

THESIS

2

2003

5902261

LIBRARY
Michigan State
University

This is to certify that the

thesis entitled

ASSESSING AGRICULTURAL DEVELOPMENT INTERVENTIONS
IN THE WESTERN HIGHLANDS OF GUATEMALA:
A FARMER CENTERED APPROACH

presented by

Paul L. Van Tongeren

has been accepted towards fulfillment
of the requirements for

Master of Science degree in Resource Development



Major professor

Date 2-21-03

PLACE IN RETURN BOX to remove this checkout from your record.
 TO AVOID FINES return on or before date due.
 MAY BE RECALLED with earlier due date if requested.

DATE DUE	DATE DUE	DATE DUE
NOV 05 2005 05 26 05		
AUG 21 2007 08 22 07		

**ASSESSING AGRICULTURAL DEVELOPMENT INTERVENTIONS IN THE
WESTERN HIGHLANDS OF GUATEMALA: A FARMER CENTERED APPROACH**

By

Paul L. Van Tongeren

A THESIS

**Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of**

MASTER OF SCIENCE

Department of Resource Development

2003

ABSTRACT

ASSESSING AGRICULTURAL DEVELOPMENT INTERVENTIONS IN THE WESTERN HIGHLANDS OF GUATEMALA: A FARMER CENTERED APPROACH

By

Paul L. Van Tongeren

Growing numbers of agricultural development organizations working with resource-poor farmers are promoting resource conserving agricultural technologies (RCATs) as a strategy to improve food security and farm family livelihoods in developing countries. Researchers have found that non-adoption and discontinuance of these technologies is frequently high. Most traditional approaches to assessing these interventions fail to reveal the reasons behind farmers' adoption, non-adoption, or discontinuance of these technologies; they also tend not to explore long-term impacts of the interventions. This study examines stakeholder experiences with agricultural development organizations promoting RCATs in four villages in the western highlands of Guatemala. The study explores the diverse factors that influence farm household participation in agricultural development groups and the adoption, rejection, continuance or discontinuance of the promoted RCATs. The study also analyzes the long-term impacts of the interventions. Finally, recommendations for research and development practice are presented.

ACKNOWLEDGMENTS

This research project would not have been possible without the support of many people. First, I want to thank the farmers and development professionals who generously gave of their time to participate in this research. I wish to thank my good friends in Guatemala, especially in Ixchiguan, who have opened their homes and lives to me and have shown me so much generosity.

I also want to thank my family. My parents introduced me early in life to the joy of helping others and always supported me in my work and studies. My brother, Mark, provided valuable technical help as well as encouragement. My wife, Ellen, was a tremendous source of encouragement throughout the process of writing this thesis.

Dr. Scott Witter, my academic advisor, provided valuable support throughout my graduate program. My other committee members, Dr. Craig Harris and Dr. John Kerr, offered valuable suggestions that greatly improved this research. Dr. Kerr provided especially helpful suggestions during the writing process.

My studies at Michigan State University would not have been possible without the generous support of the Center for the Advanced Study of International Development (CASID) and the Center for Latin American and Caribbean Studies (CLACS).

Above all, I thank God for the opportunity to pursue graduate study and for bringing the above people into my life. My life is fuller for having known them.

TABLE OF CONTENTS

LIST OF TABLES.....	viii
LIST OF FIGURES.....	ix
LIST OF ABBREVIATIONS.....	x
CHAPTER ONE	
INTRODUCTION.....	1
Introduction.....	1
Problem Analysis.....	3
Assessing Technology Adoption.....	3
Evaluating Agricultural Development Projects.....	4
A More Holistic Approach to Assessment.....	5
Purpose of the Research.....	6
Research Directions.....	6
Significance of the Study.....	7
The Research Methodology.....	8
Context of the Case Study.....	9
Organization of the Study.....	11
CHAPTER TWO	
LITERATURE REVIEW.....	12
Chapter Introduction.....	12
Agricultural Development Interventions for Small-scale Farmers.....	12
Goals.....	12
Strategies.....	13
Resource Conserving Agricultural Technologies.....	14
Commonly promoted technologies.....	15
The Agricultural Development Process.....	18
Participation.....	18
Subsidies.....	18
Focusing on the Farmers.....	20
Objectives of Farm Households.....	20
Farmers' Objectives in Technology Adoption.....	22
Farming Systems.....	23
Assessing Interventions that Promote Resource Conserving Technologies.....	24
Constraints to Adoption.....	25
Cost/Benefit Analysis of Technologies.....	25
Combined Approaches.....	27
Participatory Impact Studies.....	28
Systems Approaches to Research.....	29
Farming Systems Research Approaches.....	30
Using a Farming Systems Approach for Assessment.....	31
The Context for Agricultural Development in Central America.....	32

Biophysical and Agroecological Context.....	32
Socioeconomic and Political Context.....	33
Farming and Livelihood Systems in Guatemala.....	33
History of Agricultural Development for Smallholder Farm Households.....	34
Government efforts.....	34
Non-governmental organizations.....	36
The Qualitative Research Paradigm.....	37
Qualitative Evaluation.....	38
 CHAPTER THREE	
RESEARCH DESIGN.....	39
Design Strategy.....	39
Entry.....	39
Site Selection.....	40
Sample Size.....	40
Informed Consent.....	41
Data Collection	41
Data Collection Methods.....	41
Open-ended, Informal Interviews.....	42
Key Informant Interviews.....	42
Observation.....	42
Review of Documents.....	43
Data Collection Process.....	43
Data Analysis.....	45
Verification of Results.....	46
Transferability.....	47
 CHAPTER 4	
DESCRIPTION OF THE CASES.....	48
Chapter Introduction.....	48
The Region.....	48
The Villages.....	50
Los Pinos.....	50
Tres Rios.....	52
San Lucas.....	53
Vista Bonita.....	54
The Agricultural Development Organizations.....	55
NGO 1.....	56
GO 1.....	57
NGO 2.....	58
GRO 1.....	59
NGO 3.....	59
NGO 4.....	60
GO 2.....	61
GO 3.....	62

CHAPTER 5

FINDINGS.....	63
Chapter Introduction.....	63
Initial Adoption of Resource Conserving Agricultural Technologies.....	63
Adoption Through Project Participation.....	63
Levels of Participation.....	63
Reasons for Participation.....	64
Constraints to Participation.....	66
Spontaneous Adoption of Resource Conserving Technologies.....	68
Implementation and Farmer Assessment of the Technologies.....	69
Composting.....	69
Soil and Water Conservation.....	70
Farming without Chemical Fertilizer.....	75
Improved Agropastoral System.....	76
Other Project Components.....	77
Vegetable gardens.....	77
Irrigation.....	78
Credit.....	78
Post-Project Continuance and Discontinuance of the Promoted Technologies.....	79
What Happens When Subsidies Stop.....	79
Other Factors Influencing Continuance and Discontinuance of RCATs.....	80
Composting.....	81
Soil and water conservation.....	82
Vegetable production.....	82
Impacts of Agricultural Development Interventions.....	83
Improved Skills.....	83
Increased Production.....	84
Reduction in Seasonal Migration.....	85
Alternative explanations for the decrease in seasonal migration.....	86
Exploring Differences in the Impacts of Agricultural Development Interventions.....	86
Differences Between Farm Households.....	86
Comparing Constraints to Agricultural Improvement Between Villages.....	87
Comparing Impacts on Livelihoods—the Case of Potato Production	87

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.....	93
Summary.....	93
Initial Adoption of Resource Conserving Agricultural Technologies.....	95
Spontaneous Adoption.....	96
Farmer Assessment of Promoted Technologies.....	96
Post-Project Continuance and Discontinuance of RCATs.....	97
Impacts of Agricultural Development Interventions	98
Explaining Differences in Impacts.....	99
Conclusions.....	99
Initial Adoption	99
Subsidies and incentives.....	100

Factors Influencing Continuation or Discontinuation of Technologies.....	101
Outcomes of the Interventions on Farm Household Livelihoods.....	102
Recommendations for Future Research.....	104
Recommendations for Development Practice.....	105
Lessons for the Future.....	106
APPENDIX.....	110
BIBLIOGRAPHY.....	116

LIST OF TABLES

Table 1. Constraints to Adoption of Resource-Conserving Technologies.....	26
Table 2. Yields of Common Crops in the Study Villages.....	51
Table 3. Livelihood Practices by Village.....	53
Table 4. Communities Where the Agricultural Development Organizations Work.....	56
Table 5. Participation in Agricultural Development Projects by Village.....	64
Table 6. Farmers' Use of Soil Conservation Technologies by Village.....	71
Table 7. Labor Requirements and Costs for Soil Conservation Technologies.....	72
Table 8. Comparison of Constraints by Group.....	88
Table 9. Comparison of Potato Yields by Village.....	89

LIST OF FIGURES

Figure 1. Map of Guatemala with the study location indicated.....	10
Figure 2. Determinants of Farming Systems.....	24
Figure 3. The Suchiate Watershed.....	48
Figure 4. Factors influencing the outcomes of agricultural development interventions on small farmer households.....	104
Figure 5. Live Barriers in San Lucas.....	110
Figure 6. Agroforestry System with Pasture Grasses and Arrayán in Los Pinos.....	110
Figure 7. Contour Ditches with Live Barriers in Los Pinos.....	111
Figure 8. Terraces and Contour Ditches in Los Pinos.....	111
Figure 9. A Rock Wall in San Lucas.....	112
Figure 10. Live and dead (sod) Barriers in Tres Rios.....	113
Figure 11. Rock Walls and Dead Barriers in Tres Rios.....	113
Figure 12. Maize Planted on Narrow Terraces in Vista Bonita.....	114

LIST OF ABBREVIATIONS

CBA	Cost / Benefit Analysis
CIMMYT	Centro Internacional para el Mejoramiento de Maíz y Trigo
FAO	Food and Agriculture Organization of the U.N.
FFW	Food for Work
FSR/E	Farming Systems Research and Extension
GO	Governmental Organization
GRO	Grassroots Organization
NGO	Non-governmental organization
RCAT	Resource-conserving agricultural technology
RRA	Rapid Rural Appraisal
SWC	Soil and water conservation
TOT	Transfer of Technology
USAID	United States Agency for International Development

CHAPTER 1

INTRODUCTION

Introduction

The improvement of agriculture in less-developed countries has been a central goal of international development interventions for over fifty years. Generally, these efforts have followed one of two basic paths: conserving resources and counteracting erosion through soil and water conservation, or increasing agricultural production through the introduction of modern technologies. While these efforts have had remarkable success in some contexts, by the 1970s scholars and development practitioners were noticing that these efforts were largely bypassing small scale farmers living on less productive lands.

This awareness led to many changes in agricultural research and development approaches. The realization of the differences between the ideal research station conditions and most small-scale farmers' contexts—often 'complex, diverse, and risk-prone'—led agricultural researchers in international agricultural development to develop approaches such as Farming Systems Research and Extension (FSR/E), in which agricultural technologies were developed under the conditions faced by farmers on less productive lands. In some cases, agricultural scientists managed the entire process and farmer involvement was limited. In other cases, development professionals recognized the value of collaborating with farmers throughout the entire technology development process and they began developing more participatory approaches such as Farmer First and farmer-to-farmer extension, which increased the effectiveness of a wide variety of agricultural development projects (Chambers et al. 1989; Bunch and López 1995). For soil conservationists working in less developed countries, the increasing awareness that

soil and water conservation (SWC) was not a high priority for farmers led them to replace an erosion control emphasis with more holistic land and soil management approaches such as Better Land Husbandry (Douglas 1996; Hudson 1992; Hurni et al. 1996; Young 1998). Farmers' traditional practices have also been receiving more attention (Thrupp and Altieri 2001). Agricultural development approaches such as Low External Input Sustainable Agriculture (see Reijntjes et al. 1992) and Agroecology (see Altieri 1995) have emerged to investigate, develop and promote less costly and more ecologically appropriate agricultural systems, based in part on farmers' traditional systems.

In summary, the last 20 years of international agricultural development have seen dramatic changes in approaches to agricultural research and development practice. Farmer participation in both research and project implementation has steadily increased. High-input technologies designed to maximize productivity are being replaced in many instances with lower-cost, resource-conserving technologies.

Yet despite all these changes in agricultural development thinking and practice over the last twenty years, the results remain disappointing. The non-adoption of supposedly more appropriate technologies is common, and the incidences of farmers abandoning conservation technologies as soon as a project pulls out or once the subsidies stop still seem to be the rule (Kerr 1998; Lutz et al. 1994; McDonald and Brown 1999; Reij 1988 in Pretty and Shah 1999; Scoones 1996; Witter et al. 1996). Even technologies and practices that farmers have evaluated as effective are not being continued (Cramb and Nelson 1998; Fujisaka and Garrity 1991; Scherr 1995). Based on this evidence, it is apparent that the agricultural development community is often repeating the failures of previous efforts in promoting resource-conserving agricultural technologies (RCATs).

Problem Analysis

A solid understanding of the reasons behind farmers' adoption, rejection, continuance or discontinuance of RCATs is crucial for agricultural development organizations as they seek to develop more effective approaches for their agricultural development approaches for their agricultural development programs. However, the traditional methods used to assess or evaluate agricultural development interventions contribute little to our understanding of those reasons.

Assessing Technology Adoption

Many approaches to evaluating RCAT projects examine technology adoption to determine the success of the intervention (Chambers 1997; Enters 1996; Pinheiro et al. 1998). This focus on adoption reflects the diffusion framework. According to this framework, individuals go through a process when they are exposed to a new innovation such as an agricultural technology. This process includes gathering more information, forming an opinion, deciding to try out the technology, implementing the technology, and then confirming the decision; the result of this process is either the adoption or rejection of the technology (Rogers 1995). According to this model, the lack of awareness of a problem and/or available solutions is the greatest barrier to adoption (Napier 1995). Studies following the diffusion tradition use surveys to gather information on technology adopters and non-adopters and to find the numbers of each. Then the characteristics of the adopter and non-adopter groups are compared in order to find the variables that predict adoption. The rate of adoption is also frequently studied, and farmer categories may be constructed based on the timing of adoption. Rogers (1995) notes how well the diffusion model corresponds with the conventional or modernist development paradigm,

in which the transfer of technology is central. In the transfer of technology (TOT) approach to agricultural research and extension, scientists generate technologies to solve the problems they have defined—usually technical and productivity problems—and farmers are the recipients of those technologies (Cramb and Nelson 1998; Enters 1996; Pinheiro et al. 1998; Turkelboom et al. 1996). In the TOT approach, it is often assumed that the technology works and should be adopted by the targeted population, an assumption which Rogers (1995) calls the pro-innovation bias. Thus it is assumed that the problem is solved once farmers adopt the technology (Pinheiro et al. 1998). Non-adoption may be blamed on farmers' ignorance or resistance to change, what Rogers terms the individual-blame bias. The appropriateness of the technology is not questioned.

Many researchers have pointed out the error of relying exclusively on measurements of adoption. Reports of high and rapid adoption rates may indicate that farmers have been pressured or persuaded to adopt the technology, rather than proof of the technology's success (Enters 1996). Other researchers note that adoption studies may interpret the willingness of farmers to try out a technology as evidence that they will maintain or expand the practice in the future, when that is not necessarily the case (CIMMYT 1993; Scherr and Muller 1991).

Evaluating Agricultural Development Projects

Traditional project-centered evaluation approaches also limit the generation of in-depth understanding necessary to improve the effectiveness of RCAT promotion. The information gathered in project evaluations has tended to measure the outputs of the project. Quantitative output measurements such as kilometers of walls and bunds constructed and hectares of land conserved, the number of tree seedlings produced, or the

number of farmers participating in training, are often used to determine whether or not the project reached its proposed targets. However, these measurements do not represent the longer-term impacts of conservation efforts because frequently the structures do not last or the practices are not implemented (Pretty and Shah 1999; Shrestha and Chhetri 1996); Enters (1996:403) calls these measurements “very misleading indicators for determining success or failure.”

Evaluations in international agricultural development have multiple purposes that are generally determined by the entity conducting the evaluation. Donors are likely the most frequent evaluators of projects; they often conduct evaluations to ensure that their money was spent as specified in the proposal or to determine whether the project should continue to receive funding (Jiggins 1995; Meyer and Singh 1997; Shepherd 1998). Project management may use evaluations to evaluate personnel. Evaluation for the purpose of learning from the experience is rare (Shepherd 1998).

The timing of project evaluations is also a factor. Numerous scholars point out that very few evaluations happen several years after projects have been completed (Bunch 1999; Maddock 1994; McDonald and Brown 2000). However, longer-term studies, conducted five or more years after the end of an intervention, may provide the best information regarding success (McDonald and Brown 2000).

A More Holistic Approach to Assessment

Recognizing the weaknesses of conventional assessment methods, many researchers are calling for a broader approach to assessment that includes the following objectives:

- Understanding the farmers’ perspectives on the technologies, the farmers’ constraints, and the reasons why they choose to adopt, adapt, reject, or

discontinue the technologies (CIMMYT 1993; Maglinao 1996; Norman et al. 1995; Rogers 1995)

- Recognizing the importance of the broader context (Hurni et al. 1996; Maglinao 1996; Pretty et al. 1996; Scoones 2001)
- Understanding what happens in the longer-term (Bunch 1999; McDonald and Brown 2000; Rogers 1995)
- Greater attention to the *processes* of adoption, adaptation, and discontinuance (Sims 1999)
- Using a systems approach in evaluation in addition to project design and implementation (Shrestha and Chhetri 1996)

Purpose of the Research

The purpose of this thesis is to improve our understanding of the outcomes of agricultural development interventions promoting resource conserving agricultural technologies. Using a systems approach to assessment and a case study of stakeholder experiences of agricultural development in the western highlands of Guatemala, this study explores the processes and the impacts of the promotion of RCATs in this context.

Research Directions

The research attempts to answer four main questions through an inductive approach:

1. **What factors influence whether or not farmers initially adopt the technologies and practices promoted by agricultural development**

- organizations?** Who participates in the projects? Why do they participate? What constrains farm households from participating? Do farmers adopt the technologies without participating in a project?
2. **How do the different stakeholders assess the effectiveness of the promoted resource-conserving technologies and practices?** What criteria do they use? What advantages, disadvantages, and constraints to adopting the technologies do they identify?
 3. **Do farming households continue to use the technologies and practices promoted by agricultural development organizations after the projects leave?** What factors affect the continuance or discontinuance of RCATs and other technologies?
 4. **What are the impacts of RCAT adoption on local farming systems and livelihood systems?** What type of impacts do farmers identify? What constraints to improved agricultural production and livelihood improvement do stakeholders identify? How do the impacts differ between households and in different villages?

Significance of the Study

This study focuses on the processes involved in the adoption of resource-conserving technologies, and the long-term impacts of those technologies in the context of small-scale farm households in the western highlands of Guatemala. The study will contribute to the literature on the outcomes of agricultural development interventions in this region. In addition, this study contributes to the literature on alternative methods for

assessment in agricultural development. This research can also aid development practitioners by increasing their awareness of the wide variety of factors that influence farmers' adoption and continued use of resource-conserving technologies, as well as those contextual factors that can influence the long-term impacts of the interventions.

The Research Methodology

This interdisciplinary research draws from several different research traditions both inside and outside of agriculture and international development, including farming systems research, participatory development, sustainable agricultural development, diffusion research, and qualitative evaluation. An instrumental, collective case study approach is used; case studies are frequently being used in agricultural development research due to the complexity of both the biophysical and socioeconomic environments (see Cramb and Nelson 1998; McDonald and Brown 1999). The field research took place in different stages between December 2000 and October 2001. Research methods included informal, open-ended interviews, key-informant interviews, direct and participant observation, and the review of documents. The majority of the interviews took place in April, May, and August of 2001. Ninety-two interviews were conducted in all; 81 were held with farm households from four different villages, and the remaining eleven interviews were held with development workers and project officials from six different agricultural development organizations that had operated or were currently operating in the area. Over 30 of the farmer interviews took place in farmers' fields or included a visit to their fields.

