THE POLITICAL ECOLOGY OF NONTRADITIONAL AGRICULTURAL EXPORTS AND AN IPM PROJECT IN JAMAICA

by

Karen Ann Patterson

Thesis Submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

In

GEOGRAPHY

APPROVED:

Lawrence S. Grossman, Chair

Bonham C. Richardson

Virginia R. Seitz

Fall 1996

Blacksburg, Virginia

Keywords: Jamaica, Nontraditional agricultural exports, Integrated pest management, Political ecology

THE POLITICAL ECOLOGY OF NONTRADITIONAL AGRICULTURAL EXPORTS AND AN IPM PROJECT IN JAMAICA

by
Karen Ann Patterson

Lawrence S. Grossman, Chairman
Department of Geography

ABSTRACT

Since the 1970s Integrated Pest Management (IPM) has been promoted as an alternative to the singular reliance on pesticides to control agricultural pests. IPM involves the combination of chemical and non-chemical pest management practices to minimize pest damage to crops and reduce overall pesticide use. Although IPM has been promoted in both industrialized and Third World countries to reduce environmental and human health problems associated with pesticide use, it has not been widely adopted, particularly among small-scale farmers in the Third World. An important technical constraint to the adoption of IPM is the lack of simple, effective IPM techniques that farmers can easily incorporate into their existing farming systems. However, numerous non-technical constraints discourage farmers from adopting those IPM practices that have already been shown to be effective. Non-technical constraints to the adoption of IPM are the external political-economic forces and location-specific environmental, social and economic factors that may create obstacles to the adoption of IPM practices at the farm level. This thesis will use a political ecology approach to identify and examine the non-technical constraints to the adoption of IPM in the community of Denbigh Kraal in Jamaica.

ACKNOWLEDGEMENTS

I owe many thanks to all the people who have provided funding, technical and academic support, as well as encouragement, throughout my time at Virginia Tech. Without this support I would not have undertaken this project, let alone seen it to completion. In particular, I would like to thank the Cultural Ecology Specialty Group of the Association of American Geographers for providing the initial funding for my field work in Jamaica through the Cultural Ecology Specialty Group Field Work Grant. The availability of this grant for graduate level field work not only made the feasibility of conducting field research in Jamaica more of a reality, it also inspired me to pursue the additional funds necessary to carry out the research. For the bulk of the funding, I am extremely grateful to Dr. Virginia Seitz, who generously allotted a portion of her travel funds from the United States Agency for International Development's Integrated Pest Management Collaborative Support Program to facilitate my field research. Without Dr. Seitz's financial and logistical support, as well as her confidence in my abilities, my field work would not have been possible.

During my first semester at Virginia Tech, Dr. Bonham Richardson encouraged me to undertake my own field work, even when I could not imagine assembling the needed financial and logistical support in the short time span of a masters program. He has continued to be supportive of my research efforts and professional goals for which I am very appreciative. Dr. Larry Grossman, my advisor, provided the initial idea for this thesis topic. Although this thesis has undergone many changes, his suggestions provided important guidance in developing my research proposal and in preparing me to carry out field work in the Caribbean.

Many individuals in Jamaica assisted me throughout the duration of my stay in Jamaica. Janet Lawrence and Althea Perkins of the Caribbean Agricultural Research and Development Institution were extremely helpful with in-country logistical arrangements and in introducing me to members of the Clarendon IPM CRSP research communities. Officials with the Ministry of Agriculture, the Pesticide Control Authority, the Rural Agricultural Development Authority, the Jamaica Exporters' Association, the Jamaica Agricultural Society, the Jamaica Bauxite Institute, and the Mid-Clarendon National Irrigation Commission all provided helpful and timely assistance. The people of Denbigh Kraal and Mocho were always gracious in taking time away from their work to talk with me about their farming practices and pesticide use, as well as many other topics of mutual interest. I am particularly grateful to Laurine Lindsay who gave up a day out of her busy week to accompany me to Mocho and introduce me to her family and friends who have not yet been relocated by ALCOA. By the end of my stay in Jamaica I felt as though I had made many new friends.

I must also thank several "old" friends as well. Alexandera Jellerette, a good friend from high school fortuitously happened to be spending the month of January in Jamaica and was persuaded to stay on a little longer to share in my adventure and keep me company. Many other friends have been supportive throughout the long process of writing this thesis and were always willing to listen to my doubts and frustrations. Jeffrey Greene bore the brunt of this and tried his best to help me keep my head on straight and held high.

Most of all, however, I want to thank my parents who gave me the best education, both formal and informal, that a son or daughter could ask for. Their support and encouragement throughout every level of education has enabled me to achieve so much more than I would otherwise have done, and prepared me well for the challenge of researching and writing a masters thesis.

TABLE OF CONTENTS

TABLES and FIGURES

Chapter One

Introduction

In recent years, agricultural development strategies in Latin America and the Caribbean have begun to emphasize the production and export of nontraditional crops in order to diversify the regions' agricultural base and national economies, earn more foreign exchange, increase employment, and involve more small-scale farmers in export production (Paus 1988, Deere *et al.* 1990, McAfee 1991, Thrupp 1994). Countries in Latin America and the Caribbean have traditionally depended on the export of a few primary agricultural commodities, such as coffee and bananas ("traditional" exports), as a principal source of foreign exchange and economic growth (Paus 1988, Thrupp 1994). However, dependence on the production of low-value, relatively homogeneous traditional exports left countries in the region particularly vulnerable to the global recession of the 1980s, which depressed world markets for primary products, increased the relative costs of imported oil and manufactured goods, and led to rapid growth in the region's external debts (Murray and Hoppin 1992).

As a result of the regional economic decline, national policymakers and international aid and financial agencies, such as the United States Agency for International Development, the World Bank, and the International Monetary Fund, have sought to reduce the region's dependence on traditional primary commodities by promoting the production and export of more diverse, higher value crops, primarily to northern markets in the United States, Canada, and Europe. "Nontraditional agricultural exports" (NTAEs) are generally defined as exports that were either not previously grown in a particular country, or the export of crops that were traditionally produced only for domestic markets (Murray and Hoppin 1992, Thrupp 1994). For example, NTAEs include winter vegetables such as snow peas or broccoli; fruits such as strawberries, melons, and pineapples; non-food crops such as cut flowers and potted plants; or traditional domestic crops such as yams, cassava, and sweet potatoes that are now exported. In addition to generating more foreign exchange and reducing the region's vulnerability to declining prices for traditional primary commodities, policymakers promote NTAEs as a way of improving the welfare of the rural poor through employment on large-scale farms or processing plants, or by increasing the involvement of small-scale farmers in export agriculture[1] (Murray and Hoppin 1992, Thrupp 1994).

In the Caribbean country of Jamaica (see Map 1-1), a series of external and internal events during the 1970s, such as declining tourism due to violence and

---

1 The region's unequal distribution of land concentrates the majority of the land among a small class of wealthy elite landowners and leaves the majority of farmers to cultivate only small plots. This has meant that many small-scale farmers have been excluded from export agriculture because traditional export commodities are typically produced on large plantations (Thrupp *et al.* 1995), with the exception, perhaps of coffee. However, because NTAEs tend to be high value products, they do not require as large-scale production as traditional agricultural exports to be profitable (Thrupp 1994).

Map 1 The Caribbean region

Map 1-1 The Caribbean Region
Source: Richardson, Bonham C. 1992. *The Caribbean in the Wider World, 1492-1992. Cambridge: Cambridge University Press.*

political upheaval, rising global oil prices, declining bauxite production, and falling global prices for primary commodities, combined to produce negative economic growth, high unemployment and inflation, and a shortage of foreign exchange (Mathieson 1988). As a result of these economic problems, Jamaica is now U.S. $4.5 billion in debt, the equivalent of 132 percent of its annual GDP (Pariser 1996). The Jamaican government, with the strong support of the United States, has tried to improve the Jamaican economy through structural adjustment policies and export-led economic development strategies (McAfee 1991).

Agriculture is considered an important part of the Jamaican economy because, although it only makes up only seven to eight percent of the GDP, it employs 37 percent of the workforce (Pariser 1996). However, Jamaica's traditional agricultural exports (sugar, bananas, coffee, citrus, pimento, and cocoa) face increasing global competition and/or declining prices, and thus government officials and international organizations have promoted nontraditional agricultural exports as an important part of efforts to revive the agricultural sector and increase its contribution to the country's economy, domestic food supplies, and employment levels. In particular, government officials hope to increase the participation of small-scale farmers in export agriculture as a way of increasing rural standards of living[2] (Ministry of Agriculture 1991).

Agricultural planners, private investors, and international aid organizations and financial agencies view Jamaica's nontraditional agricultural exports as "niche" products with high added value and the potential to increase foreign exchange earnings (Reid 1994). Thus far, Jamaica's NTAEs have primarily been crops traditionally produced for domestic consumption. For example, vegetables such as sweet potatoes, yams, cassava, and pumpkins, and fruits such as papayas and mangoes that were traditionally produced for domestic markets are now being

---

2 The majority of Jamaica's farmers are small-scale growers. Of 159,000 farmers, 113,000 own or operate less than 5 acres, while one half of one percent of growers control 55 percent of the land (Pariser 1996).

exported to meet the demands of Jamaicans and other West Indians living in the United States, the United Kingdom, and Canada (Reid 1996, personal interview). Between 1982 and 1993, production of NTAEs increased 72 percent, with an average annual growth rate of 5 percent (Reid and Lawrence 1994: 4).

Despite the actual or potential economic benefits of nontraditional agricultural exports, their production has been associated with increases in pesticide use in Latin America and the Caribbean (Wright 1990, Murray and Hoppin 1992, Murray 1994, Thrupp *et al.* 1995). The dependence on, and misuse of pesticides in the region has long been attributed to its tropical climate and traditional agricultural development strategy (based on intensive, year-round monoculture cultivation), which allows pest populations to build up without interruption from cold weather or periodic breaks in cultivation (Holl *et al.* 1990, Wright 1990, Murray 1994, Thrupp 1994). Many nontraditional crops are subject to similar pest pressures, but because NTAEs are generally high-quality, high-value perishable products that must meet stringent aesthetic requirements for northern markets, their production often incurs even greater use of pesticides than traditional crops (Murray and Hoppin 1992). Furthermore, the push to involve small-scale farmers in export agriculture may be contributing to an overall increase in the number of farmers using pesticides in the region (Murray and Hoppin 1992, Murray 1994, Thrupp *et al.* 1995).

The negative impacts of pesticide use and misuse associated with agricultural export-based development strategies in the Third World, and Latin America and the

Caribbean in particular, have been well-documented (Bull 1982, Wright 1990, Murray and Hoppin 1992, Thrupp 1994, Murray 1994, Pretty 1995, Thrupp *et al.* 1995). These negative impacts include pesticide-related deaths and illnesses; degradation of soil and water resources; poisoning of wildlife and fisheries; and disruption of natural ecosystems due to increasing pest resistance and the destruction of natural predators (Wright 1990, Murray 1994, Thrupp 1994). The development of pesticide-resistant pest populations and the destruction of natural predators reduces the effectiveness of chemical applications and raises farmers' production costs as they are forced to apply an ever-increasing volume and variety of chemical controls (Holl *et al.* 1990, Murray 1994). Furthermore, when pesticides are applied heavily, or too close to harvest time, residues accumulate on the crops and may exceed residue standards established by importing countries. According to Thrupp *et al.* (1995: 6), between 1984 and 1994, 14,000 shipments of NTAEs imported into the U.S. from Latin American and the Caribbean were detained by the U.S. Food and Drug Administration because pesticide residues exceeded U.S. standards.

An alternative to the singular reliance on pesticides for the control of crop pests is Integrated Pest Management (IPM), which involves the combination of chemical and non-chemical pest control practices to minimize pest damage to crops, while reducing the overall amount of pesticides used in the farming system. Nonchemical farming practices may include cultural pest controls, genetic engineering, biological controls, and legal controls (Pimbert 1991). Under IPM, chemicals are only applied as needed, based on an economic analysis of potential loss versus cost of application, rather than on a calendar or prophylactic basis.

The potential for IPM to lower production costs, increase pest management effectiveness, lessen the negative impacts of pesticides on the environment and human health, and reduce pesticide residues on crops, has been demonstrated successfully on a number of research and demonstration plots, and on farm trials in a range of geographic locations and agro-ecosystems (Holl *et al.* 1990, Kiss and Meerman 1991, Mill 1993, Matteson 1992, Rajotte 1993, Pretty 1995). However, IPM has not been widely adopted, particularly among small-scale farmers in the Third World, for a number of reasons. First, an important technical[3] constraint to the adoption of IPM is the lack of simple, effective pest control techniques that all farmers can easily incorporate into their existing farming practices. While many IPM practices have proven effective in controlled research experiments, the techniques are often complex and not easily transferred from research stations to individual farms. Furthermore, pesticides provide more readily visible, dramatic results than do IPM practices, and thus farmers are often reluctant to reduce their use of pesticides (Kiss and Meerman 1991).

---

3 "Technical" is used here to refer to general research on the biology of pests and beneficial organisms (and their interactions) in agroecosystems, and the application of this knowledge to the design of simple, effective, pest management practices. "Non-technical" will be used to refer to external political-economic forces and local environmental, social, and economic conditions that may create obstacles to the adoption of IPM practices at the farm level.

A second set of obstacles, and the focus of this thesis, are the "non-technical" constraints to IPM that may discourage farmers from adopting IPM at the farm level (Wearing 1988, Holl *et al.* 1990, Matteson 1992). Non-technical constraints to the adoption of IPM are external political-economic forces and location-specific environmental, social, and economic conditions that interact to create obstacles to the adoption of IPM at the farm level. Of particular concern are the external and local factors that shape patterns of pesticide use at the local level. For example, political-economic forces such as government subsidies for pesticides or markets that reward farmers with higher prices for unblemished products may encourage farmers to use pesticides. Agroecological conditions, such as a hot, humid climate and monoculture cropping systems, may magnify pest problems and lead farmers to increase their use of pesticides. A lack of household labor (or cash to hire labor) might force farmers to rely on pesticides to save labor. These and other factors, and farmers' responses to them, vary from one location to another and may create obstacles to the adoption of IPM.

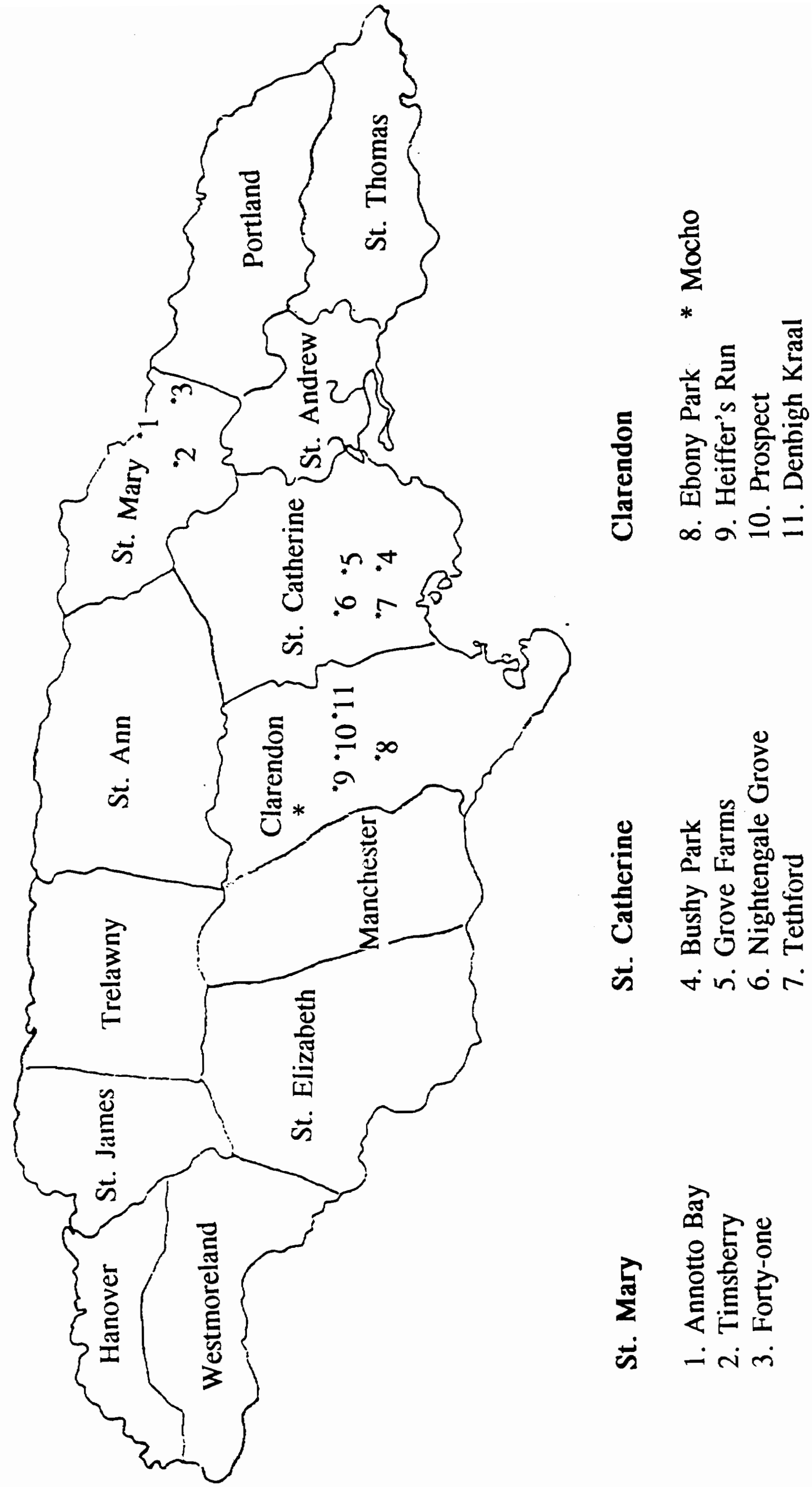
Other potential non-technical constraints to the adoption of IPM are the individual attitudes and beliefs farmers hold regarding the safety and effectiveness of pesticides (Holl *et al.* 1990, Kiss and Meerman 1991, MacKay *et al.* 1993). As Grossman (1992a) has found, there is a great deal of variation in farmers' attitudes and beliefs regarding pesticide use, which may limit or exacerbate the impacts of external political-economic pressures to use pesticides. For example, farmers who have not had problems with pesticide resistance, or who do not believe pesticides pose a health hazard, may not be as interested in alternative pest control methods as those who believe pesticides are becoming less effective or that pesticides pose a health risk. Thus, individual attitudes and beliefs may also create obstacles to the adoption of IPM practices. In addition, individual farmer's perceptions of the seriousness of non-pest problems relative to pest problems are important. Farmers who have more serious constraints to farming than pest problems, such as water or labor shortages, may show little interest in adopting IPM.

In order for even the most effective, efficient IPM practices to successfully control pest populations and reduce pesticide use, farmers must first be willing and able to adopt new pest management techniques. Farmers must trust that IPM will meet their pest control needs as well, or better than, pesticides do. As a result, appropriate IPM programs must be based on farmers' perceptions of pest problems and individual beliefs and attitudes regarding the safety and effectiveness of pesticides. Therefore, as part of the process of designing and implementing appropriate IPM programs, it is essential to identify and address both the external and local factors that shape individual patterns of pesticide use.

RESEARCH PROBLEM

In 1993, the U.S. Agency for International Development (AID) initiated the Integrated Pest Management Collaborative Research Support Program (IPM CRSP) with the goal of protecting crops and the environment in the Third World, as well as consumers in the U.S. (Virginia Polytechnic Institute and State University). While AID eventually hopes to spread IPM globally, Jamaica was selected as one of four initial research sites. The IPM CRSP project in Jamaica is being implemented in the context of government and international pressure to increase the production of NTAEs, maintain high aesthetic quality of the exports, reduce the amount of pesticides used in the production process, and increase small-scale farmer involvement in export agriculture. As a result, the specific goal of the IPM project in Jamaica is to reduce pesticide residues on vegetable crops through the design and implementation of IPM practices for small-scale farmers.

Currently, researchers from the U.S. and Jamaica are working to design IPM practices in 11 communities in the parishes of Clarendon, St. Catherine, and St. Mary (see Map 1-2). Background socioeconomic research conducted by an interdisciplinary team of sociologists, economists, and extension agents during the first two years of the project identified important differences in local environmental, social, and economic conditions, and individual attitudes and beliefs regarding pesticide use, between the research communities in St. Mary, and those located in Clarendon and St. Catherine. These variations may create different non-technical constraints to the adoption of IPM and thus must be identified and addressed as part of the process of designing appropriate IPM programs in each of the research communities.



Map 1-2 IPM CRSP Research Communities in Jamaica

As part of the effort to evaluate the potential for implementation of IPM among small-scale farmers in Jamaica, this thesis will identify the non-technical constraints to the adoption of IPM in the production of NTAEs by small-scale farmers in one of the IPM CRSP research communities - Denbigh Kraal, Clarendon. In particular, I will try to identify the local environmental, social and economic factors, as well as the individual attitudes and beliefs regarding the safety and effectiveness of pesticide use, that interact with external political-economic forces to create potential obstacles to the adoption of IPM. I will also address the larger question of whether the IPM CRSP project, in the context of NTAEs as an economic development strategy, is meeting the needs of small-scale, resource-poor farmers. In other words, are pests and pesticide problems an important obstacle to the participation of small-scale farmers in the production of NTAEs, or are there more serious constraints that prevent farmers from realizing the supposed benefits of NTAEs?

Of the 11 communities involved in the IPM CRSP project, Denbigh Kraal provides an ideal setting in which to study how external and local factors interact to influence pesticide use because many of the residents of Denbigh Kraal have recently been relocated from the hilltop community of Mocho (to make way for bauxite mining by the ALCOA aluminum company) to the recently established community of Denbigh Kraal. The relocation has led to changes in farmers' environmental, economic, and social conditions, thus providing the opportunity to compare how changes in local-level factors influence farmers' response to external political-economic pressures.

