual moisture), with new varieties of mung bean, cowpea, and bush *sitao*, with IR-60 rice in combination with legume production, and with insecticide applications on mung beans. At Malanay, the irrigated site, an economic level was set for fertilizers and two new varieties of rice were tried with some increase in yields of grain and fodder. The initial livestock feeding trials on *Ipil-Ipil* and rice bran did not show any effects, though a later trial with rice bran alone did.

The research conducted with the introduction of the women's component provides a more comprehensive look at the farming system in each village. Among the most interesting findings is the fact that women raise swine and poultry which are a significant and timely contribution to the household's income and consumption. The text reports there are several times during the year when the need for resources, in cash or kind, are acute: low rice periods (both), land preparation and harvesting (Carosucan), pulling and transplanting (both), and school fees (Malanay). In each community the raising of swine, a year-round possibility, is timed for sales to meet those needs. During the dry season in Carosucan, men are engaged in wage labor, and the responsibility for harvesting and selling legumes and vegetables also are women's responsibility. Figure 7-2 (see discussion questions) illustrates the seasonality of income needs and income-generating activity.

In interviews with both men and women, the researchers find that, during the dry season, preference is given to swine over cattle in the

feeding of *Ipil-Ipil*, an indication of swine's importance to overall household management. Women's roles in feeding the larger livestock are also made clear. The indication is that feeding *Ipil-Ipil* may not have gone as planned because women's experience with its abortive effect on swine made their husbands reluctant to feed it to livestock. In keeping with the finding that the project's training efforts went to men more than to women, the implication is that women should be involved in the instructions and training associated with the feeding of large and small livestock.

A third finding is the importance of glutinous rice in Carosucan. During the initial survey the rice is noted as "traditional." During the second survey and by observation, it is learned that the processing and selling of glutinous rice as a seasonal delicacy is an important income-producing activity conducted principally by women. Focused interviews and participant observation reveal the drudgery and inefficiency of the available processing technology and the scarcity of the raw product. Women also dominate the production of mung beans and vegetables, particularly in the dry season in Carosucan when husbands are absent for off-farm employment. Finally, women have the major responsibility for cash and budgeting. Their full understanding of the value of different opportunities for improvements in farm production—hybrid varieties, fertilizers, pesticides, alternative feeds for livestock—is an important element in family decision making.

There are several points to be made. The focus of the overall project is on crop-livestock interactions. By ignoring small livestock, the project overlooked a useful area of research (swine) and the importance of women as well as men in the raising of large livestock. The addition of mung beans or cowpeas to the cropping system in Carosucan would provide another source of income and of food for humans and livestock. Women's dominant role in production and sales was not seen and can now be incorporated in trial design and instruction. Glutinous rice, seen as "traditional" and unimportant, turns out to be a significant source of income, providing work and income when there are no other alternatives for women. There is a clear need for improvements in the production of glutinous rice in yields, quality, and timing. Improvements in the inefficient processing equipment would also be useful. By providing a more comprehensive view of the farming system, focusing not just on large animals but on the people and all their enterprises, the WIRFS researchers have illuminated a number of promising areas of research.

It is important to note that the WIRFS research included changes not only in the object of their research, women's roles and the whole farming system, but also in their methods of research. The benchmark survey was revised so that, from the beginning, more information on the whole system and men's, women's, and children's roles would be visible. Very specific information on crop and livestock production activities will provide future

researchers and extension agents with guidelines on whom to include in any training or other activities relating to particular parts of the production cycles. They also used participant observation and focused interviews to provide in-depth information on specific enterprises of interest.

The Sta. Barbara case is an example of how, in a system of what is essentially joint production based around a nuclear or extended family, it is still important to learn about men's and women's distinct roles and contributions to the entire system.

DISCUSSION QUESTIONS

A useful way to teach this case is to study the case before and after the introduction of the women's component. Begin by exploring the first year's research by the crop-livestock team and briefly review the program of trials which resulted from that research. Then move to the second stage, the addition of a women's component. By adding to the boards already created, perhaps with a different color of chalk, visibly show what new information was gained. The session can close with suggestions about a new program of trials.

1. Let's start with the first year's research by the Sta. Barbara crop-livestock team. What are their objectives? Who are they?

The stated objectives of the crop-livestock project are to improve the existing farming systems (1) through integration of crop-livestock production technologies, and (2) specifically through increased utilization of crop by-products and residues. The principal actors are IAS, the Philippines Department of Agriculture, and several departments of IRRI, all in cooperation with the ARFSN. It is important to get this up on the board to make sure that everyone understands the objectives of the project and the resources available.

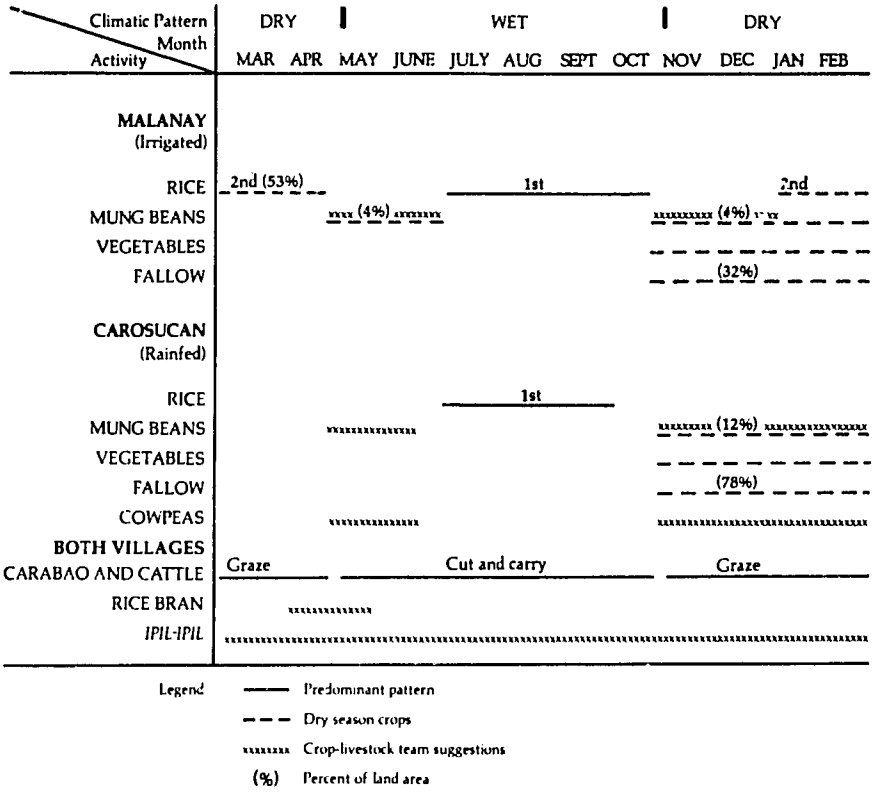
Additional Questions: Are there any women on the team? Any social scientists? There are two women mentioned—a livestock nutritionist and crop-protection specialist. There are agricultural economists. This provides background for a later discussion about how to get gender analysis done.

2. The Sta. Barbara area is characterized by seasonality related to well-defined wet and dry seasons. Let's put up a calendar and describe what goes on in these two villages.

Start by putting up the wet and dry season information as at the top of Figure 7-1. The point of this question is to get a quick overall look at the whole system. Sketch in the main activities as shown by the solid and broken lines in Figure 7-1. It is useful to point out that according to Table 8-1 (*Working Together* Vol. 1), not all of the farmers at the Malanay irri-

Figure 7-1

Cropping Calendar before the WIRFS Survey



gated site plant two rice crops. One-third have rice-fallow systems. There could be a number of reasons for this; here it is only necessary to show that "irrigated" doesn't describe the whole system. (Note: If you are going to continue this case with a cropping calendar, leave spaces in the calendar so you can fill them in later, as in Figure 7-2.)

Additional Question: Do we have any information on gender roles? There is none at this stage.

3. What resources for production are identified by the team?

Several are identified in the first part of the case:

- Irrigated and nonirrigated land
- Uplands
- Hired tractors
- Hybrid and traditional varieties of seed
- Cattle
- Carabao
- Pesticides

Little information is given about access and control except that irrigation water for dry season production in Malanay is controlled by the National Irrigation Administration (NIA). Putting this list on the board provides a reference point for later in the case. See italicized items on Table 7-1.

4. What constraints are identified by the crop-livestock team? Or, with the information available, what constraints or problems are there at these two sites?

Many constraints might be identified at this stage of the research:

- Poor feed for carabao and cattle especially during dry season
- Low yields of rice, potential for new hybrid varieties
- Lack of reliable moisture, particularly in rainfed area
- Poor land preparation for use of residual moisture in dry season crops
- Addition of mung beans or cowpeas to the cropping system in both sites
- Poor practices in mung bean production

Additional Question: What is the research program proposed by the team? A list of trials can be put on the board. They might be put to the right of the calendar, lined up with each site.

Carosucan:

- New rice variety IR-60
- New cropping pattern mung beans, cowpeas before or after rice (Here you might fill in how this affects the calendar; the *x*'s in Figure 7-1.)
- Improved varieties and practices for mung beans

Malanay:

- New rice and mung bean varieties
- Fitting in upland legume crop between rice crops
- Fertilizer rates
- Ratooning potential of first rice crop

Both sites—Livestock feeding:

- Feeding quality of crop residues (on-station)
- Quantification of pesticide residues (on-station)
- *Ipil-Ipil* and rice-bran feeding trials (with reference to the calendar)

Both sites—Household record-keeping

Additional Question: Depending on the time available, you may want to ask participants to evaluate the trials. It is noticeable that the feeding program did not work, at least in part because women were not included in the training although they do a considerable amount of the work.

5. Let us turn now to the introduction of the women's component and the WIRFS research team. What are their objectives?

The objectives of the WIRFS initiative are (1) to try out mechanisms for including women's concerns in farming systems research, (2) to identify women's roles and factors affecting these roles, and (3) to identify technological options. Put these near the objectives of the crop-livestock team. This provides an opportunity to raise the issue of how women's concerns do get integrated, having participants mention other ways in which this has been done. However, further discussion of the case will shed more light on this issue and assessing different strategies should wait until the end.

Additional Question: What means did the WIRFS researchers use to acquire more information about the system? The methods include a new and more complete census, a resurvey using a revised, more open-ended benchmark survey instrument, participant observation, topic-focused observation and interviews, and improved household record-keeping.

Table 7-1

Access and Control Analysis of Resources

	Access	Control	Notes
Land			
Irrigated site		MA>FA	NIA controls irrig.
Rainfed site		MA>FA	Control actually in hands of landlord (both sites)
Livestock			
Carabao		MA>FA	
Cattle		MA>FA	
Swine		FA	
Poultry		FA	
Cash		FA>MA	
Labor			
Family	MA, FA		
Exchange	MA, FA?		
Hired		FA>MA	
Owr	MA, FA	MA, FA	
Tractor	?	?	?
Credit			
Formal	MA>FA		Requires collateral linked to rice
Informal	FA, MA		Expensive
Inputs			
Seeds		FA	
Pesticides		FA, MA?	
Household			
Rice hulls		FA[m]	
Electricity	MA, FA		Malanay only
Glutinous rice equip.		FA	Carosucan only
Fuelwood		FA[c]	
Cow dung		FA[c]	Esp. Carosucan
Training	MA>FA		
Education	MA, FA		

Key: MA = male adult; FA = female adult; > = more than. Italicized items could be identified during the first year's research.
m = Malanay c = Carosucan

6. WIRFS researchers identified a number of activities undertaken by men and women. Let's look at the main enterprises. As each is mentioned, ask: "Who did this?" (For an alternate way to discuss this question, see point 1 under "Additional Possibilities to Consider," below.)