Context of the Case Study

Guatemala is the most populous country in Central America, with over 12 million people (UNICEF, 2000). Two-thirds of these people live in rural areas, and depend primarily on agriculture for their livelihoods (United Nations, 1999). Guatemala has the greatest diversity in terms of ecosystems in all of Central America; these include the tropical rainforests in the north and east; a semi-arid region of low mountains in the southeast; a wide, semi-arid tropical belt along the Pacific Ocean; and the mountainous highlands throughout the central and western parts of the country. Guatemala's ecological diversity is matched by its ethnic diversity—there are 22 Mayan indigenous groups in addition to the *Ladinos*—the mixed Spanish and indigenous race. Approximately half of the population is Mayan, although different definitions of 'indigenesness' result in figures as low as 40 percent or higher than 60 percent (Enge and Martinez-Enge 1991; Jonas 2000; United Nations 1999). The majority of the indigenous population lives in the western highlands, consisting of land over 1500 meters above sea level. The topography of much of the region is steeply sloped, with soils highly susceptible to erosion. Socio-economically speaking, the region is characterized by a predominantly indigenous population of subsistence farmers, the majority living in extreme poverty (Elías et al. 1997). Per capita income in the rural areas of the western highlands averages between US\$300 and \$440, while the national average is US\$880 (United Nations 1999). The research was undertaken in this biophysical and socioeconomic context, in the municipality of Ixchiguán, San Marcos. Ixchiguán is located in the southwest portion of the western highlands, high in the Sierra Madre mountain range (See Figure 1). The municipality consists of about 30 communities, with an area of 183 km² and a population

of 20,000 people. The central town, also called Ixchiguán, is located 300 kilometers from Guatemala City. Four villages located in the headwater region of the Rio Suchiate watershed were chosen as the cases to be explored. The Suchiate River eventually forms the southern part of the border between Guatemala and Mexico and flows into the Pacific Ocean. The elevations in the villages where the study took place range from 7500 to

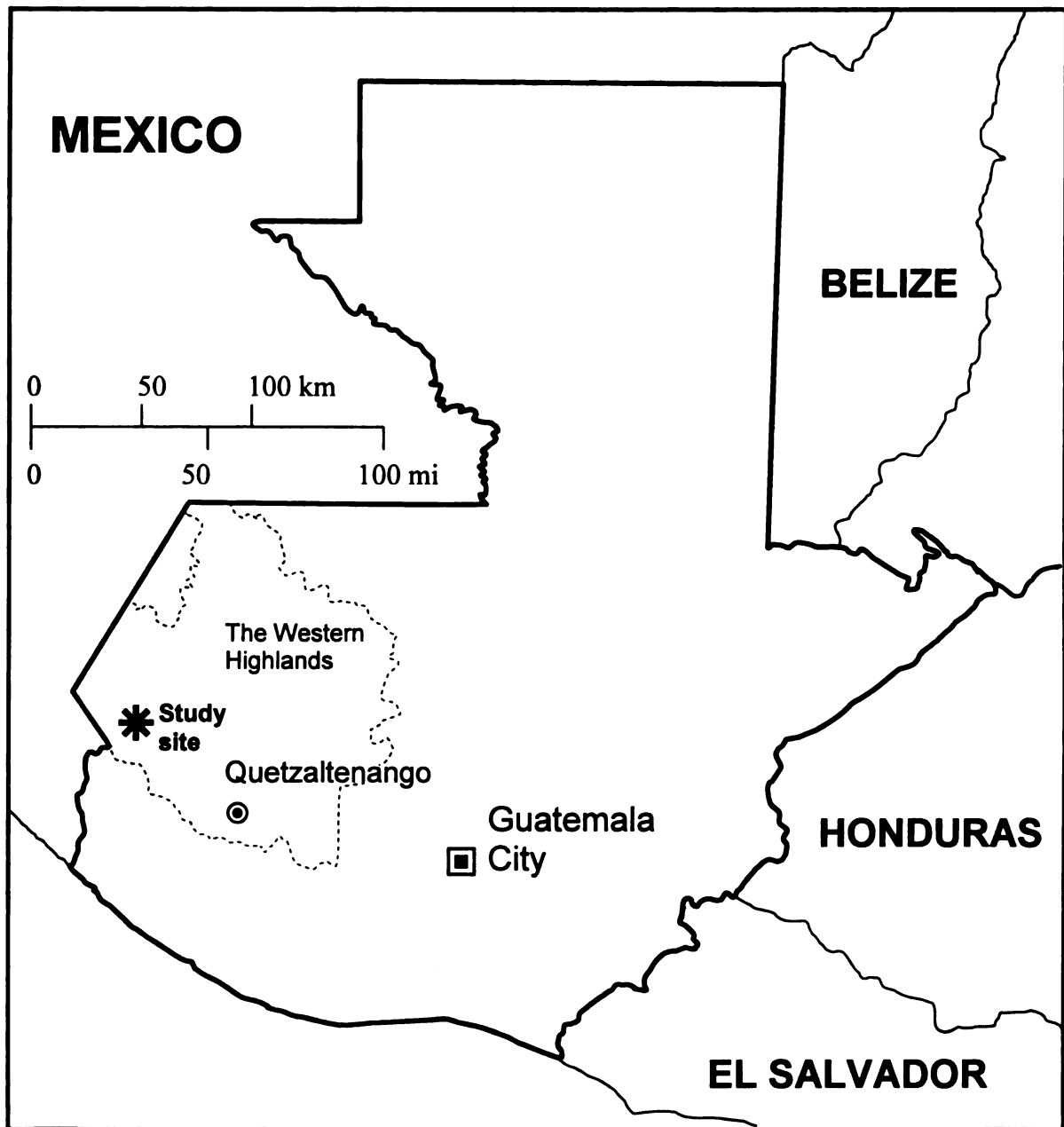


Figure 1. Map of Guatemala with the study location indicated.

11,000 feet above sea level. Due to the steep topography and expanding agricultural frontier, erosion is a widespread problem.

The vast majority of the inhabitants of Ixchiguán belong to the Maya-Mam indigenous group. They are primarily subsistence farmers, and grow corn, wheat, potatoes, beans, and a few other vegetables. Many farmers migrate to Mexico for one to three months each year to supplement their incomes. As the population has increased, agriculture has been expanding into increasingly steep and fragile lands.

There have been a wide variety of agricultural development projects here, beginning in the late 1960s. These projects have been directed by government organizations, church-based organizations, international non-governmental organizations (NGOs), and grassroots organizations.

Organization of the Study

This thesis is organized into six chapters. Chapter two contains a problem-focused literature review. The third chapter describes the research design. Chapter four provides a detailed description of the case study villages and agricultural development projects. Chapter five presents the findings and analysis of the research. The sixth and final chapter contains a summary of the study, the conclusions, and recommendations for research and practice.

CHAPTER 2

LITERATURE REVIEW

Chapter Introduction

The purpose of this chapter is to expand the understanding of the theoretical context of this study through a review of pertinent literature. This first section examines the goals, strategies and content of agricultural development interventions directed at small-scale farmers. The second section focuses on small-scale farmers: their goals, farming systems and livelihood strategies. The third section examines several methods used to assess the results of resource-conserving technologies in agricultural development. The fourth section examines the Central American context related to agricultural development, with specific attention to the context of the western Guatemalan highlands. The final section discusses aspects of the qualitative research paradigm, including qualitative evaluation.

Agricultural Development Interventions for Small-scale Farmers

Goals

As mentioned in the introductory chapter, past agricultural development efforts have tended to focus either on improving production or on conserving resources. While there remains the tendency to focus on one or the other of these goals (Reardon 1998), growing numbers of scholars have been agreeing on the need to pursue them simultaneously. Other agricultural development goals are also being forwarded, such as poverty reduction, employment growth, and biodiversity protection, among others (Lee and Barrett 2001; Pichón et al. 1999). Vosti and Reardon (1997) present a critical

triangle of development goals: agricultural growth, poverty alleviation, and sustainable resource use. Dixon et al. (2001) argues that there has been a paradigm change from a technical productivity focus to a more holistic perspective that focuses on improved livelihoods and greater food security.

Strategies

As agricultural development organizations pursue these goals in the context of smallholder agriculture on less productive or risk-prone lands, a common strategy which some call sustainable agricultural intensification (SAI) is emerging. The central idea of SAI is to increase agricultural production to meet farmers' food and income needs with technologies that maintain, or even enhance, the natural resource base (Hellin and Larrea 1999; Pichón et al. 1999; Pretty et al. 1996; Young, 1998). Pichón et al. (1999:23) call this type of strategy "the only realistic strategy for addressing poverty and environmental problems." Young (1998) argues that the primary objective must be people's welfare, so meeting people's present needs for food and cash should take first priority; this goal should be pursued in ways that conserve the resource base.

There is much debate about the best approach to reach the production goals of SAI. This debate reflects the differences in interpretations of sustainability in agriculture: some groups focus on sustainable growth, while others emphasize environmental protection, and others intergenerational equity (Harrington 1995). Many researchers promote a low-input approach, seeking to minimize the use of external inputs and to emphasize the use of internal resources such as manure and cover crops. Examples of these approaches include Low Input Sustainable Agriculture (LISA), Low External Input Sustainable Agriculture (LEISA), or Agroecology. Young (1998) stresses that LISA does not imply

minimizing external inputs—low or even medium levels may be used; what is emphasized is efficiency in the use of these inputs. Those in favor of these lower-input approaches argue that they limit ecological damage such as that caused by some Green Revolution approaches, and they are financially feasible for a wide range of farmers (Young 1998).

Reardon (1998) argues that these types of approaches are not sustainable because the growth rates obtained with these technologies cannot keep up with the increasing demand for food caused by rapid population growth. He advocates a farm capital intensification approach, combining resource-conserving technologies with improved seed and inorganic fertilizers in order to adequately speed productivity growth.

Whether the SAI approaches introduce higher or lower amounts of external inputs, scholars and practitioners agree that the benefits from new practices need to be realized in the short-run. Technologies that are designed to conserve soil, for example, should be combined with technologies that increase yields or generate income (Bunch and López 1995). Some technologies may both improve production and conserve resources; these are what Vosti and Reardon (1997) call “overlap technologies.”

Resource Conserving Agricultural Technologies

Resource conserving agricultural technologies (RCATs) often possess different characteristics than more production-oriented technologies such as fertilizer or irrigation. Many types of SWC technologies are what Rogers (1995) calls preventive innovations; these types of innovations have slow rates of adoption because the benefits are hard to perceive. Economic returns to investments in RCATs are often realized in the longer term compared to production-oriented technologies. RCATs may also require high initial

labor and cash outlays (Ellis-Jones and Tengberg 2000; Kaimowitz 1993b; Reardon and Vosti 1997). Carson (1990) mentions that numerous biophysical and socio-economic factors determine whether or not terraces are appropriate, and this applies to many other RCATs; these factors include the soil type and depth, slope, climate, land tenure system, the resources of the farmers, availability of markets, the profitability of the farming system, and the level of community organization.

Commonly Promoted Technologies

This section highlights several of the RCATs promoted worldwide and especially in Central America that target small-scale, hillside or mountain farmers. These technologies are widely evaluated as being effective and have been promoted in both governmental and NGO interventions (Adriance 1997; Celis et al. 1997; Cherrett 2001; Teller 1979).

- **Bench terraces**—Bench terraces are perhaps the most widely promoted soil conservation technology. They have been promoted in international agricultural development for over fifty years; in Kenya they were introduced in 1937 (Tiffen et al. 1994). The advantages of terraces include superior control of soil loss and runoff, and improved soil moisture (Carson 1990; Lutz et al. 1994; Tiffen et al. 1994). The disadvantages of terraces include their high construction costs and the loss of cropping area. In addition, their construction can bring up unproductive soils (White and Jickling 1994).
- **Rock Walls**—Rock walls have also been frequently promoted where rocks are prevalent. Their advantages include immediate soil retention, low maintenance requirements, and cleaner, more workable fields (Sims 1999). Disadvantages can include high labor requirements for construction,

depending on the size and quality of the construction and the loss of cropping area.

- **Contour ditches**—This technology is designed to control water runoff and to improve water infiltration. Recommendations for shape, width and depth vary greatly; they may be level, or constructed with a slight incline where infiltration is slow. Often a live grass barrier is added on the upper side. Disadvantages of the technology include a relatively high amount of labor required for construction, a high skill level required for construction, and a high maintenance requirement (Sims 1999).
- **Live contour barriers**—This technology has been promoted worldwide in many forms, from contour hedgerows with shrub and/or tree species—a form of agroforestry—to grass barriers. Often farmers have substituted other plant species in place of the ones promoted by the agricultural development organization in order to reduce competition with crops, produce fodder, or produce a cash crop (Ashby et al. 1996; Sims 1999). Farmers in Honduras mentioned the following advantages of live barriers: good soil retention, easy implementation, production of fodder, and production of biomass for soil fertility enhancement. Farmers reported the following problems: high maintenance requirements, some grass species were invasive, destruction by cattle, delayed erosion control, and a lack of planting material to establish the live barriers. Live barriers were among the most popular technologies in the two regions described (Sims 1999). In Haiti, White and Jickling (1995) found that vegetative SWC techniques were widely adopted and maintained without

incentives because they required limited labor to establish, provided multiple benefits such as fodder or wood products, and were similar to indigenous techniques.

- **Composting:** Composting involves the managed decomposition of a variety of materials such as manure, vegetation, soil, ash, and sometimes lime. Compost provides nutrients and improves aeration, soil structure and moisture retention (Pretty 1995; Tamang, 1993). It is promoted by agricultural development organizations in order to increase the amount of organic material in the soil and as a way of reducing dependence on inorganic fertilizers. The advantages of compost over manure alone are that it doubles the quantity of organic matter, reduces insect problems, and does not “burn” the crops (Tiffen et al. 1994). A primary disadvantage of composting is the labor requirement, both for building the piles and for applying the compost to the fields; farmers may also face constraints such as the unavailability of manure, the lack of access to vegetation, or the lack of crop residues needed to build compost piles (Harwood 1979; Pretty 1995).
- **Animal management strategies—**These technologies or systems take advantage of the synergistic relationships between animals and crops in the farming system (Harwood 1979). One example involves the construction of grass hedgerows that produce fodder grasses, which are cut and carried to the livestock in stables. The manure of the livestock is returned to the cropping area (Garcia et al. 2002).

RCATs are usually not promoted by themselves; projects generally include other technologies to improve production. Higher external input strategies may involve the promotion inorganic fertilizers and pesticides; more agro-ecological approaches may introduce integrated pest management. Both approaches commonly include efforts to help farmers diversify their production, often through vegetable gardens.

The Agricultural Development Process

Participation

Participation is a central element in new approaches to international agricultural development. The ideal situation is that beneficiaries participate in all aspects of the project, from problem identification to the choice of solutions to implementation, monitoring, and evaluation. In reality, participation varies greatly; low end participation involves farmers trading their labor for food, cash, or other materials, while high end participation involves real involvement in decision-making by the farmers (Bass et al. 1995; Pretty 1995). Kaimowitz (1993b) notes that although almost all of the NGOs in Central America agricultural development claim to have a participatory philosophy, most decisions are made by the NGO or the donors, and consultation with beneficiaries takes place after projects are underway. Therefore, researchers and evaluators should investigate the nature of participation whenever agricultural development projects use the term 'participation' or 'participatory' (Bass et al. 1995).

Subsidies

Many, if not most, of the agricultural development projects promoting RCATs have included subsidies or incentives. Kerr (1999:182) distinguishes between the two terms: he defines a subsidy as "a payment or service that raises the net private returns from an

activity;” an incentive is defined as “something that motivates or stimulates a person to act.” Examples of subsidies commonly provided by projects include cash payments, food-for-work (FFW), free or low-cost inputs, and credit.

There are several arguments in favor of subsidies. Many researchers argue that subsidies should be used when the social benefits of conservation are greater than the private benefits, such as in the case of SWC projects to prevent the siltation of reservoirs downstream from hillside farmers. Another argument is that since conservation benefits are often realized in the long-term, and resource-poor farmers must focus primarily on meeting short-term needs, subsidies can compensate farmers while they wait for the benefits to be realized (Zaal et al. 1998). A third argument is that subsidies reduce the risk for farmers to try out the technology (Current et al. 1995). A fourth argument is that subsidies can boost adoption rates quickly and thus maximize people’s exposure to the technology; the expectation is that farmers will realize the benefits of the technologies in time, and will continue to use them (Kaimowitz 1993b).

There are also many arguments against the use of subsidies. Perhaps the biggest arguments emerge from the experiences with subsidies in SWC projects—researchers and development workers have found repeatedly that farmers often stop using practices once the subsidies stop, that maintenance of conservation works is non-existent, and that farmers grow to expect some kind of payment for any type of conservation work (Hudson 1991; Sanders 1988; Sims 1999; Witter et al. 1996; Zaal et al. 1998). In a project in Ethiopia, farmers deliberately destroyed the conservation works in order to receive more FFW to rebuild (Sanders and Cahill 1999). Other development practitioners argue that subsidies should not be needed. Bunch and López (1995:13) state that if the technologies

generate benefits quickly, artificial incentives will not be needed; but if they do not produce short-term benefits, “...no artificial incentive will make the technology’s adoption sustainable.”

It must be pointed out that not all subsidies or incentives have the same results. Current et al. (1995) found that project contribution of seedlings and small tools were enough for farmers to try agroforestry because they took away some of the risk. Food-for-work incentives, in contrast, were linked to failed maintenance and dependency.

Focusing on the Farmers

More researchers are focusing on the farmers’ perspectives in their studies of agricultural development. The farmers are being recognized as the ultimate decision-makers regarding the use of their resources (Current et al. 1995; Dixon et al. 2001; Lutz et al. 1994). Researchers are also emphasizing that farmers have multiple objectives (Fernandez 1999; Kerr 1998; Scherr 1995; Scoones 2001; Shaxson 1999). Finally, the diversity of households in regards to resource endowments and livelihood strategies is being highlighted (Ellis-Jones and Sims 1999; Kerr 1998; Scherr 1995).

Objectives of Farm Households

Growing numbers of agricultural development scholars are pointing out that farm households often have objectives that differ from those of technology developers and agricultural development professionals, who have historically tended to emphasize production.

Reijntjes et al. (1992) classify farm household objectives under four categories: productivity, security, continuity, and identity. They define *productivity* as “the output

per unit of land, labour, capital (e.g. livestock, money, time or other input (e.g. cash, energy, water, nutrients))”(p. 30). Various authors note that while agricultural researchers have traditionally sought to maximize yields or economic profitability, farmers’ productivity objectives may be different—they may be seeking to optimize returns to their scarcest resource, or to produce a variety of outputs such as fodder from crop residues in addition to grain (Reijntjes et al. 1992; Scherr and Current 1997).

The objective of *security* involves “minimizing the risks of production or income losses resulting from variations in ecological, economic or social processes” (p. 31). One primary strategy that farmers use to increase security is diversification. This strategy takes many forms; farmers may raise a wide variety of crops, practice intercropping; or have animals as part of the farm in addition to crops. Farm households often have off-farm income sources to supplement their farming.

Continuity involves maintaining the productive potential of the farm into the future. Strategies to enhance farm continuity include not only practices of SWC and soil fertility management, but may also include educational opportunities to improve the abilities of both current farmers and their children to adapt to change.

Identity involves fitting in with the family’s values and the culture of the community. Reijntjes et al. point out that changes that threaten people’s values can caused stress and opposition, while interventions that improve self-reliance and promote community decision-making help maintain a sense of identity.

Reijntjes et al. (1992) summarize how these objectives are interrelated:

To be sustainable, a farm system must generate a level of production that satisfies the material (productivity) and social (identity) needs of the farm household, within certain margins of security and without long-term resource depletion. As the objectives of security, continuity and identity

usually compete with immediate productivity, an optimal instead of maximum level of productivity has to be sought to ensure sustainability of the farm system (33).

Farmers' Objectives in Technology Adoption

Just as farm households have multiple objectives for their farm system, they also have multiple criteria for the technologies they choose to adopt. Many researchers note that farmers are looking for short-term benefits from the technologies they consider adopting. These benefits include increased yields, lower costs, greater profits, reduced labor, and reduced risks (Brush and Turner 1987; Hudson 1991; Sanders 1988). Ashby et al. (1996) highlight the diverse criteria of farmers in choosing the type of plants they use for live barriers. While the project was promoting the species that controlled erosion the best, farmers sought barriers that would produce income and/or fodder, serve as field boundaries, and improve soil fertility in addition to slowing erosion. Kerr and Sanghi (1993) noted how indigenous conservation structures also served as field boundary markers, while the promoted contour bunds were designed exclusively for soil conservation. Another factor that researchers have identified as affecting farmers' technology adoption is the technology's compatibility with the current farming systems being used (Brush and Turner 1987; CIMMYT 1993; Sanders 1988).

Norman and Douglas (1994) distinguish between farmers' ability to adopt and their disposition to adopt. The ability to adopt is determined by whether or not the technology is technically feasible, economically viable, and socially acceptable. Farmers' willingness to adopt a technology depends on whether or not the farmers perceive that the new technology or practice will help them achieve their goals better than their current technology or practice.

Farming Systems

Many definitions of farming systems have been forwarded. Examining several definitions can reveal a variety of elements that would not be included in a single definition. Shaner et al. (1982:16) define a farming system as:

a unique and reasonably stable arrangement of farming enterprises that the household manages according to well-defined practices in response to the physical, biological, and socioeconomic environments and in accordance with the household's goals, preferences and resources.

Beets (1990: 4-5) describes a farming system as consisting of the following:

resources (land, labour, capital) used in *activities* (crop, livestock, off-farm) to produce a flow of *outputs* (food, raw material, cash)... A farming system is always a part of a larger social, political, economic, cultural, and political [sic] environment which has impact on everything happening within the farming system.

Scholars also differentiate between a *farm system* and a *farming system*: the term *farm system* applies to an individual household, its resources, and the resource flows and interactions; while a *farming system* is a population of farm systems with broadly similar resource bases, enterprises, and livelihoods (Brush and Turner 1987; Dixon et al. 2001).

The factors that determine farming systems are both biophysical and socio-economic, and also endogenous and exogenous to the farming system (Dixon et al. 2001; Fresco 1985 in Beets 1990). Dixon et al. point out that the biophysical factors tend to define the possible farming systems, while the socio-economic factors determine the actual farming system. Figure 2 is a graphical representation of the determinants of a farming system. Exogenous physical factors, represented by the large rectangle, are largely fixed, while exogenous socioeconomic factors, represented by the large oval, are dynamic and can be influenced by policy choices. Factors endogenous to the farming

system, whether biological or socioeconomic, are dynamic and can often be changed through household decision-making.

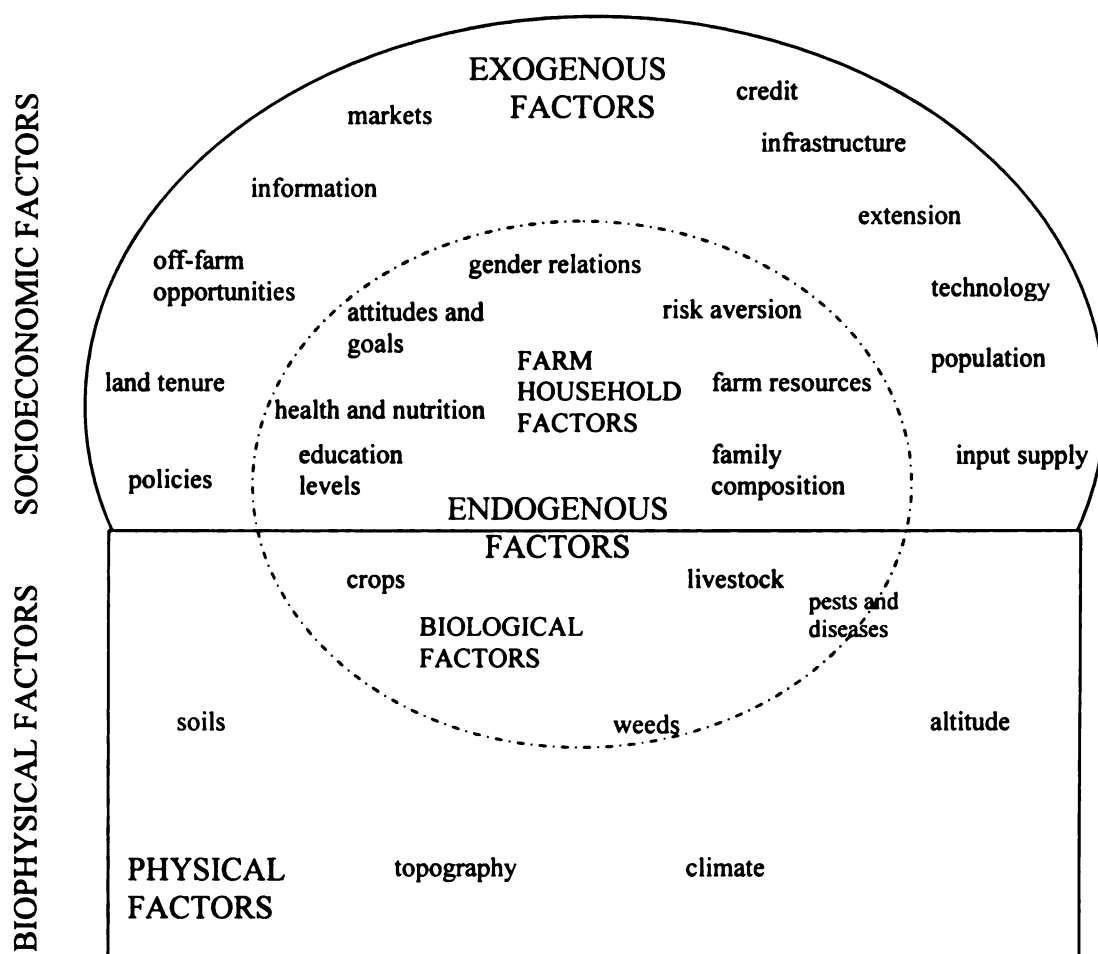


Figure 2. Determinants of Farming Systems. (using categories from Fresco 1985 in Beets 1990, and Dixon et al. 2001).