A political ecology approach, discussed in Chapter Two, will be used as the framework within which to identify and analyze the factors influencing small-scale farmers' willingness and ability to adopt IPM practices in the production of NTAEs. Political ecology combines two themes in geography; cultural ecology and political economy. Cultural ecology refers to the study of the complex interrelationships between humans and their physical environments, while political economy refers to the role of political forces, such as the state and capital, in influencing the distribution of wealth and resources. The combination of these themes allows the researcher to identify a broad range of factors that influence patterns of resource use at the local level. Thus, political ecology provides a comprehensive framework within which to identify and analyze how both local and external factors that may create non-technical constraints to the adoption of IPM in the production of NTAEs.

In the past, the political ecology perspective has been used to analyze complex patterns of resource use and environmental degradation in the Third World (Bryant 1992, Schroeder 1993, Stonich 1993). More recently, political ecology has been used to analyze the impacts of so called "sustainable development" projects; projects that are intended to both protect the environment and improve the welfare of the resource users (Schroeder 1993, Zimmerer 1993a, Rocheleau *et al.* 1995). This approach will be used to address the question of whether the IPM CRSP project, in the context of promoting NTAEs as an economic development strategy and protecting the environment, is meeting the needs of small-scale, resource-poor farmers.

After a review of political ecology in Chapter Two, I turn to a discussion of the emergence of IPM as an alternative to reliance on pesticides and constraints to the adoption of IPM in Chapter Three. Chapter Four provides background material on the IPM CRSP project and the findings of the previous socioeconomic research conducted during the first two years of the project. In Chapter Five, I present the results and analysis of my own fieldwork in Denbigh Kraal, Clarendon. I will evaluate the implications of the non-technical constraints to the adoption of IPM in Denbigh Kraal for the IPM CRSP project as well as examine the IPM CRSP strategy in the context of the IPM constraints literature and recent work in political ecology. Finally, in Chapter Seven I will conclude with an explanation of how local and external factors interact to create non-technical constraints to the adoption of IPM in Denbigh Kraal, Clarendon.

Chapter Two

Political Ecology

A wide range of local and external factors create non-technical constraints to the adoption of IPM among small-scale farmers in the Third World. In Jamaica, a number of non-technical constraints may impede small-scale farmers from adopting IPM practices in the production of NTAEs. Thus, the IPM CRSP project must identify and address non-technical constraints to the adoption of IPM as part of the process of designing and implementing appropriate IPM practices among small-scale farmers. As part of this effort, this thesis will use a political ecology framework, which provides a holistic approach to the study of human-environment relations, to identify and examine the factors that create non-technical constraints to the adoption of IPM among small-scale farmers in the community of Denbigh Kraal, Clarendon.

In the past decade, political ecology has emerged as an important framework for understanding patterns of resource use and environmental degradation in the Third World (Bryant 1992, Schroeder 1993, Stonich 1993). Political ecology integrates perspectives from cultural ecology and political economy to create an holistic approach to the analysis of changing human-environment relations. Political ecology can be contrasted with "single hypothesis" approaches that attribute environmental problems (such as deforestation, soil erosion, famine, and biodiversity loss) to Malthusian population pressures or peasant irrationality and ignorance (Blaikie 1985, Blaikie and Brookfield 1987, Bassett 1988, Grossman 1993, Jarosz 1993, Stonich 1993). Narrow "single hypothesis" perspectives, which ignore political-economic factors, tend to characterize resource users as poverty stricken peasants, indiscriminately destroying forests for fields and food (Jarosz 1993), or causing soil erosion by carelessly farming on steep slops or employing other inappropriate cultivation practices (Zimmerer 1993a). As Blaikie (1985) argues, most of the early attempts to include social factors in the study of soil erosion and conservation implied that the social problems start with 'them' - the land users. Such analyses neglect the historical and contemporary ecological and political-economic contexts in which the resource users operate, often resulting in the design of inappropriate "solutions" to environmental problems (Blaikie 1985, Jarosz 1993, Rocheleau *et al.* 1995).

To counter the narrow focus of the single hypothesis approach, geographers and other social scientists have integrated perspectives from cultural ecology and political economy to form a new perspective that encompasses the multiple environmental, political, social, and economic factors that influence the relationships between resource users and their environments. Cultural ecology refers to the study of the complex interrelationships between humans and their physical environments, and traditionally did not consider the influence of external political-economic factors. However, cultural ecology provides the analytical tools to identify environmental and social phenomena that help shape patterns of resource use at local and regional levels. Environmental and social factors that influence nature-society relationships include:

environmental variables (Grossman 1993) such as climate, topography, soil conditions, and hydrologic cycles; patterns of resource use (Bassett 1988, Grossman 1993) such as shifting cultivation, livestock herding, and agroforestry; demographic factors (Stonich 1993), such as population growth and migration; and livelihood strategies (Bryant 1992) such as multiple cropping and off-farm wage labor. Furthermore, cultural ecology recognizes that each society or social group has its own cultural traditions that it uses to adapt or adjust to the physical environment and sustain itself. Thus, cultural ecologists are also concerned with cultural differences in ethnic, racial, gender and other relations from one society to another, and how these differences affect individual and group resource use decisions. Through the identification of these local and regional environmental and social factors, and the analysis of their interactions over time, cultural ecology provides an understanding of the relationships between immediate physical environments and resource users.

The political ecology perspective, on the other hand, also considers the historical and contemporary regional, national and international political and economic forces that influence human-environment relations. More specifically, it recognizes the role of external factors, in the form of the state and capital, in altering established patterns of resource use (Grossman 1981). These external forces, over which individuals and households have little control, serve as a catalyst to the integration of local groups into regional, state, and world economies, creating new resource management opportunities and constraints (Butzer 1989). Relevant political-economic factors may include: the commercialization of property relations or the introduction of cash-income earning opportunities (Grossman 1981); colonial policies such as the prohibition of slash and burn agriculture (Jarosz 1993); formal or informal government policies such as the promotion of agricultural exports (Stonich 1993) or pastoralism (Bassett 1988); market factors such as world commodity prices and terms of trade (Grossman 1984); and institutional factors such as structural adjustment policies (Jarosz 1993). The identification of these and other political-economic factors provides the recognition (absent in the single hypothesis approach) that the state, capital, market forces, and the distribution of wealth play important roles in shaping patterns of resource use at the local and regional levels.

Simple enumeration of ecological and political-economic conditions does not, however, provide sufficient explanation for changing human-environment relations. The key to political ecology is a rigorous examination of the *interaction* among these multiple factors; an explanation of how national and international policies impact the decision-making process of resource users at the local level, as well as how the actions of the resource users themselves influence national and international policy.

The term political ecology was first used, although not explicitly defined, by anthropologist Eric Wolf in his 1972 article "Ownership and Political Ecology." Referring to property rights and strategies of production and reproduction in the Swiss Alps, Wolf (1972: 201) wrote that local rules of ownership and inheritance are "not merely an outcome of local or regional ecological processes," but are mechanisms which mediate between the pressures emanating from the larger society and the immediate demands of the local ecosystem. He called for further research to combine inquiries into multiple local ecological contexts with greater knowledge of social and political history.

Although the term political ecology was not widely adopted at the time, many academics began integrating the perspectives of global political economy and cultural ecology into studies of resource use and environmental degradation in the early 1980s. Franke and Chasin (1980), Watts (1983), Hecht (1985), Blaikie (1985) and others, criticized superficial, single hypothesis analyses of environmental degradation, calling instead for more comprehensive studies designed to consider multiple causes of changing human-environment relations. For example, studies by Franke and Chasin (1980) and Watts (1983) in western Africa, sought to dispel the myth that periodic droughts and famines were simply a matter of human populations trying, unsuccessfully, to live in an inhospitable climate. Franke and Chasin's (1980) study of the 1968-1974 Sahel drought and famine integrated an analysis of regional ecology and the resource users who rely on the land for their livelihood, with an analysis of the impacts of colonial and international political-economic policies on the region. By integrating multiple factors into their analysis, they demonstrated that although the Sahel region is prone to drought, external political-economic factors, such as the promotion of groundnut production, were responsible for "vastly" increasing the region's vulnerability to drought (1980: x). Watts' (1983) study of food and famine in Nigeria focused more specifically on the manner in which capitalist expansion, implemented through colonial and post-colonial government policies, disrupted traditional subsistence production practices and important class relations. Using an historical perspective, Watts found that traditional production practices and well-established social systems had provided "food security" during past droughts. He argued that it was the loss of these traditions, through varying levels of integration into the market economy, that increased the vulnerability of many peasants to climatic variability and market crises, thereby contributing to food shortages and famine (1983: xxiii).

Although many of the concepts now associated with political ecology were already in use during the 1980s, Piers Blaikie and Harold Brookfield (1987) are widely credited with popularizing the term and its use in studies of environmental degradation in the Third World (Bassett 1988, Zimmerer 1991, Stonich 1993, Peet and Watts 1993). In Land Degradation and Society, Blaikie and Brookfield identified land degradation as a social and physical problem. Arguing that studies of land degradation should employ analytical tools from both the social and natural sciences, they proposed a "regional political ecology" approach to combine the "concerns of ecology and a broadly defined political economy" (Blaikie and Brookfield 1987: 17).

Blaikie and Brookfield (*ibid.*) envisioned regional political ecology as identifying both the natural, such as variations in soil fertility, rainfall patterns, and topography, and social, such as outmigration of household labor, government promotion of export crops, and world commodity prices, causes of, and solutions to, land degradation in the Third World. Blaikie and Brookfield's goal in introducing the regional political ecology approach was to combine detailed local-level studies with the development of theory and generalization. Acknowledging that a single theory of land degradation does not exist, they assert nonetheless, that it is possible to identify structural similarities in the Third World (such as political and economic peripheralization, stagnant production, poverty, and outmigration) which frequently contribute to land degradation, and therefore are important to identify and consider in analyses of land degradation.

Since Blaikie and Brookfield articulated their regional political ecology approach to the study of land degradation, many geographers and other social scientists concerned with human-environment relations have adapted the approach to a wide range of resource-use issues, including: peasant-herder conflicts (Bassett 1988), shifting cultivation and deforestation (Jarosz 1993), export agriculture versus subsistence food production (Grossman 1993), conflicts between resource users and the establishment of national parks (Moore 1993), export-based economic development strategies (Stonich 1993), and most recently, planned "sustainable development" projects (Schroeder 1993, Zimmerer 1993a, Rocheleau *et al.* 1995).

In particular, a growing body of political ecology literature explicitly links colonialism to environmental degradation (e.g., Franke and Chasin 1980, Watts 1983, Jarosz 1993) and identifies the connection between contemporary national economic development strategies (often promoted and financed by international organizations such as the IMF, World Bank, and bilateral agencies) and continuing environmental problems in the Third World. A number of scholars have also begun to utilize the political ecology perspective to identify and analyze negative impacts of development strategies designed specifically to address environmental problems (e.g., Schroeder 1993, Zimmerer 1993a, Rocheleau *et al.* 1995). These strategies are referred to as "sustainable development" or "conservation-with-development," because they are intended to mitigate past (or prevent future) environmental degradation, while simultaneously improving the welfare of people who are directly dependent on the physical environment for their livelihoods.

Benign as this development strategy may sound, it has not been without its share of failures, some more serious than the initial environmental problem, because the environmental problem(s) is generally identified and defined by outsiders. For example, outside "experts" may attribute a food shortage during drought to soil degradation, whereas in reality there are multiple causes of the food shortage (e.g., Watts 1983). As a result, solutions designed solely to address soil degradation, or whatever other environmental problem is identified, will not solve the overall problem. These recent "sustainable development" studies, like the earlier political ecology studies mentioned above (Franke and Chasin 1980, Watts 1983, Hecht 1985), share the common goal of trying to identify the root causes of environmental degradation in Third World countries.

Recently, however, the diversity of issues and research strategies employed under the umbrella of political ecology has generated misgivings over the coherence of political ecology as a singular approach to the study of environmental degradation. Peet and Watts (1993: 239) describe political ecology as a broad, wide-ranging approach, grounded less in coherent theory than in similar areas of inquiry. Bryant (1992: 13) refers to political ecology as a collection of similar approaches, rather than a unified research agenda, and Moore (1993: 81) calls it a "family resemblance" among related approaches, rather than a "single-minded" conceptual vision.

Despite these reservations regarding political ecology's claim to distinction, several common elements of a political ecology framework can be identified. The most obvious one is the recognition of relevant cultural ecological and political-economic factors influencing patterns of resource use. As discussed previously, relevant cultural ecological factors may include environmental variables, patterns of resource use, demographic factors, livelihood strategies, and household and community dynamics. Political-economic factors relate to the role of the state and capital in altering patterns of resource use. Various terminologies have been employed to describe the cultural ecology and political economy perspectives. Cultural-ecological characteristics have been referred to as 'place-based' or location-specific (Blaikie 1985, Blaikie and Brookfield 1987), local-level (Bassett 1988), and micro-scale (Grossman 1984, Stonich 1993). Political economy forces are also known as external, 'non-place-based' or non-location-specific (Blaikie 1985, Blaikie and

Brookfield 1987), macro-scale (Grossman 1993), and structural (Zimmerer 1991, Moore 1993).

Regardless of terminology, however, cultural ecological and political-economic factors are generally organized, explicitly or implicitly, into hierarchical scales of analysis capable of considering various levels of socioeconomic organization (e.g., Blaikie and Brookfield 1987, Zimmerer 1991, Moore 1993, Schroeder 1993, Stonich 1993). Blaikie and Brookfield identify four such levels of analysis: 1) local-level, site-specific analysis of individual, or small-group, decision-making processes; 2) regional-level analysis of patterns of physiographic variation, types of land-use, property relations and settlement history; 3) national-level analysis of the particular forms of class relations which provide the economic, political, and administrative context for land-management decisions, and 4) international-level analysis which involves the world economy (1987: 68). Bassett (1988) demonstrates the necessity of this approach by disaggregating the local-level productive strategies of peasants and pastoralists and identifying their respective responses to political-economic forces emanating from the state. Schroeder (1993) and Moore (1993) take their analyses to the household-level, exploring the gender-based variations in patterns of resource use as they are conditioned by external political-economic forces.

Another common element in the political ecology framework is the location of relevant cultural ecological and political-economic factors within a broad geographic and historical framework (Blaikie and Brookfield 1987, Bassett 1988, Zimmerer 1991, Bryant 1992, Grossman 1993, Jarosz 1993, Stonich 1993). Historical and geographic analyses provide vital information regarding natural or human-made ecological transformations over time; changing patterns of resource use in response to evolving political-economic structures; and regional variations in physical and social systems. For example, Zimmerer (1993b) argues that most conditions responsible for soil erosion vary significantly across even short distances, and therefore require detailed case studies to determine geographic differences in environmental and other relevant circumstances. Blaikie and Brookfield (1987) underscore the importance of a geographic perspective by emphasizing a *regional* political ecology. They believe that:

> [T]he adjective 'regional' is important because it is necessary to take account of environmental variability and the spatial variations in resilience and sensitivity of the land, as different demands are put on the land through time (1987: 17).

Thus, they argue, local-level empirical studies are necessary to identify unique conditions of environmental degradation from one location to another. In addition to the geographic perspective, historical analyses are essential to identify lags between causation and consequence which often mask the true causes of environmental degradation (Blaikie and Brookfield 1987). Jarosz (1993) demonstrates the importance of this concept in her study of deforestation in Madagascar. Using a historical perspective, she argues that the introduction of colonialism in Madagascar led to changes in landuse practices and tenure traditions which were more responsible for widespread deforestation than any inherent problem with the traditional practice of shifting-cultivation.

Perhaps the most essential element of the political ecology framework, however, is the *explanation* of how the relevant cultural ecological and political-economic factors, situated in the appropriate historical, geographical, and hierarchical contexts, interact with and influence resource users' decisions at the local level. Blaikie and Brookfield (1987) refer to this process as establishing "chains of explanation" which begin with the land manager and end with the state. Referring to a study of land degradation in Nepal, they argue that each link of the explanation is "firmly closed around the next" (1987: 47). In his study of peasant-herder conflicts, Bassett (1988) refers to the establishment of a "chain of causality" in which his goal is to identify the ultimate cause of conflict between peasants and herders. Others stress the importance of identifying relationships, links, interactions, and connections between local-level decision making and the larger political economy (Blaikie 1985, Zimmerer 1991, Grossman 1993, Stonich 1993). While the methodologies employed and the emphases placed on individual factors may vary from one political ecology study to another, efforts to explain the complex relationships between local-level patterns of resource use and political-economic factors are central to political ecology studies.

The political ecology approach, with its effort to explain how cultural ecological and political-economic factors influence local resource-use decisions, is a particularly useful approach to the study of non-technical constraints to the adoption of IPM. The political ecology framework is important to the study of IPM because cultural ecological and political-economic factors shape patterns of pesticide use at the local level. And, as Chapter Three will demonstrate, these factors, and farmers' responses to them, differ from one location to the next, depending upon local environmental, social, and economic conditions. Thus, the political ecology approach of locating relevant cultural ecological and political-economic factors within the appropriate historical, geographical, and hierarchical context, is particularly important.

Chapter Three

Integrated Pest Management

Prior to World War II, farmers around the world relied primarily on non-chemical pest control methods such as crop rotation, tillage, bait-trapping, weeding, destruction of crop residues, and hand-removal of pests and egg masses to protect food supplies from destruction by insects (Holl *et al.* 1990, Kiss and Meerman 1991, Zalom *et al.* 1992, Zalom 1993). With the development of synthetic chemicals during World War II, however, farmers were presented with a new, inexpensive, labor-saving pest control method, an approach that offered immediate, visible results (Kiss and Meerman 1991, Rajotte 1993). U.S. farmers were encouraged to adopt the chemical technology through the promotional efforts of pesticide salesmen, the advice of government extension agents, and various tax incentives. As a result, pesticide development, production, and use quickly became institutionalized in the U.S., and farmers increasingly relied on chemicals to control crop pests (Zalom *et al.* 1992).

The idea that pests could be "controlled" through the application of synthetic chemicals made the technology especially appealing to governments and international organizations seeking to improve agricultural productivity in the Third World. The

Green Revolution, promoted as the key to agricultural modernization[4], was based primarily on the development and distribution of high yielding plant varieties to Third World farmers (Wright 1990, Murray 1994). To achieve the high yields, however, the new seed varieties generally required external inputs such as irrigation, fertilizers, and pesticides. As a result, synthetic chemicals became a key component of the Green Revolution technology packages exported overseas to Third World farmers (Wright 1990).

Despite the high expectations of scientists, farmers, and policymakers, synthetic chemicals have failed to provide the hoped for eradication of crop pests (Kiss and Meerman 1991). Instead, the intensive, indiscriminate use of pesticides has actually magnified pest problems, in many cases by increasing pest resistance to chemicals, destroying natural predators, and permitting the emergence of secondary pests[5] (Holl *et al.* 1990, Kiss and Meerman 1991, Zalom *et al.* 1992, Jacobsen and Backman 1993, Rajotte 1993, Zalom 1993). Attempts to completely eradicate pests have backfired because pest populations rapidly develop genetic resistance to

4 The Green Revolution strategy was first devised in 1941 as a result of collaboration between the Rockefeller Foundation and the Mexican government, with the intent that it would serve as a model for agricultural development all around the world (Wright 1990).

5 Secondary pests normally have limited impacts on plants because the populations are controlled by predators, but they become serious pests when their predators are killed off by pesticides.

chemicals. The short lifecycle of many insects means that those individuals that have an inherent genetic resistance to a particular chemical are able to survive one or more pesticide applications, then quickly reproduce and pass their resistant gene(s) on to the next generation[6] (Bull 1982, Zalom *et al.* 1992).

In response to increasing pest resistance, farmers are forced to apply a greater volume and variety of pesticides in what is known as the "pesticide treadmill" (Bull 1982, Dover 1985, Wright 1990, Murray 1994). Once "on" the pesticide treadmill, farmers are unable to get "off" because heavy use of chemicals kills the crop pests' natural predators (also known as beneficial insects) and allows secondary pests to emerge. This disrupts natural controls to the extent that the cessation of chemical controls could mean disastrous crop losses because pest populations would remain completely unchecked (Murray 1994). In short, the pesticide treadmill results in decreased chemical effectiveness and increased costs for farmers in the form of lost crops and greater expenditures on chemical inputs.

The use and misuse of pesticides has also been linked to serious environmental and human health problems (Carson 1962, Dover 1985, Wright 1990, Kiss and Meerman 1991, Pimbert 1991, Jacobsen and Backman 1993, Murray 1994, Thrupp 1994). The negative environmental impacts of pesticide use and misuse include soil

---

6 Genetic resistance to pesticides has already been documented for more that 450 insect species, as well as 100 species of plant pathogens and 48 species of weeds (Pimbert 1991).

degradation, contamination of surface- and ground-water sources; increased incidences of fisheries and wildlife poisoning; and disruption of natural ecosystems due to pest resistance and destruction of natural predators (Wright 1990, Murray 1994, Thrupp 1994). Human populations, particularly farm workers, are at risk from both acute poisonings and long-term exposure to pesticides. Acute poisonings result in sickness or death from just one or a few exposures to pesticides, while long-term exposure to pesticides may lead to birth defects, cancer, respiratory illness, and chromosomal damage (Bull 1982, Dover 1985, Wright 1990, Murray 1994.)

Pesticide resistance and pesticide-related environmental and human health problems tend to be exacerbated in Third World countries for a number of reasons. In tropical climates, the combination of high temperatures and humidity, the absence of cold winters, and continuous crop production (increasingly monoculture) allows pests to reproduce year round (Kiss and Meerman 1991, MacKay *et al.* 1993). As a result, the pesticide treadmill is intensified, which, in turn, magnifies environmental and human health problems. In addition, there are serious problems with pesticide misuse in Third World countries. For example, many countries do not regulate the importation and use of pesticides, allowing products banned, untested, or severely restricted for use in industrialized countries to be sold and applied in the Third World (Bull 1982). Registered and unregistered pesticides are often improperly labelled (or repackaged without labels), or safety and application instructions are unreadable because they are not in the local language or the users are illiterate (Bull 1982, MacKay *et al.* 1993). Safety is further compromised by the lack of protective equipment (or the failure of workers to wear appropriate protective attire due to hot, humid working conditions) and the absence of clean water sources to rinse chemicals from skin and clothing after spraying (Bull 1982, Wright 1990, MacKay *et al.* 1993). Important services that would help farmers and farm workers such as medical personnel and extension agents are also in short supply in many Third World countries (Bull 1982). As a result of these problems, pesticide-related illnesses and deaths are much more common in the Third World than in industrialized countries. According to Pimbert (1991), about 50 percent of all pesticide poisonings and 80 percent of all pesticide-related deaths occur in Third World countries, even though only 15 to 20 percent of all pesticides are used in the Third World.