There is an abundance of detailed information available in the case on men's, women's, and children's roles in crop and livestock production in both villages. The main sources of this information are the text, Table 8-5

(sources of income) and Appendix 8-C (contributions of men, women, and children to farm operations) (*Working Together* Vol. 1). Because so many tasks involve both men and women, it is not easy to represent these on the board. It is important to identify those enterprises which are predominantly men's or women's (such as swine production for women; cattle, carabao, rice production for men), those activities where women's roles have implications for current or future research (e.g. women's roles in feeding the large livestock), and those unrecognized enterprises which contribute to household welfare and are amenable to improvements in technology (e.g. swine production, glutinous rice production and processing). Enough information is given to provide the reader with a sense of who dominates which enterprise and the enterprise's contribution to the whole picture (see Table 7-2; see also point 1 and Figure 7-2 under "Additional Possibilities," below).

Table 7-2

Activities Analysis

	Malanay			Carosucan		
	Male		Female	Male		Female
Crops						
First Rice crop	MA	>	FA pulling post-harvest	MA	>	FA pulling harvest
Second rice crop				—		—
Glutinous rice	—		—	MA		
Vegetables, bush beans			FA			FA
Mung beans, cowpeas	MA		FA harvest, thresh, market	MA	<	FA[a]
Livestock						
Carabao, cattle	MA	>	FA	MA	>	FA
Swine			FA			FA
Poultry			FA			FA
Wage labor						
Transplanting, harvest	MA					
Pulling			FA			
Carpentry				MA		
Fishing	MA			MA		
Other						
Market transactions	MA		FA[a]	MA		FA[a]
Glutinous rice	—		—	MA	<	FA
Household[b]						
Dung collection			FA			FA

Key: MA = male adult; FA = female adult.
[a]Some contradictory evidence here between text and tables in Appendix 8-C (*Working Together* Vol. 1).
[b]Little information in the case.

The data in Appendix 8-C (*Working Together* Vol. 1), which identify the percentage of men and women performing the tasks, make the weight of each gender's contribution relative to the other and to a particular task difficult to determine. The discussion in the text clarifies some of these points, and the very fact of the relative jointness of activities in this area, compared to other parts of the world, makes the exact weighting less important. It is a useful point to discuss either here in assessing activities or later in assessing the research methodology.

Additional Questions: We can see that many tasks are shared or are joint activities. What does this mean about the relationship between men and women in Sta. Barbara? What could change "jointness" to "women's work"? Jointness opens up the question of intrahousehold negotiation and decision making. The implication in the text is of complementarity and we know little about bargaining processes in this system. Jointness can also be affected by changes in conditions, for instance, widowhood or separation creating female-headed households. According to Table 8-2 (*Working Together* Vol. 1), 10 percent of all the households in Malanay and 16 percent in Carosucan are female-headed. Seasonal patterns may affect jointness. The information on cattle and carabao production in Appendix 8-C shows that the women's role in Carosucan in feeding large livestock is higher than in Malanay. This is linked in the text to men's seasonal off-farm employment.

Additional Question: What are the implications of jointness for technology development? According to the data presented in Appendix 8-C, both men and women participate in most tasks. Any introduction of new technology, especially one which involves a changed or new task, should include both men and women in the initial training and the assessment. This is an important point and should generate discussion on how this is determined and what can be done. An example of problems which arise from ignoring women's roles is the lack of success in feeding *Ipil-Ipil* to livestock.

7. Let's also update our profile of available resources and who has access and control.

Go back to Table 7-1. It is not necessary to depict all the information available in the case. It is important to point out that, although most activities engage both men and women, control or primary responsibility usually is associated with one or the other. Women control cash and use informal credit; men have readier access to the cheaper formal credit. Men have title to the leases on land and to livestock. They also have greater access to agriculturally related training. The importance of this exercise is to provide a framework for screening ideas for future research and to demonstrate that in an essentially joint system there are still differences in responsibilities and control.

8. How do these enterprises contribute to household welfare? And who controls the output?

Refer to Table 7-3, which depicts the benefits or outputs from production in Carosucan in terms of access and control and in terms of the contribution of each enterprise to the whole. Again, in this relatively joint system some of the control issues are murky, though there are definite patterns of responsibility. What is important to elicit is the significance of women's enterprises to the whole, not only in terms of percentage, but also, in the case of mung bean and cowpea production and glutinous rice processing, in terms of timing (see Figure 7-2). Note that glutinous rice processing contributes 13 percent, swine production 9 percent, and mung bean and vegetable sales 6 percent in Carosucan (see Table 8-5, *Working Together* Vol. 1).

9. Now that we have seen the full complexity of this system in Carosucan and Malanay, what research would you recommend to the crop-livestock team?

The "maps" created by the activities, resources, and benefits analyses provide a means of identifying additional opportunities for research by all the scientists of the crop-livestock project and their institutions. In considering what participants suggest, have the group screen each suggestion as to its appropriateness to this project and to the resources of these scientists. The list might include the following:

- New varieties of glutinous rice for higher yields in Carosucan, including testing of these varieties for processing
- Continued experimentation with various crop residues not only for large livestock, but for swine and poultry as well

Table 7-3

Access and Control Analysis of Benefits: Carosucan

	Access	Control	Notes
HYV rice		MA>FA	18%
Glutinous rice	FA	MA, FA	9%
Processed glutinous rice		FA	13%
Mung beans, vegetables, cowpeas		FA>MA	6%
Carabao, cattle		MA	9% draft, fattening, investment
Swine		FA	9%
Cash from wage labor		MA, FA	1–2%
Rice by-product/bran	FA	FA>MA	Swine>cattle
Ipil-Ipil		FA>MA	Swine>cattle
Remittances		FA	16–17%
Cow dung			Fuel, manure

Key: MA = male adult; FA = female adult; > = more than. Percent (%) refers to percent contributions to total income, Table 8-5 (Vol. 1).

- Experimentation with use of mung bean or cowpea stover for swine and large livestock feed
- Improvements in processing equipment for glutinous rice
- Training for men *and women* in livestock nutrition that includes all livestock
- Training for women in mung bean and cowpea production, which includes women specifically as cooperators (not just female heads of household)
- Training women and men on proposed insecticide recommendations

Summary

To sum up, review with participants the information gained by the broader investigation of the WIRFS researchers and point out the number of enterprises or specific activities identified which could lead to future research within the mandate of the original crop-livestock project. The Sta. Barbara case also illustrates that, even in a system characterized by jointness, roles of men and women with respect to activities and resources differ. Having that information provides a sounder basis for identifying researchable problems of value to farmers and identifying appropriate cooperators.

Another important point is how one gets gender analysis included as part of the diagnostic toolkit. The original crop-livestock team included economists (sex not identified) and two women technical scientists (livestock nutritionist and crop-protection specialist), but the focus was on crops and livestock and not on people or "who does what." It took a team with a gender perspective and an appreciation of the information needed for technology development to do an investigation of the whole farm system. Their work resulted in identifying some promising avenues for the design of improved technologies (See Part 2 of the case, below.)

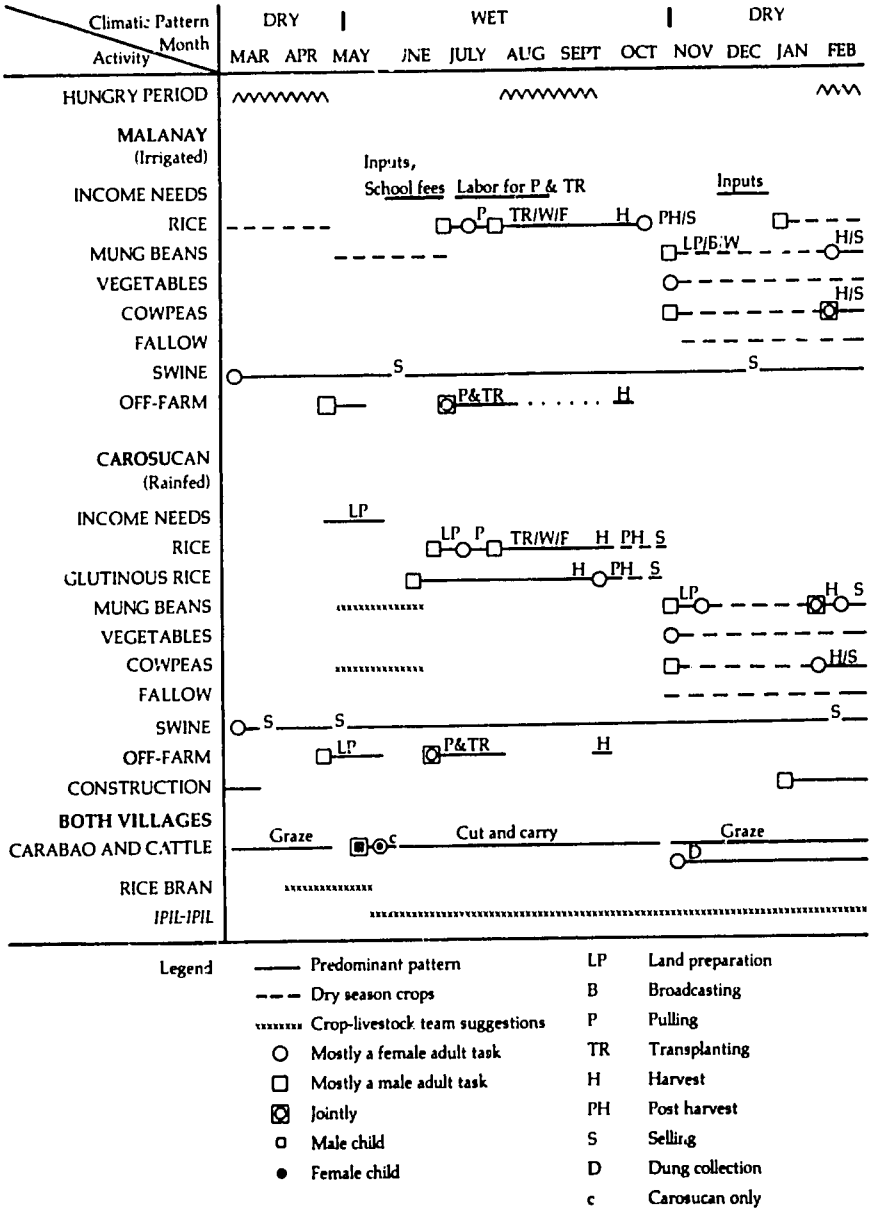
ADDITIONAL POSSIBILITIES TO CONSIDER

What is the relationship between the main income-earning activities, the seasonal calendar, and gender notes?

1. An alternative way to discuss activities and benefits is with respect to a cropping calendar. Figure 7-2 illustrates how the information gained in the WIRFS survey can be used to build on the original cropping systems calendar (Figure 7-1) and enrich an understanding of the system with respect to gender roles and the relationship between income needs

Figure 7-2

Cropping Calendar after the WIRFS Survey



and the timing of specific activities. Swine production is timed to meet the need for farm inputs, school fees, household maintenance, and labor for transplanting. In Carosucan, mung bean and vegetable production is begun predominantly by men and falls predominantly to women for harvesting and sales, because men are doing construction for wages. Glutinous rice production falls during a period of low employment opportunities for women. This makes the point that not only do these activities contribute to overall income as shown in Table 8-5 (*Working Together* Vol. 1), but their timing also meets specific needs for resources in production and consumption.

When using the case this way, as you discuss each activity, identify the gender predominantly responsible and place it on the calendar. Then ask how its timing relates to the whole farming system, fill in income needs, and draw arrows connecting the two.

2. What types of research or approach was used initially? Later? How would you assess these approaches? The first approach focused on specific parts of the farming system; the second on the whole system and it specifically included women. Though the first team included women scientists, they lacked a gender perspective. The WIRFS researchers revised the benchmark survey. Such a revised form could be used by any group of researchers in subsequent work. The WIRFS group made a point of asking questions of women, engaged in informal interviewing, did some participant observation, and did focused interviews on particular subjects. Participants could consider the utility of these methods within this project, and more abstractly, view them as a way of doing research in their own projects.

3. Observe the differences between women in male-headed or joint households and female heads of household. Notice that in Malanay none of the female heads of household are involved in agriculture while a few are in Carosucan.