Assessing Interventions that Promote Resource Conserving Technologies

Researchers dissatisfied with the use of the adoption framework to assess the success of interventions involving RCATs have developed a number of different approaches to gather the information they seek. These approaches include investigating the constraints to adoption, economic analyses using cost-benefit analysis, and farming systems approaches.

Constraints to Adoption

Shaxson (1988) argues that when conservation projects do not go well, it is crucial to find out why the farmers did not adopt or maintain the recommended practices. Many studies of projects promoting RCATs have interviewed farmers to obtain their perspectives on the factors that influence their acceptance or rejection of the promoted RCATs. These factors can be technical, economic, social, or institutional. Some common constraints that farmers mention are highlighted in Table 1.

Cost / Benefit Analysis of Technologies

Cost / Benefit Analysis (CBA) is a common method used to assess RCATs. The profitability of different technologies can be examined by comparing the flows of costs and benefits over time with or without the technology (Pagiola 1994). In using CBA to analyze soil conservation technologies, Pagiola (1994) notes that a primary difficulty is accurately estimating the effects of soil degradation on crop yield. Other difficulties in the analysis include choosing appropriate wage rates and the discount rate.

Lutz et al. (1994) document the use of CBA to analyze the profitability of mechanical soil and water conservation technologies from the farmers' perspective in ten cases in Central America and the Caribbean. The conservation technologies included terraces, diversion ditches, live barriers, rock walls, and combinations of these techniques. The studies found that the more expensive technologies, such as terraces, were only profitable when the crops being grown were highly profitable and the land was very vulnerable to degradation. Vegetative barriers and new cultivation practices were much more likely to be profitable due to their lower establishment costs. In addition, the study found that adoption rates seemed to correlate well with profitability estimates.

Table 1. Constraints to Adoption of Resource Conserving Technologies.

Type of constraint	Constraint	Source
TECHNICAL	High labor requirement for implementation and/or maintenance	Carrasco and Witter 1993; Fujisaka 1999; Garrity et al. 1998; Pellek 1992; White and Jickling 1995
	Take up too much space in the field	Carrasco and Witter 1993; Cramb et al. 1999; Sims 1999; Pellek 1992
	Some live barrier species are too invasive	Cramb et al. 1999; Hellin and Larrea 1999; Sims 1999
	High risk involved	Kerr 1998
	Insects and disease	Cramb et al. 1999; Pellek 1992
	Land conditions / soil type	Ruaysoongnern 1999
ECONOMIC	Too costly	Carrasco and Witter 1993; Garrity 1998; Igbokwe et al. 1999; Sims 1999
	No short-term economic benefit	White and Jickling 1995; Cramb et al. 1999
	Lack of time or labor	Sims 1999
	Low prices / fluctuating prices	Ruaysoongnern 1999; CIMMYT 1993
	Timing conflicts with off-farm labor opportunities	Celis et al. 1997
SOCIAL	Inadequate knowledge	Sureshwaran et al. 1996
	Unfamiliar technology	White and Jickling 1995
INSTITUTIONAL	No credit or financial incentives	Cramb et al. 1999; Sims 1999
	Insecure land tenure	Celis et al. 1997; CIMMYT 1993; Hellin and Larrea 1999; Kerr & Sanghi 1993
	No technical assistance	Sims 1999
	Lack of markets	Annis 1987; Harwood 1979
	Lack of planting material	Sureshwaran et al. 1996

Lutz et al. also point out that in addition to CBA, institutional issues and farmer's attitudes toward conservation should be considered.

Ellis-Jones and Sims (1999) used CBA to analyze the profitability of live barriers and cover crops in south central Honduras. They studied four hillside farmers in different agro-ecological environments and with different resource endowments. They found that conservation technologies were more profitable at lower discount rates, but that at the interest rates that farmers would normally face—25 percent or higher—the farmers' conventional practices were more profitable than the conservation practices. Nevertheless, live barriers were profitable for all of the farmers in the study. The authors conclude that increasing short-term benefits would likely increase the adoption of conservation technologies.

Combined Approaches

Cramb and Nelson (1998) take a two-stage approach to exploring farm-based constraints to adoption. First, they use CBA to analyze whether or not the promoted technologies are profitable in an unconstrained setting. Then they examine the technical and socioeconomic factors at the farm level that could constrain the farmers from adopting profitable technologies. Seven case study sites in the uplands of the Philippines were investigated as part of a research project through the Australian Centre for International Agricultural Research. In each site, RCATs had been promoted by an agricultural development project. The CBA revealed that hedgerow intercropping would be profitable in the long-term, but in the short-term (0 to 5 years), farmers' current practices were more profitable. For the second stage of research, the researchers used a combination of Rapid Rural Appraisal, Participatory Rural Appraisal, and a formal questionnaire survey of farm households to gather the data. They found that personal attributes of the farmers such as age and education did not significantly affect adoption,

but that managerial ability and innovativeness were important factors. Perceptions of both the usefulness and the problems of the technology were similar among adopters and non-adopters. Farm characteristics were more likely to influence adoption: farms that were larger, ones with fields close to the homestead, ones with easily erodible soils, and ones with uniform terrain were more likely to include the promoted technologies. Farmers renting their cropland were less likely to adopt conservation practices, or they used simpler conservation practices than the ones being promoted by the organization. Labor was constrained due to the household's needs to earn income off-farm.

Garcia et al. (1998, cited in Cramb and Nelson 1998), in another part of the study, documented farmer adaptations to the technologies. These changes included planting the hedgerows straight across the slope instead of using an A-frame agricultural level, spacing hedgerows at wider intervals, replacing shrubs with grasses, and choosing plants for the hedgerows that would generate income. Constraints to adoption mentioned by the authors included difficult access to planting materials, lack of immediate economic benefits, and technical problems such as hedgerow competition with crops.

Participatory Impact Studies

In the last decade, a growing number of researchers have been examining the impacts of projects that use more participatory methods to promote RCATs. Hinchcliffe et al. (1999) document 25 case studies on the impacts of participatory watershed management projects. The studies used a variety of Participatory Rural Appraisal and other methods to investigate several different types of impact, including agricultural productivity, resource degradation, livelihood diversity and stability, and increased autonomy of local groups.

Systems Approaches to Research

One emerging approach to studying complex problems such as those found in international agricultural development is called a systems approach. A systems approach differs from the traditional scientific approach, a reductionist analytical approach, because it argues that “wholes” are greater than the sum of their parts and cannot be understood by studying the parts alone (Bell and Morse 1999; Kleynhans 1996; Moore 1995). Bawden (1995:8) describes systems as “coherent whole entities...that possess properties distinct from either their component sub-systems or the suprasystems of which they are a part.” Many aspects of systems thinking originated in biology and its concept of hierarchical structures found in living things (Checkland 1981). Characteristics of systems include the following:

- Systems have boundaries. These boundaries are defined by the investigators and are arbitrary (Bell and Morse 1999; Brush and Turner 1987).
- Systems exist in an environment and interact with that environment (Bawden 1995; Beets 1990; Bell and Morse 1999).
- Systems have mechanisms of communication and feedback for regulation and control; these function both internally and between themselves and their environment (Bawden 1995; Checkland 1981).
- Systems are purposeful—they can be understood as having goals (Bell and Morse 1999; Kleynhans 1996).

System approaches, then, seek to understand a system by identifying its components, examining the relationships among the components, and examining the interactions between the system and its environment (Beets 1990).

Farming Systems Research Approaches

Farming Systems Research (FSR) involves the use of a systems approach in studying a farm (Beets 1990). Bawden (1995) calls FSR “an umbrella term for a class of research approaches,” noting that similar approaches emerged throughout the developing world as development practitioners sought to help resource-poor farmers missed by the Green Revolution. Specific approaches include Farming Systems Research and Extension (FSR/E) and Farming Systems Development (FSD).

Several scholars have pointed out differences in FSR approaches. Dent (1995) compares two approaches. The first, called technology oriented FSR/E, seeks to develop technologies in order to improve the efficiency of farming systems. Farmers are included in the research process so that significant factors that would impede adoption will not be overlooked. This concept takes the socioeconomic constraints as a given. An alternative FSR/E approach focuses on social systems, and recognizes that “bottle-necks” in farming systems development can be cultural, socio-economic, and institutional in addition to technical. The view of Turner and Brush (1987) is similar to this social systems focus; they state that the fundamental premise of farming systems thinking is that a ‘holistic perspective’—integrating the technological, socioeconomic, environmental and political elements of the system—will facilitate the understanding of agriculture.

Kleynhans (1996) advances 3 conceptualizations of systems in relation to FSR: a mechanistic view, an organismic view, and a social systems view. A mechanistic view of systems explains all relationships in the system as cause-and-effect, and takes both the environment and the goals of the farm system as given. The solutions for farm problems are technological ones. From an organismic view, the purpose of a system is survival,

which requires growth. The goals of growth and production are given, and the focus of study is to find how the system can adapt to a changing environment. A social system view stresses that farming systems are purposeful systems—they have goals and “can learn, adapt and create” (Kleynhans 1996:75). The goals are not assumed. Understanding a system involves “[being] able to explain its properties and behavior and to reveal why it is what it is and why it behaves the way it does” (Kleynhans 1996:75).

These different perspectives on FSR highlight the wide variety of approaches under the “umbrella.” Perhaps the best way to view FSR is with a continuum. Technology-oriented FSR and mechanistic views of systems lie on one end, and are similar to the conventional TOT approach. The other end of the continuum represents a holistic systems approach, which recognizes multiple actors and goals, and the influence of multiple contextual factors.

Using a Farming Systems Approach for Assessment

While farming systems approaches have often been used to document existing systems, they have been used infrequently in assessing project outcomes. One study that used a farming systems approach for assessment is documented in Wiersum (1994). This study sought to assess the initial impact of a development program promoting agroforestry in Indonesia. Four hamlets were selected; the methods used included in-depth interviews, observation, and some key informant interviews. The study first focused on the farming systems from several angles: (1) describing the biophysical, socio-economic, cultural and political context; (2) examining the households’ access to resources; (3) describing the production practices; and (4) analyzing decision-making in the farm system. Then the study examined the adoption of the promoted agroforestry

practices and their initial impacts. Farmers were also asked why they participated and/or adopted the practices. The results of the study highlight the large differences between the villages studied as well as within the villages in terms of access to resources, farmers' livelihoods, and the 'success' of the introduced technology.

The Context for Agricultural Development in Central America

A systems approach to investigating agricultural development requires an understanding of the broader context of the system being studied. This section will highlight important features of the Central American context, focusing especially on the Guatemalan highlands context.

Biophysical and Agroecological Context

Much of Central America is mountainous land and is especially vulnerable to degradation. Nearly two-thirds of the land in Guatemala is classified as having a high or very high erosion risk, and its recommended use is forestry (Elías et al. 1997, Rosado et al. 1994). However, small farm households cultivate a large amount of this land. Eighty-six percent of the annual crops grown in Guatemala are grown on hillsides (Lindarte and Benito 1993). The productivity of these regions is up to 200 percent less than that of flat or irrigated land (Elías et al. 1997).

Socioeconomic and Political Context

Unlike much of Latin America, Guatemala continues to be predominantly rural and agricultural. Over sixty percent of the population lives in rural areas, and in 1997 its agricultural exports were 57.4 percent of the total export amount (United Nations 1999). The population growth rate is 2.5 percent, and even higher among the indigenous

population. As a result, the population density of the western highlands has tripled since 1950, and is now near 140 inhabitants/km² (United Nations 1999). At the same time, the distribution of land in Guatemala is the most unequal in Central America—81 percent of farms are smaller than 3.5 hectares and occupy ten percent of the agricultural land, while the top two percent of farms occupy 67 percent of the agricultural land (Goldin 1996; Rosado et al. 1994). The vigorous opposition to land reform in Guatemala (Pichón et al. 1999), combined with the rapidly expanding population, push farmers to take the following actions: expand onto more fragile hillsides, intensify farming on the land they have, and/or seek new livelihood strategies.

Farming and Livelihood Systems in Guatemala

The predominant farming system of the Guatemalan highlands is what the FAO calls the Maize-Beans, or Mesoamerican farming system. This farming system is distinguished by the following characteristics (Dixon et al. 2001):

- the significant proportion of indigenous population;
- the central role, both agriculturally and culturally, of maize and beans;
- the high degree of on-farm consumption of production;
- the high degree of seasonal migration of wage labor to lowland agricultural and coffee estates.

Other characteristics of this farming system include low yields and extensive poverty, and sparse public infrastructure. Due to the high altitude of the study area, the farming systems there have some features that differ from the Mesoamerican system. These features include the cold climate, with frequent frost during the dry season, and a mixed

production system that includes potato and wheat crops as well as the raising of sheep by many families.

Bernstein (1992) notes that women's participation in agriculture in Latin America is much lower than in Asia or Africa. Nevertheless, women's contribution to agricultural labor is still significant and underestimated.

Off-farm income has become a much larger source of income in the Guatemalan highlands since the early 1990s (United Nations 1999). The traditional means for smallholder farmers in the highlands to supplement their income has been seasonal migration to the Pacific coast region to work as laborers in large-scale, export agriculture. Growing numbers of farmers are crossing into Mexico for agricultural work (Elías et al. 1997; Richter 2000).

During the decade of the 1990s, migration to the United States skyrocketed. It is estimated that over one million Guatemalans are now living in the U.S. (United Nations 1999). Remittances amount to \$500 million per year, the second largest source of foreign exchange after coffee (Elías et al. 1997).

History of Agricultural Development for Smallholder Farm Households

Government efforts

In Central America, agricultural research and extension institutions have focused primarily on large scale, export agriculture and have paid little attention to sustainability issues and smallholder farmers (Lindarte and Benito 1993; Pichón and Uquillas 1999). Efforts at helping resource-poor farmers in Guatemala were further hindered by political instability and armed conflict between the leftist guerrillas and the anti-communist government. While the hard-line anticommunists saw the instability as caused

exclusively by Marxist insurgents, more moderate factions recognized that the socioeconomic conditions of rural farm households were difficult and saw rural development as a way to solve the political crisis (Berger 1992). Early government efforts to help small-scale farmers occurred in the 1970s and involved technical and financial support for growing basic grains. According to Berger, wealthier farmers tended to benefit from these programs. The government also promoted state-supported cooperatives as a strategy to improve farmers' standard of living without land reform, which was politically impossible (Brockett 1998; Celis et al. 1997; Pichón and Uquillas 1999).

The biggest governmental effort to improve agriculture in the highlands began in the early to mid-1980s. Called the *Proyecto de Desarrollo Agrícola del Altiplano* (Highlands Agricultural Development Project), this USAID-financed project sought to help small farmers through assistance in irrigation development, soil conservation, credit, commercialization, and research and extension (Kaimowitz 1993a; Rosado et al. 1994). Soil conservation was a major component of the strategy; the objectives were to reduce soil deterioration, increase nutrient retention and humidity, incorporate more areas into agricultural production with greater capacity and without deterioration, and train farmers to practice SWC (Rosado et al. 1994). Many technologies were promoted, including mechanical structures such as terraces, contour ditches, contour cropping, and rock walls, and vegetative practices such as live barriers. Agronomic practices such as seed selection, crop rotation, and green fertilizers were also promoted. The program used both monetary and food-for-work incentives.

In the late 1980s and early 1990s, the Guatemalan government introduced several structural adjustment measures that affected the agricultural sector. Between 1989 and 1991, spending on public research and extension dropped by 48% and 60%, respectively (Kaimowitz 1993b). The government extension agency was eliminated in the early 1990s. Social funds were created by several multilateral development and funding agencies in the 1990s for the purpose of relieving the harsh effects of structural adjustment on poor communities. Most of these funds were destined for economic and social infrastructure, such as schools, health centers, and roads (Meyer 1999).

Non-governmental Organizations

Few non-governmental organizations (NGOs) worked in Guatemala before 1970; these included international relief and development organizations such as CARE and Catholic Relief Services. Movements affiliated with the Catholic Church were active in organizing farmer cooperatives throughout the 1970s. The numbers of NGOs grew rapidly after a major earthquake struck the country in 1976. The first agricultural projects involved donations or credit for agricultural inputs, small animal projects, and community gardens. Overall, these interventions had little impact (Kaimowitz 1993b). At the peak of the civil war in the early 1980s, the repression of community organizations and cooperatives caused many NGOs to leave the country. Many groups returned to Guatemala after a civilian government took power in early 1986 (Berger 1992; Kaimowitz 1993b).

While most NGOs in Central America have used a modernist approach to agriculture in the past, many organizations are switching to lower-input strategies promoting organic fertilizers and SWC, as well as more participatory methodologies

(Kaimowitz 1993b). Some researchers argue that although the technology content has changed, a TOT approach to disseminating the technologies persists (Jansen 1998). Kaimowitz (1993b: 188-189) notes that there is “a tendency to promote the same few simple practices in a wide variety of contexts and with farmers who have different needs, access to resources and agroecological conditions.”

The Qualitative Research Paradigm

Researchers are increasingly recognizing the need to seek the farmers' perspectives in agricultural development. The assumptions of the qualitative paradigm of research are consistent with this approach. This research framework is also commonly referred to as the constructivist, interpretive, or naturalistic paradigm (Creswell 1994).

The qualitative paradigm holds that realities are socially constructed and are multiple—there are as many realities as there are individuals, although groups of people may share many common elements (Guba and Lincoln 1989, 1994). Researchers operating in the qualitative paradigm argue that knowledge is created in the interaction between investigator and respondents (Guba and Lincoln 1994). Therefore, they seek close interactions with the individuals with whom they are involved in research; through interaction a researcher can begin to understand reality from the participants' perspectives.

Research in the qualitative paradigm holds a number of methodological assumptions common to many different research strategies:

Research is carried out in a natural setting (Creswell 1998).

The researcher serves as the primary data collection instrument, and uses qualitative methods such as interviews and observation (Guba and Lincoln 1989).

The design of the research is emergent; the researcher maintains flexibility to alter the design or research questions based on the data or issues that emerge from the participants in the field (Creswell 1994).

The aim of the research is to understand the emic views of the participants (Guba and Lincoln 1989; Creswell 1998).

In terms of data analysis, qualitative research involves an inductive approach, in which categories emerge from the data collected and the interactions between the researcher and the researched (Creswell 1994).

Marshall and Rossman (1995:39) express that the qualitative paradigm is especially suitable “for research that is exploratory or descriptive, that assumes the value of context and setting, and that searches for a deeper understanding of the participants’ lived experiences of the phenomenon.”

Qualitative Evaluation

Different authors have highlighted the usefulness of qualitative methods in evaluation and assessment. Baker (2000) discusses their advantages:

Qualitative and participatory methods can also be used to assess impact. These techniques often provide critical insights into beneficiaries’ perspectives, the value of programs to beneficiaries, the processes that may have affected outcomes, and a deeper interpretation of results observed in quantitative analysis.

Greene (1994) lists several characteristics of qualitative evaluation. First of all, it emphasizes the importance of understanding the context over the generalizability of the results. Secondly, it utilizes primarily qualitative methods. Thirdly, the investigator recognizes his or her role in the process. Finally, qualitative evaluation often makes use of case studies.

CHAPTER 3

RESEARCH DESIGN

Design Strategy

This research uses a qualitative case study approach as the design strategy. Case study research involves the in-depth study of a specific, bounded entity, called a case. Stake (1994) describes three types of case studies: intrinsic, instrumental, and collective. This study is a collective case study as several villages will be examined to better understand the issues in question. It is also an instrumental case study since the primary issues of interest are not the cases themselves but rather the issues related to the outcomes of agricultural development projects.

Qualitative case studies use multiple data collection methods such as open ended-interviews, on-site observation, and document review in order to understand the meanings held by the participants in the case. This use of multiple methods, sometimes called triangulation, serves as a way to clarify meaning and reduce the likelihood of misinterpretation (Stake 1994).

Entry

Before beginning graduate studies and this research, the researcher had spent over four years in the study area, working in two different development projects unrelated to agriculture. This familiarity with the setting and with many of the community leaders allowed the researcher to enter the research setting easily. The researcher still met with local leaders and government officials to let them know what he would be doing and the purpose of the research before beginning data collection.

Site Selection

Marshall and Rossman (1995:51) list four characteristics of an ideal site for study:

- (1) Entry is possible;
- (2) There is a high probability that a rich mix of the processes, people, programs, interactions, and structures of interest are present;
- (3) The researcher is likely to be able to build trusting relations with participants in the study; and
- (4) Data quality and credibility of the study are reasonably assured.

Four villages were chosen as the cases for study from among the villages located in the northern headwaters of the Suchiate watershed. As described above, the researcher's previous experiences in the communities made entry into the research setting and travel within each community problem-free; normally these kinds of rural communities would likely be distrustful of outsiders. To ensure a rich mix of elements to study, the researcher sought out villages that had experienced a variety of agricultural development interventions in the previous twenty to thirty years. A final criterion for village selection was relatively easy accessibility.

Sample Size

Sampling for qualitative research differs from sampling in quantitative research. In qualitative research, the amount of data collected and the quality of that data is more important than the number of subjects (Morse 1994). One means of determining when enough sources have been questioned is when there is significant repetition in the findings (Morse 1994).

Sample sizes in similar studies dealing with agricultural development in less developed countries are wide ranging. Fujisaka (1999) discusses two studies in the Philippines using 55 interviews and 39 interviews. Hellin and Larrea (1999) interviewed

65 farmers in two *municipios* in Honduras to learn about their problems and perspectives on SWC practices. The study of farming systems and RCAT adoption in Indonesia documented in Wiersum (1994) involved 120 farmer interviews in four communities, with two researchers working in each community. Kumar (1993) recommends a sample size of 25 to 50 people for informal surveys.

