CHAPTER ONE

INTRODUCTION

Concern about the health and environmental effects of pesticides have increased over the past several years. This concern is evident from the increase in scholarly work on the environmental impacts of pesticides in the United States and in Europe. Unfortunately, research of this type is sparse in developing countries despite rampant overuse and misuse of pesticides in these countries.

Since agriculture is a major source of income in most third world economies like the Philippines, crop damage from pest infestation often result in dire consequences. The farmers therefore tend to be risk-averse with respect to pest management. This often results in misuse of pesticides especially because most farmers rely solely on chemicals for pest control. Without consideration of external costs, the net benefits of pesticide use tend to be overestimated. With widespread lack of understanding about the hazards caused by pesticide use, the problem of pesticide misuse and consequent environmental degradation in the third world seems imminent.

This study attempts to make a significant contribution to environmental research in the Philippines, particularly on pesticide impacts. The study identifies the hazards posed by pesticide use to different environmental categories, estimates the value of reducing the hazards, and evaluates the benefits of an integrated pest management (IPM) program in the Philippines, a country that makes heavy use of pesticides in agricultural production.

Problem Statement

Agricultural pests can cause significant reductions in farm yields and incomes. Consequently, pesticides are heavily used in attempts to mitigate this problem. However, there are serious negative externalities related to human health and the environment that are caused by over-application of these pesticides. Alarming statistics document the threat to farmers, pesticide applicators, and harvesters in developing countries. For example, according to a World Bank document, breast milk samples from women in cotton producing regions in Guatemala and Nicaragua have some of the highest levels of

DDT[1] ever recorded in humans. Furthermore, the illness and mortality rates from pesticide poisoning in these areas approach those of major diseases (World Bank, 1992). In the Philippines, hospitals under the jurisdiction of the Department of Health recorded 4,031 cases of acute pesticide poisoning, and 603 cases resulted in death over the period 1980-1987. This number is likely to be underestimated since most cases do not reach the hospitals, and rural health officials may not always correctly diagnose pesticide poisoning (Castaneda and Rola, 1990).

Prolonged exposure to pesticides has been associated with several chronic and acute health effects like non-Hodgkin's lymphoma, leukemia, as well as cardiopulmonary disorders, neurological and hematological symptoms, and skin diseases (Blair and White, 1985; Hoag et al., 1986; Wigle et al., 1990; Pingali et al., 1994; Crissman et al., 1994; Antle and Capalbo, 1994).

Methods for safe storage, handling, and application of pesticides that may lessen health and environmental hazards do exist and are widely used in many developed countries. However, use of these safety precautions is not widely observed in most developing countries (Rola and Pingali, 1993; Crissman, et al., 1994) for the following reasons: lack of awareness about the possible risk**s**, lack of information on product use, inconvenience involved in trying to avoid contact with pesticides, pricing policies, and lack of regulations to mitigate these hazards.

Aside from human health effects, overuse of pesticides can also result in serious environmental damage to surface water, groundwater, and air quality, which consequently harm birds, aquatic species, mammals, as well as beneficial insects (also called natural pest enemies). Finally, misuse of pesticides could harm the predator-prey balance and result in higher levels of pest infestation and disrupt the existing ecosystem balance (Mullen et al., 1997; Higley and Wintersteen, 1992). In fact, scientists at the International Rice Research Institute (IRRI) already have found that injudicious use of insecticides in the Philippines, particularly early in the growing season, has disrupted the natural ability of the rice ecosystem to cope with pest infestations.

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[1] dichloro-diphenyl-trichloro-ethane, a colorless odorless water-insoluble crystalline insecticide; DDT was banned for use in most countries due to its detrimental effects on the environment (particularly on birds).

The impact of pesticides on the environment and on human health is an issue that must be addressed in developing countries where environmental legislation is either nonexistent or is ineffective. The institutional and economic structures in the rural sector of developing economies are such that policy interventions are usually needed to reconcile long-term societal objectives and short-term individual objectives in pest control (Rola and Pingali, 1993). Farmers are usually focused on their families' survival and their general well being, and therefore are more likely to adopt practices and use resources in ways that are unsustainable from society's perspective.