INTRODUCTION TO PART 2

Part 2 of the case (below) describes what the Sta. Barbara crop-livestock team and WIRFS researchers actually did in Malanay and Carosucan after the WIRFS research. It is short, but if all the activities suggested above are not covered in a single session, it could be used to evaluate the research actually done and to consider all the methodologies employed, including the work done during the second phase of experimentation. Of interest in the second phase is the number of female researchers in the technical sciences—in animal nutrition and agricultural engineering. This provides an opportunity for discussing the larger question of women's representation in the technical sciences, both how they get there and whether or not they influence what happens in a project.

Philippines: Part 2
The Second Season, Experimentation and Innovation after the Introduction of the Women's Component

THELMA R. PARIS

DESIGN AND EXPERIMENTATION

After the importance of including the women's component in the research project was discussed in one of the on-site crop-livestock workshops, several changes in the research design were recommended.

Testing of Glutinous Rice Varieties

The major problem with the production of local varieties of glutinous rice were low yields and long maturity dates. The Department of Plant Breeding at IRRI suggested IR-65, a high yielding and early maturing variety with eating qualities similar to the local variety. It had a potential yield of five tons per hectare and matured in 114 days while local varieties matured in 130–140 days with a grain yield of three tons per hectare. During 1986, HY-65 and traditional varieties of glutinous rice were tested on farmer's fields under their current level of management.

The agronomic and economic results of those trials are recorded in Tables 7-4 and 7-5. Farmers mentioned the advantages of IR-65 over the local varieties, such as early maturity, better tillering capacity, higher yields, uniform plant height, resistance to lodging, pests, and diseases, and better grain quality. The early maturity date (two weeks before local varieties) enabled farmers to generate cash during the lean months before harvesting the main rice crop.

Different ways of cooking glutinous rice were done by women to compare the cooking and eating quality of IR-65 with local varieties. In terms of eating quality, IR-65 is sticky and tacky but does not have the aroma which makes the local fancy varieties more preferred. However, what appears most important in consumers' preference is the blackness of the glutinous rice rather than the aroma.

Table 7-4

Agronomic Characteristics of Glutinous Rice Varieties

Varieties	Ht. (cm)	Maturity (days)	Panicle Length	% Filled (Grains)	PT[a] Hill	Wt. of 100 Seeds Fresh	Wt. of 100 Seeds Dry
IR-65	89	120	22	77	11	3.2	2.5
Imelda	102	130	24	75	10	3.3	2.8
Miracle	80	130	21	76	10	3.3	2.8
Milagrosa	136	130	24	89	7	3.7	2.8
Waray	111	150	26	62	9	3.7	3.2

Source: RIARS, Crop-Livestock Project, Sta. Barbara, Pangasinan, 1984.
[a]Productive tillers/hill.

Table 7-5

Costs and Returns of Glutinous Rice Varieties (in Pesos), 1986

Items	IR-65	Local
Yield (kg/ha) fresh wt.	5,420	4,680
Price/kilo	2.92	2.92
Gross returns (A)	15,826	13,666
Labor and power costs (B)	4,949	4,372
Land preparation	1,161	1,023
Crop establishment	575	569
Weed control	1	6
Fertilizer application	14	11
Insecticide application	2	2
Other care	31	28
Harvesting	3,165	2,733
Material costs (C)	797	607
Seeds	343	119
Fertilizer	425	419
Insecticides	29	63
Others	—	6
Total variable costs (D)	5,746	4,979
Net returns (A-D)	10,080	8,687
Returns to labor and power costs ((A-C)/B)	3.04	2.98
Returns to material costs ((A-B)/C)	13.65	15.31
Returns to variable costs (A/D)	2.75	2.74
Number of plots	22	22
Average plot size (m^2)	429.79	645.56

Source: RIARS, Crop-Livestock Project, Sta. Barbara, Pangasinan, July–December (1986).

Glutinous Rice Processing

To look into the possibility of developing suitable equipment for glutinous rice processing, an agricultural engineer visited the site and interviewed women about processing practices. He was followed by a female engineer who also visited the site, observed the processing methods, and interviewed women. After these series of visits, with some consultation and the help of another engineer, she designed and developed improved cooking equipment with a rotating paddle, which allows close regulation of mixing, and a wooden dehuller, which reduces drudgery and time in dehulling the grains. The criteria used in developing the equipment were efficiency, affordability, possibility for local manufacture, not requiring electric power, energy saving, income generating, not requiring training to operate, and low maintenance costs.

A female and male farmer-cooperator were invited to IRRI to test the newly designed equipment for mechanical defects and to determine whether it could be manufactured locally. IR-65 was used in testing the equipment. Based on the evaluation, adjustments were made.

After testing the equipment, the male farmer-cooperator organized a meeting with people at the village including women involved in processing glutinous rice. Initial feedback, based on pictures and his description, was positive. The improvised cooking pan was priced at P 100; the dehuller at P 300. The village organization planned to discuss the mechanics of manufacturing and distributing the equipment.

Swine Production

To improve swine production (a woman's task), an experiment to integrate cowpea, sweet potato, and pig production was conducted in November 1987 in collaboration with animal nutritionists. The objective was to reduce feed expenses by 45 percent of the total costs. The ration for pig fattening included 30 percent cowpea, 50 percent sweet potato, and 20 percent rice bran. Six farm families in Malanay were chosen as cooperators. Three families served as the control and the remainder as the experimental group. In the experimental group, male cooperators produced cowpeas, cassava, and sweet potatoes following the rice crop while their wives took care of feeding swine and other management responsibilities. The control group cooperators fed swine exclusively with commercial ready-mixed rations. These cooperators were provided with a piglet and enough feed for the entire experiment. Individual weights were monitored throughout the entire period and an economic analysis was done to evaluate the technology (Gervacio 1988).

The economic analysis of the initial experiments showed that the benefits from using cowpeas and cassava in a feeding ration were higher

than those from the ration using commercial feed and rice bran. These initial results further showed that there is a potential for reducing the present commercial feeds by substituting home-grown root crops like cowpea and cassava. Experiments should be continued to verify this technology (Ebron 1988). This project was a collaborative activity of the Institute of Animal Science (IAS) (represented by the female swine-nutritionist), the WIRFS group from IRRI, and staff of the Department of Agriculture.

Cowpea and Mung bean Trials

Cowpea and mung bean variety trials were continued in both sites. After these trials were conducted, the eating and cooking quality of the different varieties of cowpea were tested by women in the village. This experiment was conducted by the agronomist of the Department of Agriculture and an agronomist of the Multiple Cropping Department of IRRI.

The presence of pests during storage of mung beans and cowpeas was a major problem raised by women in adopting the new varieties. In June 1988, an experiment was conducted in the homes of female cooperators in Carosucan. The objectives of this research were (1) to evaluate selected indigenous materials to control pests during storage of mung beans, and (2) to recommend indigenous material(s) for use during storage at the household level. Results showed that, in storing mung beans in sealed containers for a period of three months, untreated seeds were not significantly different from the treated seeds except for ginger and neem[1] treatments, which obtained even lower germination. Garlic appeared to be the most practical and least harmful indigenous insect control for on-farm seed storage (Santos 1989).

ADDITIONAL ACTIVITIES

Crop and Livestock Classes

A series of classes were conducted on topics for women and men in the project. They were held to develop an understanding about the recommended and experimental technologies, to maintain interaction between the scientists and the farmers, to promote interest in project activities, and to obtain feedback about the proposed technology. For the first time women were included in farmers' classes. At both sites, the female livestock nutritionist explained the importance of the nutritive value of different crop residues and fodder. Many farmers admitted uncertainty about particular feed values. She clarified misconceptions about the abortive effects on pregnant cows of cassava leaves and leguminous fodder and ex-

plained the elements of the ruminants' digestive systems. At the rainfed site where mung beans were proposed to be grown before and after rice, the women were taught how to dry mung bean hay as fodder since they participated in harvesting and threshing. The swine production specialist from IAS visited both sites and explained the importance of improving the quality rather than the quantity and frequency of swine feeding.

Modifications of Household Record-keeping

Though women were observed as active in livestock production, this was not recorded in the household record-keeping. It was found out later on that the records were mostly kept by men who regarded their wives' participation in the care and management of large animals as an extension of household work. One of the problems in the record keeping was that farmers filled out forms ahead of time because of the routine nature of livestock activities. This was modified later on and routine activities such as watering livestock were standardized.

Introduction of Mushroom Production on Rice Straw

Because of the lack of access to technology and income-generating activities within the homesteads, twenty women from both research sites were given hands-on training through the "Prosperity Through Rice" program at IRRI. The technolgy involves the use of rice bran agar as the medium and rice straw as the substrate for mushroom production. The technology does not require strict temperature and humidity controls. The mushroom varieties (*Pleurotus* and *Volvariella*) commonly are used as food in both Chinese and Filipino dishes. After two weeks in production, mushrooms can be harvested and thus can provide supplementary income for the household and for women in particular.

Upon returning to their villages, women tested what they had learned from the laboratory and produced their own spawn. For the production of straw mushroom spawn, a small, portable wooden inoculum autoclave was made by a farmer-carpenter. The intellectual excitement of learning something new appeared most important in sustaining women's enthusiasm, and they experimented with other crop residues as substrate and agar medium. Since then, the women have started to market what they produce. After fifteen days, the returns-to-cash cost is P 2.26 for every peso invested. The success of the first women trained has drawn more women into growing mushrooms at both sites, and the need for a formal women's organization for marketing and credit is evolving.

Other Action Research Proposed

The WIRFS researchers have proposed that there are a number of other technologies which could be tested with women cooperators within the farming systems network. These include seed production and management, integrated pest management, a treadle-powered, medium-lift irrigation pump developed by IRRI's Agricultural Engineering Department, charcoal briquettes from combusted rice husks to free-up cow dung for manuring, composting with farm manure, and pedal threshing of rice. These will be considered in upcoming planning meetings of the project.

NOTE

1. The neem tree, *Azadirachta indica*, is widely grown in the tropics. It has many beneficial uses. Leaves, twigs, and seeds contain an insect repellent.

REFERENCES

Ebron, L. 1988. Using Farm Grown Resources: Integrating Cowpea and Cassava in Swine Rations. Paper presented at the National Socio-Economic Seminar Workshop on Root Crops held at the Philippine Root Crop Research and Training Center, Visayas State College of Agriculture, Baybay, Leyte, Philippines, 16–18 March 1989.

Gervacio, A. et al. 1988. Cowpea and Cassava to Replace Soybean Oil Meal and Corn in Swine Rations: II. On-farm Feeding Trials. Paper presented at the 25th annual convention of the Philippines Society of Animal Science held at the University of the Philippines at Los Baños, Laguna, Philippines, 17–18 November.

Santos, B. 1989. Mung bean Seed Storage Management. Paper presented at the In-House Research and Development Review and Evaluation of On-Going and Completed Researchers. Sponsored by the Department of Agriculture (DA) and Regional Integrated Research Agricultural Stations (RIARS) held at Bacnotan, La Union, Philippines, 29–30 May 1989.

Chapter 8

Zambia

Intrahousehold Dynamics and FSR/E in Zambia, A Case Study of Traditional Recommendation Domain 3 in Central Province

CONTENTS

Teaching Notes for Part 1: Country and Project Background and Results of Initial Diagnosis (in *Working Together* Vol. 1, Chap. 9)

Part 2 Description of the Farming System and Problems Identified
ARPT Analysis of the Diagnostic Information on TRD3
Trials Conducted on the Problem Areas
Female-Headed Household Survey
Note

Appendix 8-A Results of On-farm Trials: Effects of Lime on Groundnuts, Maize and Sunflower
Appendix 8-B Results of On-farm Trials Exploratory Study of Planting Method and Fertilization

This case and teaching notes were prepared as a basis for discussion rather than as an illustration of either effective or ineffective handling of a project.

Teaching Notes for Zambia: Part 1 Country and Project Background and Results of Initial Diagnosis

CASE SYNOPSIS

This case study encompasses the first three years of the Central Province Adaptive Research Planning Team (ARPT) in Zambia. Established to conduct on-farm research directed at improving the productivity of Zambia's small-scale commercial and traditional, or subsistence, farmers, the ARPT engaged in a number of diagnostic surveys to collect information on different farming systems in the province, initiated adaptive research experiments in farmers' fields, and worked to improve linkages between research and extension through on-farm trials. Part 1 of the case study describes the country and project background and the results of the various diagnostic surveys.