Informed Consent

Before each interview, the researcher obtained informed consent from the study participants. The researcher explained, in Spanish, the purpose of the study and the rights of the participants. If potential participants seemed confused about the form, the researcher attempted to explain the reasons for informed consent as carefully as possible. At times a translator was available to explain the form in the *Mam* language.

Data Collection

Data Collection Methods

This research utilized a variety of data collection methods, including several types of interviews, direct and participant observation, and the review of documents. These methods are common in social science research and they also are included in a family of research methods called rapid appraisal methods or rapid rural appraisal (RRA), now used extensively in international development research. Kumar (1993:21) states that these methods are ‘particularly appropriate’ in situations such as the following:

- examining the institutional constraints that farmers face in adopting recommended innovations;

- learning farmers' views, perceptions, and recommendations about development interventions;
- “Why” and “how” questions such as “Why are farmers not adopting...?”

These data collection methods are commonly used by many researchers when assessing the effectiveness of the promotion of resource-conserving agricultural technologies (Bunch and López 1995; Cramb and Nelson 1998; Hellin and Larrea 1999; Kerr 1993; Wiersum 1994).

Open-ended, Informal Interviews

The bulk of the research used open-ended interviews to obtain data. The researcher began each interview with a few questions and a number of topics in mind, but allowed the participants freedom to expand on the different issues being discussed and to bring up issues that were important to them in the context of agricultural development. Some surprising information was obtained in this manner, information that likely would never have surfaced using a highly structured interview approach.

Key Informant Interviews

These interviews involve the selection of respondents based on their experience or specialized knowledge (Kumar 1993). These interviews used the open-ended, semi-structured approach as well. The key informants used in this study include project staff, community leaders, leaders of local development groups, and farmer promoters.

Observation

Two kinds of observational methods were used in this research. The first involved the researcher's observations during initial rapid appraisal of the communities and during other times of walking through the villages; it did not involve contact with people but rather observations of housing locations, the locations of roads and trails, and the types of

soil conservation structures and other practices in the villages. These observations were captured primarily through photography. Participant observation took place during the interviews and at other times during the research process. During interviews, a number of farmers took the researcher to see their fields; this allowed the researcher to observe the resource-conserving technologies that had been implemented by the farmers and helped to give a better picture of the farm system. On a few occasions, the researcher “helped” a farmer harvest some potatoes or remove rocks from a field. When the researcher visited the tree nurseries of several agricultural development projects, he participated briefly in the work.

The Review of Documents

Reviewing documents allowed the researcher to learn more about the agricultural development organizations’ goals, strategies and activities. Sources of information included the web pages of international development organizations, a diagnostic survey of several villages conducted by one of the organizations, and an agronomist’s quarterly and annual work reports.

Data Collection Process

The first months of fieldwork of the study involved key informant interviews with project personnel and farmers known to the researcher. These interviews allowed the researcher to learn which organizations had worked or were currently working in the communities and what kind of activities they had promoted or were promoting. This information was used to select the four communities to be investigated: Los Pinos, Tres Rios, San Lucas, and Vista Bonita.¹

¹ Village names have been changed.

Initial visits to the communities included making observations of the types and extent of soil conservation works; many of the observations were recorded using photography. During these first visits the researcher also visited farmers he knew.

Contacting farmers to set up interviews proved to be the most difficult stage of the research. Farmer schedules are highly variable, and their fields are often located far from their homesteads. In addition, a large number of farmers work off-farm, either locally or far away. The researcher used a number of approaches to establish contacts and set up interviews.

Many interviews were conducted with farmers previously known to the researcher. The researcher visited their homes, told them about his study and asked if they would like to participate. If the time was inconvenient, a later time was arranged. Opportunistic interviews were conducted when the researcher was walking through a village and noticed a farmer or farmers working in a field. Farmers were asked if they would like to participate in a study on agricultural development. If the farmer agreed, the researcher asked for informed consent and then proceeded with the interview.

In Los Pinos and Tres Rios, many contacts were made during the weekly group activities run by the government-related rural development organization. The organization's staff provided a time for the researcher to talk about the research and ask for volunteers from the group to be interviewed. While the process was not ideal for ensuring the best representation of the villagers in the study, the variety of economic levels, ages, and experiences with development organizations represented by the study participants assured the researcher that a rich mix of data had been obtained.

In San Lucas, the lack of an active group at which to contact farmers resulted in a different strategy. A farmer well known to the researcher helped to set up several interviews and accompanied the researcher to these people's homes or fields. This farmer also served as a translator during parts of the interviews when it was easier to explain questions in the Mam language; this was especially helpful in two interviews with women.

In Vista Bonita, the researcher attempted to make contacts for interviews during a community workday. The assistant mayor gathered the group and allowed the researcher to speak about the purpose of the research. There was little response and apparently some confusion about what the researcher was doing; the farmers likely thought that the researcher was trying to form a group to carry out conservation work, rather than merely talking with them about their past experiences with conservation projects. No one volunteered to participate in the study. On a later date, the researcher discussed the research after a service in the Catholic Church. The researcher had worked with a number of these families before, and they were more willing to participate. These interviews were supplemented with opportunistic interviews.

Data Analysis

Data analysis occurred iteratively throughout the research process. Interview notes were reviewed as soon as possible after the interview, and topics that emerged in earlier interviews led to new lines of questioning in later interviews. Additional observations from the interview were added to the field notes. As common themes were

repeated in the interviews, the researcher selected the most interesting themes or issues as categories to be pursued more in-depth in later interviews.

After the fieldwork was completed, the field notes were translated into English to facilitate the analysis. A spreadsheet summarizing some of the data was constructed to obtain an overall view of the interview information and to simplify comparison between the villages. Data from the interviews were first grouped by village, and development worker data was gathered into a separate group. Then the data was grouped into the categories selected during the research in order to analyze the issues of the case. Subcategories were developed when there were large amounts of data. Category and subcategory data were later combined from the different villages for analysis across villages.

As the text was written and farmer quotes were inserted, the original interview notes were frequently consulted to ensure accuracy of the statements.

Verification of the Results

In order to ensure the validity of the research, the primary method used was triangulation. Triangulation involves the use of multiple methods and multiple data sources (Creswell 1994). The design of this study represents triangulation on several levels. First of all, multiple methods, including several types of interviews, observation, and document review were used to obtain the data. Secondly, the study of four villages provided the opportunity to study how different organizations functioned in different contexts. Finally, multiple stakeholder groups were interviewed—project workers and development administrators, community leaders, farmer promoters, participants and non-

participants, and male and female household members—in order to obtain multiple perspectives.

Transferability

Transferability refers the potential of results of the research to be applied in another context. It parallels the traditional criteria of external validity, or generalizability. Qualitative research, with its emphasis on the importance and uniqueness of the context, does not claim that its results are necessarily generalizable; it instead seeks to explain the context in as much depth as possible, and places the responsibility on the reader of the research to select which procedures and conclusions of the research can be applied in another context.

CHAPTER 4

DESCRIPTIONS OF THE CASES

Chapter Introduction

This chapter introduces the four villages that are the cases for the research and the agricultural projects that have operated in these villages. The first section will introduce the region in general. The second section describes the four villages. The third section describes the different agricultural projects and the technologies that have been promoted.

The Region

The four study villages are located in the municipality of Ixchiguán, San Marcos. Ixchiguán is located high in the Sierra Madre mountain range, between the two highest volcanoes in Central America, Tajumulco and Tacaná. Elevations of the municipality range between 2400 meters and 3700 meters.



Figure 3. The Suchiate watershed.

The climate here is cold. Daily average temperatures are between ten and fifteen degrees Celsius. Frost is common from November through February at altitudes above 2800 meters. During the rainy season, hail is not uncommon. The rainy season runs from May to October and is bimodal, with the highest amount of rain occurring in the months of June and September. The average annual precipitation for the area is 2000 millimeters.

The soils in this region are Andisols, which are formed from volcanic materials. The fertility of the two prevalent soil series is moderate to high, as is the erosion risk. Simmons et al. (1959: 229) discuss the productive potential of these soils: “In general, they are at such high elevations and on such steep slopes that they do not lend themselves to favorable production of most crops” [author’s translation].

There is a main road connecting the region to the departmental capital, 45 kilometers to the southeast. The road was gravel and very rough until recently. Paving began in 1997; the asphalt had nearly reached the entire distance to Ixchiguán by the end of this study. The asphalt has cut travel time in half. The road follows the top edge of the ridge that defines the watershed; nearly all of the villages in the region are located lower than the road. Until recently, few villages were accessible by vehicle; three of the four villages in the study have had new roads built to them within the last five years.

The population of the area is approximately 20,000 people, and the population density is 110 persons per square kilometer. Poverty in the region is high. San Marcos was recently ranked as the poorest department in the country, with 86.66 percent of its population classified as poor (Prensa Libre, 2001).

The Villages

This section describes each of the four villages included in the study. It begins by discussing the geophysical characteristics and the geographic location and layout of the village, and then discusses the typical farming systems and livelihood components found in each village.

Los Pinos

The village of Los Pinos lies in a long, gently sloping micro-watershed that begins at 3200 meters above sea level; most of the village lies between 3000 and 3100 meters, and the lowest elevation in the village is just over 2900 meters. The area of the village is 18 km². The village is accessible by vehicles year-round and is located to one side of the major road in the region. Los Pinos is divided into four different communities or neighborhoods; the combined population of these communities is roughly 2000 people. Houses are scattered throughout the basin, and most people's fields are adjacent to their homestead. The higher elevations of the village contain few houses; much of this area used to be communal land but was divided up over 20 years ago to expand the agricultural land of the village.

The population of the village is culturally diverse, containing two Mayan indigenous groups as well as a significant percentage of *Ladinos*. The vast majority of these families are farming households. They grow potatoes, corn, wheat, and a few vegetables. Potatoes are the principal cash crop. According to a recent diagnostic survey by one of the development organizations currently working here, 40 percent of the crops grown in the villages are for household consumption, and 60 percent are destined for the

market. Yields for potatoes average 18 *quintales*² (*qq*) per *cuerda*³ (18.8 t/ha.), and maize yields average 1.5 *qq/cuerda* (1568 kg/ha.). Table 2 compares the yields for different crops in all the villages as reported by the farmers. These figures are similar to yields in other regions of the western highlands as reported in Hostnig et al. (1998) and Poma M. (1998).

Table 2. Yields of Common Crops in the Study Villages.

Village	<u>Yields (in quintales per cuerda)</u>			
	potato	maize	wheat	broad beans
San Lucas	Average: 15 qq/cu. Range: 6-25	Avg.: 1.75 qq/cu. Range: 0.5-3.0	Avg.: <1 qq/cu.	Avg.: 1 qq/cu
Tres Rios	Average: 13 qq/cu. Range: 5-22	Avg.: 1.5 qq/cu. Range: 0.5-3.0	1 qq/cu.	1 qq/cu.
Vista Bonita	Average: 11 qq/cu. Range: 2-25	Avg.: 1.0 qq/cu. Range: 0.5-2.0	1.25 qq/cu.	1 qq/cu.
Los Pinos	Average: 18 qq/cu. Range: 3-30	Avg.: 1.5 qq/cu. Range: 0.5-3.0	1.25 qq/cu Range: 0.5-2.0	

A high percentage of families' incomes is obtained from non-farm or off-farm labor opportunities. In the past, nearly everyone migrated to the Pacific coast of Guatemala or to Chiapas, Mexico for the coffee harvest in the months of October to December; these days only a small percentage of families goes. Several families have small businesses—they have small stores in their homes or they sell merchandise or produce in the local markets. Many farmers pursue part-time agricultural work with other local families.

² The *quintal* (qq) is the common measurement unit for agricultural products. One *quintal* is 100 pounds.

³ The *cuerda* (cu.) is the common measurement unit for land in rural areas. One *cuerda* is approximately 435 m².

Others work as carpenters or masons. A large number of families sell animals. Several families have family members who work in the capital. The most significant employment trend in the last ten years, however, is the migration of a large number of people, primarily young men, to the United States. The variety of livelihood components and their importance in each of the villages are shown in Table 3.

Tres Rios

The village of Tres Rios lies at the headwaters of a steep microwatershed. The center of the village lies at approximately 2850 meters above sea level; elevations in the village range from 2600m to over 3100m. The topography is moderately to steeply sloping, with a few areas of gentle slopes. An all season road to the center of the village was built in the late 1990s. The village contains between 450 and 500 people. Houses are scattered throughout the village, and families have part of their agricultural land near their homes. Some families whose homes are at higher elevations also own land at lower elevations in the village. All of the families belong to the Mam indigenous group. Nearly all of the farm households are subsistence farmers, growing maize, potatoes, broad beans (*Vicia faber*), and, increasingly, vegetables such as cabbage, carrots, beets, and onions. Yields for potatoes average 15 qq/*cuerda* (15.7 t/ha.) and maize yields average 1.5 qq/*cuerda* (1568 kg/ha.) (See Table 2). Most families migrate seasonally to earn cash incomes. Many farmers still travel to Chiapas, Mexico for the annual coffee harvest; others grow maize on rented land on the coast. Farmers sell a significant portion of their potatoes, and this percentage is increasing due to the small-scale irrigation system recently constructed in the community. Some families sell potatoes and vegetables in the local markets.

Table 3. Livelihood Practices by Village.

LIVELIHOOD COMPONENT	Los Pinos	San Lucas	Tres Rios	Vista Bonita
Growing maize for consumption	XX	XXX	XXX	XXX
Growing potatoes for consumption	XXX	XXX	XXX	XXX
Growing beans or vegetables for cons.	X	X	XX	X
Growing potatoes to sell	XXX	XX	XXX	XX
Growing vegetables to sell in local markets		X	XX	
Selling merchandise in local markets	XX	X	X	X
Selling merchandise in distant communities		X		
Selling agricultural products in distant communities		X		
Selling animals	XX	X	X	XX
Selling firewood or lumber				X
Local agricultural labor	XX	XX	X	X
Local non-agricultural labor	X	X		X
Domestic work	XX			
Carpenter / mason	XX	XX	X	XX
Butcher		X		
Store owner	X	X	X	X
Renting agricultural land to others	X	X		
Migration to coffee <i>fincas</i>	X	XX	XX	XXX
Growing maize on the coast			X	X
Family members working in capital	X			
Family members working in US	XXX	XXX	X	X

Key: XXX: Most households
 XX: Several households
 X: Few households

San Lucas

The village of San Lucas is located along a ridge extending down from the continental divide toward the Pacific Ocean. Its elevations range from 3300m at its

highest point to approximately 2400m at its low point; most houses are located along the ridge between 2700m and 2900m. In the center of the village—the only large, relatively flat area—a large group of houses is clustered tightly together. Most people's fields are located on the slopes running down from the long ridge; almost all of the cropland lies on moderately sloping to steeply sloping land. The village was not accessible to vehicles until 1997 or 1998. The population of San Lucas is roughly 800 people; all belong to the Maya-Mam indigenous group.

The majority of the people here are subsistence farmers. Some grow potatoes and broad beans as cash crops; nearly everyone grows maize for their family's consumption. Crop yields in San Lucas average 1.75 qq/*cuerda* for maize (1829 kg/ha.), and 15 qq/*cuerda* (15.7 t/ha.) for potatoes (see Table 2). A number of families raise livestock, including cows, sheep, and pigs. Traditionally the men have migrated to Chiapas, Mexico for the annual coffee harvest to earn cash incomes. A few community members work as carpenters or masons. During the last eight to ten years, dozens of younger men have migrated to the United States to find work. An estimated 50 villagers are currently in the U.S., and remittances are a major income source for many families in this village.

Vista Bonita

The hamlet of Vista Bonita is located on another ridge extending from the high ridge of the Sierra Madre toward the Pacific Ocean. Elevations in the village range from 3300m down to 2500m; the majority of the houses are located on top of a narrow ridge at 3000m. The vast majority of the agricultural land is steeply sloping (greater than 50% slopes). Soils are very thin, and have a sandy subsoil. The village has approximately 500 inhabitants; all belong to the Maya-Mam indigenous group.

Access to Vista Bonita was by footpath until three years ago, when a road was built with the help of the municipal government and other government programs. The steepness of the road prevents large trucks from leaving the village with much cargo, however. There are several forested areas around Vista Bonita; most of these are privately owned. With the construction of the new road, much more firewood is being cut to be sold in the main town.

All of the farm households here farm primarily for subsistence. Very little of the farm production is sold. Farmers grow potatoes, mainly above 2700m and primarily for household consumption. Most farmers grow maize at lower elevations; many farmers own or rent land in other villages at lower elevations. Runner beans (*Phaseolus coccineus*) can be grown at lower altitudes, and a few farmers grow them as a cash crop. A few families have small-scale, homemade irrigation systems, and may grow some vegetables and potatoes during the dry season. Yields for maize average 1 qq/ *cuerda* (1045 kg/ha.), and potato yields average 10 qq/ *cuerda* (10.5 t/ha.) (See Table 2). Many families own a small number of sheep and/or goats, generally between ten and twenty animals, and often sell a few of these animals in times of economic hardship. Nearly all the male farmers migrate to Chiapas, Mexico for the coffee harvest. They work there for two to four months, beginning in September. Some farmers also migrate for four to six weeks during May or June, when cash is scarce.

The Agricultural Development Organizations

This section introduces the agricultural development organizations that have functioned or are currently functioning in the study communities. The organizations are

listed in the approximate chronological order in which they began their agricultural activities in the region. Table 4 shows the communities in which each organization has worked or is currently working.

Table 4. Communities Where the Agricultural Development Organizations Work.

Organization	Community							
	Los Pinos		Tres Rios		San Lucas		Vista Bonita	
	has worked here	currently working	has worked here	currently working	has worked here	currently working	has worked here	currently working
NGO 1	✓							
GO 1	✓		✓		✓		✓	
NGO 2	✓	✓	✓	✓	✓		✓	
GRO 1	✓	✓	✓		✓	✓	✓	
NGO 3	✓	✓						
NGO 4	✓		✓		✓	✓	✓	✓
GO 2	✓	✓	✓	✓				
GO 3	✓	✓	✓	✓			✓	
TOTALS	8	5	6	3	4	2	5	1

Non-Governmental Organization 1

The first agricultural development intervention began in the late 1960s or early 1970s, when some priests and lay people from the Catholic Church in the neighboring *municipio*, or county, came to the area to offer agricultural training. Five community members from Los Pinos traveled to the other *municipio* to receive training; they returned to the community to train their neighbors. Approximately 20 farm households were initially involved. The training included improved planting techniques, soil conservation, composting, crop rotation, and reforestation. Contour ditches were the primary conservation technology promoted, but terraces and fodder grasses were also introduced.

The organization introduced many farmers to chemical fertilizer and improved varieties of potato. Of the study villages, only Los Pinos worked with NGO 1.

As the non-participating villagers of Los Pinos noticed the great improvement in potato production, they began adopting the new practices as well. In the mid-1970s farmers began to use credit to finance their potato production activities. Farmers mentioned two sources for this credit: the national government's agricultural development bank, and the local cooperative, which had grown out of NGO 1.

Governmental Organization 1

The early 1980s apparently had minimal agricultural development activity, as these were the years when the civil war reached its highest intensity. After the new civilian administration was elected in 1985, new initiatives were begun in the region. The government's agricultural extension service joined with USAID to develop an agricultural intensification project, called the *Proyecto de Desarrollo Agrícola del Altiplano* (The Agricultural Development Project of the Highlands), which was mentioned in Chapter 2.

In the beginning, a major part of this effort involved soil conservation work using large work teams. About 200 farmers from several villages were paid between \$2 and \$3 a day to build conservation structures on public lands and on farms near the main road. This program lasted for three months. For the next several years, three or four locally-based government extension workers promoted agricultural intensification in many of the villages in the region. Extension workers visited the communities regularly, often every week. Community development committees were formed, and groups of farmers often worked together to build soil conservation structures on each other's fields. Other

practices that were taught included composting, vegetable gardens, reforestation, and improved agronomic techniques such as crop rotation and seed selection. In some instances, farmers were paid cash subsidies based on the area of conservation works they completed. In most villages, however, food-for-work (FFW) was the primary incentive used. The government extension service was ended around 1992 as a result of structural adjustment.

Non-Governmental Organization 2

In the mid-1980s a church-based organization became more active in agricultural development. Initially focusing on vegetable gardens and reforestation and working with women's groups, the organization expanded the work to include soil conservation, composting and improved agronomic practices. The organization has always provided FFW for the group participants. In the 1980s and early 1990s, this organization worked in all of the study villages.

Recent efforts of this organization have shifted more towards an agro-ecological framework, and technologies such as integrated pest management, agroforestry and organic farming have been added. The primary goal of this organization is "to improve and sustain the food security of the most vulnerable agricultural families in San Marcos" (author's translation). A formally trained agronomist visits each community every other week. Local promoters are chosen to receive training in the technologies, and they return to their communities to implement the technologies in the group with the assistance of the agronomist. FFW is now offered to participants only during the first year of activities; the organization offers credit to group members in following years, beginning with

Q.500.00 and increasing each year if the families pay back the credit on time. Communities currently involved with NGO 2 include Tres Rios and Los Pinos.

Grassroots Organization 1

This organization began in the late 1980s when a group of citizens interested in community development began to organize themselves. The organization belongs to a large group of grassroots organizations, through which it gets financing and technical support and where it networks with other agencies to provide training opportunities for its members. This organization has members from more than ten villages; most villages have fewer than ten members. A local farmer serves as the program coordinator. Agricultural development is just one of the areas in which the organization works—the organization promotes organic agriculture, specializing in composting and natural insecticides and fungicides, and it promotes animal care with natural products as well. The organization has frequently offered loans to group members for agricultural production; in 1998, 70 families received loans.

Non-Governmental Organization 3

An international NGO began working in Los Pinos in the early- to mid-1990s. Environmental protection is its primary focus, but it seeks to accomplish this goal using a “people-centered approach,” and the organization aims “to significantly improve the living conditions of poor farm families.” The agricultural and natural resource management programs have emphasized reforestation, soil conservation, and agroforestry, but the organization has also promoted group vegetable gardens, composting and organic agriculture. The organization also has programs in community

health. Most of the staff lives in the nearest city; local promoters have been used at times. Of the four study villages, this organization has only worked in Los Pinos.