Pest researchers first warned of the dangers of relying on a single pest control technology, such as pesticides, in the early 1950's (Zalom *et al.* 1992). These researchers advocated integrated controls or integrated pest management strategies, based on both chemical and non-chemical techniques, to control crop pests. While many of the non-chemical techniques, such as scouting, trap cropping, and the use of natural predators, were not "new" inventions[7], the integrated approach was innovative in that researchers sought to find the most effective combination of

---

7 Holl *et al.* (1990) assert that biological controls were first used in Latin America in the early 1900's and Zalom *et al.* (1992) believe integrated systems have been part of some pest management systems for the past 100 years.

chemical and non-chemical controls to offset the problem of pesticide resistance.

The initial goal of using an integrated approach to pest control was to enhance the overall effectiveness of pest control techniques, thereby increasing farmer profitability by reducing both crop losses and operator costs for purchased chemical inputs (Rajotte 1993). The concept of integrated pest management gained more widespread interest in the late 1960's and early 1970's when concerns over the negative impacts of pesticides on environmental and human health coalesced with scientists' and farmers' concerns over the decreasing effectiveness of chemical controls (Dover 1985). "Integrated Pest Management" (IPM) was institutionalized as a distinct pest control approach in the 1970's, when government officials, scientists, and agricultural industry groups began establishing structured research programs and funding for the development and application of IPM in the U.S. and overseas (Bull 1982, Zalom *et al.* 1992, Zalom 1993).

While IPM has gained increasing acceptance, a universal definition of the concept does not exist because IPM represents a strategy, or an approach to farming, rather than a specific methodology prescribing a given technology or set of techniques to control pests (Tsedeke 1996). More specifically, IPM is an approach to farming which integrates multiple management techniques, including biological controls, cultural practices, genetic engineering, chemical applications, and legal controls (Pimbert 1991, Zalom 1993). The goal of IPM is to keep pest populations below economically damaging levels, rather than trying to completely eradicate them (Dover

1985, Kiss and Meerman 1991).

Contrary to popular belief, IPM does not necessarily eliminate pesticide use; instead, chemicals are used selectively and in minimal amounts to target specific pests and avoid the destruction of natural predators (Dover 1985, Holl *et al.* 1990, Meerman and Kiss 1991). Ideally, chemicals are applied only as necessary, generally after non-chemical techniques have been attempted, rather than on a prophylactic or calendar basis (Pimbert 1991). Non-chemical management practices, and the combination of those practices, vary from one IPM program to another. However, some frequently used non-chemical management practices include: the manipulation of planting cycles and location of crops within plots, synchronous planting among neighboring plots, and maintaining crop diversity (cultural practices), development of pest-resistant crop varieties (genetic engineering), the release of natural predators to control crop pests and the manipulation of pheremones to disrupt the mating process (biological controls), and enforcement of sanitary practices such as the removal of crop residues at the end of the growing period (legal controls) (Pimbert 1991, MacKay *et al.* 1993).

Individual IPM programs are based on a thorough understanding of the local agroecology, such as the host crops, crop pest(s) and their natural enemies, climate, and soil fertility; the social and economic reasons for farming, such as profit, household subsistence, or the maintenance of family tradition; and the social, economic, and political incentives and constraints to farming in general and IPM in particular (Dover 1985). According to Holl *et al.* (1990: 343), "There is no one practice or combination of practices that works to control pests in all situations; each IPM system must be tailored to the specific agro-ecosystem involved." Thus, perhaps the most important factor to recognize in designing appropriate IPM programs is that they must be tailored to each specific location (Wearing 1988, Glass 1992, Matteson 1992, Perfect 1992, Mill 1993, Rajotte 1993).

Integrated pest management programs must be location-specific because they seek to maximize the benefits of natural pest controls through the creation of an agroecosystem that discourages the buildup of crop pests (Kiss and Meerman 1991). For example, by controlling factors such as soil conditions, water availability, crop mixture, and weed growth, farmers can create conditions that enhance beneficial insect populations and reduce crop pest populations. However, crop/pest interactions differ from one location to another according to individual crops and growing conditions, crop and beneficial pest populations (and their interactions), and with variations in climate, soil, and hydrologic conditions (Holl *et al.* 1990, Glass 1992, Matteson 1992, Perfect 1992, Altieri 1993). As a result, optimal IPM practices will vary from one location to another.

Furthermore, as discussed in Chapter Two, both external and local social, political, and economic factors shape patterns of resource use. Thus, in addition to variations in the biophysical components of agroecosystems, individual farmer's attitudes, beliefs, farming practices, and social and economic circumstances constitute an important part of local agroecosystems, which also vary from one location to another (Dover 1985). Such factors influence farmers' decisions regarding what types of crops to plant and when, how and where to market them, whether or not to use pesticides, and on what crops, and other important production decisions. Thus, IPM programs must also be tailored to location-specific social and economic conditions.

IPM programs have proven effective in reducing pesticide use and improving farmer profitability in a number of cases in both the industrialized and Third World. For example, in the U.S., a 1985 study found that IPM users reported a net return of $578 million per year over non-users (Rajotte 1993). In 1982, the Nicaraguan government invested U.S. $1.09 million in IPM and saved U.S. $2.39 million in pesticide costs (Holl *et al.* 1990). And in Indonesia, "graduates" of an IPM program decreased their average use of pesticides from 2.9 to 1.1 applications per season, while increasing rice yields by 0.5 tons per hectare (Pretty 1995).

Despite these and other successes, IPM practices have not been widely adopted at the farm level (Wearing 1988, Perfect 1992, Zalom 1993). As Zalom (1993: 247) notes "It is ironic that although IPM theory is fairly well understood and promoted, it has not been widely translated into practice." This is particularly true in Third World countries where IPM programs have been difficult to establish, and those that have been implemented have not been widely adopted or long-lasting (Bull 1982, Holl *et al.* 1990, Matteson 1992, Perfect 1992, Braun *et al.* 1993, MacKay *et al.* 1993, Poswal *et al.* 1993).

The lack of widespread success in designing and implementing long-term IPM programs is of particular concern in the Third World. The severity of pesticide-related problems, the high costs of importing pesticides, the potential for IPM to increase yields where pesticides are not available, and problems with pesticide residues on export crops make IPM an attractive alternative to the singular reliance on chemical pest controls (Bull 1982). To uncover the reasons for the lack of widespread adoption of IPM, a growing body of literature attempts to identify constraints to the adoption of IPM practices in general (Wearing 1988, Glass 1992, Zalom 1993) and in the Third World in particular (Bull 1982, Goodell 1984, Holl *et al.* 1990, Kiss and Meerman 1991, Matteson 1992, Murray 1994).

A serious technical obstacle to the adoption of IPM practices in the Third World is the lack of simple, practical, effective pest control techniques (Wearing 1988, Kiss and Meerman 1991, Zalom 1993). For example, a key concept of IPM is that there is a threshold level of damage below which chemical control is not economically practical and above which pest populations must be controlled in order to avoid unacceptable losses (Dover 1985, Kiss and Meerman 1991, Zalom *et al.* 1992). Threshold levels provide decision-making guidelines or criteria that enable farmers to determine what number of pests constitutes a threat to their crops, and when and what actions to take, such as the introduction of natural predators or the use of a targeted chemical, to avoid economic losses. But establishing precise threshold levels (sometimes referred to as economic or action thresholds) is difficult, as they vary depending on the crop, the specific crop pest(s), the absence or presence of beneficial pests, the economic value of the crop (Kiss and Meerman 1991, Zalom 1993), and farmers' perceptions of these factors (Goodell 1984). Farmers' response options also vary, depending on their access to resources such as cash and credit, labor, pesticides, biological controls, and advice from extension agents or other sources.

The establishment and use of threshold levels is a complex procedure that requires a more active management role for farmers than the more reactive approach of spraying when insects are first noticed (or even spraying on a calendar basis to prevent an outbreak). The lack of simple procedures for farmers to use in determining threshold levels is one of the key technical obstacles to the widespread adoption of IPM practices, and further technical research is essential to the future success of IPM (Kiss and Meerman 1991, Zalom 1993).

However, equally important non-technical constraints to the adoption of IPM exist and need to be addressed. According to Zalom (1993), while technical research is essential to the continued development of IPM, there are other more serious obstacles to the adoption of IPM practices. As he notes (*ibid.*: 248), "In spite of our general lack of knowledge, technical obstacles are often regarded as less important than other general obstacles to IPM adoption." Referring specifically to the Third World, Holl *et al.* (1990) contend that numerous examples of IPM's successes demonstrate that scientific knowledge of alternative pest-control techniques is not the limiting factor in replacing pesticides with other control measures. Rather, they argue, a variety of environmental, social, political, and economic factors impede progress towards successful implementation of IPM programs in Third World countries. These non-technical obstacles slow the adaptation and transfer of existing IPM knowledge and practices from researchers and scientists, through extension agents, to farmers.

As the discussion of political ecology in Chapter Two demonstrated, external political-economic factors interact with local social, environmental, and economic conditions to shape patterns of resource use at the local and regional levels. This is particularly true in the case of crop pests and farmers's decisions regarding pest control options. The adoption of IPM often requires significant changes in farmers' production practices in general, and pest management practices in particular (Ridgely and Brush 1992). Thus, IPM researchers must understand farmers' existing pesticide use practices, and the local and external factors that help shape patterns of pesticide use, as part of the process of designing and implementing appropriate IPM practices.

Several external political-economic forces may create obstacles to the adoption of IPM. First, many Third World governments and international organizations continue to promote the use of pesticides as a means of increasing crop production for domestic consumption and agricultural exports (Bull 1982, Kiss and Meerman 1991). As a result, pesticides are often subsidized by governments or international donor agencies, and very little, if any, legislation exists to regulate their importation, distribution, and use (Holl *et al.* 1990). Pesticide use is further promoted by agrochemical companies whose salesmen often provide the bulk of the pest control "extension" in rural communities (Bull 1982, Kiss and Meerman 1991).

Second, while national and international pesticide-related policies and funding may directly promote the use of pesticides, national agricultural priorities and international market structures may indirectly pressure farmers to use pesticides in order to increase the productivity and quality of export crops. For example, national agricultural policies that promote the production and export of fruits and vegetables often lead to increased chemical use because consumers, particularly in the U.S., demand unblemished produce (Wearing 1988, Kiss and Meerman 1991, Zalom 1993).

Third, regional, national, and international political and economic structures often fail to support the design and implementation of appropriate IPM practices. Significant changes in the design and implementation of pest control strategies cannot be accomplished without the institutional and financial support of international donor organizations and Third World governments (Holl *et al.* 1990, Kiss and Meerman 1991). According to Rajotte (1993), the cornerstone of IPM implementation is the availability of agricultural specialists located close to agricultural sites to provide expertise for adaptive research, IPM program design and implementation, farmer education, and program evaluation. However, most extension services in the Third World are often under funded, understaffed, and poorly educated in IPM (Bull 1982, Goodell 1984, Dover 1985, Holl *et al.* 1990, Matteson 1992). As Bull (1982: 136) argues "Where research and extension services are inadequate and under-financed, this can be a serious constraint on the effective implementation of IPM among small farmers." According to Goodell (1984), the problem is exacerbated by the fact that most Third World governments concentrate what limited agricultural funds they have on research and development, rather than good extension, in part because good extension services are so difficult to establish and sustain.

The actual process by which IPM is transferred from researchers to extension workers and then to farmers is also a problem. As Holl *et al.* (1990: 347) argue:

> Inadequate education is an acute problem for IPM. While continued research is necessary to improve and update IPM techniques, the failure of most IPM programs can be traced to a deficiency in extension services - particularly education and farmer awareness of IPM technology.

According to Kiss and Meerman (1991), a delivery system that effectively brings IPM techniques to farmers is as important as the research and design of effective IPM practices. They argue that because IPM practices are site-specific, dynamic, and management intensive, farmer education must focus on the IPM approach to farming, rather than on a specific set of IPM technologies. This requires a significant shift away from traditional agricultural extension methods based on the "transfer of technology"[8] (TOT) to an approach that puts the farmer at the center of problem

---

8 Under the TOT model, research priorities are set by scientists, rather than by farmers, who experiment on research stations or under controlled conditions in farmers' fields. The resulting technology is then handed over to extension agents for direct transfer to farmers (Pimbert 1991).

identification and development of solutions (Matteson 1992). The TOT approach is not appropriate for IPM technology because of the location-specific and management-intensive nature of IPM practices. Rather than simply prescribing a set of techniques, extension agents must teach farmers the principles of IPM and the skills and knowledge necessary to make autonomous, day-to-day decisions based on their own specific farm conditions (Matteson 1992, Rajotte 1993, Zalom 1993).

These and other external political-economic forces can create significant obstacles to the adoption of IPM practices in Third World countries. However, farmers' response to these factors vary according to their location-specific environmental, social and economic conditions. For example, each farmer's cultural and economic reasons for farming, such as for household consumption, domestic or export markets, or the maintenance of family tradition, influences his or her production practices in general, and pesticide use in particular. Farmers producing crops for export markets may be more concerned about the aesthetic quality of their produce (than those who are not) and perhaps be less willing to reduce their use of pesticides through the adoption of IPM. Other important location-specific factors to consider include: farmers' access to markets, both domestic and export (because this influences farmers' crop selection decisions); the availability of labor, both household and hired (because IPM practices are often labor intensive); and, access to and control over other resources such as land, income, and credit that affect the scale of production and the crops that farmers grow. These and other local-level factors affect farmers' production practices in general, and pesticide use in particular. Location-specific research is necessary to identify these factors.

In addition to variations in environmental, social and economic conditions, individual attitudes and beliefs regarding the safety and effectiveness of pesticides vary a great deal and influence each farmer's pest management decisions. According to Grossman (1992a), even when political-economic forces create pressure to increase pesticide use among small-scale farmers, there are important differences in local-level responses to these pressures. In St. Vincent, he found that some farmers are wary of agrochemicals and use a great deal of caution and selectivity in applying pesticides. Others are less concerned about the potential dangers of agrochemicals and thus less cautious in their use of pesticides. Such differences in farmers' beliefs regarding the safety of pesticides are important to identify because they may affect farmers' interests in IPM. For example, farmers who have experienced health problems as a result of pesticide use may be more interested in IPM than those who have not. Perceptions regarding the severity of pest problems, as well as the effectiveness of pesticides, also affect farmers' pest management decisions. A farmer may identify a pest as a greater threat than a researcher would, or farmers may believe that the only way to control a pest problem is to exterminate the population completely (Holl *et al.* 1990, Kiss and Meerman 1991). If pesticide use is ingrained in a farmer to the extent that he or she believes pesticides are an essential component of farming, the introduction of IPM and the concept of managing pest populations (rather than trying to eradicate them through the application of greater and greater amounts of pesticides) become more difficult (Wearing 1988, MacKay *et al.* 1993).

This problem is evident in the Philippines where, despite intensive research efforts and government support for IPM, farmers have been slow to adopt IPM practices, partly because farmers tend to trust chemical controls and distrust the unknown IPM (MacKay *et al.* 1993). Through a 1973 rice intensification program, the Philippine government promoted high yield varieties and fertilizer and pesticide use such that:

> The practice of chemical pest control has been deeply ingrained in the consciousness of the farmers, it has become a tradition. This is apparent by the farmers' practice of spraying as soon as they see an insect, even though it may be beneficial (MacKay *et al.* 1993: 34).

As a result, MacKay *et al.* (*ibid.*) argue, one of the biggest obstacles to the implementation of IPM in the Philippines is for farmers to "unlearn" their dependence on pesticides.

Equally important as farmers' perceptions of pest problems and pesticide use is the identification of other constraints to farming (Goodell 1984). According to Kiss and Meerman (1991), pest control is relevant only if it can be shown that losses to pests represent an important production constraint relative to other factors such as crop varieties, seed quality, soil preparation and fertility, and water availability. If farmers have more serious problems, such as yield reductions due to drought or declining soil fertility, insecure markets, labor shortages, or inadequate land to expand production, adoption of IPM will probably not be a priority for those farmers (Goodell 1984, Kiss and Meerman 1991).

The individual farmer is also influenced by household and community dynamics. For example, both Grossman (1992a) and Momsen (1986) have found gender differences in roles and responsibilities in the Caribbean with regard to pesticide application, with women being more reluctant to apply pesticides than men. Gender-based differences in behavior and practices related to pesticide use are particularly important to explore because of their implications for the household division of labor and the provision of household needs. According to MacKay *et al.* (1993), women in the Philippines generally control household finances and heavily influence expenditures on agricultural activities. They argue that such information "is essential in order to effectively target extension advice and training" (MacKay *et al.* 1993: 39).

Another potential non-technical constraint to the adoption of IPM is a lack of social ties and community institutions through which to implement IPM. An important component of many IPM programs is community-wide involvement and cooperation in the project. For example, some IPM practices involve major changes in farming practices over a wide area, such as switching from asynchronous to synchronous planting schedules to allow a break in the life cycle of certain pests (Kiss and Meerman 1991, MacKay *et al.* 1993). Murray (1994) found that one IPM project in Nicaragua failed, in part, because some farmers were not included in the project, thus permitting pest problems to continue to develop and spread to the farms that were using IPM practices. According to Bull (1982: 127):

> Cultural controls, such as correct timing of planting, are likely to be more effective if practiced in a coordinated fashion by many farmers in a given area. This is also true of other aspects of IPM.

As a result, in areas where small-scale farming predominates, many changes must be coordinated by a large number of individual farmers. Even where direct cooperation is not required, strong social ties within a community can be an important way to spread information about IPM to other farmers. As Ridgely and Brush (1992) found, family farmers in California are more likely to share information about IPM with other family members and farm neighbors than were people working for corporate-owned farmers, thus increasing the acceptance of IPM as an alternative pest control option.

Clearly, numerous non-technical constraints to the adoption of IPM exist. As this discussion has demonstrated, both local and external factors influence farmers' decisions regarding pest control options. These factors, and farmers' responses to them, differ from one location to another and may pose very different constraints from one place to another. As a result, each IPM program must be tailored to meet the needs of the specific population being targeted. The IPM CRSP project, in Jamaica and the other research sites, is trying to identify and overcome some of the constraints to the adoption of IPM. Chapter Four will focus on the IPM CRSP project in Jamaica and the results of the first two years of research.

Chapter Four

The IPM CRSP Project and Agriculture in Jamaica

In the early 1970s, the United States Agency for International Development (AID) initiated the "Collaborative Research Support Programs" (CRSPs). CRSPs involve research between U.S. and Third World institutions to solve agricultural problems in the Third World. One of the most recent such projects, begun in 1993, is the IPM CRSP which is being implemented through 10 U.S. and 15 host institutions in four primary countries: the Philippines, Guatemala, Jamaica, and Mali. The goal of the IPM CRSP is to design and implement integrated pest management practices to improve crop protection and prevent environmental degradation associated with pesticide use, thereby improving the "quality of life of the rural poor, while benefitting agriculture and consumers in the U.S." (Virginia Polytechnic Institute and State University 1995: 1).

The IPM CRSP is attempting to resolve "difficult, persistent constraints to the adoption of IPM," particularly in the production of horticultural export crops (fruits, vegetables, flowers, and ornamental plants) and in transitional agricultural systems, where farmers are just beginning to become involved in production for the market (US AID 1993). According to the project description, the IPM CRSP is focusing on transitional systems because many of these are on "marginal" land and AID officials believe these are more vulnerable to pest damage. Horticultural crops are a concern because:

> [H]igh value horticultural crops are subject to relatively high chemical inputs that can result in chemical residue on the products, a primary reason why such crops may not be accepted by importing countries with chemical residue tolerance standards (U.S. AID 1993: 1).

The specific goal of the IPM CRSP project in Jamaica is the reduction of pesticide residues on vegetable crops. Jamaica was selected as one of the initial IPM CRSP sites for a number of reasons. First, Jamaica has significantly increased its production of nontraditional agricultural exports (primarily fruits and vegetables) as part of an overall strategy to diversify its agricultural base, earn more foreign exchange, and increase small-scale farmer participation in export agriculture (Ministry of Agriculture 1991). Between 1984 and 1994, the production of nontraditionals increased from 16.1 million kilograms to 21.4 million kilograms, an increase of 75 percent (see Table 4-1). The value of these exports increased from $U.S. 11.6 million in 1984 to $U.S. 18.5 million in 1994, or 62 percent (see Table 4-2).

Second, a large portion of these exports are destined for U.S. markets. The growing demand for fruits and vegetables in the U.S. is due in part to more health conscious consumers, and in part to the growing population of Jamaicans and other West Indians living in the U.S. (with smaller numbers migrating to Canada and the U.K.) who are creating a demand for Jamaica's ethnic produce (Reid 1996, personal interview). The problem, however, is that the U.S. has more stringent regulations on the importation of fresh produce than does the U.K. or Canada (Reid *ibid.*).

Table 4-1 Growth in Volume of Nontraditional Export Crops, Jamaica 1984-1994 ('000 Kilgrams)

Export Crop	1984	1986	1988	1990	1992	1994
Vegetables	14,290	22,438	14,198	12,391	15,292	15,834
Fruits	1,458	4,358	1,732	1,320	3,327	5,340
Ornamentals	393	715	508	396	251	320
Totals	16,141	27,511	16,438	14,107	18,870	21,494

Source: The Planning Institute of Jamaica. 1995. Economic and Social Survey: Jamaica 1994. Kingston, Jamaica: The Planning Institute of Jamaica.

Table 4-2 Growth in the Value of Nontraditional Export Crops, Jamaica 1984-1994 (US$'000)

Export Crop	1984	1986	1988	1990	1992	1994
Vegetables	8,549	11,487	12,084	11,703	11,078	15,046
Fruit	1,549	2,232	1,400	1,046	978	1,715
Ornamentals	1,565	2,690	2,983	2,891	2,498	1,761
Totals	11,663	16,409	16,467	15,640	14,554	18,522

Source: The Planning Institute of Jamaica. 1995. Economic and Social Survey: Jamaica 1994. Kingston, Jamaica: The Planning Institute of Jamaica.

