ASSESSMENT OF POLICIES AND SOCIO-ECONOMIC FACTORS AFFECTING PESTICIDE USE IN THE PHILIPPINES

by

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Thesis submitted to the Faculty of the

Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

MASTERS OF SCIENCE

IN

AGRICULTURAL AND APPLIED ECONOMICS

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September 1995

Blacksburg, Virginia

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(ABSTRACT)

A logit model was employed to determine the relative importance of socio-economic factors influencing the misuse of pesticides on vegetables in Central Luzon, Philippines. The analysis revealed an increase in pesticide misuse associated with the following factors: a high value placed on advice from a chemical company representative; membership in a cooperative, village or farmers' association; and visits by a Department of Agriculture technician to discuss non-pesticide means of controlling vegetable pests. Those factors which reduced pesticide misuse included: increased age and educational attainment; access to integrated pest management training through the Farmer Field School; receiving credit from a cooperative; and agreement with the perception that killing natural enemies could hasten pest infestation.

The effective rate of protection on nine pesticides was calculated to quantify the net effects of pricing and exchange rate policies on the degree of subsidy or tax experienced by pesticide importers. It was found that the effective rate of protection for the nine pesticides was between negative 12 and 25 percent when the exchange rate effects were accounted for. However, the rate of protection became more negative when the equilibrium exchange rate was used indicating that exchange rate overvaluation offset the tax pesticide importers face. In addition, the analysis indicated that pricing and exchange rate policies have created a six to eight percent subsidy on pesticide prices for the years 1989 to 1993. This subsidy on pesticides has increased both consumer and producers welfare and the quantity of pesticides used in the Philippines.

Acknowledgements

My deepest thanks go to Dr. George Norton whose guidance and encouragement were instrumental in the completion of this thesis. I would also like to thank Dr. Anya M. McGuirk, Dr. Edwin G. Rajotte, and Dr. Daniel B. Taylor for serving on my committee and for their valuable comments. Dr. McGuirk has been a true friend and source of inspiration over the last two years, Dr. Rajotte has widened my perspective on both entomologists and economists, and Dr. Taylor has been a kind and sympathetic instructor and advisor. I am also grateful to Dr. S.K. De Datta, Director of International Research and Development at Virginia Tech , for the opportunity to pursue research on the Philippines. Furthermore, this thesis would not have been possible without the assistance of many individuals associated with the Integrated Pest Management - Collaborative Research and Support Program in the Philippines. Of particular help were Dr. Santiago Obien, Dr. V. Gapud, and B. Canapi of the Philippine Rice Research Institute, Dr. K.L. Heong and A. Lazaro of the International Rice Research Institute, and all the wonderful people who participated in the Philippine Participatory Appraisal. A special thanks to my parents who forever remind me of their unconditional love and to Tad and Ian, my brothers and friends. Finally, my love and gratitude goes to Dr. William J. Trainor who made my time in Blacksburg more enjoyable than I ever thought possible.

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CHAPTER I : Introduction

I.1. Problem Statement

Since World War II, increased use of agrochemicals, both fertilizers and pesticides, has contributed to sizable gains in agricultural productivity in both developed and developing countries. The result has been a growing market for these chemicals, including certain pesticides that are potentially hazardous to the environment and human health. Concerns have been expressed that these health and environmental dangers may be particularly strong in developing countries where environmental laws tend to be lax and the public is less aware of potential problems than it is in developed countries.

In the Asia-Pacific region, the pesticide market was valued at $2.53 billion in 1985 (Rola and Pingali, 1993, p. 1). The Philippines alone spent $48 million on pesticides of which over half was for insecticides. Many of these compounds pose a threat to the overall viability of the ecosystem (Woodburn from Rola and Pingali, 1993). A recent study by the International Rice Research Institute (IRRI) found that injudicious use of insecticides in the Philippines, particularly early in the rice growing season, was disrupting the natural ability of the paddy ecosystem to cope with pest infestations. It also found the unsafe application practices were damaging farmer health. Rice productivity was found to decline when health effects were considered a production cost because of a reduction in labor productivity (Rola and Pingali, 1993). Antle and Pingali concluded the following:

> "statistical analysis confirms the theory that decreases in the health of farm workers are related to increases in the average cost of agricultural production. Thus it is in society's best interest to reduce pesticide use" (Antle and Pingali, 1991, p.16).

The conclusion that can be drawn from this and other recent attempts to incorporate health and environmental costs into productivity measurement is that productivity gains from the pesticide component of agrochemical use may be declining or even negative for certain crops/sites. While these negative productivity effects may be the result of misuse rather than simply use of pesticides, they nevertheless have motivated the search for alternative pest management practices that can reduce pesticide use.