Non-Governmental Organization 4

A second church-based agricultural development organization began functioning in the early 1990s. The goal of this organization is to increase farm households' levels of productivity and to strengthen community organization, in order to improve people's standard of living and their ability to defend and promote their rights. The organization began working with 27 women's groups, each consisting of 22 women. The first technologies or practices promoted by the organization were composting and organic vegetable gardens, as well as tree nurseries. While the organization initially offered FFW, it was discontinued after a few years, and the requirement that participants belong to the women's group was also dropped. At that time the organization decided to focus its work on the poorest communities in the region, which included San Lucas and Buena Vista. The organization began promoting SWC in the mid-1990s, emphasizing soil conservation technologies that involved less labor, such as living contour barriers with fodder grasses. Formally trained agronomists visit the communities on a weekly or bi-weekly basis.

Another new technology that the organization promoted in the mid- to late-1990s was actually a new agricultural system. The system, which was being practiced in other regions of the country, involved changing the method that sheep were managed, from extensive grazing to intensive stall-feeding. New, elevated sheep pens, improved fodder grasses, and new breeds of sheep were all introduced by the project. The sheep were to be fed with the fodder grasses. The sheep manure, which would no longer be scattered

throughout

crop fields

The elimin

and would

help to bu

planting.

breed of

villages, w

sheep.

NG

on time c

active; th

Govern

TH

projects

the fun

small-s

village

55 fam

provid

organiz

govern

throughout the pasture areas, could now be used for organic fertilizer and applied to the crop fields. The fodder grasses were planted on conservation structures in the crop fields. The elimination of extensive grazing would allow forested areas to naturally regenerate and would protect areas being reforested. Approximately 100 families received financial help to build the new stables; they also received new varieties of fodder grasses to begin planting. The organization planned to give loans to the families to buy an improved breed of sheep; in some villages the families received the new sheep, but in other villages, where the improved fodder grasses did not grow well, families did not get the sheep.

NGO 4 is also providing loans to group members. Members who pay back the loan on time can receive a larger loan the following year. The group in Buena Vista is still active; the program has been suspended in San Lucas due to problems with repayment.

Governmental Organization 2

This organization is a social investment fund. Communities have to apply for projects, a process which involves a lot of paperwork and time. Projects sponsored by the fund have included small-scale infrastructure such as roads and school buildings, small-scale irrigation projects, latrine projects, and wood-burning stove projects. The village of Tres Rios applied for and received a small-scale irrigation project, benefiting 55 families. The fund paid for the materials and skilled labor, and the community had to provide all of the unskilled labor. Many respondents in Los Pinos reported that this organization has a tree nursery there. This organization collaborates closely with another governmental organization currently operating in the region, GO 3.

Governmental Organization 3

The third governmental organization began functioning in the region in the late 1990s. It focuses on community organization, agriculture, and other income-generating activities in rural communities. Both a formally trained agronomist and a social scientist visit the communities once a week. The organization worked in Vista Bonita for two years, and it is currently working in Los Pinos and Tres Rios. It promotes community tree nurseries for reforestation, and it promotes soil conservation and vegetable gardens in both of these communities. The organization is also playing a facilitating role in both communities in applying for infrastructure projects, likely through the fund described above (GO 2). In Los Pinos they are hoping to expand the potable water system, and in Tres Rios they are trying to extend the road further down to reach most of the irrigated areas.

CHAPTER 5

FINDINGS

Chapter Introduction

This chapter presents the findings of the study. The first section reports on the processes by which farmers initially adopt resource-conserving agricultural technologies. The second section examines the assessments of the promoted technologies by the farmers and the constraints to their adoption. The third section examines whether or not farmers continue to use the RCATs after the agricultural development organizations leave the community, and the factors that influence farmers' decisions. The fourth section highlights the impacts of the agricultural development projects as expressed by the farmers. The fifth section examines the reasons for differences in the impacts experienced by farm households, examining factors at the household and village levels.

Initial Adoption of Resource Conserving Agricultural Technologies

The first issue this research examined was the process by which farmers initially adopt RCATs. Farmers learned about and implemented RCATs primarily through participation in agricultural development projects, but significant numbers of farmers adopted certain technologies through other channels.

Adoption Through Project Participation

Levels of Participation

In each of the villages studied, the majority of the respondents had participated in agricultural development projects that were promoting RCATs. Seventy-two out of eighty-one farmers stated that they or someone in their household had participated in at

least one agricultural development project. In three of the communities, the majority of respondents had participated in at least two projects; only in San Lucas was this not the case. The majority of farm households had many years of experience with agricultural development projects, with 46 of the 82 respondents reporting that they had already participated in groups before 1991. Some farmers in Los Pinos had participated in an agricultural development group as long as thirty years ago, while participation for farmers in the other villages dated from the mid-1980s. See Table 5 for a detailed breakdown of participation by village. In most cases, group sizes averaged between twenty and thirty farm households. The majority of participants in the tree nursery and vegetable garden activities were women, while men predominated in the SWC work. The largest group sizes reported were 280 participants in Los Pinos, 52 in Tres Rios, 60 in San Lucas and 40 in Vista Bonita.

Table 5. Participation in Agricultural Development Projects by Village.

<u>VILLAGE</u>	NUMBER OF HOUSEHOLDS INTERVIEWED	PARTICIPATION					
		# OF GROUPS IN WHICH HOUSEHOLD HAS PARTICIPATED					HOUSEHOLDS PARTICIPATING IN AG. DEVELOPMENT BEFORE 1991
		0	1	2	3	4+	
San Lucas	26	7	10	8	1	0	13
Tres Rios	16	0	2	8	5	1	8
Vista Bonita	13	2	3	3	5	0	7
Los Pinos	26	0	3	7	9	7	18
TOTALS	81	9	18	26	20	8	46

Reasons for Participation

The farmers and development workers interviewed identified several reasons for people's participation in agricultural development groups. A first reason is to receive the

training. Several farmers expressed that they were learning new things. One woman put it this way: “One learns a lot. Staying at home you don’t learn anything!” The second reason people participate is that they have noticed the successes of previous interventions. Farmers in all of the villages explained that a few families participated at first, but gradually a majority of the population had adopted the technologies:

At first the people didn’t want it; little by little they observed the others who did it and changed their attitude.

The majority participates. They have seen the results.

Potato production was good—then everyone began to plant potatoes.

A third reason for involvement in agricultural development projects is people’s personal motivation. A few farmers stated that they did not want to leave their children in the same conditions in which they had lived, and they didn’t want to leave them with eroded fields or without any trees.

A fourth reason for people’s participation that stakeholders mentioned is to receive the subsidies and incentives provided by the projects. Subsidies included, food-for-work (FFW), tools, other agricultural inputs, cash payments for SWC, and agricultural loans. Community infrastructure projects were incentives that attracted many farm households.

In each of the communities studied, FFW is a motivating factor for a number of farm households to participate. A number of farmers were grateful to receive the food:

They help us—they give us a little food. That’s why we like to work there.

Now the institutions are helping us with a bit of food; it helps us out for a while.

They always have helped us a little with food. In other organizations there isn’t any.

However, receiving FFW is not without costs to the beneficiaries. One farmer expressed his hesitation: “I think I’m just going to work with the group this year—it takes a lot of time and the products they give always cost us money.” He then explained that the beneficiaries have to pay the cost of transporting the food from the capital and they must help unload when the products arrive; other respondents confirmed this requirement.

Special community infrastructure projects are another incentive. Recent projects include roads, an irrigation project, and a gas-powered mill for grinding maize. In Los Pinos, GO 2 was offering to bring a potable water project to the village. The farm families identified the water project as the primary incentive to participate:

Just out of necessity we’re working there—for the water.

We’re just working for the water project.... Everyone in the group is going to get water.

We have to do soil conservation, composting and work in the tree nursery and they’re going to give a potable water project.

They’re giving us a water project if we work there. If the group isn’t united, they won’t give the project. It’s worth Q. 150,000 [US \$19,500].

Now the majority is participating because of the water project. If not [for the water project], not as many people would come.

When several organizations are present in a village, farm households may choose the group in which they participate based on the subsidies that are being offered; as one farmer stated, “Everyone looks for the project that gives more help.”

Constraints to Participation

Farmers and development workers noted a number of factors that constrain farm households from participating in agricultural development projects. A first constraint is that most development organizations don’t reach the more remote areas:

I haven't participated with any group. No organization has come down here.

It's too bad that the agronomists don't go there, because vehicles can't get there. I don't know why the government employees didn't go there. Nobody's concerned about those people.

A second constraint is the need for families to earn income. The men in some of the communities may spend several months working outside the village. Even when they are home, they often look for opportunities in local agricultural day labor. As one woman active in several local development groups stated: “For people it’s a lot to lose a day working in the group, because they say they could be earning Q. 25.00.” (Q.25.00 is the government-established minimum wage for agricultural work.)

A third category of constraints to participation is negative past experiences. Farmers mentioned broken promises or outright fraud by a few organizations, incompetence or corruption by local committees or group leaders, failed technologies, and what one farmer termed “politics”—the fact that the organization was part of the current government or was tied to a political party.

A final area of constraints to participation is socio-cultural resistance. Farmers related the following experiences:

Our fathers didn't like the new techniques. We had to respect them.

A long time ago there were people who didn't like [the techniques]. They said they would lose too much land.

The people didn't like [the reforestation work] much. They said they would never receive anything from the trees.

The neighbors didn't buy it—‘where are our sheep going to eat? They are lies.’—But we decided to do it.

Spontaneous Adoption of Resource Conserving Agricultural Technologies

A substantial number of farmers had not participated in agricultural development groups but had adopted some of the RCATs that were being promoted. The majority of these farmers had observed what their neighbors had done and undertook their conservation without assistance from others:

I made these rock walls—I don't know if it's straight or if it's wrong—we just did it.

Other groups did it and I saw them. I made an A-frame level.

We're doing conservation but without levels—just with our heads.

I got the idea from the neighbors, but I did the work alone.

A few farmers had learned SWC technologies by participating in the large SWC work groups that the government sponsored in 1986; these groups conserved public lands and some private lands near the main road. One farmer had built rock walls on his own land after learning how to do the work in these work groups. Another farmer said that he had participated in the work groups in other communities, but he had not done anything on his own land until years later:

I knew how to do it, but I hadn't put it into practice until I heard the talk at church.... They advised us to protect our land.

Other farmers had asked project participants for help in laying out contours or building their conservation structures:

Some people who had done the work in a group had an A-frame level. I asked them to show me how to do it.

Someone from Los Pinos taught us. He had taken a course and came to teach us.

Finally, one farmer stated that he had learned how to do soil and water conservation while working on a coffee *finca*.

While there was widespread evidence of spontaneous SWC adoption, other RCATs were much less likely to be adopted. Only one farmer who had not participated with a group said that he practiced composting, and just one farmer among those interviewed was building an improved stable on his own, apart from the project.

The quality of RCAT implementation is highly variable among spontaneous adopters. While some farmers received help from participating neighbors or members of their extended families, and had used A-frame agricultural levels to lay out their contours, most spontaneous adopters built their conservation structures without using levels and left large distances between conservation structures, making the structures less effective at controlling erosion.

Implementation and Farmer Assessment of the Technologies

Composting

Nearly all of the agricultural development organizations had promoted composting as a way of increasing organic material for fertilizer and reducing the need for chemical fertilizer. The form of composting promoted by the organizations consisted of layering several different materials, including animal manure, crop residues, leaf litter, green plant material, soil, and ash or lime, and allowing these materials to decompose for two to three months. This practice was a new idea to farmers. Farmers described two traditional ways of generating organic fertilizer. The first involved mobile sheep corrals, which were moved every few days. The crops were later planted on the fertilized area. This

practice used to be widespread in the western highlands of Guatemala (eg. see Hostnig et al., 1998), but is now rare. The second manner of obtaining organic fertilizer is by combining animal manure and the used animal bedding and piling it up to decompose for three to six months. This practice is very common.

Adopting farmers in all of the study communities evaluated composting as being successful. The farmers discussed many advantages to composting. First of all, it increased the amount of organic fertilizer they used. One farmer said that the traditional method of producing organic fertilizer—letting the animal manure mix with the bedding and then piling it up to decompose for several months—did not produce enough fertilizer. Secondly, farmers said they now purchase much less chemical fertilizer. Thirdly, farmers were quick to point out that the compost was higher in quality than the traditional fertilizer—it decomposed much better. Fourthly, a few farmers stated that the production of maize and potatoes was higher with compost.

The constraints that farmers mentioned related to composting were the high amount of labor required and the lack of resources. These resources included animals for manure production and several types of plant materials used for composting: leaf litter, *pajón* (*Muhlebergia gigantea*—a long, coarse grass), and green plant material. One development worker claimed that people were rejecting composting because they were confusing the concept with their traditional method for preparing natural fertilizer.

Soil and Water Conservation

Soil and water conservation has been promoted by nearly all of the agricultural development organizations that have worked in the region, and the vast majority of farmers have adopted some form of the promoted technologies. Table 6 compares the

use of the different technologies among the four case study communities. See the Appendix for pictures of the different technologies in the study villages.

Table 6. Farmers' Use of Soil Conservation Technologies by Village.

Village (# of respondents)	Number of Farmers Implementing the Technology			
	contour ditches	live barriers	dead barriers	terraces
San Lucas (26)	6	8	15	9
Tres Rios (16)	7	8	9	5
Vista Bonita (13)	0	7	5	11
Los Pinos (26)	24	12	4	7
TOTALS (81)	37	35	33	32

Which technology farmers adopted depended on a number of factors, including slope, soil type, access to materials, farmer expertise, and which technologies the organization was promoting. Farmers who owned gently sloping land adopted contour ditches. The ditches took between one and two days to establish per *cuerda*. Most of the farmers in Los Pinos used this technology. Live contour barriers were another technology with relatively low labor requirements, requiring one day per *cuerda* for gently sloping land and two to three days for steeper land. Table 7 compares the labor requirements and other costs of the different SWC technologies that were promoted. Labor costs are valued at Q 25 per day, the minimum wage. Several farmers reported earning Q. 20 per day for agricultural work, especially those in the more remote villages, so opportunity costs for SWC may be somewhat lower. Most SWC work takes place during the rainy season, when labor demand is relatively high. Respondents explained that the soil would cave in if they attempted to dig contour ditches in the dry season, and that rain was necessary when trying to establish live fodder barriers.

Table 7. Labor Requirements and Costs for Soil Conservation Technologies

PRACTICE	LABOR COSTS IN DAYS <i>per cuerda</i>	LABOR COSTS IN QUETZALES	OTHER COSTS	TOTAL COST
Contour ditches	1 to 4 days	Q 25 to Q100		Q 25 to Q100
Living barriers	1 to 3 days	Q 25 to Q75	Plant material: Q 60 ?	Q 85 to Q135
Dead barriers				
stone walls	15 to 30 days	Q 375 to Q750	Tools: Q75	Q 450 to Q825
sod barriers	4 to 6 days	Q 100 to Q150		Q 100 to Q 150
Terraces	8 to 15 days	Q 200 to Q375		Q 200 to Q 375

The labor requirements for dead barriers depended on the type and quality of barrier constructed. Well-constructed rock walls required between 15 and 30 days of labor *per cuerda*, depending on the steepness of the site. They were usually constructed where rocks were abundant, especially in the villages of Tres Rios and San Lucas. Many farmers used barriers made out of sod, which were much easier to construct. This type of barrier was prevalent in Vista Bonita. These barriers required only four days of labor on less steep land and six days on steeper land.

Terraces were seen as appropriate on land that was not too steep, and with higher quality soils—farmers stated that it was impossible to make terraces where the soil was sandy. Farmers reported that a *cuerda* of terraces could require between eight and fifteen days of labor.

Farmers' evaluations of SWC technologies were generally very positive in each of the communities in the study. They mentioned four main benefits: (1) erosion control; (2) improved crop production; (3) fodder grass production; and (4) fertilizer retention.

Erosion control was the benefit that most farmers mentioned:

Before, when there wasn't conservation, the water carried everything away. Now when there are grass barriers, not as much is washed away.

Before, when you went to your field, every year there was less earth. Now we have contour ditches and walls.

It's good because it's grabbing the earth. When there aren't barriers, the earth slips away.

When there aren't curves [contour barriers], the soil washes away all at once.

The water doesn't wash the soil away—the topsoil isn't lost.

If there weren't walls, all the earth would wash away at once, and only rocks would be left.

A second benefit that many farmers mentioned is improved yields. Several farmers described the conditions without or prior to conservation:

If you don't do conservation, it doesn't produce much and the following year it doesn't produce at all. The land needs to rest two to three years.

When there weren't terraces, the maize only grew three feet high. Now it's improved a lot.

It's worth it. Before, the crops just produced for one year; the next year, the water had carried the soil away. Now it's consistent, on the upper and lower parts [of the field].

Other farmers mentioned the actual changes in yield. In terms of maize production, most farmers reported a doubling or tripling of yields; some farmers in Los Pinos said that people did not grow maize before the organizations came. One farmer said that potato production had increased from 5 *quintales* to between 20 and 25 *quintales* per *cuerda*.

A third benefit to soil and water conservation that farmers in each of the communities mentioned was the fodder grasses associated with terrace banks, live barriers or contour ditches. One farmer stated, "It's like two products—another harvest." Another family said that although they didn't have many animals, they still benefited

from the fodder grass because they could sell it in the local market. A third farmer noted how he could harvest fodder grass three times during the rainy season.

A fourth benefit that a number of farmers mentioned was the retention of fertilizer. They said that before conservation the water would wash the fertilizer away; as one farmer put it, “Before, we wasted the fertilizer.”

Not all of the technologies promoted for SWC were seen as successful. One farmer disliked live barriers, saying the soil still washes down. Farmers in different communities noted that some varieties of fodder grasses that organizations had brought from other regions of the country did not grow well.

The most frequently mentioned constraints to adopting soil and water conservation were land constraints, including steep slopes and inadequate soil types. Other constraints were the lack of tools to perform the work; the lack of skill or someone to train the farmers; and the large amount of labor required. Two farmers from Vista Bonita and a project coordinator talked about the soil:

We want to continue but the earth is pure sand. It is always collapsing.

When the earth is hard, it's good, but when it's loose, it doesn't work.

In some villages the soil is loose. People want to do conservation, but the land doesn't permit it.

Other farmers claimed that their land was too steep, one farmer reflecting, “It’s better not to touch it.” On rocky land, farmers said that contour ditches were impossible to make.

The lack of tools was another constraint mentioned by farmers in Tres Rios and Vista Bonita. They said that they needed shovels, picks, hoes and wheelbarrows to do conservation. One farmer exclaimed that he had already gone through five picks in digging out the rocks from his field and using them to build rock walls. In some cases

the organizations had given tools to the groups to be used in SWC work, but these tools were often not available.

The high labor requirement was another constraint that farmers mentioned:

I did one cuerda of terraces on my own. Alone you can't do it—it's too much work. In a group you can make progress.

It took a lot to make the terraces. We had to bring in black dirt to put on the terraces.

A few farmers who had not participated in conservation groups mentioned that they lacked the skills to do conservation or that there was no one who could teach them.

Farming without Chemical Fertilizer

Unlike composting and SWC, farming without the use of chemical fertilizers has had little success. At least four development organizations have been requesting that participating farmers experiment by planting 0.5 to 1 cuerda of their maize crop without using chemical fertilizer. The vast majority of farmers stated that farming without chemical fertilizer does not produce a harvest. The following response was typical:

It doesn't work—I wasted my time. The compost was good quality, but the crop didn't result. With chemical fertilizer, we don't get much, but we get something!

Many farmers pointed out that the results would also be poor if they planted using only chemical fertilizer; they said that both types of fertilizer were necessary. A few farmers said that the crops or the soil had grown accustomed to chemical fertilizer. One farmer did plant his maize crop without chemical fertilizer, and according to him the difference in yields was minor. He still used chemical fertilizer on his potatoes, however, saying that without it, production would be minimal. Another farmer said that potato production

without chemical fertilizer works when the land has rested for a while, and can produce yields from 8 to 10 *quintales* per *cuerda*.

Improved Agropastoral System

Groups of farmers in both San Lucas and Vista Bonita had implemented the improved agropastoral system with NGO 3. This project sought to introduce stall-feeding of sheep with new varieties of fodder grasses grown on conservation structures in farmers' agricultural lands. Approximately twelve families in each of the communities participated in the project, in which the agricultural development organization provided families a loan for the construction of the stables; in one of the villages farmers said the stables had been donated. Loans were also provided in one of the communities for purchasing a new breed of sheep. The farmers evaluated the stables very positively:

It's a valuable change. Before, we had more sheep in the old stable—on the ground. In the rainy season they would wake up in the mud. We would take out the manure. We had to get grass from down the mountain.... [Now] I don't have to carry wet grass and leaf litter for the animal bedding in the rainy season. The animals are content. And I have a lot less work.

Other farmers expressed how lambs used to die in the muddy conditions, or how the sheep would get soaking wet when they were out in the pasture and it rained. Now they stay in the stable when it rains. A few participating farmers used their own funds to build a second improved stable or to enlarge the one they had built with the project. One non-participating farmer was building an improved stable on his own, following the design of the project.

A second component of the system was fodder grasses. Grasses that were brought from other regions of the country did not grow well at higher altitudes. Farmers also

discussed how the fodder grasses did not produce at all during the dry season; they still let their sheep out to pasture during much of the year.

The third component of the agropastoral system was the introduction of improved breeds of sheep. The experiences with this component were disappointing. The improved breeds were not introduced at all in San Lucas due to the poor performance of the fodder grasses. Results in Vista Bonita were not much better. In one family's case, all of the new sheep had died; another family had one out of three die. Farmers expressed how the new sheep were more susceptible to illness and had to be watched carefully.

Other Project Components

Vegetable gardens

Results of vegetable garden promotion were mixed. Many farmers said that the vegetables grew well, but were just used for family consumption. Produce from communal gardens was divided up among the participants. A few farmers in Tres Rios and San Lucas were growing vegetables on their own to sell in the local markets.

Farmers and development workers mentioned biophysical constraints, the financial costs, and the management skills required as the constraints inhibiting vegetable production:

We tried to plant [vegetables], but there isn't any water.... They gave us training, but it couldn't be done.

We need money for the seed—it's difficult for us to obtain the seed. We planted vegetables because the organization gave us the seed.

One could sell [vegetables], but we don't know how to grow them well enough.

Vegetable gardens produced little success, due to the unfamiliarity in their management and the dependence on external inputs.

Irrigation

Farmers in Tres Rios were very enthusiastic about the irrigation project. Most farmers have used the irrigation for growing potatoes in the dry season, mostly to sell. Some farm households have planted carrots, cabbage, broad beans, and other vegetables in the dry season. Several of these families have sold the produce in local markets.

