

# Chapter 1: Introduction

## 1.1. Background

Policies that promote intensified use of resources, which in turn increase agricultural production, minimize food insecurities. One of the causes of low agricultural production in developing countries is incidence of pests and diseases. Pesticides have been used intensively to protect crops; however some pests have developed resistance to the pesticides. Also pesticides can have a negative effect on natural predators and the overall environment. Developing countries around the world are beginning to adopt a strategy called Integrated Pest Management (IPM) to sustainably control pest infestations and reduce the reliance on pesticides.

This study identifies the spatial and socio-economic factors that constrain adoption of IPM technologies, and evaluates the benefits and costs of IPM research in Bangladesh and Uganda to illustrate the functionality of the framework. It develops a framework for economic assessment of a United States Agency of International Development (USAID)-funded IPM program.

## 1.2. Problem Statement

Farmers have traditionally relied on indirect pest control measures, such as pulling out weeds, removing egg masses from plants and destroying crop residues. However, the introduction of chemical pesticides over the past several decades has caused an important shift in pest management practices, making it easier to kill large numbers of pests in a short period of time (Mengech, et al. 1995). The chemical approach has been attractive because pesticides have killed pests simply and cheaply. Kiss and Meerman (1991) point out that much of the IPM research has concentrated on breeding new crop varieties and developing agronomic practices to produce high yields using external inputs (particularly irrigation and fertilizers), with the assumption that pest problems could be easily eliminated with pesticides should they arise.

Serious problems have begun to emerge, however, that have brought the high reliance on pesticides for plant protection into question. A number of pesticides have been restricted in use after significant pesticide residues have been detected in well water, on produce, and in wildlife and human tissues (Kiss and Meerman, 1991). Serious concerns also have been raised about the impact of pesticides on soil quality and productivity due to their adverse effect on soil microorganisms. Scholars and experts are now questioning the effectiveness of the over reliance on chemical approaches to pest management. Research and experience show that intensive, widespread use of pesticides can, over time, actually worsen pest problems due to pesticide resistance developed by pest

organisms and due to the destruction of natural enemies (predators and parasites) which ordinarily kept pest populations in check (Kiss and Meerman, 1991). In the short run, chemical control can provide impressive results but, over the long-term, costs goes up and effectiveness goes down.

An alternative to the heavy reliance on chemical controls to protect crops from pest damage is IPM. IPM is frequently cited as a viable alternative to conventional pest management programs that rely heavily on scheduled applications of pesticides (Flint, 1989). IPM programs aim to reduce the pesticide load in the environment by increasing the predictability and effectiveness of pest control techniques and increasing the utilization of natural pest controls. IPM differs from conventional pest management programs in that it is a management-intensive technology, requiring a dynamic decision-making process on the part of the grower. Rather than relying on predetermined chemical applications with the goal of pest eradication, IPM emphasizes the importance of biological, cultural, other non-chemical preventive measures, and the use of pesticides in a more effective manner.

In the light of successful domestic IPM programs, in the fall of 1993 the USAID initiated and awarded a grant to Virginia Tech in order to establish a global IPM research program in collaboration with several US and international institutions. The program is called the Integrated Pest Management Collaborative Research Support Program (IPM CRSP). The aim of the IPM CRSP is to foster IPM through collaborative research between US and less developed

country (LDC) institutions for their mutual benefit by improving their abilities to develop and implement economically and environmentally sound crop protection methods. The IPM CRSP functions in countries around the globe, namely: Albania, Bangladesh, Ecuador, Eritrea, Ethiopia, Guatemala, Honduras, Jamaica, Mali, Philippines, Uganda and Ukraine.

This study focuses on an economic impact assessment for the IPM CRSP program. The main objective of this thesis is to develop a sound framework for evaluating of aggregate economic impacts of IPM CRSP activities. The thesis develops a framework for assessing economic impacts of IPM CRSP activities, and applies the framework to evaluate specific IPM CRSP activities in Bangladesh and Uganda. The aim of the applications is to illustrate the use of the proposed framework.