This increases the difficulty of producing export quality crops because produce going to the U.S. must be of high aesthetic quality, pesticide residues must not exceed certain levels, and produce cannot bring the risk of disease or insects to U.S. crops.

Third, although Jamaica has not had as severe a problem with pesticide residues and rejection of its horticultural exports as some other Latin American and Caribbean countries have experienced (see Table 4-3), AID has already invested a great deal of money in the development of the NTAE sector in Jamaica, and therefore has a clear interest in seeing this particular economic development strategy succeed. For example, AID spent $18 million on crop diversification and irrigation projects in Jamaica from 1985 to 1990 and $7.6 million on other agricultural research related to NTAEs from 1986 to 1993 (Thrupp *et al.* 1995). In 1984, U.S. AID provided funding and training to establish a pre-clearance facility at Norman Manley International Airport in Kingston. The pre-clearance program funds a USDA-trained inspector to certify that Jamaican produce complies with U.S. standards before it leaves the country, thus reducing waiting time [for inspection] once shipments arrive in the U.S. This program has been credited with greatly increasing Jamaica's volume of exports (Reid 1996, personal interview; Allen 1996, personal interview). In addition, AID provided one half of the funding (U.S. $10 million) for the Agricultural Export Services Project (AESP), a joint project between the U.S. and the Government of Jamaica to increase exports of traditional and non-traditional crops through the provision of technical and management assistance in the production, packaging, and marketing of export crops (Agricultural Export Services Project Handbook: no date).

Table 4-3 United States Food and Drug Administration Detentions of Fruit and Vegetable Imports Due to Pesticide Residues, 1984-1994

Country	Total Number of Detentions*	Total $US Value of Shipments Detained
Mexico	7,429	54,589,000
Guatemala	3,168	17,972,000
Dominican Republic	2,259	11,257,000
Chile	666	9,475,000
Jamaica	150	583,000
Costa Rica	102	411,000
Colombia	79	200,000
Honduras	66	269,000
El Salvador	39	977,000
Ecuador	35	158,000

Source: World Resources Institute analysis of U.S. Food and Drug Administration Data (Thrupp et al. 1995: 7)

* *Number of shipments detained for pesticide sampling when a random sampling of the shipment indicates potential violations of FDA regulations, or when a product from a certain country is under automatic detention. After further testing, shipments are either released for entry into the U.S. or rejected.*

United States researchers involved with the IPM CRSP project are collaborating directly with researchers from the Caribbean Agricultural Research and Development Institute (CARDI), and indirectly with other Jamaican personnel from organizations such as the Ministry of Agriculture (MINAG), the Pesticide Control Authority (PCA), and the Rural Agricultural Development Authority (RADA) to introduce IPM practices to small-scale farmers in 11 communities. The IPM CRSP project is focusing on small-scale agriculture in Jamaica because of the Jamaican government's desire to increase the participation of small-scale farmers in export agriculture through the production of NTAEs and the IPM CRSP's mandate to improve the quality of agriculture and rural life in Third World countries. In the Caribbean this is particularly important because average yields in almost all of the region's principal agricultural crops are significantly below other producing regions and the world average (Thomas 1988).

Agriculture and Marketing in Jamaica

In the Caribbean, small-scale farmers make up over one half of all farmers (Besson 1984), and in Jamaica small-scale farmers make up 55 percent of all farmers (Pariser 1996). Small-scale agriculture in the Caribbean is generally defined as the cultivation of less than 5 acres for home consumption and some surplus for sale in domestic markets (Thomas 1988), although it has been defined as 10 acres or less as well (Mintz 1989). However, there is agreement that the majority of landholdings are closer to one acre in size (Mintz 1989, Thomas 1988). Small-scale agriculture developed as a livelihood strategy in Jamaica and many other British colonies following emancipation in 1838, when slaves sought to gain their economic as well as legal independence from the plantations (Thomas 1988, Brierly 1991).

While many facets of small-scale agriculture differ from one Caribbean nation to another, and even from one region to another within each country, several common features can be identified. Several of these features can be attributed to the common experience of slavery and the continued dominance of plantation agriculture following emancipation (Besson 1984, 1988). Perhaps one of the most interesting and important features is the institution of "family land," also known as children's land or generational land, throughout the Caribbean (Besson 1984). Following emancipation, the primary goal of the newly freed slaves was to obtain their own land and begin farming for themselves, even on a small scale, as a means to avoid continued labor on the plantations. Although the plantations (primarily sugar) already occupied the most accessible and fertile coastal and alluvial plains (Beckford 1987) and the former slaves were forced to seek less fertile, smaller, and often fragmented plots of land in the hilly interiors of the islands, the land the former slaves obtained took on important cultural as well as economic meaning because it served as a symbol of freedom from slavery and plantation labor (Besson and Momsen 1987, Mintz 1989, Trouillot 1990). In Jamaica and other Caribbean countries, this land, which is often some distance from the home, is passed down intact from one generation to another, with each family member (male and female) having equal claim to the land, to ensure that the land will be maintained in the family (Berleant-Schiller and Pulsipher 1986). If an individual leaves the area or the country, he or she may return to the land at any time and begin to cultivate it or construct a shelter on this land. Because of the land's symbolic value, it is rarely sold, even if it is not under agricultural production. Besson (1984) has identified this practice with underproduction because family members who are living on the land are hesitant to invest their time and money in production when absent members can return at anytime to lay their claim to the land and its produce.

A number of crops and cultivation practices have been identified as common to small-scale agriculture in the Caribbean (Berleant-Schiller and Pulsipher 1986). During their first years on the islands the slaves combined familiar West African crops and skills with indigenous crops in adapting to their new environmental and economic conditions (Mintz 1989). Berleant-Schiller and Pulsipher (1986) identify seven core crops that emerged from the combination of cultural practices and environmental conditions that are still predominant in the region. These crops include bananas and plantains, maize, beans, pigeon peas, squash and pumpkins, sweet potatoes, and yams. Berleant-Schiller and Pulsipher (*ibid.*) also identify a number of cultivation practices common to the region. These include the short-handled hoe as a tool for mounding and ridging, characteristic intercrop patterns, flexible forms of tenure and degrees of intensification that respond to changing demographic, economic, and physical conditions, family land, livestock tethered on fallow land, and the use of pigeon peas as a symbolic and boundary marking crop.

Many of the skills needed to sustain small-scale agriculture were obtained during slavery (Mintz 1989). In Jamaica, as well as other Caribbean countries, slave owners sought to reduce their food costs by allowing slaves to cultivate small plots around their homes, or on land unsuitable for plantation agriculture (often in the hills surrounding the plantation). Slaves were able to produce much of their family's food needs, and often a surplus for sale. Such food surpluses led to the development of island market systems and slave owners permitted their slaves to attend weekly Sunday markets to trade or sell their produce (Mintz 1989). According to Mintz, this practice gave slaves a sense of independence and the skills necessary to produce and market their own produce once they obtained their freedom.

Under the institution of slavery, Caribbean women in particular developed a strong sense of independence (within the household) that has continued to this day (Massiah 1983). According to Massiah, the basic elements of sharing and sustaining households among married couple were not available under slavery, thus women were often solely responsible for the care and provision of the household. Women became involved in the slave market system, either cultivating and marketing produce and crafts, or just by marketing as a means to provide for their families. In Jamaica, this sense of independence and involvement with agriculture continued following emancipation, when women, known as "higglers," began to act as the "middlemen" between farmers and the market place (Mintz 1989). These women travel from one farm to another to obtain small amounts of produce, from one or more farmers, then take it to the market and sell it, returning the farmer's profits (at a pre-determined percentage of the sale) when they come back for more produce. According to Mintz (1989), Jamaican women's independent role as marketer and contributor to family income has influenced conceptions of authority, equality, dignity, and other basic values within the family.

Women's work as higglers also provides an essential link between the producers and consumers in the distribution of produce in Jamaica (Mintz 1989). According to Mintz, small-scale farmers are unwilling to put even half of their small plots into one crop out of fear of a seasonal glut on the market that might mean selling produce at a loss, or not at all. Because there is no guaranteed market for produce in Jamaica (and many other Caribbean countries), farmers cannot put all their resources into one crop. Thus small farmers prefer to diversify crops and thereby reduce their risk. However, this means that farmers are only able to sell a small amount of produce at a time and this precludes a more large-scale marketing system from developing (such as the use of trucks to obtain produce in the countryside because there is rarely enough produce to justify that). Mintz (*ibid.*) believes the irregularity of demand among the majority of the consumers probably precludes any overall replacement of this marketing system. Thus, women who purchase small amounts of produce from several different farmers provide an important service.

The IPM CRSP Project

Despite the many common experiences of small-scale cultivators in the Caribbean, particularly that of plantation slavery and the continued monopolization of the best land by plantation owners, differences in environmental, economic, and social conditions have resulted in important variations in how crops are grown and marketed, when crops are grown, and with what labor, from one country to another and even within countries. Thus, even though small-scale agriculture in Jamaica exhibits many common features of small-scale agriculture in the Caribbean, location-specific research is still needed to uncover the extent and nature of these differences as part of the process of designing and implementing IPM practices in Jamaica. During the first two years of the project, an interdisciplinary team of economists, sociologists, agronomists, entomologists, extension agents, and field technicians from both Jamaica and the U.S. selected the crops for IPM research as well as the communities that would be involved in the project. Project members then carried out exploratory biological and socioeconomic research within those communities. The criteria for selecting the research crops included: the export importance of the crop, classification as a vegetable crop, use of pesticides in the production of the crop, the presence of pesticide residues on the crop, and the potential for developing and implementing an IPM program for that particular crop. The researchers selected three crops for initial IPM research: sweet potato (*Ipomoea batatas*), pepper (hot and sweet) (*Capsicum sp.*), and callaloo (*Amaranthus sp.*), a leafy, green vegetable. The

11 communities, located in three different parishes (see Map 1-2), have diverse physical environments, cropping systems, market opportunities, and social systems. The IPM CRSP researchers selected a diverse group of communities in order to provide varied research settings that would reflect the wide range of constraints to farming and IPM in Jamaica.

Integrated pest management practices vary from one location to another because agroecosystems differ within and among regions and communities. Therefore, once the crops and communities were selected, IPM CRSP scientists began location-specific background biological and socioeconomic research. Research issues included: the basic biology of crop pests (weeds, insects, diseases, nematodes, and rodents); cropping systems, such as soil fertility and moisture, and different crop varieties; pesticide residues in soils and on crops; control options, including biological controls, resistant varieties, cultural practices, and pesticides and herbicides; production practices, such as pesticide usage and traditional cultural pest management practices, crop rotation and intercropping; economic analyses, including production costs and market prices; market opportunities and constraints, such as access to domestic and export markets, demand for Jamaican NTAEs; and social systems, including farm/household decision-making processes, household and community dynamics, extension services and other sources of information delivery, off-farm job opportunities, and land tenure.

This information was obtained by using "participatory appraisals" in the 11 communities selected for inclusion in the IPM CRSP project. According to the IPM CRSP Update (Virginia Polytechnic Institute and State University 1995), a participatory appraisal is a systematic, semi-structured approach to assessing and understanding situations with the participation of the people affected by a project. IPM CRSP researchers used the participatory appraisal approach to data collection in an effort to include community members in the process of identifying pest problems. The researchers interviewed key informants and a stratified sample of community members to obtain information on community stratification, production practices, livelihood strategies, and household and community dynamics. They interviewed at least one member from all households in the samples about crops, livestock, daily routines, seasonal agricultural calendars, pesticide use, land tenure, and sources of information (such as radio, television, extension workers, and religious leaders). Researchers also asked respondents to rank the crops they currently planted and their reasons for planting them, their farm and non-farm problems, and the existence and importance of local institutions (through which the IPM CRSP project might implement IPM practices). The researchers then used the information obtained as the basis for selecting key farmers for IPM field trials.

RESULTS OF THE PARTICIPATORY APPRAISALS[9]

Despite exhibiting many features typical of agriculture in the Caribbean in general and Jamaica in particular, the research communities included in the IPM CRSP project also have their own unique features. The participatory appraisals carried out during the first two years of the IPM CRSP project in Jamaica identified several important differences between the St. Mary research communities and the research communities in St. Catherine and Clarendon. These differences in the social and physical environment of the various research communities are important to understand and consider in the process of designing and implementing IPM programs, due to the location-specific nature of IPM. This section will examine how the research communities in St. Mary differ from those in Clarendon and St. Catherine with respect to the physical environment, demographics, farming practices, marketing opportunities, pesticide use, and non-pest constraints to farming.

Physical Environments

St. Mary is a mountainous area on the northeastern side of the island. The region receives an average of 78 inches of precipitation annually (CARDI 1995). The research communities in St. Catherine and Clarendon are located on the southern

9 Unless otherwise noted, all information in this section comes from the Working Report on Exploratory Research in Jamaica for the Annotto Bay Site (Seitz 1995a) and drafts of exploratory research reports in St. Catherine (Seitz and Perkins 1995) and Clarendon (Perkins 1995).

coastal plain where the terrain is relatively flat. These communities receive less than 50 inches of annual precipitation (CARDI 1995). Despite the lower rainfall amounts, the research communities in St. Catherine and Clarendon are often subject to flood damage due to poor drainage systems and the annual flooding of the Rio Minho and Rio Cobre rivers. Soils within all communities are predominantly clays, some of which have been produced from old and recent alluvium and limestone (CARDI 1995).

Demographics and Land Tenure

Farming is the primary occupation in St. Mary, with the majority of the farmers being older men and women (average age is not known, but most are grandparents), which is characteristic of the Caribbean (Hills 1988). Most of the residents have been farming all their lives, though many of the men leave the community at some point to supplement their household incomes with off-farm labor. The primary means of land control is through family land. Often land is held in several small parcels some distance from the home, although there is a relatively adequate supply of land in the area and tenure is generally secure.

In the St. Catherine and Clarendon research communities, the farming population is more heterogenous. There is a wider range of age groups involved in farming, with the majority being older farmers (at least grandparents), but with some younger (25-40 year range) people involved as well. Farming is less likely to be a person's primary occupation. Many people reported farming as a part-time activity, with off-farm labor used to supplement household income or vice versa. In addition, means of land control are more varied, with some farmers owning the land they work (through purchase rather than inheritance), others leasing, and still others acting as caretakers for absentee owners.

Farming Practices

Farmers in St. Mary practice hillside agriculture and use machetes, hoes, and pitchforks as their primary tools. These farmers grow a wide range of crops in an effort to minimize risk. They plant both trees, such as coffee, cocoa, mango, grapefruit, ackee, and breadfruit, and a variety of other fruits and vegetable crops, including, bananas and plantains, dasheen, peas, tomatoes, sweet potatoes, pumpkin, turnip, corn, and yams. However, farmers often prefer tree crops because they have fewer pest problems and are easier to cultivate, especially for older female farmers. Currently, much of the land is under-utilized due to the lack of resources, such as labor and cash, and limited market opportunities. Advancing age and illness also restrict agricultural production.

Farmers in both St. Catherine and Clarendon practice some mechanized farming, such as the use of tractors to prepare fields for planting, although machetes are still widely used. Farmers plant both trees, such as mango, coconut, papaya, and citrus, and numerous fruit and vegetable crops, including bananas and plantains, peas, sweet potato, callaloo, peppers, okra, cucumbers, tomatoes, pumpkins, and string beans, are grown, as well as some ornamentals. Tree crops are less abundant than in St. Mary due to the warmer, drier climate. Crop selection is primarily market-driven. Farmers schedule crops according to market demands as they are wary of glutting the market and lowering prices as frequently occurs in Jamaica. For example, some farmers in Clarendon plant sweet potatoes in July because farmers in the neighboring parish of Manchester plant in October, and the main buyer, Manchester Packers, will only purchase a certain amount of crops. Farmers give preference to crops that can generate revenue for at least three months, and they consider susceptibility to pests when deciding what crops to plant. For example, some farmers prefer sweet pepper to hot peppers and tomatoes, which are more susceptible to pest problems.

Market Opportunities

In the St. Mary research communities, crops are primarily produced for home consumption and the domestic market, although several farmers have recently begun to produce for export. Crops for domestic consumption are sold to the St. Mary's Development Project Co-Op (an organization established and supported by the Catholic church in the area) and in the Annotto Bay (the capital of St. Mary) or Kingston (the capital of Jamaica) markets. In the past, female household members transported the products to markets in Annotto Bay or Kingston or farmers sold them to higglers who then transported produce to those markets. However, due to advancing age and ill health, many women can no longer go to markets themselves, and thus they must rely on higglers or sell produce to the Co-Op. In addition, some farmers grow carrots under contract with Grace Kennedy, Inc. (a food processing company), which supplies seeds and fertilizers to the farmers, and then purchases the crop (deducting the cost of supplies) from the farmer.

The research communities in Clarendon and St. Catherine are closer to Kingston and the export businesses located in or near the metropolitan area. There is also a more established transportation infrastructure than in St. Mary, which makes participation in export agriculture more feasible. The combination of these factors has resulted in a higher level of participation in export agriculture, relative to the research communities in St. Mary (CARDI 1995).

Pesticide Use

In the St. Mary research communities, farmers employ a variety of non-chemical techniques to reduce pest damage to crops and enhance production. For example, planting by the moon is seen as a way to minimize pests and increase yields (farmers associate certain moon phases with lower pest populations), and many farmers apply liquid from breadfruit trees or ashes to some vegetable crops to control worms. IPM CRSP researchers found very little use of synthetic pesticides there, in part because pesticides are not readily available. Some farmers have stopped producing pest-prone crops, such as callaloo, because they have problems with pests and do not have access to pesticides. However, some farmers expressed distrust of agrochemicals, and some community members associated use of fertilizer with lower quality produce and ill health.

In Clarendon and St. Catherine, on the other hand, most farmers use synthetic pesticides as their primary method of pest control. IPM CRSP researchers found that the level of pests and pesticide use is much higher in St. Catherine and Clarendon than in St. Mary (Seitz 1995b). In addition, the head of the Jamaican Agricultural Society (JAS) reported that the high use of pesticides may have already resulted in the destruction of natural predators.

Despite the seemingly more intensive use of pesticides in St. Catherine and Clarendon, attitudes towards and use of these chemicals vary greatly. Many of the farmers do not recognize a relationship between the type of pest and its impact on a crop(s), and thus they tend to rely on a mixture of two or more multi-purpose pesticides, known as pesticide "cocktails" (Seitz 1995b). However, while some farmers expressed the belief that "more" is better, others acknowledged that it is the care with which the spray (pesticide) is applied, rather than the quantity, that determines effectiveness. IPM CRSP researchers also found that some farmers are quite careless in their application of pesticides, such as not wearing protective equipment, spraying when windy, and improperly disposing of empty containers, while other farmers reported adhering to recommended precautions. Most farmers reported spraying on a calendar basis, such as every eight days for pumpkins, or every three days for callaloo, even if they are aware that they should check for insects before deciding whether an application of pesticides is necessary.

Non-pest Constraints to Farming

In St. Mary, interviewees consistently identified the lack of, or poor quality and high cost of, labor as a serious problem. Older people complained that young people show little interest in farming and often leave the community, or the country, in search of other job opportunities. Older people are worried about the future of farming in their community because they are getting too old or ill to farm and their children do not want to take over for them. The lack of labor is even more serious for women who are not able to engage in "day for day"[10] labor sharing arrangements because of other household duties, such as childcare, cooking, and cleaning. This means that women have to hire labor more frequently. Other constraints to farming include: the poor quality of both main roads and paths to agricultural fields that make access to gardens and markets difficult; lack of cash and credit; low prices received for produce; and health problems.

In Clarendon and St. Catherine, water is a major problem for many farmers

---

10 Under "day for day" labor sharing arrangements, farmers organize to work on one farm for a day, often to accomplish a specific task. The recipient then reciprocates when other farmers have a certain task which requires additional labor (Smith and Kruijer 1957).

because of the high costs of irrigation or inadequate supply of water from the National Irrigation Commission (NIC). In St. Catherine, the destruction (in 1994) of the Rio Cobre Dam, which had provided irrigation water, has seriously limited farmer's production capabilities. Farmers in both communities identified low market prices, the high cost or lack of inputs, such as labor, agrochemicals, and mechanized farm equipment, poor extension services, and periodic flooding as constraints to farming. In the St. Catherine research communities, farmers complained that the roads are dilapidated, unpaved, and flood-prone when it rains. Even though these communities are close to the main road (to Kingston), the roads are in such poor condition that taxis refuse to travel on them so people have to carry their produce out to the main road. In two of the research communities in Clarendon, farmers complained about the loss of social ties that has accompanied their relocation by the ALCOA aluminum company to make way for bauxite mining.

As this summary has demonstrated, many important differences exist between the St. Mary research communities and the research communities in St. Catherine and Clarendon (see Table 4-4). The political ecology approach, with its recognition that a wide variety of factors shape patterns of resource use, is particularly useful in trying to understand how differences in the two regions' physical environments, marketing opportunities, livelihood strategies, and pest and non-pest constraints to farming,

Table 4-4 Summary of Differences Between the St. Mary Research Communities and the Clarendon and St. Catherine Research Communities

Research Issues	St. Mary	St. Catherine/ Clarendon
Physical Environments	Mountainous, cool, above average rainfall	Coastal plain, drier, warmer
Demographics	Older, full-time farmers, family land	Wider range of ages, more part-time farmers, variety of land access arrangements
Farming Practices	Long-term tree crops, no mechanized farming	Short-term vegetable crops, some mechanization
Market Opportunities	Primarily domestic market, also Co-Op and contracts with Grace Kennedy	Domestic and export markets
Pesticide Use	Little pesticide use, various cultural pest control methods	Rely on pesticides to control crop pests
Non-pest Constraints to Farming	Lack of labor, age, bad roads, lack of cash or credit, low produce prices	Water shortages, flooding, bad roads, loss of social ties

influence the types of crops that farmers grow in each region, whether they are involved in the production of NTAEs, and their attitudes and beliefs regarding the safety and effectiveness of pesticides. In general, farmers in the St. Mary's research communities are just beginning to become involved in export agriculture and tend to use less pesticides. Farmers in the Clarendon and St. Catherine research communities, however, are more involved in the production of NTAEs and appear to rely on pesticides to a greater extent than do those in St. Mary.