Credit

Farmers in each of the study villages had experience in using credit for agricultural production. Sometimes this credit was offered by the agricultural development project; in one case the increased production as a result of a development project's work led to a demand for credit to plant potatoes.

Farmers in Los Pinos related how the government's agricultural development bank had offered credit for potato production to many farmers in the village in the late 1970s. At harvest time, the price for potatoes dropped to Q. 1.00/qq [exchange rate at the time: Q 1.00: US\$1.00]. Dozens of families were unable to pay, and according to some farmers, a few families had lost some of their land. As a result, development organizations hesitate to offer loans to groups from this village. In addition, most farmers in Los Pinos and in other communities are reluctant to go into debt for commercial agricultural production, sentiments echoed in the following comments:

Just a few people use loans. Most people work with their own resources.... When people sell at a low price, and if they have loans, they have to go to the coast for 2, 3, 4, up to 6 months to earn the money that they lost.

Taking out a loan is risky—it's hard to pay it back. Now we're happier because we don't have a commitment with the bank or the cooperative. We're happier using our own resources.

We're not getting under a loan. What happens if we have a loan and we don't make [any money]? Where are we going to get the money?

The majority of people don't want loans. The price of potatoes varies a lot, and animals can die. Then people have more debt.

Farmers receiving loans from church-based NGOs reported mixed results. One farmer in Vista Bonita said that fifteen members out of twenty-two original recipients were up to date with their payments; some families were unable to pay off the loans on time and therefore were not eligible to receive any more loans. Three farmers described how they use the loans:

With beans—if that doesn't work, with broad beans. If not with broad beans, with potatoes. If not with potatoes, we use the money in business (bringing merchandise from Mexico).

If it's good weather, you can pay off the loan with the crop. When the price goes down, we lose. We have to find a way to earn [the money] so that we don't default, so we have the right to credit again. The credit helps us a lot.

They can be used for a business, a store. One can buy and sell things. With loans, people don't have to go far away, they don't have to suffer on the finca.

Post-Project Continuance and Discontinuance of the Promoted Technologies

What Happens when Subsidies Stop

As mentioned in the introductory chapter, agricultural development researchers have found that the technologies promoted by agricultural development organizations are often discontinued when subsidies stop. This research examined whether or not this phenomenon occurred in the four study villages. Many community leaders and development workers felt that farmers were only participating to receive the subsidies, and quit working when the subsidies stopped:

VISTA BONITA: What people are interested in is that there is help, that there are rations. When there isn't help, people scatter again. Those who are committed keep working. Those who aren't go to el otro lado [Chiapas].

TRES RIOS: When there's a project and rations, everyone is doing their conservation, and when there aren't rations, they aren't.

LOS PINOS: Many people participate just out of self-interest, to receive food.

Development workers had very similar experiences with subsidies:

People have grown accustomed to paternalism—getting handouts. They don't continue without the stimulus.

People have grown accustomed to rations. With rations they do anything.

When the FFW was discontinued, several groups broke up....

Other community leaders and development professionals did not think that subsidies made a major difference in most people's continuance of RCATs:

SAN LUCAS: Not everyone continued, because there were no longer rations, but many people did continue with conservation.

DEVELOPMENT STAFF MEMBER: Many people work for development, but there are always those who work for food (a few).

The following sections highlight the evidence obtained in this research that many farmers do indeed continue to practice some of the promoted RCATs after subsidies stop or projects end.

Other Factors Influencing Continuance and Discontinuance of RCATs

While the end of subsidies may explain some of the discontinuance of RCATs in the short term, factors related to the farm household and the broader context must also be examined in order to discover the reasons for continuance or discontinuance in both the short and the long term. Farmers gave a variety of reasons for their decisions to continue

or discontinue RCATs that are not related to subsidies but rather are related to the characteristics of the technologies, the household's particular situation, and economic and institutional factors. The following section highlights some of these reasons for three of the promoted technologies: composting, SWC, and vegetable production.

Composting

In San Lucas and Buena Vista, where a large number of farmers had used composting in the past, the current number of users was much lower. The majority of farmers in these communities currently use the traditional method for making organic fertilizer—combining the animal manure and used animal bedding and letting it decompose for several months. Farmers explained why they no longer use composting:

We made compost piles back then, but now that we have animals [sheep], they give us manure.

Now I have the mule to make fertilizer. It stays in the stable. The pajón [a tall grass used for bedding] decomposes with the heat. Now it's easier—it is difficult to make compost piles.

The second farmer related that he had better production with the compost piles, but he doesn't do it because of the time it takes. He said that his sons were working in the United States and that there was no longer anyone to help him.

In Los Pinos, two farmers said that the majority of farmers in their community currently practiced composting. A farmer in San Lucas said that more farmers have continued with composting than with SWC. In Tres Rios, farmers also expressed that they were using composting. Given that there were a number of projects currently functioning in Los Pinos and Tres Rios, it was not possible to determine if farmers would continue to practice composting once these organizations left the community.

Soil and Water Conservation

Many farmers in each of the study communities expressed that they had continued practicing SWC after projects had ended or had adopted the practices after observing their neighbors. Several farmers shared how conservation activities had spread through their villages:

VISTA BONITA: Those who didn't want [to do conservation at first] have now made their barriers and terraces.

LOS PINOS: Almost all the neighbors have done conservation.

LOS PINOS: Now the majority has their curves, their conservation but it has taken a long time.

SAN LUCAS: Not everyone continued, because there were no longer rations, but many people did continue with conservation.

TRES RIOS: It is worth it to do conservation. Almost everybody is improving their land.

Other farmers described how much conservation they had done on their own. One farmer had purchased 35 *cuerdas* of land and had done conservation on all of it. Another had done one *cuerda* of conservation with a group, and then conserved 14 more *cuerdas* on his own. Some farmers expressed that they had conserved all of their agricultural land.

Vegetable Production

Few farmers continue planting vegetables after projects leave. Only in Tres Rios, in which the majority of families recently obtained irrigation, were significant numbers of farmers planting vegetables on their own. Many Tres Rios farmers expressed that they intended to start producing vegetables in the coming dry season with irrigation, but had not grown them at any large scale yet. In each of the villages, the cost of the seed, the

difficulty obtaining the seed, and the specialized knowledge required were the most frequently mentioned reasons for discontinuance:

They gave us the seed first. Later, when we had to buy [the seed], many people didn't plant. The seed is expensive.

We need money for the seed—it's difficult for us to obtain the seed. We planted vegetables because the organization gave us the seed.

We've planted vegetables on our own (my wife and I). It produces well—we're just lacking a bit of knowledge. We'd like another organization to come to train us and help us out.

One doesn't have a lot of knowledge. Those who are skilled at it say that it does produce well. Perhaps with practice it produces good results.

Impacts of Agricultural Development Interventions

Besides their evaluations of the technologies, farm families were asked how the projects as a whole had changed their work. They mentioned a number of areas, including an improvement in their skills, an increase in their agricultural production, and a significant change in their reliance on seasonal migration.

Improved Skills

A first area that farm families mentioned is how participating in the projects increased their farming skills. Farmers in all of the communities commented:

TRES RIOS: We're learning to farm. We're realizing that the work looks better, and the crops produce more now. We can make a tree nursery, plant vegetables, and make compost piles.

VISTA BONITA: Thank God, I can do [SWC]. I can use an agricultural level, lay out contours.

VISTA BONITA: I improved my skills—how to farm. I farmed before, but now the production is better.

SAN LUCAS: We still put their teachings into practice. They're good—our land looks better.

LOS PINOS: The teaching was excellent. Here we didn't know how to plant potatoes before. The results on the land are good. Soil conservation was good for us.

One farmer compared the new practices with those of farmers in another village at a lower elevation that had not experienced agricultural development interventions:

Down below, there is better land, but people don't do conservation. They burn all the leaf litter. They apply chemical fertilizer three times to their crop.

Increased Production

Changes in production were the second type of impact mentioned. Farmers from Los Pinos explained the transformation in agriculture resulting from the training received from agricultural development organizations:

With the organizations, it has improved a lot. Without the organizations, we can't improve production.

Before, the crops didn't produce anything. Now there's maize, potatoes, broad beans and oats. When the chemical fertilizer came and when the foreigners came to teach us how to plant, then it changed.

We don't buy maize. In the past, when we didn't have the training, people didn't plant here—they went to the coast to plant.

We have maize and potatoes now that we've done soil conservation.

Before, maize didn't grow here, but now with chemical fertilizer and good organic fertilizer we are succeeding.

In Tres Rios, farmers saw the irrigation project as having the most impact on production. They explained that with irrigation they could now plant potatoes and vegetables in the dry season. They would then sell these products.

Not all farmers experienced large increases in production. One farmer in Vista Bonita had participated in several groups. They had built terraces and barriers, had

planted vegetables and made compost piles. Despite these efforts, he said that production remained low. He then made the following comment:

It's a wasted effort. Although one struggles and [the development workers] help, the land is the reason.

Reduction in Seasonal Migration

Perhaps the largest impact of agricultural development projects that farmers mentioned was the reduction in migration to the coffee *fincas* in Chiapas, Mexico and the western Pacific coastal region of Guatemala. One farmer in Los Pinos described conditions in the past:

Before, there weren't curves [SWC]. People worked exclusively on the fincas—men, women and children lived on the fincas. We're better off now with the contour ditches and composting along with the improved varieties of potatoes and wheat.... In the past when there wasn't the knowledge, people didn't plant here. They went to the coast to plant. Before, people would plant 1 cuerda [of potatoes] and then would go to the coast to plant maize. Now, people don't go to the finca.

In Vista Bonita, all of the farmers interviewed still migrate to the coffee *fincas*. Non-participating farmers did not note a big decrease in the time they would migrate, but those farmers who had been active in agricultural development projects reported going to Chiapas for less time than in past years:

Before, we mostly went to work with the rich and abandoned our families. Now I don't have to go to el otro lado [Chiapas] in May and June. We have food. I go just once a year.

We would go for two months at a time for a total of six months in the year. Now I don't go much—just six weeks during the coffee harvest. Now I like to work here, even with few resources. I've been going less to Mexico for 3 or 4 years now.

Development professionals had varying perspectives on the impacts of the interventions on migration. One worker estimated that only five to ten percent of the people who used

to go to the coast still go. A second professional stated that the people still migrate, but for less time. A former coordinator of an organization targeting the poorest communities in the region said that there had been “a slight decrease in migration.”

Alternative Explanations for the Decrease in Seasonal Migration

While farmer adoption of RCATs is one reason for the decrease in seasonal migration, there are several other factors involved. In Los Pinos and San Lucas, many people have migrated to the United States. Remittances not only keep the recipient families from migrating to Chiapas; the families use some of the money to hire local agricultural workers and to fund house construction projects, creating new employment opportunities for a large number of villagers. In Tres Rios, the irrigation project may be responsible for a substantial part of the reduction in migration, because farmers can now work at home and grow crops in the dry season. In Vista Bonita, another reason for the decrease in migration is that some families are currently receiving loans from the development organization active in the community. These loans enable farmers to stay in their community during the months when cash is scarcest.

Exploring Differences in the Impacts of Agricultural Development Interventions

A closer analysis of the data reveals differences, both among the study villages and within each village, regarding both the types and magnitude of impacts related to participation in agricultural development interventions and the adoption of RCATs.

Differences Between Farm Households

Within each village, farm households experienced different levels of impact. While nearly all farmers recognized how the SWC technologies were effective in controlling

erosion, fewer farmers noted dramatic increases in production levels. One major reason for different impacts is that farm households face different economic constraints. For example, some farmers who had implemented SWC saw only minor production gains because they were unable to purchase chemical fertilizer or fungicides, or they had too few animals to produce sufficient quantities manure for organic fertilizer. The amount of land owned by the household played a role in determining impacts as well. Families with less than half a hectare of land rarely sold much of the food that they produced. A third reason for these differences was the type of land the farmers had—production was lower on steeper fields and on fields with sandy soils. A fourth major factor in determining impacts is the makeup of a farm household's livelihood strategy. Farmers with a stable source of income, such as those working as carpenters and masons or those households receiving remittances, could make investments and take risks that poorer farmers reliant on local and migratory agricultural labor could not.

Comparing Constraints to Agricultural Improvement Between Villages

Similar biophysical, socioeconomic, and institutional constraints were mentioned by farmers in all the study villages and by the development workers. However, the importance of each constraint varied substantially among the different groups. Table 8 compares the relative importance of different constraints according to farmers in each village and the development workers. The numbers reflect how frequently the constraints were mentioned when respondents were asked what were farmers' biggest problems.

Comparing Impacts on Livelihoods—The Case of Potato Production

The differences in the impacts of RCAT adoption, both among the villages and among the households within each village, can be illustrated by studying the most

Table 8. Comparison of Constraints by Group.

BIOPHYSICAL CONSTRAINTS	VILLAGE OR GROUP	VISTA BONITA	TRES RIOS	SAN LUCAS	LOS PINOS	Development workers
	Frost	2	4	3	6	} Climate: 5
	Wind	1	2	5	1	
	Late blight in potatoes	2	1	5	1	1
	Insect pests	3	-	1	1	-
	Soil type	2	-	1	1	2
	Topography	2	1	1	-	-
	Lack of water	3	-	2	1	3
	Illnesses in animals	1	1	2	2	-
Both	Low production levels	2	2	6	3	4
SOCIOECONOMIC AND INSTITUTIONAL CONSTRAINTS	Lack of resources	7	5	2	3	3
	Lack of work opportunities	3	-	3	-	3
	Lack of productive land	1	-	-	1	4
	Low product prices	1	4	1	14	2
	High input prices	-	-	2	5	-
	Lack of devel. assistance	1	1	1	1	2
	Lack of markets	2	-	1	6	3
	Lack of roads		2			1
	Illiteracy	-	-	-	-	3
	Cultural resistance	-	-	-	-	1
	Lack of organization	-	-	-	-	1
	Poor economic conditions	-	-	1	-	1

common livelihood component in the region: potato production. Potatoes are the primary crop in the region—every farm household interviewed grows them. Most families must

plant potatoes in the rainy season since they do not have irrigation. Potatoes are relatively expensive to produce; one *cuerda* costs between Q. 700 and Q. 1000 to plant.

Differences both between the villages and among households within villages are evident when examining the potato yields that the farmers reported. As seen in Table 9, average potato production differed substantially between villages, as did yields among farm households within the same village. The lowest yields were reported by farmers who did not use chemical fertilizer and/or fungicides due to financial constraints; there were two or three of these farmers interviewed in each village. These differences in yields influence the role of potato production in the livelihood strategies pursued in the different villages, since it is much more difficult to make money where production is low.

Table 9. Comparison of Potato Yields by Village.

VILLAGE	AVERAGE POTATO YIELD (in <i>quintales</i> per <i>cuerda</i>)	RANGE OF REPORTED YIELDS (in <i>quintales</i> per <i>cuerda</i>)
Vista Bonita	11	2 – 25
Tres Rios	13	5 – 22
San Lucas	15	6 – 25
Los Pinos	18	5 - 30

Vista Bonita

Farmers in Vista Bonita credited the RCATs with improving production, even doubling the yields, but this increase still does not make potato production profitable under most circumstances. Only a small fraction of farmers said that they sold potatoes, and then only in small quantities such as 5-10 *quintales*. Potatoes were a major food source, nevertheless, reducing the amount of maize that families had to purchase. The lack of resources, as indicated in Table 8, was clearly the primary constraint these farmers faced:

I think economic resources are what we're lacking. It's just that here one doesn't have money to plant well.

*We lack the money to buy fertilizer and to fumigate.
If one has money, here there is potato, broad beans. But money is what we're lacking, to buy chemical fertilizer. Without that, it doesn't produce.*

The lack of local work opportunities was another major problem in Vista Bonita:

More than anything we go to the finca to work because here there isn't any work.

We make practically all our money there [Chiapas, Mexico]. When we come home, we work with that money. Here there isn't anywhere to make money.

There from the finca comes all our money. Here, the planting is only to see if it produces something or not.

Tres Rios

In Tres Rios, farmers were able to plant potatoes in the dry season as a result of the recent irrigation project—they now have a comparative advantage over most other farmers in the region, and can receive higher prices for their products. One farmer said that his family does not plant potatoes in the rainy season at all due to the low prices and the late blight fungus, which thrives in damp conditions. The primary constraints to potato production that Tres Rios farmers mentioned were the lack of financial resources and low prices for their products:

The potato crop did produce but we need the resources to maintain the crop—chemical fertilizer or something else.

In the rainy season, sometimes there's no money to buy fungicides—sometimes we're worse off.

We've realized that potatoes don't work—sometimes the price is good and sometimes it isn't.

People lost big with potatoes last year. But those who planted this year made good money.

San Lucas

San Lucas showed the greatest variety in the role of potatoes in farm household livelihood strategies. Approximately 25 percent of the farmers interviewed had some type of informal irrigation, which they used primarily to plant potatoes. About half the farmers interviewed reported selling potatoes, but all households grew them. Farmers here most frequently mentioned the control of soil erosion as the biggest impact of the RCATs; fewer farmers stated that production had improved substantially. Farmers here mentioned biophysical constraints and low production levels as the principal constraints that they faced:

It doesn't produce much, even when you use fertilizer. Maybe the soil doesn't help.

The land doesn't help much. The late blight affects potatoes and maize, and it's very windy. There we run into problems.

Agriculture doesn't help us. It just pays for your labor—there isn't any profit.

The land doesn't produce enough to eat. People have to work outside the community.

Los Pinos

In Los Pinos the vast majority of farmers reported selling potatoes, with one farmer saying that he had sold 100 *quintales* from five *cuerdas*. One resource-poor farmer who owned about one hectare of land reported that he sells sixty percent of his crop, or about 50 *quintales*. As indicated in Table 8, most farm families interviewed mentioned the low prices for potatoes or the lack of markets for potatoes as their largest problem:

The price is what hurts us—the price is highly variable.

Now we have had disasters with potatoes in that there isn't a market to which to bring them, or the price is low.

What we need is a market, so that our products are worth more. No organization has been concerned with looking for markets.

I've been working with potatoes for six years and I haven't made any [money].

Potato prices tend to be higher in the dry season (November through May), reaching as high as Q. 150 per *quintal*, and drop when the rainy season harvest begins. In May and June of 2000, prices dropped all the way to Q. 10 to Q. 15 per *quintal*, and many farmers explained that they had lost a lot of money. When the interviews were conducted in May of 2001, prices were about Q. 50, and in August of 2001, the time of the year when prices are normally the lowest, farmers reported prices between Q. 80 and Q. 120. These variations in price illustrate that potato production is risky for all farmers, especially for farmers with few resources. They also explain farmers' hesitance to use credit for agricultural production.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The present study began by arguing that many traditional methods used to assess the promotion of resource-conserving technologies in agricultural development projects—namely, methods that focus primarily on measuring adoption—fail to consider the diversity of factors that affect the adoption of technologies, do little to build understanding why farm households adopt, adapt, reject, or discontinue the technologies, and ignore what happens after the projects end, both in the short and the long term.

The purpose of this thesis was to improve our understanding of the outcomes of agricultural development interventions promoting resource-conserving agricultural technologies (RCATs). A holistic systems approach to assessment was applied to examine stakeholders' experiences with agricultural development interventions and resource conserving technologies in the western highlands of Guatemala. The study addressed the following research questions:

- 1. What factors influence whether or not farmers initially adopt the technologies and practices promoted by agricultural development organizations?** Who participates in the projects? Why do they participate? What constrains farm households from participating? Do farmers adopt the technologies apart from participating in a project?
- 2. How do the different stakeholders assess the effectiveness of the promoted resource-conserving technologies and practices?** What criteria do they use?

What advantages, disadvantages, and constraints to adopting the technologies do they identify?

3. **Do farming households continue to use the technologies and practices promoted by agricultural development organizations after the projects leave?** What factors affect the continuance or discontinuance of RCATs and other technologies?
4. **What are the long-term outcomes of RCAT adoption on local farming systems and livelihood systems?** What constraints to improved agricultural production and livelihood improvement do stakeholders identify? How have the agricultural development interventions made a difference?

Four communities in the western highlands of Guatemala were selected as cases to explore stakeholder experiences of agricultural development projects that promoted RCATs. Eighty-one interviews were conducted with members of farm households in the four communities, and eleven interviews were conducted with staff members of organizations that had worked or were currently working in the study communities.

The first phase of field research involved interviews with key informants to determine which villages to select for study and to develop a general overview of the cases. The main phase of research involved multiple data collection methods, including open-ended, informal interviews, direct observation, participant observation, and a review of documents. Farmers in the four villages were asked about their experiences with agricultural development projects, the characteristics of their farming systems, their use of RCATs, other income-earning strategies they used, and problems that they faced.

Development workers were questioned about the technologies and programs they promoted, the levels of participation and technology adoption in the study villages, the impacts related to the technologies that they perceived, and the constraints to livelihood improvement for small farm households.

Initial Adoption of Resource Conserving Agricultural Technologies

Farmers learned about the promoted RCATs primarily, but not exclusively, through the activities of a number of agricultural development organizations in the region. Most promoted activities involved weekly or bi-weekly meetings of the local agricultural development group with a project representative. Farm families are trained in agricultural technologies or they work in communal tree nurseries and vegetable gardens. In the first few agricultural development interventions, farmers implemented RCATs such as SWC by working in groups on each other's land. However, in most cases the RCATs were implemented by the farmers working individually.

Most of the organizations provided subsidies and other incentives; the most common subsidy was food-for-work (FFW), followed by project provision of seeds and/or tools. Cash payments were used by only one organization and with a limited number of farmers. A few organizations offered community infrastructure projects such as potable water or micro-irrigation. Most organizations offering FFW distributed it by household based on the amount of work that the household had done, measured by the area of land conserved, the size of the compost piles constructed, or the number of days that family members had worked in the communal tree nurseries or vegetable gardens. The approval of community infrastructure projects was also conditioned on the levels of village participation in and implementation of RCAT activities.

Spontaneous Adoption

In addition to the households that participated with the agricultural development groups, there was widespread evidence of spontaneous adoption of these technologies by farm households that had not participated with a group. These farmers adopted either by observing group members from a distance and copying their work, or by asking group participants for help.

Farmer Assessment of Promoted Technologies

Farmers evaluated most of the promoted RCATs very positively. The benefits associated with SWC technologies included the reduction in soil erosion, the increase in soil moisture, an increase in crop production, fodder grass production, and fertilizer retention. Benefits from composting included a reduction in chemical fertilizer use, and increases in the both the amount of natural fertilizer available to farmers and crop yields.