### **1.3. Justification**

The IPM CRSP is engaged in research to develop strategies and technologies for reducing usage of harmful pesticides and promoting alternative biological and cultural controls that will increase yield and reduce production costs. Evaluating the impact of the IPM CRSP-induced practices on profitability, production and income risk, pesticide applicator safety, and other potential private benefits and costs must be assessed in order to help farmers (end-users) decide whether they should adopt these particular IPM practices (Norton and Mullen, 1994). Information on the expected benefits and costs of alternative

research strategies is needed to set research priorities, to design research, and to evaluate research (Antle and Capalbo, 1997). It is generally accepted that impact assessment must be an integral part of IPM research and extension. A successful pest management strategy must be profitable to individual farmers and for the industry as a whole if it is to be adopted.

Therefore, this study develops a framework and applies methods for assessing the benefits of IPM technologies to the aggregate economies of the countries IPM CRSP operates in. The framework is applied in two case studies from Bangladesh and Uganda. It further employs GIS technology to investigate the possibility of transferring IPM technologies on a regional basis within Bangladesh and Uganda. The framework developed in this study will enable the various donor-funded institutions and other stakeholders to prioritize their research agendas and justify investments in IPM research.

#### **1.4. Objectives of Study**

The overall objective is to develop a strategic framework for assessing and monitoring the economic benefits of IPM CRSP activities. The study will determine if IPM CRSP activities in Bangladesh and Uganda have significant impact on the overall economies of the respective countries. It will also illustrate how technologies developed by IPM CRSP can be transferred across agro-ecological regions within the Bangladesh and Uganda. The framework will be

presented in a manner such that it can be used for assessing other IPM technologies in different localities. Sub-objectives of the study are:

1. To determine the benefits of a subset of IPM CRSP activities in Bangladesh's eggplant/cabbage production system, and in Uganda's bean/maize production system
2. To illustrate how to assess the potential spillover economic impacts of IPM practices on a regional basis

### **1.5. Research Hypothesis**

The two main hypotheses for this case study are:

1. The potential national level impacts of IPM CRSP activities in Bangladesh's eggplant/cabbage production system, and in Uganda's bean/maize production system are positive and significant.
2. Regional economic spillovers of IPM CRSP activities within Bangladesh and Uganda are positive and significant.

### **1.6. Summary of Procedures**

Partial budgeting and ex-ante economic surplus analysis are employed to estimate the aggregate benefits of IPM CRSP strategies in Bangladesh and Uganda. In Bangladesh, an altered schedule of hand weeding in cabbage production and Neem leaf powder as an insecticide for eggplants were selected

for assessment. In Uganda, the maize pest-resistant variety Longe-1 and seed dressing with Endosulfan for management of bean fly and root rot on beans, are evaluated. Also, a Geographic Information System (GIS) is used to help project the transferability of IPM CRSP strategies beyond the primary sites. Data on production, consumption, prices, price elasticities for demand and supply, and experiment costs are gathered and refined to derive aggregate benefits for each country. Expert questionnaires were developed to determine adoption rates, and to elicit information about yield and cost changes due to the adoption of these technologies. Agro-ecological and socio-economic data were collected to facilitate the framework in exploring the spatial dimension of adoption patterns.

## **1.7. Thesis Organization**

This study is divided into four additional chapters. Review of the literature is given in Chapter two. This review starts with an overview of previous socio-economic studies of IPM followed by review of economic surplus modeling. Chapter Two will also introduce the role of GIS in assessing the transferability of IPM technologies across regions. In Chapter Three, the methodology of the study is discussed in detail. Chapter Four presents results and discussions of the case studies in Bangladesh and Uganda. Finally, Chapter Five presents summary, conclusions, study limitations, directions for further research, and policy implications.