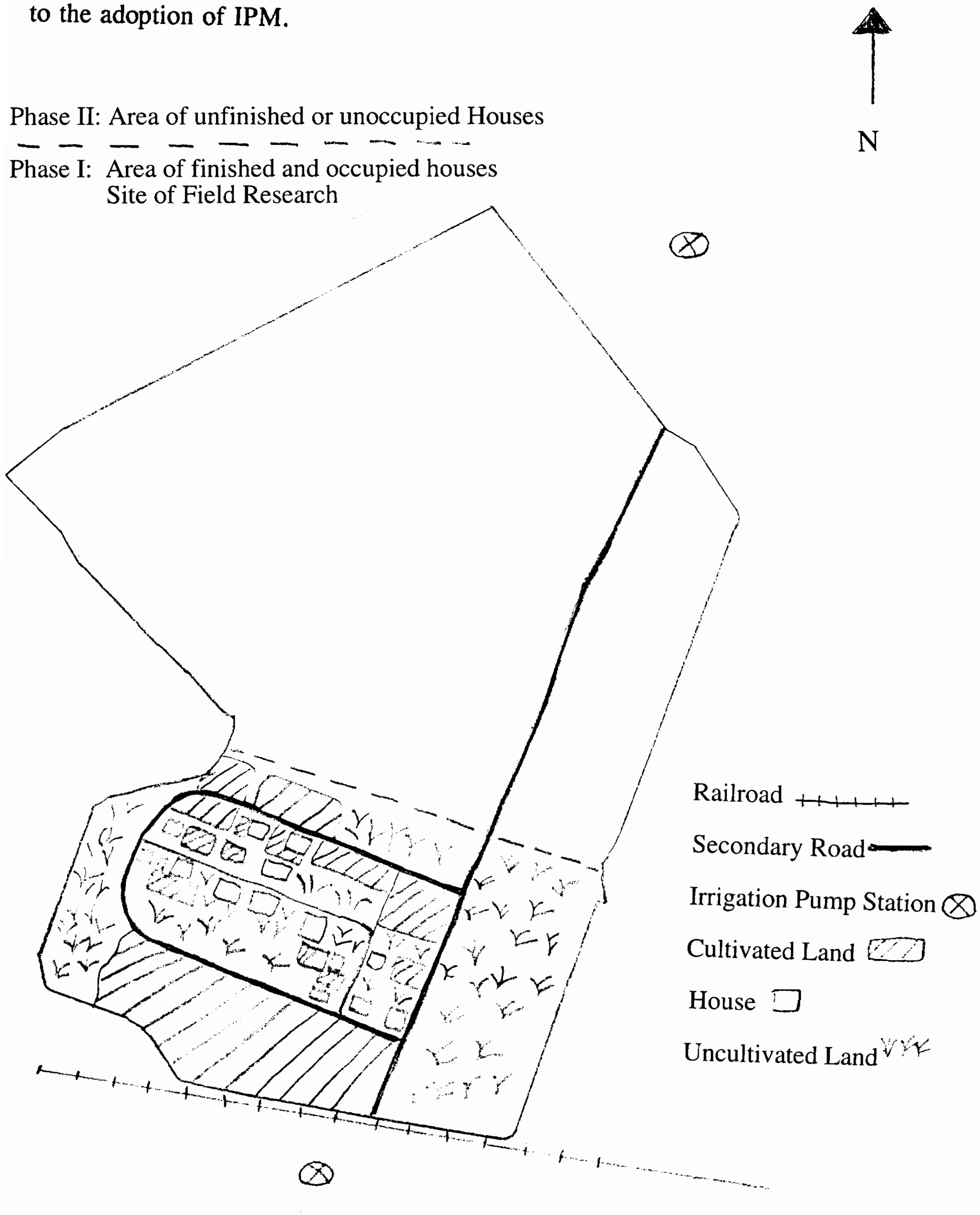
While the recognition of such differences is an important first step in identifying potential obstacles to the implementation of IPM among small-scale farmers in Jamaica, more detailed studies of each community are necessary in order to identify location-specific, non-technical constraints to the adoption of IPM. Detailed local-level studies are needed to identify and analyze how local environmental, social, and economic conditions, and individual attitudes and beliefs regarding pesticide use, interact with external political-economic forces to create obstacles to the adoption of IPM. This is especially important in the communities where farmers are already involved in the production of NTAEs and reliant on pesticides. The pressure to produce high quality crops and their familiarity with pesticides suggests that it may be more difficult to convince farmers to reduce their use of pesticides through the adoption of the unknown IPM. Thus, the next chapter will provide results of a detailed study of the non-technical constraints to the adoption of IPM in the community of Denbigh Kraal, one of the IPM CRSP research communities in Clarendon.

Chapter Five

Analysis of the Non-technical Constraints to the Adoption of IPM in Denbigh Kraal, Clarendon

The participatory appraisals, carried out during the first two years of the IPM CRSP project in Jamaica, identified farmers in the research communities in Clarendon and St. Catherine as more involved in the production of NTAEs and more reliant on pesticides than the farmers in the St. Mary's research communities. These are important differences because the pressure to produce export quality crops and farmers' existing reliance on pesticides are potential non-technical constraints to the adoption of IPM in those communities. Furthermore, the participatory appraisals identified important differences in social organization between the research communities in St. Mary and those in Clarendon and St. Catherine. IPM CRSP researchers found more tightly knit communities and strong social ties in St. Mary, while the research communities in St. Catherine and Clarendon had relatively weak social ties and a stronger sense of individualism. IPM CRSP sociologists believe this may be an important constraint to the adoption of IPM in the Clarendon and St. Catherine research communities because IPM often requires the sharing of labor and knowledge, as well as coordination of production activities. However, to fully identify and analyze these and other potential non-technical constraints to the adoption of IPM in each community, more detailed, location-specific studies are necessary. Therefore, I selected one of the research communities, Denbigh Kraal, Clarendon (see

Map 5-1), in which to conduct a more thorough study of the non-technical constraints to the adoption of IPM.



Map not drawn to scale

Map 5-1 Denbigh Kraal, Clarendon

A wide range of external and local factors shape patterns of resource use at the local level. Chapter Three demonstrated that this is particularly true in the case of farmers' decisions regarding pest control options. As I will show in the case of Denbigh Kraal, numerous local and external factors interact to influence individual farmer's patterns of pesticide use, which, in turn, may create obstacles to their adoption of IPM. Denbigh Kraal is an ideal community in which to study non-technical constraints to the adoption of IPM because the majority of the residents have recently been relocated from the hilltop community of Mocho (by the Aluminum Company of America to make way for bauxite mining) to the newly established subdivision of Denbigh Kraal. The relocation has led to significant changes in the farmers agroecological environment, marketing opportunities, and social ties, among other things. Thus, Denbigh Kraal provides the opportunity to learn how changes in local environmental, social, and economic conditions affect farmers' responses to external political-economic forces.

In particular, I will focus on five potential non-technical constraints to the adoption of IPM in Denbigh Kraal. First, and perhaps most important, are farmers beliefs and attitudes regarding the role of pesticides in farming. As discussed in Chapter Three, farmers who view pesticides as essential to farming may be less willing to reduce their use of pesticides through the adoption of IPM. Second, I will identify both external and local factors that may be creating an actual or perceived need to *increase* the use of pesticides in Denbigh Kraal. In addition to the pressure to produce high quality export crops discussed in Chapter One, several factors specific to Denbigh Kraal may influence the amount of pesticides farmers use in Denbigh Kraal. Third, I will examine individual attitudes and beliefs regarding the safety and effectiveness of pesticide use among farmers in Denbigh Kraal. Farmers' attitudes and beliefs regarding the safety and effectiveness of pesticides vary and may mean that some farmers are less willing than others to adopt IPM. Fourth, residents of Denbigh Kraal have complained that their relocation from Mocho to Denbigh Kraal has resulted in the loss of important social ties. Cooperation among community members can directly impact the success of some IPM practices because they are labor intensive and may require, or benefit from, labor sharing arrangements and coordination of activities among farmers to implement some pest management techniques. Finally, I will identify non-pest problems that farmers may consider as being more serious constraints to farming than crop pests. Non-pest problems are important to consider because farmers are unlikely to adopt new farming practices that do not directly meet their needs.

RESEARCH SETTING

Denbigh Kraal is located on the southern coastal plain of Jamaica, approximately 45 miles west of Kingston, the capital of Jamaica, and 1 mile west of May Pen, the capital of Clarendon. Denbigh Kraal is a residential and agricultural subdivision-style community, established in 1992 when the Aluminum Company of

America (ALCOA) began relocating residents from the hilltop community of Mocho (about 20 miles away) to make way for bauxite mining[11]. ALCOA has also provided agricultural land for a small number of farmers from Bowens (about 5 miles away), where ALCOA acquired their land for the construction of a bauxite processing plant.

Denbigh Kraal occupies 372.5 acres of land that formerly served as a large citrus farm. ALCOA purchased the land to provide new homes and farmland for people displaced by bauxite mining operations, and it installed the physical infrastructure, including gravel roads, electricity, cement irrigation canals, fire hydrants, telephone hook-ups, and fences. ALCOA also builds new houses for those residents who had them in Mocho. The first Mocho residents were relocated to Denbigh Kraal in 1992, thus the longest anyone has farmed there is four years (see Table 5-1). However, some people began farming as recently as November 1995. Furthermore, the company is still in the process of building houses and relocating people from Mocho. When complete, there will be 35 houses in the community; however, at this time only 14 houses have been completed and are occupied. ALCOA estimates that approximately 115 of the 372 acres will be used for agricultural purposes once the sub-division is complete.

---

11 See Beckford (1987) for a detailed discussion of the social impacts of bauxite mining in Jamaica.

Table 5-1 Background Information on People Interviewed in Denbigh Kraal

		Number of Individuals (n=22)
Current Residence	Denbigh Kraal	13
	Elsewhere	9
Former Residence	Mocho	10
	Bowens	4
	Elsewhere	8
Occupation	Full-time farmer	6
	Part-time farmer/ part-time other	3
	Full-time other/ part-time farmer	2
	Full-time other	6
	Occupation unknown or unemployed	5
		Number of Households (n=19)
Home/land access	Own land/home	7
	Own land	4
	Rent land/home	3
	Rent land	3
	Laborer	2
Farm type	No farming	3
	Home-consumption only	5
	Home-consumption and local market only	2
	Home-consumption, local and export markets	9
		Number of Farmers* (n=11)
Length of time farming in Denbigh Kraal	Up to 1 year	3
	1.1-2 years	4
	2.1-3 years	3
	3.1-4 years	1

*The term farmers refers only to individuals producing cash crops.

As part of the resettlement agreements, ALCOA plants long-term crops (primarily citrus trees) to replace the ones people had in Mocho, and provides maintenance (primarily weeding and spraying) for several years. ALCOA also provides irrigation water free of charge for two to four years (depending on each individual resettlement agreement). The company purchases the water from the Mid-Clarendon National Irrigation Commission (Mid-Clarendon NIC) and distributes it through the community's irrigation system via two pumps located in the community.

The amount of agricultural land people receive in Denbigh Kraal is based on the amount of arable land they had in Mocho. If a family had three acres in Mocho, but one acre was too steep or rocky for "modern" farming practices (according to ALCOA's standards "modern" means a tractor can be used to prepare the land for cultivation), ALCOA will only provide two acres in Denbigh Kraal. Most plots range in size from 0.5 acres to 5 acres, although one farmer owns 24 acres. Excluding the 24 acre plot, the average size of farm plots in Denbigh Kraal is 2.5 acres. While many of the people living in Denbigh Kraal are originally from Mocho, or had family there, many others residents of Denbigh Kraal are not originally from Mocho (see Table 5-1). Several property owners from Mocho who are living in other parts of Jamaica, or overseas, have rented or sold their homes and/or land in Denbigh Kraal to people who are not originally from Mocho.

Residents of Denbigh Kraal have experienced several changes since they moved to Denbigh Kraal. First, farmers' production practices have changed significantly. Mocho is located in the hills at an elevation of approximately 1500 feet and receives 76-100 inches of rain per year. In contrast, Denbigh Kraal is located on the coastal plains at an elevation of 200 feet and receives less than 50 inches of rain per year (the average rainfall in Jamaica is 75 inches per year). The change from a cool, moist climate in Mocho to a warmer, drier climate in Denbigh Kraal is partly responsible for the switch from an emphasis on tree crops such as coffee, citrus, and cocoa in Mocho, to short-term crops such as callaloo, sweet potatoes, pumpkins, and peanuts in Denbigh Kraal (Beckaroo 1996, personal interview; Burrels 1996, personal interview).

Second, the relocation has led to changes in marketing opportunities which has also contributed to the change in the types of crops farmers grow. Mocho is a more isolated community where distance, steep hills, and poor roads make transportation to markets somewhat difficult. Therefore, people in Mocho primarily produce crops for the local market and home consumption. In Denbigh Kraal, farmers are closer to urban areas and have greater access to export markets, thus they have more opportunity to participate in the production of export crops (primarily vegetable).

Several other changes that have resulted from the relocation include increased opportunities for off-farm income and changes in social ties and community dynamics. For example, all the residents of Denbigh Kraal are not farmers, and not all the farmers in Denbigh Kraal live there. Only two of the individuals interviewed in Denbigh Kraal (representing two different households) farm full-time. The other residents either farm part-time and supplement their incomes with off-farm labor, work full-time and maintain "kitchen" gardens primarily for home consumption, or do not raise any crops at all. The majority of the other individuals (four) who farm full-time (see Table 5-1) live outside the community and "commute" to their farms. The wide range of occupations and the relatively large number of farmers commuting from outside Denbigh Kraal has resulted in a community structure very different from that in Mocho, where the majority of the residents live and farm full-time in their community.

METHODOLOGY

I spent three and a half weeks during January of 1996 conducting field research in Denbigh Kraal. Denbigh Kraal still has a relatively small population (because many of the homes have not been completed yet), and thus I was able to meet and interview all but one farmer in Denbigh Kraal (whom I was unable to locate because he lived outside the community and was rarely in his field during the time of my research). I took the opportunity to interview farmers about both their current and past (in Mocho or other locations) farming practices, pesticide use, marketing opportunities, and non-pest constraints to farming. In addition, I interviewed both farmers and non-farmers about how they obtained land in Denbigh Kraal, non-farm employment opportunities in the area, and their social ties in the community.

Because I was interested in how people's farming practices and social ties have changed since they moved to Denbigh Kraal, I also visited the community of Mocho and interviewed members of four farm households in Mocho. A resident of Denbigh Kraal (whose family still lives in Mocho) invited me to Mocho, primarily to show me the differences in climate, topography, and crops, between Denbigh Kraal and Mocho. While I was in Mocho only one day, I took the opportunity to interview the residents I met about their farming practices, pesticide use, marketing opportunities, and social ties, in an effort to corroborate the information Denbigh Kraal residents were providing about their life in Mocho before they were relocated to Denbigh Kraal.

In addition to speaking with farmers in Denbigh Kraal and Mocho, I also interviewed government officials, extension agents, and others involved with agriculture in Jamaica, as well as officials with ALCOA and the Jamaican Bauxite Institute. I interviewed officials from ALCOA, the Pesticide Control Authority (PCA), the Ministry of Agriculture (MINAG), the Rural Agricultural Development Authority (RADA), the Jamaica Exporters' Association (JEA), the Jamaica Agricultural Society (JAS), the Jamaica Bauxite Institute (JBI), and the Mid-Clarendon National Irrigation Commission (Mid-Clarendon NIC). I also conducted phone interviews with officials from the Jamaica Agricultural Development Foundation (JADF), and the Citrus Growers' Association, and obtained data from the Ministry of Agriculture (MINAG) Data Evaluation Division, Jamaica Environmental Trust, the Planning Institute of Jamaica, and the Statistical Institute of Jamaica.

I used a combination of interviews and observations to gather information. Interviews varied from formal interviews where the respondents were asked a predetermined set of questions (see Appendix A) to less formal conversations on topics such as farming practices in Jamaica and the U.S., Jamaican politics, and winter weather in the U.S. Interviews with farmers centered around the following topics: length of time and experience each person had in farming; types of crops produced and why (both currently and in the past); primary constraints to farming, such as pests, water, cash, and labor; marketing opportunities; use of, and attitudes towards, pesticides; non-chemical pest control techniques; off-farm employment; length of residence in the community; familiarity with neighbors and other farmers; and problems with ALCOA and the relocation process.

Over the course of three and a half weeks I interviewed a total of 22 individuals (nine women and thirteen men) in Denbigh Kraal at least once, and some up to four times. These individuals represent ten households[12] in Denbigh Kraal and nine households in surrounding communities. Three of these households in Denbigh Kraal were involved in cash crop farming, five households were producing vegetable and tree crops for home consumption only, and two households were not involved in farming at all. Nine of the individuals interviewed farmed in Denbigh Kraal but lived in other communities. A total of eleven individuals (representing eleven different

---

12 A household is defined here as the people living under one roof, whether related by kinship ties or not.

households) interviewed were currently, or had been in the last year, involved in cash crop farming for export and/or local markets. Only two of the eleven were producing crops solely for the domestic market. The following discussion will focus primarily on the eleven farmers who are producing cash crops, but where relevant, I will also refer to information from other interviewees in Denbigh Kraal and Mocho.

RESULTS

IPM programs must be location-specific, thus the results of my field work are not intended to represent obstacles to the adoption of IPM throughout Jamaica. To the contrary, this thesis will demonstrate the necessity of identifying non-technical constraints to the adoption of IPM in individual communities, and even on individual farms. However, my intention is also to raise awareness of the many ways that local environmental, social, and economic conditions and external political-economic pressures can create non-technical constraints to the adoption of IPM among small-scale farmers in Jamaica and in other Third World countries.

Use of and Attitudes Towards Pesticides

Pesticide use is widespread in Jamaica. A 1994 study commissioned by the Jamaican Pesticide Control Agency (PCA) found that only five percent of 1000 farmers surveyed do not use pesticides (Stone Team 1994). According to Chung (1994), agricultural workers first introduced synthetic pesticides to Jamaican farmers during the 1950s and 1960s in hopes of increasing crop yields. Pesticide usage became more widespread in the late 1970s following a government subsidized program to provide pesticides and other inputs to farmers. As Chung (1994) asserts, this produced a generation of policymakers, agricultural scientists, teachers, extension agents, and farmers committed to the use of pesticides. As a result, he argues, many farmers went from using multiple pest management strategies before the 1950s, to almost total reliance on pesticides today. An official from the Pesticide Control Authority (PCA) supported the view that pesticide use has become the "traditional" method of pest control among Jamaican farmers because growers believe pesticides are the only way to control crop pests (Gayle 1996, personal interview).

Pesticide use is widespread in Denbigh Kraal as well. The eleven farmers producing cash crops (for domestic or export markets) all reported using pesticides as their primary or only means of pest control. The farmers reported that they apply pesticides to almost every crop grown in Denbigh Kraal, with the exception of sweet potatoes (see Table 5-2). Farmers reported that they do not apply pesticides to sweet potato because they do not know of any that control the sweet potato weevil, the primary sweet potato pest in Denbigh Kraal. Three of the five households producing crops for home consumption also reported using pesticides, either themselves or by

Table 5-2 Crops Grown and Pesticides Used in Denbigh Kraal

Crop	Number (n) individuals reported growing crop within past year	Number (n) individuals that applied at least one pesticide on the crop
Pumpkin	8	8
Callaloo	3	3
Sweet Potato	3	0
Tomato	3	3
Peanut	2	2
Corn	2	2
Peppers	1	0
Okra	3	3

n=11

having ALCOA spray their tree crops periodically. In addition, the four farmers interviewed in Mocho reported that they use pesticides on some, or all, of their crops and that pesticides are necessary to control crop pests.

Of the 11 farmers who are producing crops for domestic or export markets, seven apply pesticides themselves and four hire someone to spray. Of the farmers who hire labor for spraying, their reasons for hiring labor include, lack of equipment (namely the backpack container that holds the spray), dislike for application of pesticides, off-farm full-time employment, and pesticide-related illness.

Although some studies have found that women are reluctant to use pesticides (e.g., Momsen 1986, Grossman 1992b), this does not appear to be the case in Denbigh Kraal. All four female farmers spray their crops themselves, and one man told me that his wife sprays his crops for him "because she knows garden good." All of the female farmers were the primary farmers in their households. Two of these women were married, but their husbands had non-farm jobs, and the other women were single heads of their households. None of the women indicated any hesitation about using pesticides, such as a desire to hire labor for this task if funds were available. However, one woman reported that she uses herbicides rather than hiring laborers to weed because herbicides are less expensive than paying for labor. An older woman from Mocho (who had to stop farming when she moved to Denbigh Kraal because of ill health and poor eye sight) reported that she was always the one who applied pesticides in her household, although she and her husband farmed together. And another woman who is still farming in Mocho shares the pesticide application duties with her husband. Thus, it does not appear that women are reluctant to apply pesticides, either in Denbigh Kraal or Mocho.

All eleven farmers reported that they obtained their pesticides at farm stores in May Pen, the closest urban center. Two women reported that they had also obtained pesticides from nearby tobacco growers in the past, but, that this source no longer exists. While a wide variety of agrochemicals are, or have been, used in

Denbigh Kraal, including Basudin, Bravo, Champion, Decis, Diatine, Diazine, Gramoxone, Kocide, Malathion, Paraquat, Radomil, Sevin, Selecron, and Tydin, most farmers were vague about the types of pesticides they use and on which crops they apply them. Some farmers listed several specific pesticides they have tried on a particular crop, while others either did not know the names of the pesticides they used (or could not remember), or, they hired someone to spray and did not know which sprays were used (see Table 5-3). Many farmers said they experiment with different pesticides and use whatever seems to work, and thus they were reluctant to specify a particular pesticide (s). In addition, some farmers said they used the same pesticide on all their crops, while others said some pesticides could not be used on certain crops.