The agropastoral system was a partial success. Farmers were most enthusiastic about the new stables, noting fewer health problems and risks with the animals, greater capture of sheep manure, and the significant labor savings due to the elimination of the need for animal bedding. The failure of many of the fodder grasses to grow and the health problems with the introduced breed of sheep greatly reduced the economic potential originally envisioned for this project. Also, the lack of fodder grass in the dry season limits the envisioned environmental benefits of reduced over-pasturing and increased potential for natural forest regeneration, because farm families are still using these non-agricultural areas for pasture during much of the year.

Vegetable production was a modest success, according to farmers. Most vegetable garden promotion took place in communal gardens, and participants received a share of

the harvest. Farmers who had individual gardens used the vegetables mainly for consumption; only a few farmers sold vegetables, and these farmers had irrigation.

The irrigation project in Tres Rios was seen as a major benefit. Not only did irrigation allow farmers to grow crops in the dry season; the farmers also did not have to pay for the materials.

The only RCAT that the vast majority of farmers found to be unhelpful was farming without using chemical fertilizer. Yields of the crops were much lower than those obtained with farmers' usual practices.

Agricultural credit received mixed reviews from farmers. Many farmers, especially those in Los Pinos, had negative experiences with credit and would not use it for crop production. On the other hand, small credit programs run by church-based NGOs gave farmers flexibility to pursue a variety of income-earning enterprises, both in agriculture and outside of agriculture.

Post-Project Continuance and Discontinuance of RCATs

While most development workers and many community leaders argued that FFW was harmful, and that people had grown accustomed to the handouts and would not participate without them, the evidence from this research shows that many farm households continued certain RCATs after the projects had ended. This was especially the case with soil and water conservation (SWC) technologies. In the case of other promoted technologies and practices, such as composting and vegetable growing, the results were less clear. Although composting was evaluated highly by all the farmers, discontinuance was high in two of the villages. In the other two villages results were mixed, but there were still active projects that were promoting composting in these

villages. Why did farmers discontinue composting? In some cases, they lacked the resources, such as animals to produce manure or access to leaf litter or live plant material. In many other cases farmers said that they now have enough animals to produce manure and that mixing the manure and animal bedding is much easier than composting.

Continuation of vegetable production by farm households after an agricultural development project had left the community was less common. In some cases the farmers noted biophysical constraints, such as frost or the lack of water for irrigation. In other cases, the high cost of the seeds or the difficulty of obtaining the seeds was mentioned. A final factor mentioned frequently by farmers was their lack of knowledge or skill in growing vegetables. This factor was somewhat surprising, given that nearly all of the organizations have promoted vegetable gardening. One possibility for this lack of confidence may be that most garden promotion has utilized communal gardens, and the development workers are often present to manage the work in these gardens; household members may not learn enough in these settings to do the work confidently without supervision in their own gardens.

Despite their positive contributions, the possibility of the improved stables being widely adopted is remote. The cost of the materials and labor is out of reach for most families, and the economic benefits certainly do not match the costs in the short-term.

Impacts of Agricultural Development Interventions

Farmers expressed three key ways in which agricultural development projects had improved their livelihoods. First of all, the training provided by the projects had increased their skills in farming. Secondly, farm families' agricultural production had increased substantially. In Los Pinos, for example, potato yields increased by at least five

times over previous yields, and farmers who had not produced maize before the organizations arrived were now producing it. Thirdly, the farmers said that they did not need to migrate to the coffee *fincas* as much anymore. In Los Pinos, very few of the farmers still migrated; in the other communities many farmers still migrated, but for less time than they used to go. Now they spend more time working on their own land.

Explaining Differences in Impacts

Examining the constraints that farmers and development workers identified as affecting farm household livelihoods revealed significant differences both between the study villages and among households within each village. In terms of biophysical constraints, the cold climate, severe terrain, and crop diseases were the largest obstacles. Farmers in Vista Bonita and San Lucas faced more biophysical obstacles to improving production than did farmers in the other villages.

In terms of socioeconomic and institutional constraints, the lack of financial resources was mentioned most frequently and was mentioned by farmers in each of the villages as well as by the development workers; low prices for agricultural products were also mentioned by all of the groups. The lack of work opportunities was mentioned in four out of five groups. Farmers in Tres Rios and Vista Bonita seem to face more socioeconomic limitations. Many families in Los Pinos and San Lucas were likely better off because they were receiving remittances from family members working in the U.S.

Conclusions

Initial Adoption

Farm households learn about RCATs in a variety of ways. While most farm households learn through participation in agricultural development projects, other sources

include neighbors, family members, and work experiences. There are several factors that contribute to the participation of farm households in agricultural development projects. Three factors evident in this study are the geographic, economic, and social characteristics of the households.

There are two geographic characteristics that influence participation—the location of the village, and the other the location of the household within the village. Villages that are easily accessible have received more development interventions than those that are more isolated, and thus farm households in these accessible villages have had many more opportunities to participate than do households in remote villages. In terms of individual households, the families that live far from the center of the villages are much less likely to participate in agricultural development projects.

The household's economic condition is a second factor that influences participation. Poorer families often earn crucial income through part-time agricultural day labor and may not have the time to participate in agricultural groups. Some farmers may spend a major portion of their year working off-farm. Families that are better off financially, such as those with family members in the United States, have the flexibility to participate.

A third factor is social involvement. Households involved in church groups, women's groups, or community development committees have many more opportunities to be exposed to different organizations than those households that keep to themselves.

Subsidies and Incentives

It is evident from this research that development organizations' use of subsidies and incentives does increase the number of farm households participating in agricultural development groups. In the case of the potable water project in Los Pinos and the

irrigation project in Tres Rios, it was clear that these infrastructure projects were the primary motivation for people's participation and implementation of RCATs. Food-for-work subsidies also tend to attract farm households that would otherwise choose not to participate. In other organizations' projects, when FFW was discontinued, several groups disbanded. However, the fact that subsidies are used frequently does not imply that farm households automatically stop using the technologies after subsidies stop. The results of this study show that many farmers have continued to implement RCATs without project support. Clearly, there are multiple factors involved.

Factors Influencing Continuation or Discontinuation of Technologies

Whether or not farm households continued to use the RCATs that they had initially adopted depended on a variety of factors, including the characteristics of the technologies, the resources of the farm household, and the broader context.

The characteristics of the technologies were very important in determining whether or not farm families continued to use them. For SWC technologies, those that involved less labor to implement, such as contour ditches and live barriers, were much more likely to be practiced than were terraces. Rock walls were an exception—despite their high labor requirements, a few farmers were continuing to build them, likely because the removal of the rocks from the fields greatly improved crop production.

Composting was less likely to be continued. It is apparent that many farmers discontinued composting because it had what Rogers (1995) calls a low *relative advantage*—it was not perceived as being significantly better than the traditional method of organic material preparation, due to the additional labor it required. Another factor for

discontinuance, which was not explored in this research, may be the distance between the farm homestead and the agricultural fields.

The resources available to farm households also determined continuance or discontinuance. One important resource is labor. Farmers whose sons were no longer in the household found it more difficult to do SWC or build compost piles. Another important resource is financial capital. Many farmers stated that they did not have the resources to afford fertilizer and other inputs. The high cost of vegetable seed was a constraint that limited vegetable production for several families. A third resource is physical capital. Farmers that had many farm animals were more likely to discontinue composting, because the traditional method of combining the manure with animal bedding was less labor intensive and the animals generated enough manure to improve crop production. Farmers that had little access to fresh vegetative material nearby were constrained from making compost piles. Finally, farmers' agronomic knowledge or skills were another factor that influenced continuation. Farmers who were confident in their abilities were more likely to continue with vegetable production, for example, while others said that they did not have the skills to do it well.

Outcomes of the Interventions on Farm Household Livelihoods

Bush (1997:1) states, "Development projects must show significant long-term impacts on poverty or they are pointless." Most evaluations of development do not examine the long-term impacts or outcomes; most organizations leave the communities, and policies and priorities change for both governments and NGOs. Farm household priorities and livelihood strategies change as well, given the dynamic nature of both the farm household and the broader context.

The results of this study show that agricultural development interventions have made significant impacts on farming systems and livelihood systems in the complex, diverse and risk-prone environment of the western Guatemalan highlands. Farmers have improved their skills and gained confidence, production has increased for nearly all farmers participating, and there is less dependence on seasonal migration to earn cash incomes. Food security for these families has improved significantly. Most farm families stated that the development organizations have helped them improve their lives.

However, significant constraints exist that continue to limit the impacts of the agricultural development interventions on people's livelihoods. Some of the relationships between project impacts and endogenous and exogenous constraints are illustrated in Figure 4. Agricultural development organizations attempt to introduce new products, but biophysical constraints such as the cold climate and steep slopes severely limit the possibilities for agricultural diversification and commercialization. The lack of financial resources prevent most farmers from making more than minor changes in their production systems. Although production has clearly improved, highly variable prices cause many farmers to be risk averse and avoid using credit to finance commercial agriculture production. Harwood (1979) states that markets need to be accessible, stable, and predictable in order for farmers to trust them. Clearly this is not currently the case with potatoes, the only cash crop these farmers grow.

In conclusion, agricultural development organizations and RCATs have made valuable contributions to the production, stability and continuity of farming systems in this context. However, the agroecological limitations of the climate, combined with the limited economic resources of these families and the limitations of the greater economy

for small farmers, indicate that for most households, farming will continue primarily as a subsistence activity, and farm households will have to continue to rely on off-farm activities to meet their income needs.

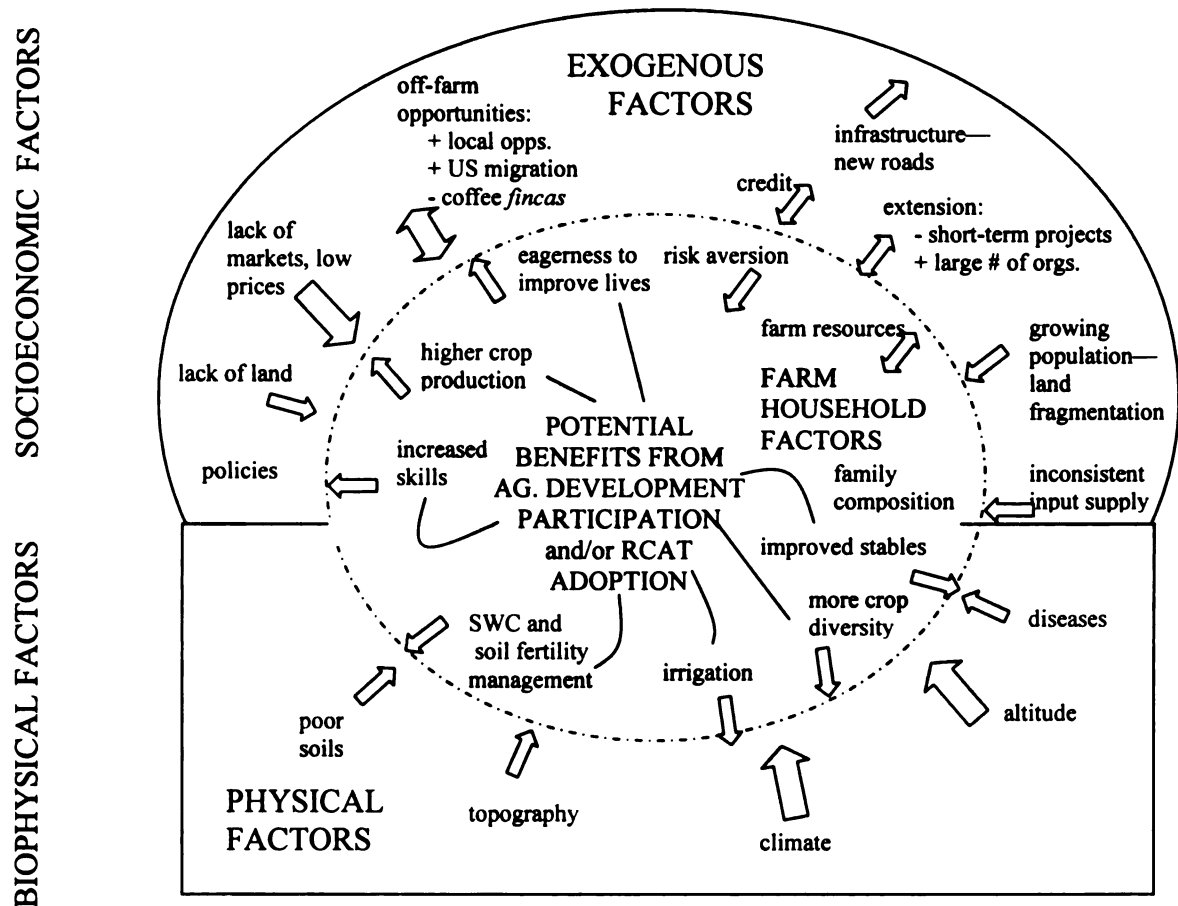


Figure 4. Factors Affecting the Outcomes of Agricultural Development Interventions on Small Farm Households.

Recommendations for Future Research

This research was conducted under the assumption that a detailed understanding of the context is necessary to understand the outcomes of RCAT promotion. While the results of this study do not necessarily apply in other areas, similar studies in communities with different biophysical and socioeconomic contexts could help to

determine which factors are more common in their influence on farm household responses to RCAT promotion, and which factors are more context-specific.

This research focused on a region of the western Guatemalan highlands that is especially risk-prone and marginal for agricultural production. More studies in less vulnerable regions would be necessary to determine whether these outcomes are common or are determined primarily by the harsh climate.

Although this research included women's perspectives, gender issues were not a major focus of the study. However, it was clear from the study that gender plays a large role in how people participate in and experience agricultural development projects. In the projects examined in this study, women were the primary participants in both communal vegetable gardens and communal tree nurseries. Research that explicitly focuses on gender issues is necessary to determine the processes, impacts and outcomes of agricultural development interventions *within* the farm household in addition to examining the farm households as a whole.

One surprising result of the research was the large amount of spontaneous adoption of SWC technologies. Research exploring this process in-depth would be helpful so that future agricultural development interventions can improve the likelihood that their training can spread to non-participants within the communities and in other communities.

Recommendations for Development Practice

Agricultural development organizations should continue to promote simple, low cost soil and water conservation technologies. Farmers do continue to use them after projects leave and expand the area of their fields that are conserved. Establishing sources

of fodder grass for farmers seeking to adopt live barriers would eliminate one constraint for this technology.

Agricultural development organizations should consider promoting a composting technology that starts with farmers' traditional methods of organic material preparation—combining animal manure with the animal bedding. If changes can be made to this system that involve minimal additional labor, the technology may be more widely adopted.

Organizations may want to promote individual gardens at the same time that they promote community gardens. This step could increase farm households' management abilities so that they can continue to grow vegetables in the future. Also, a method of ensuring access to the necessary gardening inputs after the active phase of the project could increase farmers' likelihood of continuing to grow vegetables.

Agricultural development organizations should continue to train local promoters in each community so that the knowledge of these technologies is readily available to farmers after the project ends. Several people in each community should be trained, so that if one person leaves the community, the knowledge will not be lost.

The marketing of the agricultural products, not production itself, now seems to be the largest constraint for the majority of farmers in this study. Agricultural development organizations should make this aspect of agriculture a major focus of their efforts in the years to come.

Lessons for the Future

As funding for agricultural development continues to shrink, greater pressure is being put on organizations to use resources as efficiently as possible. The questions of

what techniques to introduce and whether or not subsidies are necessary are most common. This research showed that certain technologies were much more helpful than others in this biophysical and socioeconomic context. It also showed that subsidies attracted people to participate in agricultural development that otherwise would not have participated. On the other hand, many farmers continue practicing RCATs after subsidies end, and many non-participating farmers adopted technologies without receiving any subsidies at all.

One further question that needs to be asked more often is where should the organizations be working. From this research it was clear that the villages with the easiest access have enjoyed many more agricultural development opportunities, while those communities more difficult to reach have experienced far fewer interventions. Just from observation one can notice how much less conservation behavior is occurring further down in the valley; farmers noted this difference also. Meanwhile, some farm households are participating with two or even three agricultural development organizations, which are promoting almost exactly the same technologies, in order to receive more FFW or other incentives. Agricultural development organizations and funding organizations need to ask the hard questions about reaching the long-neglected communities. When access is a problem, a greater reliance on farmer-promoters may be the answer. A farmer who can speak in people's native language and who knows their situation may be much more effective than a well-educated agronomist from the city. The development organizations also have to coordinate their efforts better. Rather than competing over participants by offering better subsidies, organizations should be willing to spread the wealth into more remote areas.

A final question that agricultural development organizations need to ask is how long should organizations work in a community. There are no easy answers. It is apparent from this research that interventions that have lasted one or two years had fewer lasting impacts. It takes time for farmers and development workers to build trust and to understand each other. At the same time, needs in other communities continue to be unmet. Organizations should be flexible in this area, recognizing that the more isolated communities may need more time to adopt new agricultural ideas. Organizations can also recognize these long-neglected communities as opportunities to attempt new approaches to agricultural development, taking advantage of all that has been learned in the last 30 years and letting the farmers themselves control their own development.

APPENDIX



Figure 5. Live Barriers in San Lucas.



Figure 6. Agroforestry System with Pasture Grasses and Arrayán (*Baccharis vaccinoides*) in Los Pinos.



Figure 7. Contour Ditches with Live Barriers in Los Pinos.



Figure 8. Terraces (foreground) and contour ditches in Los Pinos.



Figure 9. A Rock Wall in San Lucas.



Figure 10. Live and dead (sod) barriers in Tres Rios.



Figure 11. Rock walls in Tres Rios.



Figure 12. Maize planted on narrow terraces in Vista Bonita.

BIBLIOGRAPHY

BIBLIOGRAPHY

- Adriance, J. 1997. A new "model" for peasant farming is emerging in Honduras and Central America. In: Serageldin, I. and D. Steeds, (eds.) 1997. *Rural Well-Being: From Vision to Action*. Environmentally and Socially Sustainable Development Proceedings Series 15. Washington, D.C.: The World Bank. 191-194.
- Altieri, M.A. 1995. *Agroecology: The Science of Sustainable Agriculture*. Second Edition. Boulder, CO: Westview Press.
- Annis, S. 1987. *God and Production in a Guatemalan Town*. Austin, TX: University of Texas Press.
- Ashby, J.A., J.A. Beltrán, M.P. Guerrero, and H.F. Ramos. 1996. Improving the acceptability to farmers of soil conservation practices. *Journal of Soil and Water Conservation* 51 (4): 309-312.
- Baker, J. 2000. *Evaluating the Impact of Development Projects on Poverty: A Handbook for Practitioners*. Washington, D.C.: The World Bank.
- Bass, S., B. Dalal-Clayton, and J. Pretty. 1995. *Participation in Strategies for Sustainable Development*. Environmental Planning Issues No. 7, May 1995. London: International Institute for Environment and Development.
- Bawden, R. On the systems dimension in FSR. *Journal for Farming Systems Research-Extension* 5(2): 1-18.
- Beets, W.C. 1990. *Raising and Sustaining Productivity of Smallholder Farming Systems in the Tropics*. Alkmaar, Holland: AgBé Publishing.
- Bell, S. and S. Morse. 1999. *Sustainability Indicators: Measuring the Immeasurable?* London: Earthscan Publications.
- Berger, S.A. 1992. *Political and Agrarian Development in Guatemala*. Boulder, CO: Westview Press.
- Bernstein, H. 1992. Agrarian structures and change: Latin America. In: Bernstein, H. B. Crow and H. Johnson. 1992. *Rural Livelihoods: Crises and Responses*. Oxford, UK: Oxford University Press. 27-50.
- Brockett, C.D. 1998. *Land, Power, and Poverty: Agrarian Transformation and Political Conflict in Central America*. Second Edition. Boulder, CO: Westview Press.

- Brush, S.B. and B.L. Turner II. 1987. The nature of farming systems and views of their change. In: Turner II, B.L. and S.B. Brush, (eds.) 1987. *Comparative Farming Systems*. New York: The Guilford Press. 11-48.
- Bunch, R. 1985. *Two Ears of Corn: A Guide to People-Centered Agricultural Improvement*. Oklahoma City: World Neighbors.
- Bunch, R. and G. López. 1995. *Soil Recuperation in Central America: Sustaining Innovation after Intervention*. Gatekeeper Series No. SA 55. London: International Institute for Environment and Development.
- Bush, A. 1997. Evaluation and impact assessment. *Appropriate Technology* 24 (2): 1-3.
- Carrasco, D.A. and S. Witter. 1993. Constraints to sustainable soil and water conservation: a Dominican Republic example. *Ambio* 22 (6): 347-350.
- Carson, B. 1990. Terracing re-examined in the light of recent findings in Nepal and Indonesia. In: *Research Needs and Applications to Reduce Erosion and Sedimentation in Tropical Steeplands* (Proceedings of the Fiji Symposium, June 1990): IAHS-AISH Publ. No. 192: 364-373.
- Celis, R. M.A. Vedova, and S. Ruano. 1997. A new approach to poverty alleviation and sustainability in the dry tropical hillsides of Central America: a Guatemalan case study. In: Vosti, S.A. and T. Reardon, (eds.) 1997. 328-338.
- Chambers, R. 1994. The origins and practice of Participatory Rural Appraisal. *World Development* 22 (7): 953-969.
- Chambers, R. 1997. *Whose Reality Counts? Putting the First Last*. London: Intermediate Technology Publications.
- Chambers, R., A. Pacey, and L. Thrupp, (eds.) 1989. *Farmer First: Farmer Innovation in Agricultural Research*. London: Intermediate Technology Publications.
- Checkland, P. 1981. *Systems Thinking, Systems Practice*. New York: John Wiley and Sons.
- Cherrett, I. 2001. Decentralization, rural poverty, and degradation of uplands in Central America. *Mountain Research and Development* 21(3): 221-225.
- CIMMYT Economics Program. 1993. *The Adoption of Agricultural Technology: A Guide for Survey Design*. Mexico, D.F.: CIMMYT.
- Cramb, R.A., J.N.M. Garcia, R.V. Gerrits, and G.C. Saguiguit. 1999. Smallholder adoption of soil conservation technologies: evidence from upland projects in the Philippines. *Land Degradation and Development* 10: 405-423.