Central Province ranks as one of Zambia's most agriculturally productive regions, especially in terms of maize. Other commercial crops produced in the province include sunflower, beans, groundnuts, and sorghum from which beer is made. However, like the rest of Zambia, Central Province has suffered from unreliable rainfall conditions since 1978 that have particularly hurt low-resource farmers who depend on rainfed production systems. Since these farmers are the principle maize producers, maize production has dropped and led to drastic food and income shortages. Thus, a critical objective for the Ministry of Agriculture and Water Development was to develop technology appropriate to the needs and limitations of these farmers. Collaboration with the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT) East and Southern Africa Economics Program led to experimentation with on-farm research methods and the creation of the ARPT. Over time, the farming systems research and extension (FSR/E) approach has become incorporated in the Zambian agricultural research and extension system.

Both men and women engage in agricultural production. While some activities are done jointly, most are gender specific and some crops, such as finger millet, beans, and groundnuts, are customarily designated as "women's crops." Men are largely responsible for land preparation of the main field crops, particularly when animal traction is involved, and for the

production of maize, though women collaborate in planting, weeding, fertilizing, harvesting, and processing. During the period covered by Part 1 of the case (*Working Together* Vol. 1, Chap. 9), the ARPT undertook a zoning survey in Central Province and defined six recommendation domains. For the initial diagnosis of TRD3, Mkushi District, they undertook an informal survey and a labor study which are reported in the case.

Findings from the diagnostic surveys indicate that land is not a limiting factor for production; but labor is. Use of hybrid seed is common for maize, but not for other crops. Fertilizers are widely used but pesticide use is limited. Oxen and tractor hiring are the major sources of draft power. Those who do not own traction power are dependent upon hiring traction from traction owners who first complete their own land preparation before allowing others the use of their animals or equipment. Credit is limited and unreliable. extension agents have little contact with farmers (even less with women farmers), and the supply of inputs is erratic. Details on the labor activities associated with crop production are given in Tables 9-5, 9-6, and 9-7 (*Working Together* Vol. 1).

Part 1 ends at the point when the ARPT sets out to analyze the survey findings, determine priority constraints and opportunities, and plan its research activities for the next season.

USE OF THE CASE

The Zambia case study works well as the first case in a series of cases used in a training activity. or it can be used alone to introduce participants to many of the initial concepts of gender diagnosis and analysis. In particular, the case is good for developing skills in the generation of a gender-disaggregated agricultural production calendars, analysis of resources and benefits, and the screening of potential changes in technology against differential impacts on male and female labor and other resources. Care should be taken to ensure that participants understand how to construct a cropping calendar before beginning the case study. The sample calendar in the conceptual framework (*Working Together* Vol. 1, Chap. 1) can be used as an example.

With plenty of time, the case can be used over several different discussion sessions. The first could cover study questions 1–5, which would elicit the production system, activities, resources, incentives, and problems. In a second session, participants could be given the tasks in study question 6 and, optionally, question 7 to complete and the subsequent discussion would be a presentation of the results from each small group's effort. A final session could focus on Part 2 of the case study and highlight the implications from the bean-maize intercropping trial and the survey of female-headed households.

When time is short, it is most efficient to include study question 6 in the first round of discussion and cover the alternative solutions and possible on-farm trials in the plenary. Part 2 can be saved as a final handout and summarized as part of the closing statements by the facilitator.

LEARNING OBJECTIVES

1. To do an activity analysis and construct a gender-disaggregated agricultural calendar for a farming system

2. To analyze resources and incentives for a specific farming system

3. To do an *ex ante* analysis which uses the activities, resources, and incentives profiles as screens for determining research priorities and designing on-farm experiments

4. To develop appropriate evaluation criteria for on-farm research that will reflect concern for both men's and women's needs for new technology

STUDY QUESTIONS

1. Why were the ARPTs created and what are their overall objectives?

2. What were the objectives of the ARPT activities in TRD3?

3. What are the activities of men and women in agricultural households and when are they done throughout the year?

4. What are the resources of men and women and what benefits do they derive from their productive activities? From other activities?

5. What are the primary constraints facing farmers in TRD3 and what are their causes?

6. For two of these problem areas, suggest solutions which might be tested and criteria for evaluating such tests.

7. Design an on-farm trial based on one of the solutions proposed. (optional)

ANALYSIS OF THE CASE

The main point of this case is that men's and women's activities in TRD3 are gender defined. Men and women have separate crop responsibilities and often own and manage separate fields, though some production tasks for both male- and female-tended crops are done jointly. Because of the interrelatedness of the production activities, even though they are gender differentiated, both men and women farmers need to be included in the diagnosis of the farming system. Overall, women are involved in a greater diversity of crops and production activities than are men. Men focus their attention on the hybrid maize crop and on the livestock and plowing technology, where used.

With the establishment of the ARPT in Central Province and the selection of Mkushi District (TRD3) for on-farm research activities, the ARPT initiated a number of activities designed to characterize the farming systems in the area and identify problems of low-resource commercial and traditional (subsistence) farmers. A series of surveys (zoning, informal, and labor) were done to collect information on the farming practices in the area, identify problems, and define the research agenda for the ARPT. The initial zoning survey or the division of the area into research domains was determined through interviews with the extension staff in the district. Since men dominate the extension service, it is likely that only male agents were included in this survey. The zoning phase was followed by an informal survey[1] designed to check the characterization of TRD3 and to gather information on production problems in the zone. In this survey, twenty-four farmers were interviewed in groups. It is not clear whether the groups were all male farmers or mostly male farmers; however, by examining Table 9-2 (*Working Together* Vol. 1) where it is shown that all but three of the twenty-four produce maize (a male-dominated crop) and very few produce sorghum, groundnuts, or beans ("female" crops), we might infer that mostly men were included in the informal group survey. Thus, the information on the production methods and problems of the predominantly female crops is scanty.

Labor was identified early on as a major constraint in TRD3, and a labor study was initiated to measure the nature and extent of the labor shortages and how labor is utilized to supplement the informal survey. Results of the studies showed that households provide the bulk of the labor, supplementing with hired labor during the peak labor season from December to January. Male labor is concentrated on land clearing and preparation and the maize production tasks. Men also do the plowing with teams of oxen. Oxen and tractor hiring constitute the major source of draft power. Draft owners have first access to draft power so their fields are plowed first and they are thus able to plant in a timely fashion. Only after their fields are plowed is the draft available for hire. Poorer

households lacking cash find it particularly hard to hire draft power and often rely more on hand labor, thus suffering greater labor bottlenecks and untimely planting. Poor female-headed households are the most constrained by the lack of draft power, and paying for access to draft either with exchange labor or cash constitutes a major expense. Access and control of draft power thus is a determining variable which conditions the ability of households to plant on time, a key cultural practice that will determine whether the crops will be able to maximize the available rainfall during the production season. This issue can be a useful way to partition farmers into groups for further research and problem definition. Technology appropriate for those farmers with control over draft power will be different from that which is appropriate for those lacking control, and especially for those for whom access is relatively more difficult due to a greater lack of cash.

While institutional support to agricultural production in TRD3 is limited for all farmers in terms of credit, marketing support, input supply, and information (from extension), female farmers are particularly disadvantaged by the system. They are not members of the cooperatives so input access is more difficult. Access to new information and technology is limited by the fact that few female farmers are contacted by the extension service and few female farmers attend on-farm demonstrations.

Information on the major production activities reveals the nature of the labor constraints on productivity and the specific production problems of the crops grown in the area. Maize is the first crop in the production cycle. When lack of labor (hired, draft) causes late planting, the rest of the system is affected and other crops must be planted late or planted in more rapid fashions that decrease overall production. In particular, this affects sorghum, which is broadcast on a field by women followed by a team of oxen that plough the field. Lack of labor to plant seeds spaced in furrows gives way to broadcasting, a method which then requires two to three weedings and transplanting to fill gaps. The labor shortage also affects other women's crops, causing finger millet to be raked and planted at the same time and reducing the ridging and weeding for *dambo* crops.

Other production problems identified by the ARPT include the misuse of hybrid maize seed (planting of F2 hybrid seed), stalkborers and termites on maize, low fertility of sorghum fields combined with a low seeding rate, birds for all cereal crops, and pops or empty shells with groundnuts.

The ARPT, at the end of the diagnostic activities, must assess the identified problems, determine the range of causes for these problems, prioritize the problems, and identify alternative solutions to deal with them. One of the questions to be considered by the ARPT is how to deal with the labor constraints as described above. Another question is the relative weight to give to different crops—maize, sorghum, groundnuts, fin-

ger millet, beans. Given the predominance of maize among male and more commercial farmers, this is likely to be the focus of attention. However, sorghum is also very important, particularly with lower income households, because of its less risky nature under conditions of uncertain rainfall. For women, particularly in female-headed households, sorghum is the raw ingredient for beer which they can sell or exchange for labor. Sorghum and groundnuts are not the main cash crops in TRD3, but they are important to women.

In examining any intervention, the researchers need to look at how it affects the whole system. Maize and sorghum compete for time. They also compete with the planting of groundnuts, a cash crop for women. Any intervention which affects one crop will have effects on the others. These can be anticipated by examining a gender-disaggregated activities calendar such as Figure 8-1 (see discussion questions, below). The ARPT's initial decisions and experimentation are summarized in Part 2 of the case study.

DISCUSSION QUESTIONS

This case lends itself to beginning with the objectives and activities of the ARPT and then moving into identification of the production system. If time is short, the trainer can summarize the setting of the case study including the objectives of the ARPT and the three key survey activities, and then move quickly into questions designed to elicit the agricultural calender by starting with discussion question 4. If time is adequate, it is useful to have the participants discuss the objectives and activities in order to be sure that all understand the nature of the diagnosis and the type of information generated.

1. What are some of the general characteristics of Zambia that affect the conditions of agricultural production for small-scale farmers?

This question is aimed at promoting discussion on the general features of Zambia, what are sometimes called exogenous features, that influence the state of agricultural production. It is important to note that the country is facing decreasing rainfall and seasonal drought. There is a strong move towards urbanization caused by jobs there and in the mining sector. This draws young men in particular away from the agricultural production sector and adds to a labor shortage in rural areas. The concentration of people in the urban areas, however, creates a strong need for food staples and accounts for the growing demand for these, especially maize, and thus the growth of the small-scale commercial producers. These producers are scattered about the rural landscape without nucleated villages, making extension organization for training or information and communication more difficult

Decreasing rainfall has made it imperative that crops be planted as soon as possible in order to capture the most of the limited water. This has resulted in a growing dependence on draft power from both tractors and animals and has created two categories of people: those controlling draft and those who must seek access to draft. Ability to gain access to draft power is conditioned by resources, particularly cash to pay for draft power. Women farmers are most constrained by lack of draft power.

As these various constraints and features of the agricultural system are elicited, it will be useful to list them on a corner of the board, clearly enough so that they can be referred to again later in the discussion and analysis.

Additional Questions: What have been the various approaches taken by the Ministry of Agriculture and Water Development (MAWD) to deal with increasing production in the agricultural sector? Here it is important to elicit the sequence of efforts moving from a basic commodity approach initially to the creation of the LIMA recommendations and finally to collaboration with CIMMYT and the ultimate creation of the ARPT. Why was the MAWD so willing to collaborate with CIMMYT in 1980?

2. What are the objectives of the ARPT in general? Are these the same for TRD3?

The explicit objective of the ARPT was to produce recommendations relevant to the needs of Zambia's subsistence and small-scale commercial producers in the hope of improving the farmers' output and welfare. The ARPT strategy for reaching these objectives was

a) to collect information on farming systems,

b) to undertake adaptive research on farmers' fields,

c) to improve the link between research and extension through on-farm trials, and

d) to make results available to the relevant institution in order to remedy infrastructure and institutional problems facing farmers.