In the Philippines, the government continually seeks increased self-sufficiency in food. This increased self-sufficiency hopefully should come at a minimal social cost. To minimize social costs, the Philippine government must provide farmers with the proper policy incentives to induce them to adopt sustainable practices. An understanding of the impacts of pesticide use on human health and the environment is needed in designing optimal policies to minimize the social costs.

Integrated Pest Management (IPM) is the main strategy being used by countries around the world to specifically address the overuse or misuse of pesticides in agriculture. IPM involves the use of cultural, biological, and chemical techniques to control pest populations. A good definition of IPM is provided by Flint and Van den Bosch (1981):

"IPM is the use of the best possible combination of methods to reduce and maintain pest populations below a level that would cause economic damage. It is based on a principle of optimum rather than maximum pest control. It constitutes a major component in an agricultural production system, which will allow sustained agricultural production with minimal deleterious effects on the producer, consumer, the agrosystem, and the environment in general."

In 1986, the Philippine government issued a directive to make IPM technology the core of its pest control policy in agriculture; however, its spread has been spotty. IPM activities in rice were initiated in the Philippines by the Food and Agriculture Organization (FAO) as early as the late 1970's (Rola and Pingali, 1993). In recent years, the Philippine Department of Agriculture and the International Rice Research Institute (IRRI) have been active in research, extension, and farmers' training in IPM. Most IPM training is devoted to identifying pests and natural enemies, recognizing appropriate thresholds, and recommending chemical control when pest populations exceed threshold levels.

The impacts of IPM programs, if successful, can extend beyond the economic effects on farms where IPM is adopted. The effects of IPM on water quality, food safety for humans and wildlife, pesticide applicator safety, and the long run sustainability of pest management systems all generate benefits that can potentially be measured in economic terms (Norton and Mullen, 1994).

In September 1993, The United States Agency for International Development (USAID) awarded a group of institutions led by Virginia Tech a grant for the Integrated Pest Management Collaborative Research Support Program (IPM CRSP). The Philippines was one of the primary host countries selected for IPM research particularly on the rice-vegetable farming systems. The Philippine Rice Research Institute (PhilRice), the International Rice Research Institute (IRRI), and the University of the Philippines at Los Banos (UPLB) serve as collaborating institutions for IPM research in the Philippines. The purpose of the program is to reduce crop losses, increase farmer income, reduce pesticide use, reduce pesticide residues on export products, improve IPM research and education capabilities, improve ability to monitor pests, and increase involvement of women in IPM decision making and program design in the host country sites and beyond.

IPM CRSP research in the Philippines was established in Nueva Ecija, the primary rice producing region and also a major source of onions for the country. IPM CRSP work began in March 1994 with a meeting of all the collaborating institutions and other resource persons. A Rice-Vegetable IPM Program was developed and research, technology development, and technology transfer efforts are ongoing. This study is part of the IPM CRSP research effort focusing on the economic measurement of the benefits and costs of IPM implementation in the Philippines. It involves an in-depth examination of both health and environmental impacts of pesticide use. A comprehensive measure of the environmental and health risks is developed to arrive at a more complete economic analysis of the impacts of pesticide use in the Philippines. The rice and vegetable farming systems in Nueva Ecija are a good target for IPM CRSP activities in that these farming systems involve heavy use and/or misuse of pesticides. Pesticides are often applied in inappropriate amounts to vegetables to capture any price premium attached to unblemished and "fresh" looking produce. The most widely used pesticides in this area are Category I and II pesticides, the most harmful in terms of toxicity.

Research Objectives

The overall objective of the study is to develop and test a method for assessing the economic value of environmental and health impacts of the IPM program in the Philippines. The study addresses a serious challenge facing agricultural researchers, that is, to develop an appropriate framework to analyze human health and environmental impacts of pesticide use and translate this into an aggregate economic measure. Ideally, the method should be designed to be sensitive to the socio-cultural and environmental conditions specific to a developing country like the Philippines, yet useful enough to be replicated if needed in other sites.

The specific objectives of the study are to:

1) identify alternative methods of measuring environmental and health savings resulting from reduced pesticide use through IPM;
2) measure the environmental and health benefits associated with the vegetable IPM program in Nueva Ecija using the most appropriate method; and
3) assess the policy implications for the Philippine government, of the environmental and health impacts.