Table 5-3 Awareness of Pesticides Used

Awareness of Pesticides Used	Number (n)of indiviudals
Farmers who reported using specific pesticides	4
Farmers who hired someone to spray and did not know what pesticide are used	3
Farmers who could not name the pesticides they used	4

n=11

Table 5-4 Source of Initial Knowledge About Pesticides

Table 5-4 Source of Initial Knowledge About Pesticides

Source	Number (n) of individuals
Growing up on a farm (parent/ experience)	6
Advice from other farmers and/or own experiments	3
Formal training (school or extension agent)	2

n=11

Despite the widespread use of pesticides in Denbigh Kraal, farmers' experiences with pesticides vary a great deal (see Table 5-4). Farmers in Denbigh Kraal who had previously farmed in Mocho said they learned to use pesticides from their parents, who used pesticides on citrus and coffee trees. An extension agent for the Citrus Grower's Association (a national organization) who provides technical assistance to citrus farmers in Mocho, such as planting, spraying, harvesting, and marketing, believes that most people in Mocho already knew how to use sprays before they got involved with citrus because they had experience using them on livestock and on coffee (Donaldson 1996, personal interview). An elderly woman who used to farm when she lived in Mocho said that "someone in agriculture" (an agent for the citrus or coffee growers' association) used to visit farms in Mocho and show people how to apply agrochemicals. Another woman responded that she had learned to use pesticides from "her parents and everyone" in Mocho because everyone used them. A male farmer stated that he had learned to use pesticides from his parents in Mocho when they sprayed their coffee trees.

Farmers who had not grown up in farm households and who have just recently started farming said they had learned through experimentation on their own or from advice from other farmers. For example, two female farmers who had not used pesticides before they began farming in Denbigh Kraal (one because she had never farmed before and the other because her family had not used pesticides on their farm in Westmoreland, a parish in the western part of Jamaica) learned by asking other farmers in Denbigh Kraal which pesticides to use, where to get them, and how to apply them. Only two farmers had formal training in the use of pesticides (one from an agricultural school and the other as an employee at a pest control company). One individual who was producing crops for the first time (rather than working as a hired laborer) said he learned to use pesticides as a farm laborer "because you have to use them." In other words, he learned how to use pesticides because they were considered an integral part of the production process.

Almost all the farmers (ten out of eleven) view pesticides as an essential component of farming necessary to control crop pests. Only one farmer in Denbigh Kraal reported that he also uses cultural practices such as sprinkling ashes around his tomato plants and planting crops at certain times of the month. This farmer stated that his primary methods of controlling crops pests are spraying (pesticides) and the timing of planting. He asserted that "you can't plant when there is moonshine because worms eat the crops that way. Wait until dark night to plant."[13] However, he hires someone to spray his cash crops on a regular basis, and he stated that "if you don't spray, you don't get much crop."

Although he was the only farmer who acknowledged that he uses any cultural controls, and despite farmers' claims that pesticides are the only way to control crop pests, I did observe some other farmers carrying out non-chemical pest control practices. One farmer was clearing his fields of callaloo plants which had been destroyed by insects. He was concerned that if he left the plants in the field, the insects would spread to his other crops. Another farmer mentioned that she plants sweet potatoes at a certain time of year in an effort to avoid problems with the sweet potato weevil. However, neither of these farmers had reported these activities as pest control methods because they viewed these non-chemical practices as a last resort, and used them only when a pesticide did not work or was not available.

While farmers generally expressed the belief that pesticides were necessary to control pests, some recognized that they cannot be used on certain crops. One female farmer said that she could not use herbicides on her peanut crops because chemicals would "burn" the plant. However, she later revealed that she had treated the peanut

---

13 This practice, known as "Planting by the moon," is widely used in the Caribbean. Farmers plant at certain times during the lunar cycle because it is thought to help assure rainfall at the appropriate stage in the plant life and to control pests.

seeds in pesticide (by rubbing them in a powder, but she did not know the name of the chemical) before planting. Farmers who were growing sweet potatoes reported that there are no pesticides to control the sweet potato weevil, the primary sweet potato pest in Denbigh Kraal. Because there are no known pesticides for the sweet potato weevil, the sweet potato farmers were interested in learning about and using IPM practices that might help them control this pest; for example, one sweet potato farmer was eager to participate in the IPM CRSP project because he had heard about traps that might be used to control the sweet potato weevil.

Pressures to increase the use of pesticides

A number of farmers reported that their pesticide use has increased since they were relocated from Mocho (or moved from another location) to Denbigh Kraal. I found that both external and local factors have contributed to an actual or perceived need to increase the use of pesticides.

First, there is a perception among many farmers in Denbigh Kraal that pest problems are worse than they were in Mocho. While farmers reported that they had used pesticides in Mocho to control crop pests, they believe that more pesticides are required in Denbigh Kraal in order to control a greater number and variety of crop pests. For example, several farmers mentioned that it is harder to control the Whitefly on the tomato in Denbigh Kraal than in Mocho. One farmer spent "thousands of dollars" (Jamaican) on tomatoes but only made J$600 because of insect damage, despite using large amounts of pesticides. As a result, he no longer plants tomatoes in Denbigh Kraal, although he continues to produce tomatoes on land he still owns in Mocho. Another farmer reported that it is more difficult to control weeds in Denbigh Kraal than in Mocho. Her assessment is based on the fact that in Mocho she only had to weed once during a pumpkin crop, but in Denbigh Kraal she has to weed two to three times per crop. She believes this is because the land is "fat," or more fertile than the land in Mocho, because it has not been used for farming in a long time.

In addition, farmers relocated from Bowens, as well as farmers from other parishes in Jamaica, such as St. Thomas in the east and Westmoreland in the west, reported that pest problems seem to be more severe in Denbigh Kraal. One woman reported that her family never used sprays in Westmoreland. A farmer from Bowens said that the pests are different in Denbigh Kraal, and as a result he has to spray more. A farmer originally from St. Thomas believes that pest problems are not as serious in St. Thomas because people there plant mostly carrots, red peas, cabbage, and okra - crops that do not have as many insect problems as those grown in Denbigh Kraal. As a result he said, people in St. Thomas do not use as many pesticides as people in Denbigh Kraal do.

An extension agent and an agricultural official explained that farmers' perception of pest problems as more severe in Denbigh Kraal are based on two primary factors. First, the change from a relatively cool, moist climate in Mocho to a warmer, drier climate in Denbigh Kraal, has forced farmers to switch from an emphasis on long-term tree crops (primarily citrus, but also coffee and cocoa) to short-term vegetable crops such as callaloo, pumpkins, sweet potatoes and peanuts. According to the Rural Agricultural Development Authority (RADA) extension agent for Clarendon, the change to short-term vegetable crops has "undoubtedly" led to an increase in pesticide use because vegetables "require more pesticides" (Beckaroo 1996, personal interview). The Clarendon representative of the Jamaican Agricultural Society (JAS) echoed the same view (Burrels 1996, personal interview).

Second, the relocation of farmers from Mocho to Denbigh Kraal has led to a significant change in marketing opportunities. Farmers in Mocho sold their produce once a week at the local market in May Pen. Either a female household member took the produce to market, or the farmer sold the produce to a higgler who transported the goods to the market. However, the closer proximity of Denbigh Kraal to the Kingston metropolitan area and the export businesses located there has created the opportunity for farmers to become involved in export agriculture. Export buyers from the Kingston area travel to Denbigh Kraal to purchase crops for export, primarily to the U.S., but also to Canada and the U.K. This change in marketing opportunities has contributed to the change in emphasis from long-term crops to short-term vegetable crops.

Third, the increased opportunity to produce export crops has also contributed to the actual or perceived need to increase the use of pesticides to prevent pestinduced blemishes on crops. Several farmers who regularly sell produce to exporters stated that they have to use more pesticides in order to produce export quality commodities, or risk having their crops rejected. During one observed transaction between an export buyer and a farmer, the export buyers went into the field and selected each individual vegetable (pumpkins in this case) they wanted, and then the farmer harvested only those selected by the buyer. Even after selecting the pumpkins themselves, the exporters still rejected a few harvested ones that had blemishes on the surface, because, they said, "these are going to the U.S. and have to be proper."

An official with the Jamaican Export Association (JEA), a private organization that promotes Jamaican exports abroad and works to increase production of export goods in Jamaica, confirmed the farmers' perceptions about the higher aesthetic standards for export crops. According to this official, Jamaican farmers have not been accustomed to producing high quality produce. In the past, farmers produced crops primarily for home consumption and then sold whatever was left on the local market, and thus they were not particularly concerned about the quality of their produce. However, since high quality products are now being emphasized by export buyers, farmers are feeling more pressure to produce unblemished products. He reported that the consolidators (the packhouses in Kingston where orders for vegetable produce from overseas are filled and prepared for shipment) demand high quality produce from the buyers (the "middlemen" who go to farmers and purchase their crops) and may refuse to pay the buyer if he[14] brings products of a lesser quality than originally specified. The buyers pass the demand for high quality products on to the farmers by refusing to buy products below a certain quality or by paying lower prices for them. Farmers are able to sell more crops and receive a better price for high quality products, and thus they have an incentive to use pesticides.

Whether or not pesticide use has *actually* increased since relocation is beyond the scope of this thesis. However, what did become clear during my interviews is that farmers *perceive* pest problems to be more severe, both because local climate conditions and specific crop types seem to be encouraging more pests, and because their increased involvement in the production of export crops has created pressure to produce high quality, unblemished products.

Beliefs and attitudes regarding the safety and effectiveness of pesticides

Despite the general view that pesticides are essential for farming in Denbigh Kraal, there are a variety of beliefs and attitudes regarding the safety and effectiveness of pesticides among the farmers. I found variations in attitudes regarding the safety of pesticides, whether or not the farmer knows appropriate safety measures, the frequency with which they should be applied, and whether or not

14 In contrast to the domestic market, where women act as the "middlemen" between farmers and the market, the export "buyers" are men who travel from Kingston to surrounding areas in private cars or trucks, often equipped with cellular phones so they can constantly monitor prices and demand from the consolidators back in Kingston.

pesticides are effective in controlling crop pests.

Of the 11 farmers, only one reported that he had become ill as a result of applying pesticides. He now hires someone to spray for him in order to avoid health problems. An elderly woman who used to farm in Mocho asserted that pesticides were not dangerous, although sometimes she had an allergic reaction. But she said "You never know what that is from." No other farmers reported pesticide-related health problems.

Knowledge of safety precautions and farmers' use of them varied. Most farmers acknowledged that a person should wear long sleeve shirts and pants when spraying, boots, and something over the mouth (either a mask or a handkerchief)[15]. One also said that a person should try to spray when it is not windy, but, if it is windy, a person should spray with the wind so that the pesticide is not blown back towards the farmers. Another grower stated that a person should not spray when it is windy because the spray will blow away and therefore be wasted. This same farmer (who also had reported becoming ill from sprays) said "we all know if you use it [spray] without breakfast it can kill you." He believes that a person must always eat something before spraying and wash well afterwards in order to avoid becoming ill.

Other people appeared less cautious, however. I observed a worker hired by ALCOA to spray residents' citrus trees spraying on a very windy day right next to a

---

15 Very few people were spraying during my field research, thus I was not able to confirm whether or not they actually followed the recommended guidelines.

home where children were playing in the yard. A woman, who had never used pesticides before, applied a powdered pesticide to her peanut seedlings by hand before planting them. She did not know what pesticide this was, or what the safety precautions were, because the person who owned the land she was renting selected it for her. Nonetheless, she said neither she nor her hired workers had any side effects from this pesticide.

The RADA extension agent for Clarendon stated that RADA provides training on safe and effective use of pesticides to farmers. RADA encourages farmers not to use any one chemical for very long and to use the minimum amount suggested. In addition, RADA tries to discourage farmers from spraying on a set schedule in order to avoid build-up of insect resistance. However, most farmers with whom I spoke reported that they spray on a set (calendar) schedule. Nine of the eleven farmers growing crops for export or local markets reported that they spray crops at particular intervals (e.g., every four days, every eight days, etc.). Farmers determine the appropriate interval based on the chemical being used. Those growing callaloo reported spraying every three days because the spray for callaloo is supposed to be effective for only three days. Farmers growing pumpkins reported spraying every eight days. One stated that he sprays his callaloo every three days, unless he uses a stronger one which lasts longer. A female farmer explained that a seven day chemical is absorbed into the leaf and lasts longer. As a result, she cannot use these on callaloo because she reaps twice a week and the residues would still be on the plant. Pesticide residues concerned her because an extension agent had told her that some pesticides cause abortion in laboratory animals, and therefore they may be dangerous to humans as well. She also stated that she is careful to avoid using too much or too little spray because otherwise the pests may become resistant (so she is careful to read the directions). Another woman, who had farmed in Mocho, but does not farm in Denbigh Kraal due to advancing age and illness, reported that she used to spray her tomatoes 10-15 days before harvesting.

Only two of the eleven farmers reported that they scout for pests before spraying in order to determine whether it is necessary or not[16]. One of those farmers said that he checks for insects before spraying and that he usually has to spray his corn twice a month. He says that if he sees an insect "no fool around" - he has to spray right away. He uses the same chemical to spray all his crops because "you have to spray everything right through." Other farmers said that they could not wait to see an insect or it would be too late, and thus they sprayed at specified intervals in order to prevent any insects from entering their fields.

Several farmers mentioned serious pest problems on callaloo, a leafy green vegetable, that they were unable to control with pesticides. One farmer who had been farming in Denbigh Kraal for three years (but had not been growing callaloo the entire time) reported that she could not find any pesticide effective on the callaloo

---

16 Unfortunately I failed to ask whether either of these farmers distinguished one type of pest from another. In other words, whether there are "good" insects and "bad" ones.

pest. Another person who had been farming in Denbigh Kraal for three years, reported that despite using pesticides on callaloo, the pests "swarm the place." A third lost his entire first crop of callaloo to insects. Despite these problems, two of the three farmers planned to plant callaloo again (the third had temporarily stopped farming to return to school, but emphasized that she did not "give up" farming just because of pest problems). One of these farmers also planned to grow sweet peppers again even though he had lost most of his previous crop to pests.

Other farmers, however, realized that some crops are not worth growing because they require too much pesticides or because no amount of pesticide would protect that particular crop. One farmer does not grow callaloo because the pest problems are so severe that the pesticides would be too expensive. The farmer who had given up growing tomatoes had also given up on growing tobacco on his land in Bowens because the sprays were too expensive and he still had problems with pests. He also reported using pesticides on his pumpkins but still having problems with worms. Several people in the community were aware of this farmer's problems with pests. They reported that he "sprays all the time but still has insects."

Loss of social ties

During the participatory appraisal in Denbigh Kraal, several residents complained about the loss of social ties they had experienced as a result of the ALCOA resettlement scheme. Many had to leave friends and family, whose land

ALCOA did not want for bauxite mining, behind in Mocho. At the same time, many people, especially the younger ones, reported that they like living in Denbigh Kraal because they are closer to stores, doctors and off-farm job opportunities, and because they have electricity and telephone services, which are not available in Mocho. Nonetheless, everyone who had been relocated from Mocho to Denbigh Kraal said that there is very little feeling of community in Denbigh Kraal. Many said they do not know their neighbors, whereas in Mocho, "everyone knew everyone." An elderly woman, who was sad to leave Mocho because her friends and church are there, said that people there had always helped each other out with advice about crops, shared food with each other, and provided support during illnesses and deaths[17].

New social ties have been slow to form, in part, because Denbigh Kraal has a more heterogeneous population than Mocho. Not everyone farms as people did in Mocho, and not all the farmers live in Denbigh Kraal. For example, seven of the eleven cash crop farmers live outside Denbigh Kraal and "commute" to work (see Table 5-1). One man said that Mocho is a much more close-knit community than Denbigh Kraal and that Denbigh Kraal needs a church, school, and a bar where people can get to know each other. Others believe the lack of community atmosphere is due to the fact that the sub-division is not "full" yet and believe things will improve once everyone moves in.

17 In the Caribbean, people in rural areas often share food with friends and family in time of need or to reinforce social ties (Thomasson 1994).

Non-pest Constraints to Farming

Market insecurity

Farmers in Denbigh Kraal cited insecure markets as a serious constraint to farming. According to the Director of the RADA office in May Pen, farmers in the area use the "open" market to decide what and when to plant. The RADA official stated that farmers know from experience what crops sell best during each particular time of year. For example, the dry period brings higher prices because of scarcity. In Denbigh Kraal, most of the farmers reported that they decide what crops to grow based on the price. However, several complained that after they have planted a crop, the price often drops and they are not able to sell it for the price for which they had hoped. One farmer even reported that he has had to leave crops in the ground because the price had dropped so much that it would cost him more to hire labor to harvest the crop than he would obtain for it.

In the past, in Mocho and in Jamaica generally, farmers produced traditional crops for an "assured" market such as the Citrus Grower's Association or the Coffee Grower's Association (Reid 1996, personal interview; Donaldson 1996, telephone interview). In other words, farmers had more of a guarantee that they could sell certain amounts of their crops. In Mocho, farmers produced citrus primarily for one large citrus company which would send its trucks to Mocho each week to purchase citrus from the farmers. In other parts of Jamaica, farmers were assured of certain prices or quantities under the British system of quotas which guaranteed the purchase of a certain amount of Jamaican produce (bananas, sugar...). However, the supply and demand for non-traditionals is more market-driven, and thus producers of NTAEs are subject to greater fluctuations in demand and prices than are the growers of traditional crops (Reid 1996, personal interview).

Furthermore, according to the official from the JEA and several of the farmers in Denbigh Kraal, farmers generally receive better prices for vegetable crops on the local market than they do from exporters. However, most of the food produced in Jamaica is sold fresh, and the population size limits demand; thus farmers have to be careful not to flood the domestic market and drive prices down. Many farmers in Denbigh Kraal reported that they have experienced problems with low prices when the local market is flooded with too much of certain types of produce (particularly tomatoes). As one farmer put it, if everyone plants the same thing "there is no price." As a result, farmers are forced to produce at least some crops for the export market, where they can usually sell a greater quantity, even if at a lower price. However, even with NTAE crops, farmers sometimes have problems with low demand and lower than expected prices. According to the director of the RADA office in May Pen, when there is an overabundance of a particular crop, the farmers themselves have to search for buyers, rather than having an exporter come to their farm to purchase it.

Labor

Another potential non-technical constraint to the adoption of IPM in Denbigh Kraal is labor availability. Five of the eleven cash crop farmers hire one or more individuals to help them, or in some cases, perform most of the labor. For example, one man works full-time and hires people to do most of his farm work, while another man is too old to very much work himself, and thus he primarily supervises his laborers. This man complained that it is hard to get people to work, and those he does hire demand too much money and do not perform good work. He also complained that his workers come and go frequently. He says some workers stay a week, some more, some less.

The costs of hiring labor must also be considered. Because IPM practices are often labor-intensive, adoption of IPM may require farmers to hire more labor. Farm laborers earn $J200 to $J250 ($US5 to $US6 per day). This is a large expense for farmers who only manage one or two acres of land and several farmers reported that they cannot afford to hire labor because it is too expensive. One woman reported that she uses herbicides to weed because it is less expensive than hiring labor.

Water

Perhaps the most serious obstacle to farming in Denbigh Kraal is a shortage of water for irrigation purposes. Several farmers reported that the water shortage is their most serious problem. The most frequently mentioned problems related to water shortages were the loss of crops due to inadequate water supplies and the inability to plant crops at particular times because of a lack of water.

While the high cost of water limits the amount of water farmers are able to buy and thus hinders crop production in several of the research communities in Clarendon and St. Catherine, high water costs are not a problem in Denbigh Kraal. ALCOA currently pays for irrigation water as part of the resettlement agreements and provides it free of charge to resettled farmers. However, farmers complained that the amount of water supplied by ALCOA is inadequate and that the pumps are often broken. One complained that ALCOA does not purchase sufficient water supplies from the Mid-Clarendon NIC. He claimed that he needs more water for his farm (24 acres) than ALCOA purchases for the entire community of Denbigh Kraal. This farmer has lost several crops due to lack of water. One of his farm workers, interviewed separately, reported that his boss had recently lost $44,000 Jamaican (approximately $1,100 U.S.) on a pumpkin crop for lack of water. The lack of water also influences the crops this farmer grows. For example, he plants a great deal of cassava because it requires less water than some other crops, such as sweet potato, one of the IPM CRSP research crops. The shortage of water is so severe that he regards this as a much more serious problem than pests. Two other farmers blamed crop losses directly on water shortages, and several other farmers also reported insufficient water supplies.

In addition to the inadequate amount of water supplied by ALCOA, several people complained that farmers closer to the water supply (pump source) divert so much water from the canal to their fields that very little, if any, water remains in the canal once it reaches their properties. One couple said that if two farmers "upstream" are withdrawing water at the same time, they have to wait until those farmers are finished in order to obtain water for their crops. Another woman claimed that people closer to the water source "steal" the water supply. Part of the problem is that there are no regulations as to how much an individual may withdraw from the canal at any given time. The canal system is gravity powered and therefore farmers can easily divert as much water to their fields as they want to. An official with the Mid-Clarendon NIC explained that the canal system is very inefficient and water is wasted through evaporation or in the process of diverting water to farmers' fields (Perkins 1996, personal interview). According to this official, a drip or pressurized irrigation system would have been much more efficient than the canal system.

A few farmers (those closest to the water supply source) reported that the water supply is usually sufficient. However, during the time of my field research, one of the two pumps in the community had been out of order for two months and several farmers were experiencing water shortages. One farmer had not been able to plant anything during this time period. He had not even hired a tractor to prepare his land because he was waiting for water to become available before investing in land preparation. He stated that this is a recurring problem and that water shortages have prevented him from planting several times in the past three years. Another farmer was worried about losing his current crop of sweet potatoes if water did not become available soon.

The lack of water directly affects some farmers' pest control decisions. Two farmers mentioned that they cannot use pesticides when there is no water because the chemicals must be mixed (diluted) with water before spraying. Another farmer stated that the only way to control the sweet potato weevil (one of the pests the IPM CRSP project is focusing on) is by keeping the soil moist. However, he is unable to do this when there is no water. A fourth farmer does not hire people to spray when there is an inadequate supply of water because he does not want to invest money in pest control when he risks losing the crop because of a water shortage.