Note that "recommendations" refers to components or other technologies and policies which will be beneficial to subsistence and small-scale commercial producers. These objectives were the same for TRD3 and influenced the team in selecting TRD3 as a research site. It is important to draw out in discussion why it is important to focus on small-scale producers and the difference between commercial and traditional or subsistence producers. It is also important to discuss the relevance of the particular strategy chosen by the ARPT to meet its objective of working with

small-scale farmers. It is useful to point out the historical context of the situation and note that in 1981, when the activities were begun, FSR/E was in its infancy and methodologies were not as well developed as they are today. Also, the source of training and technical assistance for the ARPT at this time was CIMMYT, an organization that focuses on the improvement of maize and wheat technology. Would this have any impact on the type of activities conducted by the ARPT?

3. What were the activities conducted by the ARPT in TRD3 and what were the results?

It is useful to list these on one of the boards and elicit the information in chronological order by asking what they did first, why, who they contacted (type, number of farmers) and what the resulting information was. This can be listed in a table similar to Table 8-1.

Though the information in the case does not directly state that the majority of the information during these diagnositic activities comes from men, it is possible to deduce this from the context of the case study. For example, the extension agents are largely male and almost all of the farmers in the informal survey produce maize (a male crop). The labor survey covered households with men and women. What are the implications of interviewing largely a male group of farmers? What might be different for female farmers, especially those in female-headed households?

It is useful at this point in the discussion to draw attention to the six traditional recommendation domains taken from the zoning survey and compare TRD3 with the others. What features serve to characterize the

Table 8-1

ARPT Activities in TRD3

	When	Who Contacted	Type of Information
Zoning survey	Oct. 1979	Extension agents w/CIMMYT	Draft Major crops Labor, inputs
Informal survey	Oct. 1982	24 farmers in groups	Same as above, plus: Cash sources New cash crops Labor hire Farm size Sources of info. Crop yields Sold/stored
Labor survey	Nov. 1982–Oct. 1983	10 farmers but 9 completed	No. of workers Labor allocation

zone as poorer than others? Was it appropriate to select this zone as the focus of the ARPT efforts in Central Province? It is likely that participants will notice the discrepancies between the survey results of zoning and the informal survey with respect to maize. Table 9-1 (*Working Together* Vol. 1) indicates no maize in TRD3 while the informal survey points to maize production among the majority of the farmers interviewed. What would be the reasons for this discrepancy? The fact that extension agents were the group interviewed for the zoning survey could be a key reason for these differences. Would the composition of the ARPT (agronomist, agricultural economist, mostly expatriate) influence the nature of the results of the diagnostic surveys? (See also Note 1 at the end of the teaching notes.)

4. What are the activities of men and women in TRD3? When do these activities take place?

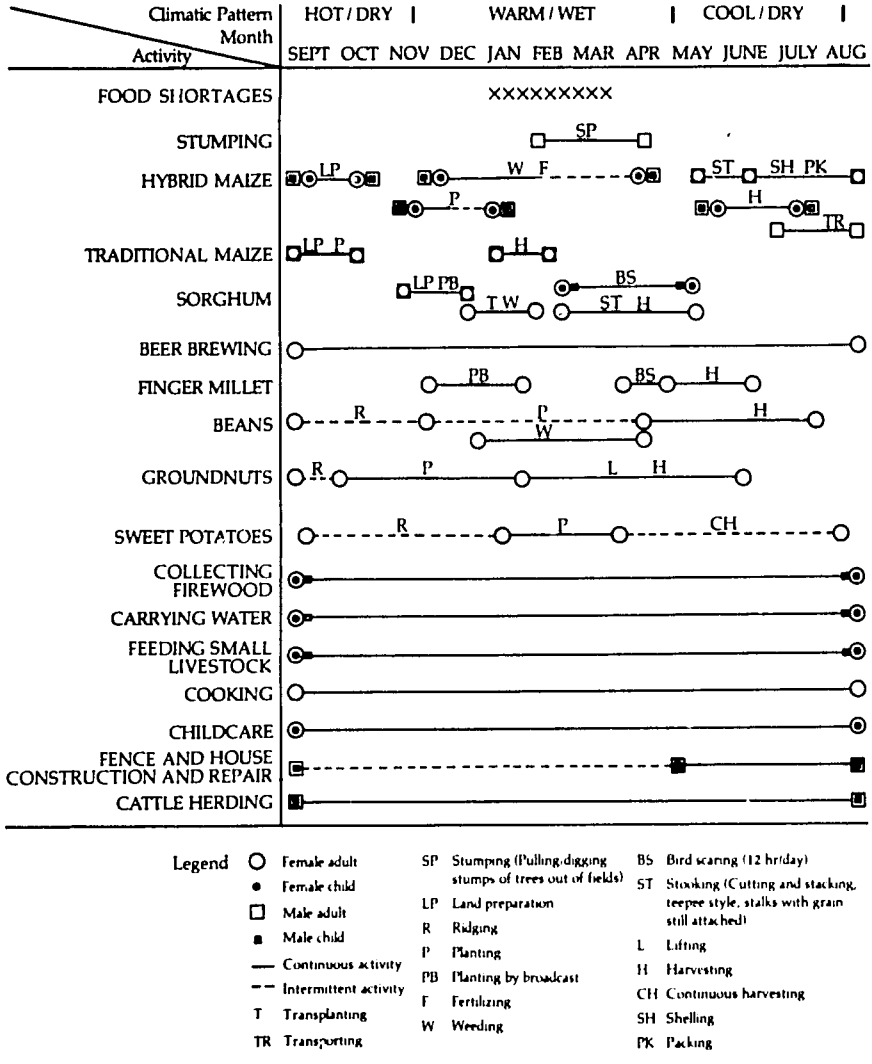
These questions are designed to lead into the discussion of the activities calender. In introducing the case to participants before they read it, the facilitator should have focused their attention on the example of a production calendar in the conceptual framework (*Working Together* Vol. 1, Chap. 1) and the utility of creating such a calendar as they study the Zambia case. In preparation for leading the discussion of the case, it is useful for the facilitator to create a calendar like the one in Figure 8-1. (See the notes on the use of gender-disaggregated activities calendars in Chap. 1.) Having the calendar already framed allows participants to add missing information. You may wish to purposely leave out a crop or activity on the calender, such as the reproduction and maintenance activities, and then elicit these following the discussion of the cropping and livestock activities. It takes about five to ten minutes to elicit the genderizing information and place it on the calendar. This gives a very nice visual image of the roles of men and women in production and shows where there are labor bottlenecks.

Discussion at this point should focus on clarifying the information in the calendar. Possible questions include: What time of the year is labor most constrained? Why is sorghum broadcast? Why are there ranges of planting times? (Some farmers must plant late due to lack of timely access to draft power.) What kind of time is involved in each of the activities shown on the calendar? Some of this information comes from the tables as well as the text. For example, up to twelve hours a day is spent by women in bird scaring during specific times of the production cycle. What impact does this labor drain have on other activities in the household?

5. What are the resources available to men and women for production in TRD3? Who has access to and who has control over these resources? What impact does this have on production?

Figure 8-1

Gender-disaggregated Activity Calendar for Mkushi District



Responses to these questions can be organized on the board similar to Table 8-2. From this analysis it is to possible to begin to see the differences between female and male farmers not only in terms of what crops they produce and their activities, but also in terms of the resources they can access or control to enable them to produce. In a labor-restricted system such as this one, all of the resources concerning labor (oxen, cash, family labor) become critical constraints to production. It may be useful at this point to begin discussion of how these specific resource constraints impact women producers and what some of the alternatives are that could assist them in gaining better access to and control of resources.

There are also differences in access to and control of land and the kind of land available. Female heads of household can apply directly to the village headman for land. Wives acquire land through their husbands. Newly cleared land is limited because of the labor needed for stumping and priority is given to maize production. There is some indication that

Table 8-2

Resources Analysis for TRD3

	Access	Control	Comments
Land			
Who uses	MA>FA	MA	FHH from village head FA from husband, or relative
How used		MA, FA	
Fertilization of plots	MA>FA		FA sorghum on less fertile land
Labor			
Own	MA>FA		
Family	MA, FA	MA>FA	
Hired	MA, FA		Depends on cash
Oxen	MA, FA	MA	Depends on cash
Cash	MA, FA	MA, FA	
Agricultural credit	MA>FA		
Extension information	MA>FA		FA don't attend OF demonstrations MA don't speak to FHH, FA
Markets			
Cash crops	MA		
Food crops	FA		
Education	MA>FA		
Off-farm employment	MA		
Crop residues	MA, FA	MA, FA	For fertilizer, animal feed

Key: MA = male adult; FA = female adult; FHH = female head of household; OF = on-farm; > = more than.

sorghum production is done on inferior land. The production of finger millet, sweet potatoes, beans, and groundnuts is done on small plots, often the wetter *dambo* plots.

With the picture of the resources on the board, it is now time to make the transition to the incentives for production in this system.

6. What drives this system? How do people decide what work to do? What kinds of incentives make people do what they do? What benefits do they derive from their work?

These questions lead to the benefits or incentives analysis which, like the resources analysis, can be placed on the board as in Table 8-3. It is useful to allocate board space parsimoniously in order to place the resources and benefits sections side by side.

Additional questions can be asked to get information on incentives such as: What do people get income from? Who gets this income? As with resources, it is important to consider who has access to and control over the incentives and benefits. For instance, men seem to have control or predominate in hybrid maize production, but women predominate and control income from groundnuts, beans, and sorghum production. There are different interests and incentives at stake here. It is also useful to note on the board the gender differences for how income is used. Men are responsible for capital items, inputs, and school fees. Women are responsible for food and clothing.

Throughout the entire discussion, the differences between male-headed and female-headed households should begin to surface. These can be drawn out by asking how the picture differs for different types of house-

Table 8-3

Benefits Analysis for TRD3

	Access	Control	Uses/Preferences
Maize, traditional	MA, FA	?	Consumption, sweetness
Maize, hybrid		MA	Sold for cash
Groundnuts		FA	Consumption, sale
Sorghum		FA	Consumption, beer
Beer	MA	FA	Consumption, sale, labor exchange
Millet		FA	Consumption, beer
Beans		FA	Consumption, sale
Livestock			
Sales		MA	
Rent		MA	
Plowing	FA	MA	

Key: MA = male adult; FA = female adult.

holds. It is important to take the information on benefits and trace the information back to the resources and back into the agricultural calendar so that the linkages and implications are seen across the entire system.

With the full mapping of what farmers do, what resources they have, how these are allocated, and what drives the system in terms of incentives and benefits, it is time to identify the production problems and begin to explore alternative options or possibilities for solving the problems. It is useful to remind the participants that the objective of the ARPT was to focus on improving the production of subsistence and small-scale commercial producers.

7. What are the problems facing farmers for the commercial crops they produce? What are some possible routes for solving these problems?

It is useful to begin this discussion by focusing on the crops that are sold for cash, such as maize, groundnuts, and beans. However, the discussion does not have to be limited to these and it is useful to consider the other crops in the system, whether they are also used for cash or food purposes only, and whether they represent potential future sources of income. Table 8-4 presents a way of organizing the information from participants on the board.

Once all of the data is up on the board concerning the crops, the problems, and the clarification of the problems, ask for possible alternatives for technical solutions to these problems. This leads to the design of possible experiments and again the use of gender analysis to screen the design elements. Referring back to Worksheet 1-6 in the conceptual framework (*Working Together* Vol. 1, Chap. 1) is useful here; alternatively, the information can be placed on another board for illustration.

The crux of the analysis at this point is to go through the alternative solutions and try them out in the calendar, looking for social, cultural, and technical fit. You may not need to go through all of them, but try out enough so that the technique of using the calendar as another screen in the process of *ex ante* evaluation of technology becomes clear. Some questions to guide discussion might be: How would your solution work given this allocation of labor and responsibilities? Whom would you be involving? Do they have time during that month? What would be the implications given the way that resources are allocated? Whose resources are you using? Would the solution change the overall pattern of allocation? Who would gain from your suggestion? What incentives would that change offer? For whom? How would the change affect the pattern of benefits that we saw here earlier?