The Study Area

The study site is San Jose, Nueva Ecija, located in Central Luzon, Philippines. This area is popularly known as the rice bowl of the Philippines. Because of its proximity to the capital city of Manila, Nueva Ecija supplies most of the rice requirements of the metropolis. San Jose is one of the three major cities in the province of Nueva Ecija, serving as one of the principal trading and commercial centers of the province. San Jose has a total land area of 18,725 hectares with a population of 92,083. More than 50 percent of the total land area is devoted to agriculture (9,628 has.). Sixty-nine percent of the agricultural land is irrigated and 31 percent rain-fed. In 1990, San Jose had a total of 4,752 farmers and about 62 percent of them managed farms of 1-3 hectares. Sixty-eight percent of the farms were rented or leased and 22 percent were fully owned.

Rice is the major crop in San Jose. About 3,380 farmers cultivate rice in irrigated land, while 1,373 farmers cultivate rice in rain-fed environments. San Jose also produces substantial amounts of vegetables during the dry season and is considered the heart of the onion growing area in the Philippines. Other field crops grown are corn, rootcrops, legumes, leafy vegetables and spices. The area contains eight retail outlets for pesticides, nine banks, and 34 farm cooperatives.

Nueva Ecija has been the target of several pesticide studies in the past. A farmer survey (Lazaro et al., 1995) and participatory appraisal activity with rice-vegetable farmers in Nueva Ecija found both heavy pesticide use on onions, eggplant, and yard long beans as well as apparent pesticide misuse. Rola and Pingali (1993) studied the area of Guimba, Nueva Ecija and found that frequent application of highly toxic chemicals has resulted in health damage from chemical exposure. Pesticide pricing and the regulatory structure combined with inadequate storage, unsafe handling practices, too short reentry intervals, and inefficient sprayer maintenance expose not just farmer applicators but their whole household to an increased risk of chemical poisoning. In a study by Huelgas (1989), it was concluded that constantly changing pest complexes, a widening range of insecticide products, and the absence of unique and specific control recommendations against insect pests all contribute to farmers' confusion regarding the type of chemical to use, the rate of application and timing of control. Two baseline surveys were also conducted in San Jose as part of the Integrated Pest Management Collaborative Research Support Program (IPM CRSP) which began in 1994. Pest control practices in rice were found to be very similar with pest control practices in vegetables. In particular, early spraying by the farmers was common in both crops.

These studies suggest that there is a problem of overuse and misuse of pesticides in the area. Incomplete knowledge about pests and misperceptions about the risks/environmental and health impacts contributed to the inappropriate use of insecticides. Nueva Ecija should provide a rich source of information and insights regarding the direct and indirect costs of pesticide application.

Previous Research and Some Methodological Issues

The methodological challenge for this study is to develop a comprehensive measure of the environmental and health benefits of an IPM program in the Philippines, given the fact that most of these environmental and health impacts are not priced in the market.

Relatively little empirical work has been completed that attempts to estimate the aggregate environmental benefits of IPM programs (Norton and Mullen, 1994), even though increased attention has focused in recent years on the actual or potential environmental benefits of IPM. Measurement of these benefits is difficult because assessing the physical or biological effects of alternative levels of pesticide use under different IPM practices is not straightforward. Evaluation of the benefits associated with environmental effects has to be derived indirectly because market values for improved human health and environmental conditions do not exist.

Rola and Pingali (1993) provided a framework for evaluating pest management techniques being used in the Philippines, giving consideration to traditional factors such as input prices and production risk, explicitly including health effects of pesticides in the analysis. They compared prophylactic pesticide applications with integrated pest management and natural control practices. When health effects were considered in the study, the net benefits of pesticide use were negative. Antle and Capalbo (1994) also outlined a conceptual framework that can be used to test behavioral hypotheses and to measure health-productivity tradeoffs. They discussed how the framework could be used to assess solutions to the pesticide-induced health problems in developing countries. Following Antle and Capalbo, Crissman et al. (1994) quantified the interaction among production technology, environmental quality, and human health in Ecuador. They reported significant health problems that caused loss of labor, exorbitant private health care costs, a reduction in productivity and impairment in decision-making abilities. These studies focused primarily on the health hazards caused by pesticides. Few studies have considered the other environmental impacts of pesticide use.