- Cramb, R.A. and R.A. Nelson. 1998. Investigating constraints to the adoption of recommended soil conservation technology in the Philippines. In: Penning de Vries et al. 1998. 99-120.
- Creswell, J.W. 1998. *Qualitative Inquiry and Research Design: Choosing Among Five Traditions*. Thousand Oaks, CA: Sage Publications.
- Creswell, J.W. 1994. *Research Design: Qualitative and Quantitative Approaches*. Thousand Oaks, CA: Sage Publications.
- Current, D., E. Lutz and S. Scherr. 1995. The costs and benefits of agroforestry to farmers. *World Development* 10 (2): 151-180.
- Dent, B. 1995. Theory and Practice in FSRE: Consideration of the role of modeling. *Journal for Farming Systems Research-Extension* 5(1): 31-43.
- Denzin, N.K. and Y.S. Lincoln (eds.) 1994. *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage Publications.
- Dixon, J., A. Gulliver, and D. Gibbon. 2001. *Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World*. Rome and Washington D.C.: FAO and the World Bank.
- Douglas, M. 1996. A participatory approach to better land husbandry. In: Sombatpanit et al. 1997. 107-121.
- Elías, S., G. Gellert, E. Pape, and E. Reyes. 1997. *Evaluación de la Sostenibilidad: El caso de Guatemala*. Guatemala: FLACSO.
- Enge, K.I. and P. Martinez-Enge. 1991. Land, malnutrition, and health: the dilemmas of development in Guatemala. In: Whiteford, Scott and Anne E. Ferguson, (eds.) *Harvest of Want: Hunger and Food Security in Central America and Mexico*. Boulder, Colorado: Westview Press. 75-101.
- Ellis-Jones, J. and B.G. Sims. 1999. Una evaluación económica de tecnologías de manejo de suelo: barreras vivas y cultivos de cobertura en fincas de ladera en Honduras. *Ceiba* 40(1): 21-34.
- Ellis-Jones, J. and A. Tengberg. 2000. The impact of indigenous soil and water conservation practices on soil productivity: examples from Kenya, Tanzania and Uganda. *Land Degradation and Development* 11: 19-36.
- Enters, T. 1996. Adoption: section review. In: Sombatpanit et al. 1997. 399-403.

- Enters, T. 1996. The token line: adoption and non-adoption of soil conservation practices in the highlands of northern Thailand. In: Sombatpanit et al. 1997. 417-427.
- Fernandez, A.P. 1999. The impact of technology adaptation on productivity and sustainability: MYRADA's experiences in southern India. In: Hinchcliffe et al. 1999. 75-89.
- Fresco, L. 1985. *Comparing Anglophone and Francophone approaches to farming systems research and extension*. Farming Systems Support Project. Networking Paper No. 1. Cited in Beets, W.C. 1990.
- Fujisaka, S. 1999. A retrospection of soil conservation in Claveria, Philippines. In: McDonald, M.A. and K. Brown. 1999.
- Fujisaka, S. and D.P. Garrity, 1991. Farmers and scientists: a joint effort. In: Moldenhauer, W.C., N.W. Hudson, T.C. Sheng and S.W. Lee, (eds.) 1991. *Development of Conservation Farming on Hillslopes*. Ankeny, IA: Soil and Water Conservation Society.
- Garcia, J.N.M., R.V. Gerrits, and R. A. Cramb. 2002. Adoption and maintenance of contour bunds and hedgerows in a dynamic environment: experience in the Philippines uplands. *Mountain Research and Development* 22(1): 10-13.
- Garrity, D.P., A. Mercado Jr. and M. Stark. 1998. Building the smallholder into successful natural resource management at the watershed scale. In: Penning de Vries et al. 1998. 73-82.
- Goldin, L.R. 1996. Economic mobility strategies among Guatemalan peasants: prospects and limits of nontraditional vegetable cash crops. *Human Organization* 55 (1): 99-107.
- Greene, J. 1994. Qualitative program evaluation: practice and promise. In: Denzin, N.K. and Y.S. Lincoln, (eds.) 1994. 530-544.
- Guba, E.G. and Y.S. Lincoln, 1989. *Fourth Generation Evaluation*. Newbury Park, CA: Sage Publications.
- Guba, E.G. and Y.S. Lincoln, 1994. Competing Paradigms in Qualitative Research. In: Denzin, N.K. and Y.S. Lincoln, (eds.) 1994. 105-117.
- Harrington, L. 1995. Sustainability in perspective: strengths and limitations of farming systems research in contributing to a sustainable agriculture. *Journal of Sustainable Agriculture* 5 (1/2): 41-59.
- Harwood, R.R. 1979. *Small Farm Development: Understanding and Improving Farming Systems in the Humid Tropics*. Boulder, CO: Westview Press.

- Hellin, J. and S. Larrea. 1999. Uso de vegetación para la conservación de suelo y agua en laderas: consideraciones sociales y técnicas. *Ceiba* 40 (1): 35-39.
- Hinchcliffe, F., J. Thompson, J. Pretty, I. Guijt, and P. Shah, (eds.) 1999. *Fertile Ground: The Impacts of Participatory Watershed Management*. London: Intermediate Technology Publications.
- Hinchcliffe, F., I. Guijt, J.N. Pretty and P. Shah. 1995. *New Horizons: The Economic, Social and Environmental Impacts of Participatory Watershed Development*. Gatekeeper Series No. SA 50. London: International Institute for Environment and Development.
- Hostnig, R., R. Hostnig and L. Vásquez V. 1998. *Etnobotánica Mam*. Quetzaltenango, Guatemala: GTZ, Proyecto Educación Bilingüe Intercultural Maya.
- Hudson, N.W. 1991. *A Study of the Reasons for Success or Failure of Soil Conservation Projects*. Rome: Food and Agriculture Organization of the United Nations.
- Hudson, N.W. 1992. *Land Husbandry*. Ithaca, New York: Cornell University Press.
- Hurni, H., M.G. Cook and S. Sombatpanit., 1996. Soil conservation extension—a world perspective. In: Sombatpanit et al. 1997. 3-11.
- Igbokwe, K.N., R. San Buenaventura, C. Basilio, S. Killough, N. Pandhare and Ramanchandrappa. 1999. Participatory technology development in southern India: improving rainfed agriculture. In: Hinchcliffe et al. 1999. 48-61.
- Jansen, K. 1998. *Political Ecology, Mountain Agriculture, and Knowledge in Honduras*. Amsterdam: Thela Publishers.
- Jiggins, J. 1995. Development impact assessment: impact assessment of aid projects in nonwestern countries. *Impact Assessment* 13 (1): 47-69.
- Jonas, S. 2000. *Of Centaurs and Doves: Guatemala's Peace Process*. Boulder, CO: Westview Press.
- Kaimowitz, D. 1993. *La Experiencia de Centroamerica y Republica Dominicana con Proyectos de Inversión Que Buscan Sostenibilidad en Las Laderas*. San José, Costa Rica: Instituto Interamericano de Cooperación para la Agricultura (IICA).
- Kaimowitz, D. 1993. NGOs, the State and Agriculture in Central America. In: Bebbington, A., G. Thiele, P. Davies, M. Prager and H. Riveros. *Non-Governmental Organizations and the State in Latin America: Rethinking roles in sustainable agricultural development*. London and New York: Routledge, 178-198.

- Kerr, J.M. 1998. The economics of soil degradation: from national policy to farmers' fields. In: Penning de Vries et al. 1998. 21-38.
- Kerr, J.M. and N.K. Sanghi, 1993. Indigenous soil and water conservation in India's semi-arid tropics. In: Baum, Eckhard, Peter Wolf, and Michael A. Zobisch, (eds.) 1993. *Acceptance of Soil and Water Conservation: Strategies and Technologies*. Witzzenhausen, Germany: German Institute for Tropical and Subtropical Agriculture (DITSL). 255-289.
- Kerr, J.M., N.K. Sanghi and G. Sriramappa. 1999. Subsidies in watershed development projects in India: distortions and opportunities. In: Hinchcliffe et al. 1999. 178-193.
- Kleynhans, T.E. 1996. *Contributions from social systems thinking to farm systems research and extension*. Journal for Farming Systems Research-Extension 6 (2): 69-81.
- Kumar, K. 1993. An overview of rapid appraisal methods in development settings. In: Kumar, K., (ed.) 1993. *Rapid Appraisal Methods*. Washington, D.C.: The World Bank.
- Lee, D.R., P.J. Ferraro and C.B. Barrett. 2001. Introduction: changing perspectives on agricultural intensification, economic development and the environment. In: Lee, D.R. and C.B. Barrett, (eds.) 2001. *Tradeoffs or Synergies? Agricultural Intensification, Economic Development and the Environment*. New York: CABI Publishing.
- Lindarte, E. and C. Benito. 1993. *Sostenibilidad y Agricultura de Laderas en America Central: Cambio Tecnológico y Cambio Institucional*. San José, Costa Rica: Instituto Interamericano de Cooperación para la Agricultura.
- Lutz, E., S. Pagiola, and C. Reiche. 1994. The costs and benefits of soil conservation: the farmers' viewpoint. *The World Bank Research Observer* 9 (2): 273-295.
- Lutz, E., S. Pagiola and C. Reiche, (eds.) 1994. *Economic and Institutional Analyses of Soil Conservation Projects in Central America and the Caribbean*. World Bank Environment Paper No. 8. Washington, D.C.: The World Bank.
- Lutz, E., S. Pagiola and C. Reiche. 1994. Lessons from economic and institutional analyses of soil conservation projects in Central America and the Caribbean. In: Lutz et al. 1994b. 3-18.
- Maddock, N. 1994. Monitoring and evaluation of agricultural and rural development projects: a review. In: MacArthur, J.D. and J. Weiss, (eds.) 1994. *Agriculture, Projects and Development*. Aldershot, England: Avebury/Ashgate Publishing. 104-123.

- Maglinao, A.R. 1996. Accelerating technology transfer and adoption: the challenge to research and extension. In: Sombatpanit et al. 1997. 405-416.
- Marshall, C. and G.B. Rossman. 1995. *Designing Qualitative Research (Second Edition)*. Thousand Oaks, CA: Sage Publications.
- Maxwell, J.A. 1996. *Qualitative Research Design: An Interactive Approach*. Thousand Oaks, CA: Sage Publications.
- McDonald, M.A. and K. Brown. 1999. *Issues and Options in the Design of Soil and Water Conservation Projects*. School of Agricultural and Forest Sciences Publication Number 17, University of Wales, Bangor.
- McDonald, M. and K. Brown. 2000. Soil and water conservation projects and rural livelihoods: options for design and research to enhance adoption and adaptation. *Land Degradation and Development* 11: 343-361.
- Meyer, C.A. 1999. *The Economics and Politics of NGOs in Latin America*. Westport, CT and London: Praeger.
- Meyer, M. and N. Singh. 1997. Two approaches to evaluating the outcomes of development projects. *Development in Practice* 7 (1): 59-64.
- Moldenhauer, W.C. and N.W. Hudson, (eds.) 1988. *Conservation Farming on Steep Lands*. Ankeny, IA: Soil and Water Conservation Society.
- Moore, K.M. 1995. The conceptual basis for targeting farming systems: domains, zones, and typologies. *Journal for Farming Systems Research-Extension* 5(2): 19-37.
- Morse, J.M. 1994. Designing funded qualitative research. In: Denzin, N.K. and Y.S. Lincoln, (eds.) 1994. 220-235.
- Napier, T.L. 1995. Socioeconomic and institutional constraints to adoption of conservation practices: implications for sustainable agriculture. In: Singh, R.B. and M. J. Haigh, (eds.) 1995. *Sustainable Reconstruction of Highland and Headwater Regions*: Proceedings of Third International Symposium on Headwater Control, New Delhi, Oct. 6-8, 1995. Rotterdam, the Netherlands: A.A. Balkema
- Narayan, D., 1993. *Participatory Evaluation: Tools for Managing Change in Water and Sanitation*. Technical Paper # 207. Washington, D.C.: The World Bank.
- Norman, D.W., F.D. Worman, J.D. Siebert, and E. Modiakgutla. 1995. *The Farming Systems Approach to Development and Appropriate Technology Generation*. FAO Farm Systems Management Series No. 10. Rome: FAO.

- Norman, D.W. and M. Douglas, 1994. *Farming Systems Development and Soil Conservation*. FAO Farm Systems Management Series No. 7. Rome: FAO.
- Pagiola, S. 1994. Cost-benefit analysis of soil conservation. In: Lutz et al. 1994b. 21-39.
- Pellek, R. 1992. Contour hedgerows and other soil conservation interventions for hilly terrain. *Agroforestry Systems* 17: 135-152.
- Penning de Vries, F.W.T., F. Agus, and J. Kerr. 1998, (eds.). *Soil Erosion and Multiple Scales: Principles and Methods for Assessing Causes and Impacts*. New York: CABI Publishing.
- Pichón, F.J. and J.E. Uquillas. 1999. Rural poverty alleviation and improved natural resource management through participatory technology development in Latin America's risk-prone areas. In: Pichón, F.J., J.E. Uquillas, and J. Fechine, (eds) *Traditional and Modern Natural Resource Management in Latin America*. Pittsburg, PA: University of Pittsburg Press.
- Pinheiro, S.L.G., S. Chamala and C.J. Pearson. 1998. Participation in FSR/E: new perspectives for small family farmers or just a reformulation of old development paradigms? In: Ranaweera, N.F.C., H.P.M. Gunasena, and Y.D.A. Senanayake, (eds.) 1998. *Changing Agricultural Opportunities: The Role of Farming Systems Approaches*. Proceedings of the 14th International Symposium on Sustainable Farming Systems. Sri Lanka: Asian Farming Systems Association.
- Poma Morales, J.D. 1998. *La Produccion de Maíz y Trigo y Su Incidencia en el Nivel de Ingresos de Los Asociados de la Asociación de Desarrollo Integral Nuevo Palmira – ADINP—Caserío Nuevo Palmira, Aldea El Carmen, Palestina de Los Altos*. Tesis para Licenciatura. Unpublished thesis. Universidad de San Carlos de Guatemala—Centro Universitario de Occidente.
- Prensa Libre staff writer. 2001. Pobreza en Guatemala. Pg. 3. *Prensa Libre* 51 (16,376), Guatemala, 4 Sep, 2001.
- Pretty, J. 1995. *Regenerating Agriculture: Policies and Practice for Sustainability and Self-Reliance*. Washington, D.C.: Joseph Henry Press.
- Pretty, J. and P. Shah, 1999. Soil and water conservation: a brief history of coercion and control. In: Hinchcliffe et al. 1999. 1-12.
- Pretty, J.N., J. Thompson and F. Hinchcliffe. 1996. *Sustainable Agriculture: Impacts on Food Production and Challenges for Food Security*. Gatekeeper Series No. 60. London: IIED.

- Reardon, T. 1998. African agriculture: productivity and sustainability issues. In: Eicher, C.K. and J.M. Staatz, (eds.) 1998. *International Agricultural Development*. Third Edition. Baltimore and London: The Johns Hopkins University Press. 444-457.
- Reardon, T. and S.A. Vosti. 1997. Policy analysis of conservation investments: extensions of traditional technology adoption research. In: Vosti, S.A. and T. Reardon, (eds.) 1997. 135-145.
- Reckers, U. 1997. Participatory project evaluation: letting local people have their say. *Development in Practice*, 1 (3): 298-300.
- Reijntjes, C., B. Haverkort and A. Waters-Bayer. 1992. *Farming for the Future: An introduction to Low-External-Input and Sustainable Agriculture*. London and Basingstoke: Macmillan Press.
- Richter, M. 2000. The ecological crisis in Chiapas: a case study from Central America. *Mountain Research and Development* 20 (4): 332-339.
- Rogers, E.M. 1995. *Diffusion of Innovations*. Fourth Edition. New York: The Free Press.
- Rosado P., P., L.E. Barrientos C. and S. A. Lima L. 1994. Soil erosion control efforts in Guatemala. In: Lutz et al. 1994b. 58-62.
- Ruaysoongnern, S. 1999. Adoption of sloping land conservation practices by farmers in the northeast of Thailand. In: McDonald, M.A. and K. Brown. 1999. 47-55.
- Ruonavaara, D. 1996. *Traditional Household Gardens of the Peten, Guatemala*. Unpublished Master's Thesis. Michigan State University.
- Sanders, D.W. 1988. Soil and water conservation on steep lands: a summary of workshop discussions. In: Moldenhauer and Hudson 1988. 275-282.
- Sanders, D.W., 1996. Implementation: section review. In: Sombatpanit et al. 1997. 237-243.
- Sanders, D.W. and D. Cahill. 1998. Where incentives fit in soil conservation programs. In: Sanders, D.W., P.C. Huszar, S., and T. Enters, (eds). 1999. *Incentives in Soil Conservation: From Theory to Practice*. New Hampshire: Science Publishers. 11-24.
- Sanders, D.W., P.C. Huszar, S., and T. Enters, (eds). 1999. *Incentives in Soil Conservation: From Theory to Practice*. New Hampshire: Science Publishers.
- Scarborough, V., S. Killough, D. A. Johnson, and J. Farrington, 1997. *Farmer-Led Extension: Concepts and Practices*. London: Intermediate Technology Publications.

- Scherr, S.J. 1995. Economic factors in farmer adoption of agroforestry: patterns observed in western Kenya. *World Development* 23(5): 787-804.
- Scherr, S.J. and E. Muller. 1991. *Technology impact evaluation in agroforestry projects*. Agroforestry Systems 13(3): 235-238.
- Scherr, S.J. and D. Current. 1997. What makes agroforestry profitable for farmers? Evidence from Central America and the Caribbean. *Agroforestry Today* (4): 10-15.
- Scoones, I. 2001. Transforming soils: the dynamics of soil-fertility management in Africa. In: Scoones, I. (ed.) 2001. *Dynamics and Diversity: Soil Fertility and Farming Livelihoods in Africa*. London and Sterling, VA: Earthscan Publications.
- Scoones, I., C. Reij, and C. Toulmin, 1996. *Sustaining the Soil: Indigenous Soil and Water Conservation in Africa. Issues Paper No. 67*. London: International Institute for Environment and Development.
- Serageldin, I. and D. Steeds, (eds.) 1997. *Rural Well-Being: From Vision to Action*. Environmentally and Socially Sustainable Development Proceedings Series 15. Washington, D.C.: The World Bank.
- Shaner, W.W., P.F. Philipp, and W.R. Schmehl. 1982. *Farming Systems Research and Development: Guidelines for Developing Countries*. Boulder, CO: Westview Press.
- Shaxson, T.F. 1988. Conserving soil by stealth. In: Moldenhauer and Hudson, 1988. 9-17.
- Shaxson, F. 1999. *New Concepts and Approaches to Land Management in the Tropics with Emphasis on Steeplands*. FAO Soils Bulletin 75. Rome: FAO.
- Shepherd, A. 1998. *Sustainable Rural Development*. New York: St. Martin's Press.
- Shrestha, A. and P.B. Chhetri. 1996. Development projects, success or failure? Personal perspectives on an FAO fertilizer project in Nepal. *Agriculture and Human Values* 13 (4): 71-74.
- Simmons, C.S., J.M. Tarano T. and J.H. Pinto; P.T. Sulsona, Spanish Edition. 1959. *Clasificación de Reconocimiento de los Suelos de la República de Guatemala*. Guatemala: Instituto Agropecuario Nacional.
- Sims, B.G. 1999. Percepciones de los agricultores sobre las practicas de conservación: estudios de caso en Guinope y El Rosario, Honduras. *Ceiba*: 40 (1): 13-20.
- Stake, R.E. 1994. Case Studies. In: Denzin, N.K. and Y. S. Lincoln, (eds.). 1994. 236-247.

- Stake, R.E. 1995. *The Art of Case Study Research*. Thousand Oaks, CA: Sage Publications.
- Sureshwaran, S., S.R. Londhe, and P. Frazier. 1996. A Logit model for evaluating farmer participation in soil conservation programs. *Journal of Sustainable Agriculture* 7(4): 57-69.
- Tamang, D. 1993. *Living in a Fragile Ecosystem: Indigenous Soil Management in the Hills of Nepal*. Gatekeeper Series No. 41. London: International Institute for Environment and Development.
- Teller, F. 1979. *Agricultura: para allí donde no hay agrónomo*. Guatemala: Piedra Santa.
- Thomas, D.B. 1996. Soil conservation extension: constraints to progress and lessons learned in East Africa. In: Sombatpanit et al. 1997. 245-256.
- Thrupp, L.A. and M. Altieri. 2001. Innovative models of technology generation and transfer: lessons learned from the South. In: Wolf, S. and D. Zilberman, (eds.) 2001. *Knowledge Generation and Technical Change: Institutional Innovation in Agriculture*. Norwell, MA: Kluwer Academic Publishers. 267-290.
- Tiffen, M., M. Mortimore and F. Gichuki. 1994. *More People, Less Erosion: Environmental Recovery in Kenya*. New York: John Wiley and Sons.
- Turkelboom, F., G. Trébuil, and C. Vejpas. 1996. Starting from the farmers' fields: on-farm analysis and development of conservation strategies on steep lands. In: Sombatpanit et al. 1997. 141-152.
- Turner II, B.L. and S.B. Brush, (eds.) 1987. *Comparative Farming Systems*. New York: The Guilford Press.
- United Nations. 1999. *Guatemala: el rostro rural del desarrollo humano*. Edición 1999. Guatemala: United Nations.
- UNICEF. 2000. *Realidad Socioeconómica de Guatemala: Estudios Sociales para 5º Bachillerato*. Guatemala: UNICEF and Piedra Santa.
- Vosti, S.A. and T. Reardon. 1997. Introduction: the critical triangle of links among sustainability, growth, and poverty alleviation. In: Vosti, S.A. and T. Reardon, (eds.) 1997. 1-15.
- Vosti, S.A. and T. Reardon, (eds.) 1997. *Sustainability, Growth, and Poverty Alleviation: a Policy and Agroecological Perspective*. Baltimore and London: The Johns Hopkins University Press.

- White, T.A. and J.L. Jickling. 1994. An economic and institutional analysis of soil conservation in Haiti. In: Lutz et al. 1994b. 98-106.
- White, T.A. and J.L. Jickling. 1995. Peasants, experts, and land use in Haiti: lessons from indigenous and project technology. *Journal of Soil and Water Conservation* 50(1): 7-14.
- Wiersum, K.F. 1994. Farmer adoption of contour hedgerow intercropping, a case study from east Indonesia. *Agroforestry Systems* 27: 163-182.
- Witter, S.G., M.P. Robotham, and D.A. Carrasco. 1996. Sustainable adoption of conservation practices by upland farmers in the Dominican Republic. *Journal of Soil and Water Conservation* 51(3): 249-254.
- Young, A. 1998. *Land Resources: Now and for the Future*. Cambridge, UK: Cambridge University Press.
- Zaal, F., M. Laman, and C.M. Sourang. 1998. *Resource Conservation or Short Term Food Needs? Designing Incentives for Natural Resource Management*. Issue Paper No. 77. London: International Institute for Environment and Development.