Another area for discussion at this point is to consider the revenues from various crops and how they might influence which enterprise should be the focus of on-farm research. Tables 8-5 and 8-6 are derived from Table 9-2 and Appendix 9-B (*Working Together* Vol. 1).

Summary

At this point, wind down the discussion and begin the summary. If using the expanded use of the case proposed earlier, this is the point to set groups to the task of designing on-farm trials. Alternatively, work can begin on Part 2 of the case study. Where time is a constraint, you might elect to move into a summary of the analysis derived from Part 1 and summarize what the ARPT actually decided to do, based on Part 2. If summarizing, it is important to make the following three points:

1. Knowledge of the gender involved in agricultural tasks and the gender differentiation of resources and incentives helps to discover the implications of alternative solutions to identified problems and sets the stage for the way in which experiments will be designed.

2. This information is significant, not secondary to the diagnosis of farming systems problems. The whole effort of FSR/E and any on-farm, client-oriented work will be improved by a gender focus to the analysis of the problems facing farmers.

3. Constraints that farmers work with and that agricultural development practitioners encounter are both technical/physical and social/political/economic. To address only one set of these is to fail to anticipate possible problems and to fail to take advantage of real productive opportunities in any given context.

It is important to close the session by asking the participants to list the general lessons learned from the analysis of the case study and how they would apply these lessons to their own work, either in progress or anticipated.

Table 8-4

Sample Problem Clarification and Proposed Solutions for TRD3

Objective: Recommendations relevant to needs of traditional small-scale producers of commercial crops to improve output and welfare

Crop	Problems	Clarification	Technical Solutions Possible Trials	Screening and Design Issues
Maize	Poor yields Late planting Late fertilization	Land prep. difficult Lack of draft Labor constraint especially at weeding	Oxen prog. w/credit	Who needs oxen? FHH, FA access to cash, credit?
			No till herbicide	Whose labor? MA/FA? Whose labor saved? MA/FA? Resources cost MA Benefit from yields MA Benefit for FHH not using oxen; need to compare cost and timeliness
			Shorter season variety	Benefit labor MA/FA; resources cost MA Breeding characteristics: marketability, taste (FA)
Sorghum	Poor yields	Late planting Poor weeding Losses to birds	Better planting	Who plants? FA, therefore trials w/them; possible labor constraint
			Fertilization	Face FA labor and cash constraint
			No till herbicide	Possible FA cash constraint
			Varietal improvement	Needs to have cooking and beer-brewing characteristics, FA

Groundnuts	Pops	Soil fertility	Fertilizer	Need economic analysis of returns on basis of additional income since some consumed Possible FA cash constraint Rotates w/MA crops, so question of costs/benefits fertilizer cost
Beans	Has high return but hectarage limited	Labor constraint esp. land preparation by FA by hand	Intercrop w/maize	FA benefit from reduced labor for land preparation and joint activity of planting beans and weeding maize Benefits from output? FA beans? MA land?
Other	General labor cost	FA also has HH workloads	Fuel-efficient stoves	FA cook time? Fuel gathering
	Soil fertility	Use of manures?	What are current practices?	MA and MC have that information

Key: FA = female adult; MA = male adult; FHH = female-headed household; MC = male child; HH = household.

Table 8-5

Estimated Revenues From Crops

Crop	Year	Avg. ha	Yield/ha bags	Yield/ha kg	Price[a]	Revenue/ha
Sorghum as beer	1981–82	1.2	11.0	990	K 26.90/bag K 100/bag after brewing	K 296 K 1,100–1,210
Maize	1981–82	2.20	11.6	1,044	K 23.32/bag	K 270
Groundnuts	1981–82	0.04	13.4	1,206	K 33.64/bag	K 451
Beans	1981–82	0.08	7.3	657	K 1.50/kg	K 985
Sunflowers	1981–82	1.20	4.3	215	K 27.83/bag	K 120

Note: This is a rough calculation of the revenues from various crops per acre based on Table 9-2, and Appendix 9-B (Vol. 1).
[a]1982–83 prices are used for all calculations.

Table 8-6

Estimated Revenues Per Day of Labor

Crop	Revenue per Hectare	Persondays per Hectare	Revenue per Personday
Sorghum	K 296	369	K 0.80/day
Maize	K 270	106	K 2.55/day
Groundnuts	K 451	382	K 1.18/day
Beans	K 985	337	K 2.92/day

Note: This is a rough calculation of revenue per day worked based on Table 8-5 above, and Tables 9-5 and 9-6 (Vol. 1).

SUGGESTIONS FOR TEACHING PART 2

Part 2 presents what the ARPT considered as the key defining features of TRD3 and the priority problems faced by farmers. It then describes several on-farm experiments designed to test alternative solutions to these problems and the results of these experiments. Farmer views are provided as part of the evaluation of the experiments. Finally, because of the concern over the particular constraints facing female-headed households, a survey of a sample of these was conducted and the results are presented. Some brief suggestions for areas of discussion dealing with this information are listed below.

1. Compare the key features of the TRD3 system with the results of the activities mapping completed in the previous discussion session. Are there any differences? Why? What are the implications?

2. Compare the list of problems generated in the previous discussion with those identified by the team. Are there any differences? Why? What are the implications?

3. How did farmers view the various experiments and their results? Why were women not in favor of the bean and maize intercropping trial? What are the implications of their disapproval? What would be an alternative way to design the trial, taking their considerations into account?

4. Discuss the design and outcome of the female-headed household survey. What are the implications of only including women who are heads of households? Do these results hold true for all women in the TRD3 production system? Should female-headed households be considered as a separate research domain based on the results of this survey? How can the ARPT best address the needs of female-headed households or of all women farmers in the system?

NOTE

1. Reading carefully one notices there are a number of discrepancies between the zoning survey and the informal survey. The most obvious is that the former designates sorghum as the main staple, the latter finds maize is the main staple. Generally the informal survey describes a more market-oriented system. Note the different sources—extension agents and a group of selected farmers. The case states that whereas the zoning survey was intended to characterize districts, the informal survey was intended to check that characterization but also describe small-scale commercial farmers. This emphasis on commercial producers may explain some of the difference between the two surveys.

   In teaching the case we have focused on gender differences rather than the differences between the two surveys. For instance, we don't focus on a main crop. If the differences become an issue with a class, it may be useful to lay out the differences and discuss the sources of information for each and how these might lead to a different set of data. Then go on with the case using the labor survey, for it is the source of most of the information in the case.

Zambia: Part 2 Description of the Farming System and Problems Identified

CHARLES CHABALA AND ROBERT N. GICHIRA

ARPT ANALYSIS OF THE DIAGNOSTIC INFORMATION ON TRD3

In TRD3, farming systems data were collected during an informal survey and as part of a daily labor use study. The major purpose of the studies during the diagnostic stage was to verify the findings from the zoning exercise. These surveys corrected earlier information and gave a better understanding of the farming system. On the basis of this data, the ARPT characterized TRD3 as follows:

1. Maize was the main starch staple in the domain, closely followed by sorghum.
2. Hybrid maize was the major cash crop.
3. Sorghum was important for beer brewing, which was a significant source of income.
4. Oxen were the main source of draft power.
5. Labor was limited, especially during December and January.
6. Birds were a common pest of sorghum, finger millet, and sunflower, and much labor was needed for bird scaring.

The data collection was undertaken in order to better understand the problems being worked on. The problems identified by the researchers included (1) late planting of hybrid maize, (2) use of retained hybrid maize seed, (3) soil fertility problems on sandveldt soils, (4) poor sorghum husbandry, and (5) labor constraints in bean production because of land preparation.

TRIALS CONDUCTED ON THE PROBLEM AREAS

Based on survey findings, a trial program was designed as a means of solving some of the problems farmers were facing. The trials involved using the farmers' land and labor, while the managerial input was pro-

vided by the ARPT, which also undertook the risk element of the trial. A special effort was made to get farmers' perceptions of the results of the experiments. At the end of each research program, researchers met with men and women farmers to discuss the results. Questions were directed specifically to women where they had responsibility for cultivation. The trials conducted on the problem areas are treated below.

Residual Effects of Lime on Maize and Sunflower

The objective of the trial was to study the residual effects of lime on hybrid maize and sunflower. This trial was addressed specifically to the problem of pops (empty shells) in groundnuts, for which the application of lime would be a solution. A previous trial had indicated significant increased yields in the groundnut variety Mt. Makulu Red with the application of 1,000 kilograms of lime per hectare; there was little to no increase in the local variety. However, since lime was expensive, its application to groundnuts only, which are grown on small hectarage and are used largely for home consumption, might not be profitable. The study therefore was aimed at assessing the residual effect on maize and sunflower, which are usually grown following groundnuts in the farming system.

The trial was conducted on three farms on plots which had been planted the previous year to Mt. Makulu Red (an introduced variety) and local varieties of groundnuts. This was a long-term trial and the results wouldn't be conclusive until the trial had run on the same plots for five seasons. Appendix 8-A presents a list of the protocols and results from this trial.

Evaluation of Herbicides for Zero-Tillage Maize

This experiment evaluated the agronomic and economic feasibilty of zero-tillage as a technique for encouraging early maize planting by reducing the land preparation bottleneck and the need for hiring oxen. The trial was conducted on four farms and on the Kabwe Regional Research Station.

Treatments were with Gesaprim, Primagram, and Gramoxone alone, and in combinations of Gramoxone plus Gesaprim and Gramoxone plus Primagram and conventional land preparation. A seventh treatment with the application of Dieldrin for insect control was included by a split-block design. Results of weed counts showed that Gramoxone in combination with Gesaprim or Primagram provided significantly better weed control than conventional tillage. There were nonsignificant differences beween treatments in the number of eaten, diseased, and marketable ears or stand counts. Yields from the Gramoxone-Gesaprim combination were greater than those of conventional land preparation, but the differences were not statistically significant. Economic analysis indicated that the variable costs of the herbicide treatment were less than those of land preparation with oxen due to a saving of labor for weeding and the elimination of the

need to hire oxen. Therefore the net benefits of the herbicide treatment exceeded those of conventional land preparation (K 1,250 versus K 1,037), and the marginal rate of return on investment was 433.6 percent which adequately covered the cost of borrowing capital. Though there was some reduced insect damage with the use of insecticide, it was uneconomical to apply. Similar results were obtained from the Kabwe Research Station, where it was found that perennial weeds were much more common and persistent. None of the herbicide treatments was effective in controlling these perennial weeds.

Exploratory Study on Local Sorghum

The study was designed to identify areas of improvement in the management practices of traditional sorghum growers. The trial, on three farms, looked at planting methods and fertilization. It was observed that the broadcast and transplant method spread labor over a longer period of time than did the row-planting method. A list of the protocols and results of this trial is given in Appendix 8-B.

Newly developed short-season commercial sorghum varieties which could be planted in January were also tried on two farms and on the research station. Planting was done on different dates and with and without fertilization. The trial failed on the farms because of poor seedling establishment and the presense of striga, though the farmers' local varieties were unaffected. On the research station various treatment combinations resulted in yields ranging from 1,800 to 3,870 kilograms per hectare. During the year, the government support price was raised to K 40 per 90-kilogram bag as an incentive for the farmers to grow more sorghum for sale.

Maize Variety Trial

The objective of the study was to assess the performance of short-maturing varieties as a way of overcoming the problems of the short rainy season and late planting. Different hybrid varieties were planted at different planting dates. A variety called Across 7844 from Mexico outperformed all the other varieties.

Together with other varieties, Across 7844 was tested under farmer conditions on farmers' fields. It outyielded most of the other varieties including the widely used variety (SR52), and it had additional agronomic advantages such as a short maturity period, a short stem enabling easy harvesting by hand, resistance to common maize diseases such as cob rot, and hard kernels which made it resistant to weevils during storage.

Bean Intercropping Trial

The main objective of this trial was to test the intercropping of maize and bean yields on prepared fields. It was hoped that the intercropping of beans

with maize in fields prepared by tractor or oxen would save female labor (from land preparation in their own fields), increase hectarage, and increase bean yields indirectly from the fertilizer applied to maize. Weeding for maize and beans could be done simultaneously. The trial was conducted on five farms and five treatments were used: (1) maize and beans planted in the same row, (2) maize and beans planted on the same hill, (3) beans planted between maize rows, and control plots of pure stands of (4) beans and (5) maize. All but the control plot of beans were given the standard fertilizer treatment for maize. Results showed no reduction in maize yields because of intercropping. Beans grown in the same row or same hill as maize showed an increase in yields; those grown between rows had lower yields.