Some studies conducted in the United States provide useful insights into possible approaches to measuring environmental risks and benefits associated with IPM. Kovach et al. (1992) compared the environmental impacts of traditional pest management strategies with IPM strategies. They categorized the different environmental impacts into four major components: farmers, consumers, workers, and ecological effects. A variety of databases on toxicity of pesticides in different settings were then used to further classify and weigh the environmental impacts of various pesticides based on dermal toxicity, chronic toxicity, fish toxicity, and systemicity. This weighting allowed them to arrive at an environmental impact quotient (EIQ) by pesticide. Kovach and colleagues however, did not attempt to place an economic value on these differences in environmental impacts.

Higley and Wintersteen (1992) on the other hand, were able to determine the relative importance and monetary value of avoiding several environmental risks caused by pesticides through contingent valuation surveys. They used the contingent valuation method (CVM) to assess the relative importance that individuals place on various environmental risk categories and the amount they would be willing to pay to avoid high, moderate, and low levels of risk from a pesticide for a single application on a per acre basis. They assessed the environmental risks of pesticides on three broad areas of environmental risk: water quality, non-target organisms, and human health. These categories were further subdivided into eight specific categories (surface water, groundwater, aquatic organisms, birds, mammals, beneficial insects, and humans (acute and chronic toxicity). This model provided a formal method for assessing aggregate environmental risk from pesticides at the level of the individual users, as well as the regional or national level. Weights used to arrive at an aggregate environmental risk quotient were arbitrary however.

The contingent valuation method is one of the few procedures available for estimating environmental benefits of pesticide use reductions that has a theoretical rationale for the weights used to aggregate across environmental categories. Contingent valuation studies provide respondents with information about a hypothetical action that would reduce the likelihood of an environmental problem such as pesticide exposure. Respondents are confronted with a question or questions about the maximum amount they would be willing to pay to reduce the problem.

CVM as a technique for valuation of environmental goods or amenities is quite controversial. Some argue that because of the hypothetical nature of the CV questions, the method is prone to informational, hypothetical and strategic biases. Others believe that with a well-constructed survey, these biases can be minimized so that CVM results can be as reliable and accurate as other market-based valuation techniques.

Other methods like hedonic approaches, averting behavior, and replacement cost techniques can also be useful depending on the availability of data, complexity of the analysis, and validity of assumptions.

While techniques have been developed for valuing environmental costs, there remain serious theoretical and practical problems with use of these techniques. Measuring outputs of interest such as environmental quality, health, and profitability requires good empirical measures. There is also a need to go beyond measuring cost-of-illness, which others have done before, and to develop a method for measuring the multiple environmental and health outcomes.

Another challenge is to develop a quantitative measure of IPM adoption, as IPM is a collection of practices designed to reduce reliance on pesticide use. An ideal measure incorporates both absolute risks from pest management in a crop and relative progress toward diminishing the risk.

This study attempts to come up with an appropriate method to measure the economic value of environmental and health benefits of the IPM program in Nueva Ecija, Philippines. It draws on methodologies used in previous research (Owens et al., 1997; Mullenet al., 1997; Teague et al., 1995; Pingali et al., 1994; Kovach et al., 1992; Higley and Wintersteen, 1992) to develop a conceptual framework suitable to situations in developing countries like the Philippines.

Organization of the Study

The next chapter takes a closer look at previous research and the state of knowledge on the valuation of environmental and health impacts of pesticides. A description of existing methods used to measure environmental costs and benefits is provided.

Chapter Three describes the research methodology. The analytical framework and theoretical context of the study as well as the step-by-step procedure in evaluating the IPM program are discussed. Chapter Four describes the design and implementation of the survey conducted in Nueva Ecija, Philippines from November 1997- February 1998. Chapter Five reports the results of the descriptive analysis of the survey data and the results of the evaluation of the IPM program. Finally, the conclusions and recommendations derived from the study are provided in Chapter Six.