Although ALCOA currently pays for irrigation water in Denbigh Kraal and farmers are not concerned with the expense, the cost of water is rising rapidly and will most likely become a problem for farmers when ALCOA ceases to supply free water in the near future. The official from the Mid-Clarendon NIC explained that water costs for farmers using irrigation in Jamaica have risen dramatically because water subsidies from the government have been completely phased out over the last four years (from a 96 percent subsidy in 1991 to zero percent in September 1995). The cost of water is high because the Mid-Clarendon NIC now must assume all the costs of supplying water, including provision of infrastructure, maintenance, salaries, and pumping costs (which have increased dramatically due to increases in electricity prices).

Farmers in Denbigh Kraal view the shortage of water, high cost of labor, and insecure markets as serious constraints to farming. While these problems may not appear to be directly related to the IPM CRSP project in Jamaica, their existence could prevent farmers' interest in IPM, particularly if they view these problems as more serious than any pest problems that they might have. Chapter Six will examine the implications of these non-pest constraints to farming, as well as the other non-technical constraints to the adoption of IPM presented in this chapter, for the success of the IPM CRSP project in Denbigh Kraal.

Chapter Six

Implications of the Non-technical Constraints to the Adoption of IPM in Denbigh Kraal

A wide range of factors influence farming practices and pest control decisions among farmers in Denbigh Kraal. A number of these create potential non-technical constraints to the adoption of IPM, and thus have important implications for the IPM CRSP project. First, the prevailing attitude that pesticides are an essential component of farming in Denbigh Kraal, particularly in the production of export crops, is a significant obstacle that IPM CRSP researchers will have to overcome. As discussed in Chapter Three, once pesticide use has become ingrained in farmers as the only way to control crop pests, many are reluctant to "regress" to non-chemical pest management practices. Furthermore, farmers are familiar with pesticides, their applications, and perhaps most importantly, their immediate results. IPM, on the other hand, is unfamiliar, and thus poses a risk that many farmers may not be willing to take. As a result, any efforts to introduce IPM practices in Denbigh Kraal will have to overcome farmers' reliance on, and trust in, pesticides.

The most promising opportunity to demonstrate the benefits of IPM and convince farmers of the feasibility of controlling crop pests without pesticides (or with reduced pesticides in Denbigh Kraal) is through the introduction of IPM practices to control the sweet potato weevil. As discussed in Chapter Five, farmers in Denbigh

Kraal do not know of any pesticides that can control the sweet potato weevil, and thus farmers are already interested in learning about IPM practices for this crop. The IPM CRSP researchers are in the process of developing and testing IPM practices for sweet potatoes, such as traps and improved planting and harvesting practices, in Denbigh Kraal and the other Clarendon research communities. However, an immediate problem in Denbigh Kraal is that farmers are becoming discouraged with growing sweet potatoes because of the lack of water to keep the ground wet, the only method they know of to help control the sweet potato weevil. Thus, it is important that the IPM CRSP researchers work with the farmers to help them obtain sufficient water, as they continue to develop, test, and introduce new practices to control the sweet potato weevil. Otherwise, farmers may become so discouraged with the lack of water and their ability to control the sweet potato weevil, that they will cease to grow sweet potatoes and switch to another, perhaps more pesticide-intensive crop.

The recognition among some farmers that pesticides are not always successful in controlling crop pests provides another opportunity to demonstrate the benefits of IPM. Farmers who have begun to realize that pesticides cannot eradicate, or even control, some crop pests, may be more receptive to the introduction of IPM practices. In the case of callaloo in Denbigh Kraal, all three farmers who had grown callaloo in the past year had experienced a great deal of difficulty with pests, despite their best efforts to control them with pesticides. Callaloo farmers may be more receptive to IPM than other farmers who have not had problems with pesticide-resistant insects.

However, the question is, will farmers who have become discouraged (and perhaps given up growing certain crops) due to pest problems or who react to serious pest problems with higher and more frequent doses of pesticides be willing to try IPM? Some of these farmers may have already decided certain crops are impossible to grow, with or without pesticides. Others who have used pesticides and are willing to try again may refuse to believe that *not* using pesticides could possibly succeed if pesticides have already failed. The solution may be that farmers will have to actually see effective IPM techniques put into practice before they will attempt IPM practices on their own crops.

Another significant obstacle for the IPM CRSP project is that most farmers in Denbigh Kraal believe that it is necessary to spray their crops on a calendar schedule, before they even sight insects in their fields. Because IPM involves the recognition that a certain level of pests are acceptable, and that some insects are even "good," IPM CRSP researchers will have to make a concerted effort to convince farmers of the merits of scouting for insects and evaluating their potential danger before spraying.

While not directly related to farming or pesticide use, the lack of a strong community spirit in Denbigh Kraal is a potential obstacle to the success of the IPM CRSP project. The lack of social ties, and the (relatively) large number of people who commute from other places to farm in Denbigh Kraal may make it difficult to organize farmers to work cooperatively to implement IPM, or make it difficult for farmers to share information. Some IPM practices that involve synchronization of planting schedules or maintaining field sanitation practices require farmers to at least meet to discuss and coordinate their pest control strategies. However, farmers who live outside Denbigh Kraal or who are part-time farmers may only come to their fields a couple of times a week. Thus, they are difficult to locate, let alone organize to work together or coordinate their efforts. For example, one farmer who works full-time for ALCOA and hires people to do most of his field work is very rarely in his fields, and thus both myself and the IPM CRSP researchers had a great deal of difficulty in locating him. Furthermore, one of the goals of the IPM CRSP project in Jamaica is to work through existing community institutions to implement IPM. However, in the case of Denbigh Kraal, where very few social ties exist at this time and a number of farmers come from outside the community, efforts to organize growers and introduce them to IPM and provide the necessary education and extension services may have to take another approach.

The problem of market insecurity has two important implications for the IPM CRSP project. First, farmers appear to be more concerned about the lack of strong markets for their produce than they are about pest problems. Farmers may be more interested in receiving assistance in marketing than in IPM, and thus the IPM CRSP project may need to address marketing issues, or at least farmers' concerns about marketing, in conjunction with efforts to implement IPM. For example, NTAEs in Jamaica are currently marketed through consolidators who employ agents to travel out to farms and fill orders for particular export crops. One of the main problems with this system is that the buyers, acting as middlemen between consolidators and farmers, often give farmers a lower price than the consolidators have agreed to pay, thereby making a profit for themselves (Reid 1996, personal interview). The Jamaican Exporter's Association is trying to address this problem by improving communications between the consolidators and small-scale farmers so that farmers have a better idea of the actual value of their crops. The IPM CRSP project should seek ways to assist in this effort, which, in turn, may increase the likelihood of farmers adopting IPM when they learn that their efforts to produce export quality crops will be more highly rewarded.

A second problem with market insecurity is that designing and implementing IPM practices among farmers who are constantly changing crops in search of the best price will be difficult. As discussed in Chapter Three, IPM practices are often crop and pest specific, thus farmers who change crops frequently would have to learn a greater number of IPM techniques, or approaches, for the control of each particular crop pest. The IPM CRSP project is focusing on three specific crops, yet over the course of the project farmers may switch crops several times. This could mean IPM CRSP researchers would have to keep switching farms in search of farmers who are growing the crops they are interested in or they may have to expand the number of crops that they are including in the project. Each alternative interferes with the goal of working with farmers to develop IPM practices for particular crops and then sharing those practices with other farmers.

Another non-pest constraint to farming in Denbigh Kraal, the limited availability and high cost of labor, is important for IPM CRSP researchers to consider because IPM practices are generally more labor intensive and more complex than pesticide applications. Half of the Denbigh Kraal farmers already hire laborers to assist with planting, weeding, harvesting, and, in some cases, spraying. Thus, these farmers may be unwilling or unable to invest their own time or money in additional labor. As Grossman (1992b: 184) argues, "Programs designed to reduce pesticide use that require significant increases in labor inputs into farming will likely meet resistance from farmers, unless the financial rewards are also appealing." For example, at least one farmer in Denbigh Kraal acknowledged that she relies on herbicides to control weeds because she cannot afford to hire labor and cannot keep up with manual weeding herself. Thus, it is unlikely that she, or other farmers who cannot afford to hire labor, would be able to devote additional time or money to IPM practices. A similar problem was evident at a farm day sponsored by CARDI, for farmers from the Clarendon IPM CRSP research communities. During a discussion of methods to control the sweet potato weevil, one farmer suggested that, in addition to keeping the soil wet, being careful to plant "slips" (the portion of old sweet potatoes that are planted for the next crop) without sweet potato weevil eggs in them is important. However, a number of farmers expressed concern that they would have to hire labor to collect the slips because they do not have the time to do it themselves or they do not have time to check to see whether the slips are "clean." Thus, although the procedure may seem like a simple solution to the problem of the sweet potato weevil, labor constraints may prevent farmers from acting on the suggestion.

Another potential problem with labor is that because so many farmers rely on hired laborers that come and go on a weekly or even daily basis, farmers will either have to be well educated in IPM so that they can instruct their employees to carry out IPM practices or the IPM CRSP researchers may have to include laborers in IPM education. Farmers at the field day in Clarendon were concerned that hired laborers would not be careful to collect clean slips, and thus they would have to spend extra time monitoring hired laborers as to whether they had collected clean slips or not.

Despite problems with market insecurity and labor supplies and costs, the most significant non-pest constraint to farming in Denbigh Kraal at the time of my field research was the lack of water for irrigation. The inadequate water supply in Denbigh Kraal affects farmers' production practices in general, and pesticide use in particular. Farmers' abilities and decisions about whether to apply pesticides are affected by water availability, and in the case of sweet potatoes, the lack of water reduces farmers' ability to control pests without chemicals. IPM CRSP researchers must be aware of farmers' concerns regarding the inadequate water supply and realize that the constraints imposed by the shortage of water (and the potentially high costs of water in the future) may supersede farmers concerns for pest problems. For example, one farmer reported that fewer people are farming now than did in the previous year because of frustration over the shortage of water. If people are being forced out of farming because of a lack of water, this problem must be addressed before, or in conjunction with, the introduction of IPM.

The existence of several non-pest constraints to farming in Denbigh Kraal is particularly troublesome for the IPM CRSP project. While farmers complained about pest problems, most farmers still feel they can deal with pests using pesticides. Farmers expressed greater frustration over the problems of water shortages and market insecurity, and most seemed to feel that these problems pose more significant constraints to farming in Denbigh Kraal than pests. This should be a concern to IPM CRSP researchers because farmers will not be interested in adopting new farming practices that do not directly meet their needs. According to Kiss and Meerman (1991: 15):

> Pest control is relevant only if it can be shown that losses to pests represent an important production constraint relative to other factors such as crop varieties, seed quality, soil preparation and fertility, water availability, etc.

In the case of Denbigh Kraal, where farmers sometimes lose entire crops for lack of water or have to leave crops in the ground because the market price is too low to hire labor to harvest, pest problems often are not the highest priority.

This raises the question of whether the IPM CRSP project, in the context of NTAEs as an economic development strategy, is meeting the needs of small-scale farmers. In other words, are pest problems a primary constraint to the participation of small-scale farmers in the production of NTAEs? In the case of Jamaica, government officials and U.S. AID development planners identified excessive use of pesticides in the production of NTAEs as an economic problem (i.e., the threat of Jamaican produce being rejected by importing countries) as well as a danger to the environment and human health. In response, government officials and development practitioners designated the design and implementation of IPM practices, through the IPM CRSP project, as the solution to the economic, environmental, and human health problems associated with excessive pesticide use.

In Denbigh Kraal, however, the IPM CRSP project may be too narrow in scope. While the IPM CRSP project is technically a research project rather than a direct social and economic development project, its goal is to improve the production of NTAEs and thereby contribute to economic growth. Thus the IPM CRSP project has the potential to enhance the economic welfare of the farmers involved by improving their production of NTAEs. However, the project may also have a negative effect if it conceals the importance of non-pest problems constraints to the production of NTAEs. As discussed in Chapter Two, sustainable development projects intended to protect the environment and improve the welfare of resource users are usually designed by outside "experts" who may not understand the full range of problems facing the targeted population. In the case of Denbigh Kraal, farmers regard the problems of water shortages and market security as more serious constraints to farming in general and to their production of NTAEs in particular. This is not to say that pesticide use in Jamaica is not an environmental and economic problem that needs to be addressed. According to Wearing (1988), however, in order for IPM programs to be adopted they must be designed and implemented based on farmers' perceived agricultural problems, whether they are pest related or otherwise. An IPM program will do little to reduce the problems associated with pesticide use if farmers do not adopt the new pest control management practices. As a result, Wearing (*ibid.*) believes that the most important element in the implementation of IPM is improving the "fit" of IPM to farmers' social, economic, cultural, technical, organization, and political needs. As he notes:

> [T]he lack of education of IPM developers about the perceptions of farmers is probably a much greater obstacle to the implementation than the reverse, particularly as this can direct the whole research and development process and lead to inappropriate technology (1988: 27).

In the case of IPM and NTAEs in Jamaica, this means that IPM CRSP researchers must address a wide range of constraints to the production of NTAEs, not just pest and pesticide-related farming constraints. The need to consider a wide range of problems as part of the IPM CRSP project is remarkably similar to an approach recommended by Richardson (1972) in Guyana. Referring to a "Green Revolution" development scheme to improve rice production in Guyana in the early 1970s, Richardson argued that a successful development program to improve rice production must include a careful assessment of all aspects of the project, including important ecological, cultural, and economic conditions that affect rice production. Thus, in at least one respect, the IPM approach to farming suffers from a problem characteristic of attempts to encourage farmers to adopt the Green Revolution approach.

Chapter Seven

Conclusion

Political ecology is a holistic approach to the study of changing human-environment relations and it has become an important framework for geographers and other social scientists studying patterns of resource use and environmental degradation around the world. The political ecology approach is important to the field of human geography, which focuses on the relationships between humans and their environments, because it integrates perspectives from cultural ecology and political economy to identify a wide range of environmental, political, economic, and social factors that influence human-environment relations. While cultural ecology seeks to understand the interrelationships between people, resources, and space (Butzer 1989), the political economy perspective provides the needed recognition that historical and contemporary regional, national, and international political and economic forces, such as the state and capital, also play an important role in shaping patterns of resource use at the local level. However, although the political ecology approach recognizes the importance of political-economic forces in shaping patterns of resource use at the local level, it also recognizes that responses to external political-economic forces vary from one place to another according to location-specific environmental and social conditions. Thus, the key to political ecology studies is the recognition that local cultural ecological factors and external political-economic forces *interact* to influence and change human-environment relations at the local level, and that these interactions vary from one location to another.

The political ecology approach is particularly useful in the study of non-technical constraints to the adoption of IPM because of the framework it provides for identifying and analyzing the wide range of factors that influence farming practices in general and pesticide use in particular. Initially I intended to focus solely on the implications of the lack of social ties in Denbigh Kraal for the IPM CRSP project because IPM CRSP researchers had identified this as a potential constraint to the adoption of IPM. However, the political ecology approach, with its recognition that a wide range of factors interact to influence resource use decisions, showed that several local and external factors, and their interactions, were as important, if not more important, constraints to the adoption of IPM in Denbigh Kraal than the lack of social ties. In particular, the relevant political-economic forces include international pressure to produce high quality produce (expressed in the form of northern capital and consumers' demands for unblemished produce), international and national pressure to reduce government spending (felt through the elimination of subsidized irrigation), national efforts to increase the production of NTAEs without accompanying improvements in the market system, and the economic and legal pressure from ALCOA to relocate homes and farms from Mocho to Denbigh Kraal. Important local environmental, social, and economic factors include the difference in climate between Mocho and Denbigh Kraal and the different marketing and off-farm labor opportunities available in Denbigh Kraal. While each of these factors either directly, or indirectly affects farmers' willingness and ability to adopt IPM in the production of NTAEs, the effects of the interaction of these factors on farmers' willingness and ability to adopt IPM is even more important.

The recent relocation of residents from Mocho to Denbigh Kraal provided a unique opportunity to learn how local environmental, social, and economic factors interact with external political-economic forces to shape patterns of production and pesticide use. The most direct, and obvious, influence on farmers' production practices and pesticide use is the relocation of people from Mocho to Denbigh Kraal. ALCOA, with the power of a national mining law authorizing the relocation of people to allow access to bauxite reserves, is directly responsible for changes in farmers' environmental, economic, and social conditions.

With their relocation to a warmer, drier climate, farmers have switched from an emphasis on long-term tree crops to short-term vegetable crops. Denbigh Kraal's closer proximity to export markets in Kingston has also contributed to farmers' decisions to change crops. However, the change in crops has led to an actual or perceived need to increase the amount and variety of pesticides farmers use. Both extension agents and farmers believe that vegetable crops have more serious pest problems than do tree crops. At the same time, national and international pressures to produce high quality, unblemished export crops have contributed to the perception that more pesticides are required for farming in Denbigh Kraal than in Mocho.

While changes in local conditions have affected farmers responses to external pressures, individual farmer's attitudes and beliefs regarding the safety and effectiveness of pesticides also affect their responses to both local and external pressures to increase their use of pesticides. While most farmers in Denbigh Kraal believe that pesticides successfully control crop pests and thus are essential for farming, a few farmers are beginning to realize that pesticides are not always the "quick fix" they were once thought to be, or that pesticides cannot be used on every crop, such as sweet potatoes. Such variations in individual attitudes and beliefs regarding the safety and effectiveness of pesticides emphasize the need for local-level studies as part of the process of designing and implementing appropriate IPM programs.

Another way in which changes in local factors have interacted with external political-economic pressures to influence farming practices in Denbigh Kraal is the problem of water shortages. Farmers in Mocho generally received sufficient rainfall to meet their needs for farming. However, because rainfall is lower in Denbigh Kraal, farmers must rely on irrigation to meet their water needs. The structural adjustment policies that Jamaica has undergone in the past several years resulted in the privatization of the water system in September of 1995, which until then, had been heavily-subsidized by the government (McAfee 1991). The removal of subsidies led to a large increase in the cost of water, and although Denbigh Kraal residents are not directly responsible for the cost of water at this time, the high cost of water may be affecting the amount of water ALCOA purchases for the community. Furthermore, high water costs will certainly affect farmers' directly once ALCOA ceases to provide water free of charge. As discussed in Chapter Six, the lack of water affects the crops farmers grow, whether or not they use pesticides, and whether or not they are able to control certain crop pests (namely, the sweet potato weevil). Thus, the local and external factors affecting water availability are directly relevant to efforts to implement IPM practices through the IPM CRSP project.

The problem of water shortages also highlights the need to conduct location-specific studies in the process of designing and implementing appropriate IPM programs. In one of the IPM CRSP research communities in Clarendon (Heifer's Run), farmers must purchase irrigation water themselves. The sharp increase in the water prices which took effect in September 1995 hurt many farmers. Some are even afraid that they may have to stop farming because of the high cost of water. However, in another IPM CRSP research community in Clarendon (Ebony Park), some farmers are able to withdraw water from a river near their fields free of charge, and thus water costs are not a constraint for them.

These variations in water problems from one community to another demonstrate the importance of having IPM CRSP researchers work closely with farmers on a continual basis. When the participatory appraisals were carried out in 1994 and 1995, the cost of water had not increased yet, thus farmers did not cite problems with high water costs. This means that if IPM practices for sweet potatoes were developed using the 1994 information, they would probably include provisions to keep the ground wet to control the sweet potato weevil. However, now that sufficient water is often unavailable or too expensive, farmers would not be able to carry out this practice. On a similar note, if IPM CRSP researchers instruct farmers to harvest sweet potatoes early to protect them from the sweet potato weevil (which creates more damage the longer the sweet potato is in the ground), but market prices are too low at that time, farmers will not follow that suggestion either.

While these are just a few examples of how local and external factors interact to create non-technical constraints to the adoption of IPM in Denbigh Kraal, they do reinforce the need to conduct location-specific studies as part of the process of designing and implementing IPM programs. Although the population of Denbigh Kraal is small, this study nonetheless demonstrates how local environmental, social, and economic conditions, and individual attitudes and beliefs regarding the safety and effectiveness of pesticides, interact with external, political-economic forces to influence farmers' willingness and ability to adopt IPM practices. While non-technical constraints to the adoption of IPM will vary from one IPM CRSP research community to another, and even within communities, important lessons about the types of problems farmers face, and their impact on farmers' willingness and ability to adopt IPM can be learned from this case study. As Blaikie and Brookfield argue (1987), referring to the problem of land degradation in Third World countries, although a single theory of land degradation does not exist, it is possible to identify structural similarities which frequently contribute to land degradation and therefore are important to identify and consider in any analyses of land degradation.

Likewise, this study of non-technical constraints to the adoption of IPM highlights important factors that influence farmers' willingness and ability to adopt IPM and which should be considered in other locations when trying to identify non-technical constraints to the adoption of IPM. For example, although the population of Denbigh Kraal is small, farmers have similar problems in common with small-scale farmers throughout the Caribbean. In particular, Thomas (1988) identifies water shortages, crops pests, and market problems as significant constraints to farming in the region. With regards to marketing, he argues that the small share of revenues going to the farmers themselves is reducing the viability of agriculture as an occupation, while he considers water shortages to be the region's most severe natural constraint to farming. Thus, the problems of water shortages and market security are not limited to Denbigh Kraal. As a result, the lessons learned in Denbigh Kraal regarding the implementation of IPM may have relevance for other locations.

While political ecology has proved to be a very useful approach to the study of non-technical constraints to the adoption of IPM among small-scale farmers in Denbigh Kraal, as it has in many other studies of human-environment relations, we now need to begin incorporating political ecological analysis into development *planning*. Thus far, political ecology has primarily been used as an analytical tool to uncover causes of environmental degradation after the fact. However, a political ecology approach to development planning would increase development practitioner's awareness of the need to understand complex local, national, and international variables which influence environmental and socioeconomic welfare in the Third World. In the case of the IPM CRSP project in Jamaica, this would involve the recognition of the non-pest constraints to the production of NTAEs, namely water and market insecurity in Denbigh Kraal, and how this prevents small-scale farmers from expanding production as much, or more, than pest problems do. Reducing the amount of pesticides farmers use in the production of NTAEs may protect the environment and improve the quality of the NTAEs produced. However, if non-pest constraints to the production of NTAEs are not addressed as well, the introduction of IPM will do little to enhance small-scale farmer's production of NTAEs and thus their social and economic welfare.