Farmer Views

At the end of the season, the ARPT team discussed the trials with farmers. Team members doing the labor survey also gained farmers' views in the course of collecting information on activities. Farmers expressed considerable interest in the herbicides as a labor-saving technology in planting maize and supported the need for further research. In the maize variety tests, male farmers were very excited by the variety Across 7844 and most of them were willing to try it. However, the women asked were not happy with the variety. Its hard kernels meant longer time for pounding or more money for machine grinding.

Discussions with male and female farmers indicated that, by intercropping beans with maize, beans became a men's crop and marketing decisions would now be made by males. It would now be viewed more as a cash crop and no longer as a relish crop. Males expressed reservations about the intercropping because the AFC required growing maize in a pure stand. The new support price for sorghum was received with a lot of enthusiasm by the male farmers. Women argued that as long as sorghum remained such a labor-intensive crop, acreage expansion would be very limited. Farmers were positive about the residual lime experiment, but were reserving judgment until the full set of trials were completed.

FEMALE-HEADED HOUSEHOLD SURVEY

In 1985, a formal survey of female-headed households in Central Province was undertaken by the ARPT.[1] The study was based on a five-page questionnaire covering seven subheadings (general, maize husbandry, cropping pattern, input usage, labor, cash sources, and decision making). Four enumerators were used and 135 female-headed households were sampled in the vicinity of six extension stations. Because of difficulties in recruiting female enumerators, male trial assistants who had lived and worked in the area were the enumerators. Of the completed questionnaires, 88 were

from Mkushi District. The main characteristics of male- and female-headed households in Mkushi District are shown in Table 8-7. A marked difference between male- and female-headed households was that female farmers reported being busier during the months of May to July, which corresponds with the period of bird scaring in sorghum, maize harvest, and maize shelling. Additional findings showed that 41 percent of the female farmers were heads of their own villages; others lived in villages headed by their brother, uncle, mother, grandfather, or son.

Overall, most of the farms had been in operation for four to six years. Characteristics of their households and farming practices are presented in Table 8-8. The size of acreage planted to maize was shown by regression analysis to be correlated with the presence of a greater number of adult males, adult females, and oxen on the farms. As shown in Table 8-9, analysis of households with and without men present showed marked differences in household size (2.0 without men, 5.5 with men). In households with men present, oxen ownership, labor hiring, and the importance of crop sales increased. Labor hiring was for the periods of land preparation, maize weeding, and maize harvest.

Maize occupied 34 percent of the cropped land followed by sorghum on 24 percent. Though maize *nshima* is preferred to sorghum *nshima*, sorghum was frequently planted on new land because it was less risky, and sorghum beer could be used to hire labor for periods of labor shortage. Hybrid maize varieties were grown by 65 percent of the maize grow-

Table 8-7

Main Characteristics of Male- and Female-Headed Households (HH) in TRD3

	Male HH	Female HH
Avg. family size (#/household)	6.5	3.7
Avg. area cultivated (ha)	6.5	1.3
Avg. maize acreage (ha)	2.0	1.0
Percentage cultivated (%)	18.8	5.0
Own oxen (%)	43.9	15.9
Own ox implements (%)	43.9	14.8
Hire oxen (%)	27.0	38.6
Hire labor (%)	50.0	48.9
Use hired labor for plowing (%)[a]	5.0	29.6
Purchase maize seed (%)	81.0	33.0
Use fertilizer on maize (%)	88.0	56.8
Cash source	Maize/beer	Chickens/mushrooms
Cash crops	Cotton/sunflower	Squash/pumpkins/beans

Source: Adapted from R. E. Hudgens (1988), 378.
[a]Refers to subgroup of farmers who hire labor.

Table 8-8

Statistics on Female-Headed Households in TRD3

	Measurements
Firewood collection (hr/day)	2.4
Water collection (hr/day)	2.9
Food preparation (hr/day)	3.0
Maize plant height at basal fertilizer dressing (cm)	7.8
Bags of basal fertilizer/ha	8.6
Maize plant height at fertilizer top dressing (cm)	72.4
Bags of top dressing fertilizer/ha	9.1
Total maize production/# bags	10.4
Farmers (%)	
Own knapsack sprayers	7.1
With male working children	12.7
With female working children	12.7
Unmarried with children	5.7
Hire oxen equipment	6.9
Borrow oxen equipment	1.2
Use hybrid maize seed	58.0
Prepare land with hand hoe	29.9
Dribble maize seed behind ox plow	16.2
Clear land annually	71.2
Buy seed for crops	38.0
Receive remittances	34.5

Source: Adapted from R. E. Hudgens (1988), 384.
Note: The sum of these percentages exceeds 100 percent only because some oxen owners also hire and borrow oxen.

ers, but only 52 percent reported buying seed. Most farmers owned chickens. In addition to chickens and mushrooms, female farmers also sold caterpillars, *munkoyo,* and crops. The survey reported that most farm production decisions were made by the women, but, in 15 percent of the cases, male relatives helped decide.

After reviewing the results from several sets of trials and further surveys, the ARPT team evaluated the year's work and began planning the next season's program.

NOTE

1. This material was drawn principally from Robert Hudgens, "Diagnostic Survey of Female Headed Households in the Central Province of Zambia," in *Gender Issues in Farming Systems Research and Extension,* edited by Susan V. Poats, Marianne Schmink, and Anita Spring (Boulder: Westview Press, 1988).

Table 8-9

Comparison of Female-Headed Households in TRD3

	Presence of Men		Oxen Ownership		Size of Holding	
	Without Men	With Men	Without Oxen	Oxen Owners	<3.5 Acres	>3.5 Acres
Marital status percentages						
Divorced	45.0	29.0				
Widowed	33.0	22.0				
Married w/husband elsewhere	10.0	27.0				
Family size (#/household)	2.0	5.5	3.5	3.5	3.8	3.50
Area cultivated (ha)	7.4	7.9	6.9	10.1	4.9	13.60
Maize cultivated (ha)	6.9	5.7	6.2	6.7	4.4	9.10
Percentage of households						
Own oxen	11.9	22.0	—	—	25.0	60.00
Hire oxen	38.0	35.0	39.2	8.0	14.3	22.21
Borrow oxen	19.0	13.0	—	—	11.0	8.00
Hire labor	43.0	51.0	41.9	57.0	38.0	67.01
Purchase maize seed	41.9	41.0	29.7	36.4	34.0	51.00
Use fertilizer	67.0	68.0	62.2	71.0	57.0	89.01
Listen to radio	39.0	46.0	51.4	50.0	40.0	46.00

Source: Adapted from R. E. Hudgens (1988), 380.

Appendix 8-A: Results of On-Farm Trials: Effects of Lime on Groundnuts, Maize, and Sunflower

1. Title	The immediate and residual effect of lime at three rates on groundnuts and two cash crops (hybrid maize and sunflower) grown in two cropping systems over a three-year period
2. Location	Three farms in TRD3 (Mkushi District)
3. Objectives	To evaluate the residual effects of three rates of lime applied to two varieties of groundnuts the previous season. The residual effects will be measured by the productivity of maize and sunflower.
4. Treatments	a) Lime at 0, 500, and 1,000 kg/ha (applied during the 1982/83 season) b) Sunflower variety CCA75 c) Maize variety SR52
5. Design	A randomized complete block design (RCBD) was superimposed on the RCBD of the groundnut study of the previous season.
6. Plot size	4.5 m x 6.0 m = 27 m^2 (Experimental area 4.5 m x 5.0 m = 22.5 m^2)
7. Management	a) Row spacing was 75 cm for both crops. Within row spacing was 25 cm for maize and 30 cm for sunflower. b) Maize plots were to be planted in mid-November with the first heavy rains of the season when land preparation was complete. Sunflower plots were planted in late December. c) Maize plots received both basal and top dressing fertilizer at the standard rates for farmers in the area according to the diagnostic surveys, but the sunflower plots were not fertilized.
8. Criteria for evaluation	a) Soil analysis b) Plant stand at emergence and at harvest c) Pest incidence d) Yield and yield components e) Economic net benefit
9. Dates	Planting dates were delayed because of delays in land preparation. The first site was planted on 29 November 1983, but the last site was not planted until 17 December 1983. Sunflower was planted on all sites on 19–20 December 1983. The trials were all harvested on 7 May 1984.
10. Records taken	a) Plant stand at emergence and at harvest b) Insect and disease damage on maize ears c) Yield of both maize and sunflower d) Shelling percentages and moisture content
11. Results	The results of this experiment for both crops are summarized in Tables 8-A.1, 8-A.2, and 8-A.3.

Source: ARPT Central Province (1983/84).

Table 8-A.1

Summary of Maize Results: Lime Study—Year 2 (TRD3)

Treatment	Stand at Emergence	Stand at Harvest	Diseased Ears	Eaten Ears	Good Ears	Yield
	pl/m^2	pl/m^2	#/m^2	#/m^2	#/m^2	kg/ha
MM Red						
L/0	5.19	5.35	0.42	0.43	3.80	8,466.6
L/1	5.20	5.40	0.28	0.30	4.53	8,786.4
L/2	5.19	5.25	0.67	0.37	4.17	9,034.2
Local						
L/0	5.21	5.50	0.67	0.20	4.37	7,870.7
L/1	5.31	5.33	0.42	0.19	4.49	7,614.9
L/2	5.27	5.25	0.60	0.37	3.57	7,957.9
% CV	1.41	9.99	61.26	80.86	13.90	10.63
LSD/0.05	—	—	—	—	—	—

Source: ARPT Central Province (1983/84).
Key: pl = plants; MM Red = Mount Makulu Red.

Table 8-A.2

Summary of Sunflower Results: Lime Study—Year 2 TRD3

Treatment	Stand at Emergence	Stand at Harvest	Yield
	pl/m^2	pl/m^2	kg/ha
MM Red			
L/0	3.69	4.40	1,141.7
L/1	3.72	4.30	957.9
L/2	4.25	4.10	1,148.3
Local			
L/0	4.14	4.48	1,038.3
L/1	4.13	4.45	1,291.7
L/2	4.25	5.10	1,225.0
% CV	4.56	19.80	24.89
LSD/0.05	—	—	—

Key: pl = plants; MM Red = Mount Makulu Red.

Table 8-A.3

Summary of Residual Effects of Lime on Crop Yields

Lime Treatment Level	Maize	Sunflower
0 kg/ha	8,162	1,090
500 kg/ha	8,[illegible]	1,245
1,000 kg/ha	8,496	1,187

Appendix 8-B: Results of On-Farm Trials Exploratory Study of Planting Method and Fertilization

1. Title	Exploratory study on planting method and fertilization of local (traditional) sorghum
2. Location	Three farms in TRD3 (Mkushi District)
3. Objectives	a) To compare farmer planting method (broadcasting) with row planting b) To evaluate the use of LIMA fertilizer recommendations for sorghum compared to farmer practice (not fertilizing)
4. Treatments	a) Planting method--broadcasting and row planting b) Fertilization—0 fertilizer and 200 kg "X"/ha
5. Design	This experiment was set up as a 2 x 2 complete factorial in a randomized complete block design with two replicates/farm site.
6. Plot size	4.5 m x 5.0 m = 22.5 m^2
7. Management	a) Land preparation was accomplished according to farmer practice, and planting was done by hand. b) Row planting treatments had row spacing of 75 cm with 15 cm between plants in the row. c) Broadcast planting treatments used the same quantity of seed as plots receiving the row-planting treatments. d) Farmers provided the seed of the local sorghum variety used in the experiment. e) Fertilized plots received a broadcast application at planting, but no top dressing fertilizer was applied.
8. Criteria for evaluation	a) Soil analysis b) Plant stand at emergence and at harvest c) Plant height at harvest d) Yield e) Economic net benefit
9. Dates	Planting dates were 22–29 of November 1983. Although one site was lost, the other two were harvested on 19 June 1984 and 15 July 1984.
10. Records taken	a) Stand count at emergence and at harvest b) Plant height (2 plants/plot) c) Yield, shelling percentage, and moisture content
11. Results	The results of this experiment are summarized in Table 8-B.1

Source: ARPT Central Province (1983/84).

Table 8-B.1

Summary of the Results for the Local Sorghum Experiment

Treatment	Stand Count Emergence	Stand Count at Harvest	Plant Height	Yield
	pl/m^2	pl/m^2	m	kg/ha
Planting method				
Broadcast	6.84	5.73	1.69	521.1
Row	6.90	6.07	1.97	550.7
Fertilizer				
0 Fertilizer	6.74	5.54	1.45	477.8
200 kg X/ha	7.00	6.26	2.21	594.0
% CV	24.98	32.57	20.85	29.73
LSD 0.1	—	—	0.60	—

Key: pl = plants.

Notes:

1. One site of this experiment (2 reps) was abandoned because of poor stand establishment. Witchweed (*Striga* sp.) was noted on another site but the trial was not seriously affected. The local sorghum variety seemed to tolerate poor growing conditions and infertile soils, but yield levels were exceptionally low.
2. There was a significant planting method by fertilizer interaction, in which the broadcast treatment showed a greater yield response to fertilizer than did the row-planting treatment. Plant height increased in plots to which fertilizer had been applied.

Contributors

Jacqueline A. Ashby is a Rural Sociologist with a Ph.D. from Cornell University currently coordinating a project on farmer participation in the design and transfer of technology at the Centro Internacional de Agricultura Tropical (CIAT) in Colombia, South America. Dr. Ashby previously worked with the International Fertilizer Development Center (IFDC) as a Social Scientist in a multidisciplinary, on-farm research team. She has also conducted research on the diffusion of green revolution technology in Nepal. Her various publications include most recently a bibliography of *Women in Latin American Agriculture*, which won the 1987 Oberly Award of the American Library Association. Dr. Ashby's ongoing activities include the production of videos and other training materials on techniques for participatory research with farmers, and on techniques for integrating gender issues and intrahousehold differences into participatory research methods.

Doyle C. Baker is an Agricultural Economist with a Ph.D. from Michigan State University. He currently is working with the International Institute of Tropical Agriculture as the Senior Agricultural Economist for the National Cereals Research and Extension Project, Cameroon, conducting on-farm research in the semihumid zone, coordinating four on-farm research teams and analyzing support systems affecting technology adoption. Previously, as the Farming Systems Economist for the Agricultural Technology Improvement Project in Botswana, Dr. Baker designed, implemented, and analyzed farm-level surveys and agronomic experiments.

Louise E. Buck has an M.Sc. in Natural Resource Planning from Colorado State University and most recently was the Regional Technical Advisor on Agriculture and Natural Resources for CARE International, Nairobi. In this position, she designed projects and extension curricula and did staff training and technical backstopping for thirteen projects in nine countries. She earlier developed the Kenya Agroforestry Tree Seed Project, which assessed the availability and identification of species for five agroclimatic zones, and the Mazingira Institute Agroforestry Plots Project, which monitored the introduction of agroforestry interventions to rural smallholders in Kenya. Ms. Buck's *Agroforestry Extension Training Sourcebook* has been published by CARE International, Nairobi, Kenya.

Charles Chabala received his M.Sc. in Agricultural Economics from the University of Illinois and is currently employed as Senior Economist and Head of the Agricultural Policy and Planning Department of the Zambia Cooperative Federation Limited in Zambia. The Zambia Cooperative Fed-

eration is the apex organization for the cooperative movement in Zambia, and represents approximately 400,500 small-scale farmers across the country. He was formerly the Farming Systems Research Economist and Provincial Adaptive Research Planning Team Coordinator for Lusaka Province, responsible for linkage with commodity specialist research teams as well as for agroeconomic and socioeconomic diagnostic surveys and evaluations to identify production constraints and viable technologies for small-scale commercial and traditional farmers. Prior to entering the University of Illinois, he conducted a labor survey in Central Province as part of the Adaptive Research Planning Team.

Kathleen Cloud is currently the Director of the Office for Women in Development at the University of Illinois. She has a doctorate from Harvard in Administration, Planning, and Social Policy. Dr. Cloud is a coauthor of the Harvard analytic framework on gender roles and development projects, and coeditor of gender analysis case studies prepared for the World Bank and the United States Agency for International Development. She is the author of a number of papers on women's roles in agricultural systems, and has directed a series of projects on women's roles in world food systems.

Carol J. Pierce Colfer is an Associate Professor at Sultan Qaboos University, College of Medicine, in the Sultanate of Oman. She has a Ph.D. in Anthropology from the University of Washington. Previously she was the Team Leader and Farming Systems Researcher for the University of Hawaii with the Tropsoils Project in Sitiung, Indonesia. Dr. Colfer has done research on energy for rural development with the East-West Resource Systems Institute and on interactions between people and forests in East Kalimantan for the U.S. Man and Biosphere. For two years she was the Women in Development Specialist for the University of Hawaii.

Hilary Sims Feldstein is an independent consultant and Co-director of the Gender and Agriculture Project. She has an M.A. in Anthropology from University of California at Los Angeles and an M.P.A. from the John F. Kennedy School of Government, Harvard University. Ms. Feldstein has previously been an Associate Program Officer with the Ford Foundation in New York City and in Nairobi, Kenya, she has done program evaluations for the African Medical Research Foundation, and the United States Agency for International Development. She has conducted training activities on gender analysis in development projects and in agricultural research for the International Development Research Centre, the United Nations Development Program and the World Bank.

Robert N. Gichira is a professional consultant to the International Labor Organization (ILO) in Nairobi, Kenya, and a doctoral candidate at the University of Illinois. His research is on evaluating small business development training programs in Kenya. For ILO he trains trainers in business manage-

ment and coordinates entrepreneurship education programs in the youth polytechnics.

Joseph G. Nagy, a Canadian citizen, is employed by the International Food Policy Research Institute, Washington, D.C. He is stationed at the International Fertilizer Development Center's African office in Lome, Togo. Dr. Nagy received his Ph.D. in Agricultural and Applied Economics from the University of Minnesota. Previously, he worked as Principle Economist for the International Center for Agricultural Research in Dry Areas in Pakistan on farming systems research, and he conducted research on the same topic in Burkina Faso for Purdue University/SAFGRAD. Dr. Nagy is co-owner of a family farm in Yarbo, Saskatchewan, Canada.

Rosalie Huisinga Norem is the advisor for agriculture and natural resources for Program and Policy Coordination/Women in Development/United States Agency for International Development. She received her Ph.D. from the University of Minnesota in Family, Social Science, and Psychology. She is on leave from Iowa State University. Dr. Norem has written in the areas of training in farming systems, families and international development, women in development, and communications and farming systems.

Herbert Ohm grew up on a grain and livestock farm in southern Minnesota. He received his M.S. degree in Agronomy from North Dakota State University and his Ph.D. in Genetics and Plant Breeding from Purdue University. Dr. Ohm is currently Professor of Agronomy in the Agronomy Department of Purdue University. From 1983 to 1985, Dr. Ohm served as Team Leader of the Purdue University Farming Systems Unit for the SAFGRAD Project, stationed at Ouagadougou, Burkina Faso.

Thelma R. Paris is an Assistant Scientist in the Department of Agricultural Economics of the International Rice Research Institute (IRRI). She has an M.S. in Agricultural Economics from the University of the Philippines, Los Baños. Ms. Paris is involved in action research in a farming systems project and has conducted intensive field studies on incorporating nutrition and women in farming systems research. She is currently Assistant Coordinator of the Women and Rice Farming Systems Network based at IRRI. For the past three years, she has been conducting action research on gender issues, training, and networking to facilitate the incorporation of women's components into research and development activities of national agricultural systems, farming systems projects, agricultural universities, and within IRRI.

Susan V. Poats is an Agricultural Anthropologist and Co-director of the Gender and Agriculture Project. She received her Ph.D. from the University of Florida in 1979 after completing a field study in the Brazilian Amazon on preschool malnutrition. Dr. Poats worked from 1979 to 1983 for the International Potato Center (CIP), Lima, Peru, as a postdoctorate fellow. She was the associate director of the Farming Systems Support Pro-

ject (FSSP), University of Florida/USAID, from 1983 to 1987 and was responsible for training activities concerning gender analysis in agricultural research and development. In April 1990 she joined the Centro Internacional de Agricultura Tropical (CIAT) as the social scientist for the cassava program and is based in Quito, Ecuador.

Dianne E. Rocheleau is currently an Associate Professor of Geography at Clark University, Worcester, Massachusetts. Formerly she was a Program Officer with the Ford Foundation in Nairobi, Kenya. Dr. Rocheleau has a Ph.D. in Geography from the University of Florida. She has conducted ecological research on hillslope farming systems in the Dominican Republic (1979–81) and has worked as a Rockefeller Foundation Fellow and Senior Scientist at the International Council for Research in Agroforestry (1983–86), focusing on environmental and equity issues and community-based research in agroforestry.

Sibiri Sawadogo was born in the northern central plateau of Burkina Faso and received a B.A. and M.Sc. in Agricultural Economics from Laval University, Québec, Canada. He is currently working as a Farming System Research Specialist for a Canadian International Development Agency (CIDA) funded project in Rwanda, Central Africa. Previously Mr. Sawadogo worked jointly with the Purdue University farming system research team within the SAFGRAD/FSU for four years and led the Burkina Faso national farming system research program for two years.

Vickie A. Sigman has a Ph.D. in Agricultural Education from the University of Illinois. Her specialty is development communication. She was the co-investigator for a study of women's participation in agricultural and home economics educational institutions in the Third World and helped develop an agricultural communications training program for Latin America. Dr. Sigman is currently the Agricultural Extension Specialist with the Tropsoils Project, working with extension, research, and farmers in Indonesia.

Kathleen Wilson is Associate Professor of Urban and Regional Planning at the University of Hawaii and the Project Coordinator of the Agricultural Systems Task Force for the National Agricultural and Natural Resources Curriculum Project that was designed to review the higher education curriculum in agriculture. She has a Ph.D. in Non-Formal Education from Michigan State University and is the author of twenty-two books on community resource development.

Russell Yost is a Researcher in the Department of Agronomy and Soil Science, College of Tropical Agriculture and Human Resources, at the University of Hawaii. He has a Ph.D. from the Department of Soil Science at North Carolina State University. Dr. Yost's major research interest is expert systems, and, in that capacity, he developed an expert system for managing soil acidity with the Tropsoils Project in Sitiung, Indonesia.

259 -

Other important books from the Kumarian Press Library of Management for Development

A Winner!
Best Book, World Hunger Media Awards

Change in an African Village: Kefa Speaks
by Else Skjønsberg

❖ ❖ ❖

Getting to the 21st Century: Voluntary Action and the Global Agenda
by David C. Korten

Keepers of the Forest: Land Management Alternatives in Southeast Asia
edited by Mark Poffenberger

Reports that get Results: Guidelines for Executives
by Ian Mayo-Smith

Training for Development Second Edition
by Rolf P. Lynton and Udai Pareek

❖ ❖ ❖

Gender Roles in Development Projects: A Case Book
edited by Catherine Overholt, Mary B. Anderson, Kathleen Cloud, and James E. Austin

Managing Organizations in Developing Countries: A Strategic and Operational Approach
by Moses N. Kiggundu

Transforming a Bureaucracy: The Experience of the Philippine National Irrigation Administration
edited by Frances F. Korten and Robert Y. Siy, Jr.

Women's Ventures: Assistance to the Informal Sector in Latin America
edited by Marguerite Berger and Mayra Buvinic

❖ ❖ ❖

For a complete catalog of Kumarian Press titles, please write or call:

Kumarian Press, Inc.
630 Oakwood Avenue, Suite 119
West Hartford, CT 06110-1529 USA

Tel: (203) 953-0214 ❖ **Fax:** (203) 953-8579