Appendix A

Interview Questions

1. Were you relocated by ALCOA?

2. If yes, from where and how long ago?

3. If no, where did you move to Denbigh Kraal from, and how long ago?

4. How much land did you have before you were relocated? Now?

5. Did you own and have title to your land before relocation? Do you now?

6. If you were not relocated by ALCOA, how did you obtain land in Denbigh Kraal, and how much do you have? Do you own or rent the land?

7. Are you a full-time farmer?

8. If no, what other work do you do?

9. Is anyone else in your household involved in farming?

10. If no, what types of work do the other household members do?

11. What crops did you grow before you relocated/moved to Denbigh Kraal?

12. Where and how did you market your crops?

13. What crops do you grow now?

14. Where and how do you market your crops now?

15. If you are growing different crops now, why?

16. How do you decide what crops to plant?

17. What problems do you have with marketing your crops now? And in the past?

18. Did you use pesticides on your crops before you were relocated/moved to

Denbigh Kraal?

19. Which crops did you use pesticides on and why?

20. Where did you obtain the pesticides and the information on how to use them?

21. Do you use pesticides now? On which crops and why?

22. Do you have more or less problems with crop pests since moving to Denbigh Kraal?

23. Do you use more pesticides (volume and or frequency) on crops in Denbigh Kraal than in you previous location?

24. Where do you get pesticides and the information on how to use them?

25. What safety precautions do you take when using pesticides?

26. Have you ever had any health-related problems with pesticides?

27. What methods of controlling crop pests (including weeds) that do not involve chemicals do you use?

28. How long have you been farming and where did you learn or get your experience?

29. Where and when did you learn to use pesticides?

30. Do you do all the farm labor yourself?

31. If you have help is it family or hired labor?

32. Do you ever share labor with other farmers? Did you in the past?

33. Do you share, or obtain information on pesticides or other farming practices with other farmers?

34. Do you have any problems with hired laborers?

35. Do you grow as much produce would you like to?

36. If no, what are your primary constraints to production?

37. Do you know many people in the community of Denbigh Kraal?

38. If relocated from Mocho, how does the community of Denbigh Kraal compare to the community of Mocho in terms of social ties (e.g., do most people know each other?, do neighbors help each other in times of illness or death?, do you attend the same church as any or your neighbors or do your children go to school together?).

39. Did you experience any problems with ALCOA related to the relocation process? If yes, what types of problems?

40. Do you like living and or farming in Denbigh Kraal as well as or better than Mocho (or other previous location)?

References

Agricultural Export Services Project Handbook, No place, No date.

Allen, Office of the Ministry of Agriculture, Jamaica. Personal interview. January 15, 1996.

Altieri, Miguel A. 1993. "Designing and Improving Pest Management Systems for Subsistence Farmers." in Altieri, Miguel, A. (ed.) Crop Protection Strategies for Small Farmers. Boulder, CO: Westview Press.

Bassett, Thomas J. 1988. "The Political Ecology of Peasant-Herder Conflicts in the Northern Ivory Coast." *Annals of the Association of American Geographers*. Vol. 78, No. 3: pp. 453-472.

Mr. Beckaroo. January 12, 1996. Extension agent, Clarendon branch of the Rural Agricultural Development Authority, Jamaica. Personal interview.

Beckford, George. 1987. "The Social Economy of Bauxite in the Jamaican Man Space." *Social and Economic Studies*. Vol. 36, No. 1: pp. 1-56.

Berleant-Schiller, Riva and Lydia M. Pulsipher. 1986. "Subsistence Cultivation in the Caribbean." *Nieuwe West-Indiche Gids*. Vol. 60: pp. 1-40.

Besson, Jean, and Janet Momsen, eds. 1987. Land and Development in the Caribbean. London: Macmillan Caribbean.

Besson, Jean. 1984. "Family Land and Caribbean Society: Toward an Ethnography of Afro-Caribbean Peasantries." in Thomas-Hope, Elizabeth, ed. Perspectives on Caribbean Regional Identity. Liverpool, England: Centre for Latin American Studies, The University of Liverpool. pp. 57-83.

Blaikie, Piers. 1985. The Political Economy of Soil Erosion in Developing Countries. New York and London: Longman.

Blaikie, Piers, and Harold Brookfield. 1987. Land Degradation and Society. New York and London: Methuen.

Braun, H.R., A.C. Bellotti, and J.C. Lozano. 1993. "Implementation of IPM for Small-Scale Cassava Farmers," in Altieri, Miguel (ed.) Crop Protection Strategies for Small Farmers. Boulder, CO: Westview Press. Pp. 103-115.

Brierly, John S. 1991. "Kitchen Gardens in the Caribbean, Past and Present: Their Role in Development." *Caribbean Geography*. Vol. 31, No. 1: pp. 15-28.

Bryant, Raymond. 1992. "Political Ecology: An Emerging Research Agenda in Third-World Studies." *Political Geography*. Vol. 11, No. 1: pp. 12-36.

Bull, David. 1982. A Growing Problem: Pesticides and the Third World Poor. Oxford, England: Oxfam Press.

Burrels, Mr. January 23, 1996. Clarendon branch representative of the Jamaican Agricultural Society, Jamaica. Personal interview.

Butzer, Karl W. 1989. "Cultural Ecology," in Gaile, Gary L. and Cort J. Willmott (eds.) Geography in America. Columbus, Ohio: Merrill Publishing Company. Pp. 192-208

CARDI. 1995. "IPM CRSP Annual Report: Jamaica Site, Year II (October 1994-September 1995)." Mona, Jamaica: CARDI.

Carson, Rachel. 1962. Silent Spring. Boston and New York: Houghton Mifflin Company.

Chung, Phillip C. 1994. "Integrated Pest Management in Jamaica." in Reid, Janice and Janet Lawrence, "The Participatory Approach to Integrated Pest Management," Kingston, Jamaica: CARDI.

Deere, C., P. Antrobus, L. Bolles, E. Melendez, P. Phillips, M. Rivera, and H. Safa. 1990. In the Shadows of the Sun: Caribbean Development Alternatives and U.S. Policy. Boulder, CO: Westview Press.

Donaldson, Jonathan. January 23, 1996. Clarendon representative of the Citrus Grower's Association, Jamaica. Telephone interview.

Dover, Michael. 1985. A Better Mousetrap: Improving Pest Management for Agriculture. Washington, D.C.: World Resources Institute.

Franke, Richard W., and Barbara H. Chasin. 1980. Seeds of Famine: Ecological Destruction and the Development Dilemma in the West African Sahel. Lanham, MD: Rowman & Littlefield Publishers, Inc.

Gayle, Diane. January 25, 1996. Pesticide Control Authority, Jamaica. Personal interview.

Glass, Edward H. 1992. "Constraints to the Implementation and Adoption of IPM." in Zalom, Frank, and William Fry, (eds.) Food, Crop Pests, and the Environment. St. Paul, MN: The American Phytopathological Society. Pp. 167-174.

Goodell, Grace. 1984. "Challenges to International Pest Management Research and Extension in the Third World: Do We Really Want IPM to Work?" *Bulletin of the Entomological Society of America*. Vol. 30, No. 3: pp. 18-27.

Grossman, Lawrence. 1981. "The Cultural Ecology of Economic Development." *Annals of the Association of American Geographers*. Vol. 71, No. 2.: pp. 220-236.

Grossman, Lawrence. 1984. Peasants, Subsistence Ecology, and Development in the Highlands of Papau New Guinea. Princeton, NJ: Princeton University Press.

Grossman, Lawrence. 1992a. "Pesticides, Caution, and Experimentation in St. Vincent, Eastern Caribbean." *Human Ecology*. Vol. 20, No. 3: pp. 315-336.

Grossman, Lawrence. 1992b. "Pesticides, People, and the Environment in St. Vincent." *Caribbean Geography*. Vol 3, No. 3: pp. 176-186.

Grossman, Lawrence. 1993. "The Political Ecology of Banana Exports and Local Food Production in St. Vincent, Eastern Caribbean." *Annals of the Association of American Geographers*. Vol. 83, No. 2: pp. 347-367.

Hecht, Susanna. 1985. "Environment, Development and Politics: Capital Accumulation and the Livestock Sector in Eastern Amazonia," *World Development*. Vol. 13, No. 6: pp. 663-684.

Hills, T. L. 1988. "the Caribbean Food Forest, Ecological Artistry or Random Chaos?" in Brierly, J.S. and H. Rubenstein (eds) Small Farming and Peasant Resources in the Caribbean. Winnipeg, Canada: Manitoba Geographical Studies 10, the University of Manitoba.

Holl, Karen, Paul Ehrlich, and Gretchen Daily. 1990. "Integrated Pest Management in Latin America." *Environmental Conservation*. Vol. 17, No. 4:

pp. 341-350.

Jacobsen, Barry J., and Paul A. Backman. 1993. "Biological and Cultural Plant Disease Controls: Alternatives and Supplements to Chemicals in IPM Systems." *Plant Disease*. March 1993: pp. 311-315.

Jarosz, Lucy. 1993. "Defining and Explaining Tropical Deforestation: Shifting Cultivation and Population Growth in Colonial Madagascar (1896-1940)." *Economic Geography*. Vol. 69, No. 4: pp. 366-379.

Kiss, Agnes, and Frans Meerman. 1991. Integrated Pest Management and African Agriculture. Washington, D.C.: The World Bank.

MacKay, Kenneth, Candida Adalla, and Agnes Rola. 1993. "Steps Toward an Alternate and Safe Pest Management System for Small Farmers in the Philippines." in Altieri, Miguel, (ed.) Crop Protection Strategies for Subsistence Farmers. Boulder, CO: Westview Press. Pp. 23-45.

Massiah, Joycelin. 1983. Women as Heads of Household in the Caribbean: Family Structure and Feminine Status. United Kingdom: UNESCO.

Mathieson, John A. 1988. "Jamaica." in Paus, Eva, (ed.) Struggle Against Dependence: Nontraditional Export Growth in Central America and the Caribbean. Boulder, CO: Westview Press.

Matteson, Patricia C. 1992. "'Farmer First' For Establishing IPM." *Bulletin of Entomological Research*. Vol. 82: pp. 293-296.

McAfee, Kathy. 1991. Storm Signals: Structural Adjustment and Development Alternatives in the Caribbean. Boston: South End Press in Association with Oxfam America.

Mill, Alan E. 1993. "Putting the Farmer First in Rice Rat Control." *Outlook on Agriculture*. Vol. 22, No. 2: pp. 115-118.

Ministry of Agriculture. 1991. "Jamaica Five Year Development Plan 1990-1995: Agriculture." Kingston, Jamaica: Planning Institute of Jamaica.

Mintz, Sydney W. 1989 (Morningside Ed.). Caribbean Transformations. New York: Columbia University Press.

Momsen, Janet. 1986. "Boserup Revisited: Economic Restructuring and Gender Roles in Caribbean Agriculture." University of Newcastle Upon Tyne, Department of Geography. Seminar Paper No. 46.

Moore, Donald S. 1993. "Contesting Terrain in Zimbabwe's Eastern Highlands: Political Ecology, Ethnography, and Peasant Resource Struggle." *Economic Geography*. Vol. 69, No. 4: pp. 380-401.

Murray, Douglas, and Polly Hoppin. 1992. "Recurring Contradictions in Agrarian Development: Pesticide Problems in Caribbean Basin Nontraditional Agriculture." *World Development*. Vol. 20, No. 4: pp. 597-608.

Murray, Douglas. 1994. Cultivating Crisis: The Human Cost of Pesticides in Latin America. Austin, TX: University of Texas Press.

Pariser, Harry, S. 1996. Jamaica: A Visitor's Guide. Edison, NJ: Hunter Publishing.

Paus, Eva (ed.). 1988, Struggle Against Dependence: Nontraditional Export Growth in Central America and the Caribbean. Boulder, CO: Westview Press.

Peet, Richard, and Michael Watts. 1993. "Introduction: Development Theory and Environment in an Age of Market Triumphalism." *Economic Geography*. Vol. 69, No. 3: pp. 227-252.

Perfect, T.J. 1992. "IPM in 2000." in Aziz, Abdul, S.A. Kadir, and Henry S. Barlow, (eds.) Pest Management and the Environment in 2000. Oxon, U.K.: C.A.B. International, pp. 47-53.

Perkins, Althea. 1995a. "St. Catherine: Decriptive Data." Working Paper. Mona, Jamaica: CARDI.

Perkins, Althea. 1995b. "Clarendon: Decriptive Date." Working Paper. Mona, Jamaica: CARDI.

Mr. Perkins. January 22, 1996. Mid-Clarendon National Irrigation Commission, Jamaica. Personal interview.

Pimbert, Michael. 1991. "Designing Integrated Pest Management for Sustainable and Productive Futures." *Gatekeeper Series No. 29*. London: International Institute for Environment and Development.

Poswal, M.A.T., A.D. Akpa, and O. Alabi. 1993. "Cultural Control of Pests and Diseases: Prelude to Integrated Pest Management Practices for Resource-Poor Farmers in Nigerian Agriculture." *Journal of Sustainable Agriculture.* Vol. 3 (3/4): pp.

Pretty, Jules, N. 1995. Regenerating Agriculture: Policies and Practices for Sustainability and Self-Reliance. London: Earthscan Publications, Ltd.

Rajotte, Edwin, G. 1993. "From Profitability to Food Safety and the Environment: Shifting the Objectives of IPM" *Plant Disease*, March 1993: pp. 296-299.

Reid, Charles. January 16, 1996. Jamaican Exporters' Association. Personal interview.

Reid, Janice, and Janet Lawrence. 1994. "The Participatory Approach to Integrated Pest Management." Kingston, Jamaica: CARDI.

Reid, Robert. 1994. "Current Trends in Exports Crops and Agribusiness." in Reid, Janice and Janet Lawrence "The Participatory Approach to Integrated Pest Management" Kingston, Jamaica: CARDI.

Richardson, Bonham, C. 1972. "Guyana's "Green Revolution": Social and Ecological Problems in an Agricultural Development Programme." *Caribbean Quarterly*. Vol. 18, No. 1: pp. 14-23.

Richardson, Bonham C. 1992. The Caribbean in the Wider World, 1492-1992. Cambridge: Cambridge University Press.

Ridgely, Anne-Marie, and Stephen B. Brush. 1992. "Social Factors and Selective Technology Adoption: The Case of Integrated Pest Management." *Human Organization*. Vol. 51, No. 4: pp. 367-378.

Rocheleau, Dianne, Philip Steinberg, and Patricia Benjamin. 1995. "Environment, Development, Crisis, and Crusade: Ukambani, Kenya, 1890-1990." *World Development*. Vol. 23, No. 6: pp. 1037-1051.

Schroeder, Richard. 1993. "Shady Practice: Gender and the Political Ecology of Resource Stabilization in Gambian Garden/Orchards." *Economic Geography*, Vol. 69, No. 3: pp. 349-365.

Seitz, Virginia, R. 1995a. "Report on Exploratory Social Research in Jamaica for IPM CRSP: Annotto Bay Site." Working Paper. Blacksburg, VA: Virginia Polytechnic Institute and State University.

Seitz, Virginia, R. 1995b. "Trip Report: IPM CRSP Research in Jamaica." Blacksburg, VA: Virginia Polytechnic Institute and State University.

Smith, M.G. and G.J. Kruijer. 1957. "A Sociological Manual for Extension Workers in the Caribbean." *Caribbean Affairs Serios*. The Extra-Mural Department, University College of the West Indies.

Stonich, Susan. 1993. "I am Destroying the Land!": The Political Ecology of Poverty and Environmental Destruction in Honduras. Boulder, CO: Westview Press.

The Planning Institute of Jamaica. 1995. Economic and Social Survey: Jamaica 1994. Kingston, Jamaica: The Planning Institute of Jamaica.

The Stone Team. 1994. "Pesticide Usage Survey in the Agricultural Sector." Prepared for the Pesticides Control Authority. Kingston, Jamaica: The Stone Team.

Thomas, Clive, Y. 1988. The Poor and the Powerless: Economic Policy and Change in the Caribbean. New York: Monthly Review Press.

Thomasson, David, A. 1994. "Montserrat Kitchen Gardens: Social Functions and Development Potential." *Caribbean Geography*. Vol. 5 No. 1: pp. 20-31.

Thrupp, Lori Ann. 1994. "Challenges in Latin America's Recent Agroexport Boom: Sustainability and Equity of Nontraditional Export Policies in Ecuador." Washington, D.C.: World Resources Institute.

Thrupp, Lori Ann, Gilles Bergeron, and William F. Waters. 1995. Bittersweet Harvest for Global Supermarkets: Challenges in Latin America's Agricultural Export Boom. Washington, D.C.: World Resources Institute.

Tsedeke, Abate. 1996. "IPM and Small-holder Agriculture." Presentation sponsored by the Entomology Department of Virginia Polytechnic Institute and State University, March 21, 1996.

Trouillot, Michel-Rolph. 1988. Peasants and Capital: Dominica in the World Economy. Baltimore: The Johns Hopkins University Press.

U.S. AID. 1993. "Integrated Pest Management CRSP." Washington, D.C.: U.S. AID.

Virginia Polytechnic Institute and State University. 1995. "IPM CRSP Update," Blacksburg, VA: Virginia Polytechnic Institute and State University, Winter 1995, Vol. 1, No. 1: pp. 1-6.

Watts, Michael. 1983. Silent Violence: Food, Famine, and Poverty in Northern Nigeria. Berkley, CA: University of California Press.

Wearing, C.H. 1988. "Evaluating the IPM Implementation Process." *Annual Review of Entomology*. Vol. 33: pp. 17-38.

Wolf, Eric. 1972. "Ownership and Political Ecology." *Anthropological Quarterly*. Vol. 45. No. 3: pp. 201-205.

Wright, Angus. 1990. The Death of Ramon Gonzalez: The Modern Agricultural Dilemma. Austin, TX: University of Texas Press.

Zalom, Frank G. 1993. "Reorganizing to Facilitate the Development and Use of Integrated Pest Management." *Agriculture, Ecosystems, and the Environment*. Vol. 46: pp. 245-256.

Zalom, Frank G., Richard E. Ford, Raymond E. Frisbie, C. Richard Edwards, and James P. Tettle. 1992. "Integrated Pest Management: Addressing the Economic Issues of Contemporary Agriculture." in Zalom, Frank G., and William E. Fry, (eds.) Food, Crop Pests, and the Environment. St. Paul, MN: The American Phytopathological Society, pp. 1-12.

Zimmerer, Karl. 1991. "Wetland Production and Small-holder Persistence: Agricultural Change in a Highland Peruvian Region." *Annals of the Association of American Geographers*. Vol 81: pp. 443-63.

Zimmerer, Karl. 1993a. "Soil Erosion and Labor Shortages in the Andes With Special Reference to Bolivia, 1953-1991: Implications for Conservation-With-Development." *World Development*. Vol. 21, No. 10: pp 1659-1675.

Zimmerer, Karl. 1993b. "Soil Erosion and Social (Dis)Courses in Cochabamba, Bolivia: Perceiving the Nature of Environmental Degradation." *Economic Geography*. Vol. 69, No. 3: pp. 312-327.

VITA

KAREN A. PATTERSON

EDUCATION

Virginia Tech, Blacksburg, VA, M.S. Geography, 1996
Clark University, Worcester, MA, B.A. Geography, *magna cum laude*, 1992

HONORS AND AWARDS

Association of American Geographers Cultural Ecology Specialty Group Field Work Grant, 1995
Alice Higgins Scholar Athlete Award, 1991, 1992; Ellen Churchill Semple Award, 1992; Paul P. Vouras Social Science Award, 1992
Honor Societies: Phi Kappa Phi, 1996; Phi Beta Kappa, 1991; Gamma Theta Upsilon, 1991

WORK EXPERIENCE

Teaching Assistant, Virginia Polytechnic Institute, Blacksburg, VA, August 1994-May 1996

- Teaching Assistant, World Regions, Fall 1994, occasional lectures, grading, and student assistance;
- Teaching Assistant, Physical Geography, Spring, Fall 1995, grading and student assistance;
- Assist in development of a new course for the Spring 1996 semester, developed lecture on environmental justice, identified appropriate multi-media resources through the Internet, videos, and computer software packages.

Analyst, The Cadmus Group, Inc., Alexandria , VA, May 1995 - August 1995

- Analyzed and conducted quality assurance/quality control of responses to the Environmental Protection Agency 1995 Drinking Water Needs Survey, including authorization of infrastructure, treatment, and maintenance needs;
- Collected additional data through individual contacts with public works directors and other authorized personnel.

Research Assistant, The Cadmus Group, Inc., July 1992 - October 1993

- Provided analytical and organizational support on projects for the U.S. Environmental Protection Agency.
- Analyzed the ecological benefits of the Superfund Program for the Office of Emergency and Remedial Response;
- Planned conferences and provided on-site support for Acid Rain Division and Office of Wastewater Enforcement and Compliance conferences;
- U.S. Environmental Protection Agency Region III certified Class V well inspector U.S. EPA;
- Analyzed pollution prevention laws for the Office of Policy, Planning and Evaluation and developed boiler plate language for Best Management Practices;
- Developed NPDES permit for animal feedlots for the Office of Wastewater Enforcement and Compliance;
- Created, developed, and produced outreach materials used in training EPA staff and the regulated community.

Publications Intern, Massachusetts Riverways Program, March 1992 - June 1992

- Edited and produced annual calendar of river events and the bi-annual *Riverways Newsletter*;
- Organized community participation in a state-wide river basin mapping project;
- Lobbied state Congress members for passage of the Massachusetts River Protection Act.

Volunteer, Australian Trust for Conservation Volunteers, February/March 1992

- Performed practical conservation work in local communities in Victoria and South Australia, including seed collection and renovation of a historic building for use as an environmental education center.

Communications Intern, Zero Population Growth, Summer 1991

- Assisted the Communications Director in all facets of communication for a non-profit, environmental membership organization;
- Conducted research on current environmental issues for feature articles in *The ZPG Reporter*;
- Assisted in editing and producing *The ZPG Reporter*.

Karen Patterson — October 21 1996