Integrated Pest Management (IPM) has been proposed as an alternate technology to confront crop loss due to pests. According to Allen and Rajotte,

> "IPM is a systematic approach to crop protection that uses increased information and improved decision-making paradigms to reduce purchased inputs and improve economic, social, and environmental conditions on the farm and in society" (1990, p.381).

IPM is a process that incorporates the use of multiple tactics and multiple management goals. Tactics include social/cultural, biological, chemical, and legal/regulatory control (Allen and Rajotte, 1990). Management goals are a product of economics, regulation, community influences, and personal choice. Examples of IPM techniques include scouting, use of natural enemies, crop rotations, cultivation of pest resistant varieties, and pesticide applications only when economically justified after environmental and health costs are considered. IPM involves monitoring of pest populations and the crop involved in order to determine the best course of action for each particular pest problem. Rajotte describes IPM as, "determining how serious your problem is, and what your management options are, before you take action" (1993, p.296) The step-wise decision-making activity is essential to the IPM concept.

IPM techniques are currently practiced in the Philippines, particularly on rice, and IRRI, the Philippine Rice Research Institute (PhilRice), and other agencies of the Department of Agriculture of the Philippines (DA) conduct IPM training for farmers in many regions of the country. These efforts are fairly extensive and a large proportion of rice growers in the Philippines have already been exposed to IPM for rice. However, few IPM alternatives are currently available for vegetable producers in the Philippines. Vegetable IPM has received less research compared to IPM in rice, corn, and estate crops such as coconut, pineapple, and sugar. This inattention persists despite the increasing importance of vegetable production in the Philippines. Traditional rice farmers are turning to vegetable production to supplement their income, particularly in the dry season, as evidenced by the proportion of rice farmers who also produce vegetables and the growth rate of vegetable production (see discussion in Chapter 2). The support of IPM by PhilRice and IRRI is resulting in more appropriate pesticide use and an overall reduction of pesticides applied to rice. Yet, little information has been generated or disseminated on pest management for the vegetables cultivated by these rice farmers (e.g. onions, stringbean, eggplant and tomatoes).

Vegetable IPM is only beginning to demand the attention of the National IPM program and international donors through a small program on cabbage. The primary pest control alternative currently available for vegetable farmers is pesticide use. Not surprisingly, the lack of attention given vegetable IPM has created an information vacuum that has been filled by pesticide dealers, chemical company representatives, vegetable traders, and money lenders. Pesticide dealers and chemical company representatives perform on-farm trials, visit individual farms, and make recommendations as to production procedures. Vegetable traders encourage pesticide use, especially on exported vegetables, in order to protect the appearance of the crop. Money lenders, who often provide credit to vegetable farmers, support high levels of pesticide use as pest infestation would significantly reduce the ability of the farmer to pay back their loan. The result of these influences on farmer practices has been a heavy reliance on pesticides for all pest problems on vegetables and, in many cases, apparent pesticide misuse. For example, producers in the Philippines apply up to 50 insecticide sprays per season on eggplant (Lazaro et al, 1995). This excessive spraying may be due to a lack of information about alternative IPM practices.

From the farmers' perspective, pesticide misuse occurs whenever a pesticide is applied such that its choice, amount, or timing fails to control the pest in an economically optimal manner and/or if the pesticide is applied in such a way that it causes health problems for the farmer or the farm family. From society's perspective, pesticide misuse occurs whenever a pesticide is applied such that its choice, amount, or timing fails to control the pest in an economically optimal manner, where economically optimal implies that all environmental and health costs associated with pesticide use have been included. Pesticide misuse has both short and long term impacts. Short-term impacts include deterioration of the farmers' health, potential productivity loss, increased input costs, and decreased water quality on the farm. Long-term impacts of pesticide misuse can include pollution of streams and groundwater, immunity of pests to certain pesticides and the resulting pest infestations, deterioration of natural enemy populations, endangerment of other animal species, and a general decrease in human welfare due to pesticide residuals on vegetables.

Despite these short and long-term effects, the current policy environment could also be encouraging misuse of pesticides. Credit, pricing, and exchange rate policies may be providing economic incentives for pesticide misuse, while regulatory policies make enforcement of pesticide policies difficult. For example, the Landbank of the Philippines was created to assist farmers with credit as a part of the land reform legislation of the 1970s. It is a government agency with branches in each region of the Philippines which assists farmers in securing credit for agricultural production. Landbank loans are usually funneled through cooperatives before they reach the farmer. A percentage of these loans can be provided in the form of inputs such as fertilizers and pesticides. One stipulation for receiving Landbank funds is that the farmer prepare a "farm plan" which must be signed by an agricultural technician from the Department of Agriculture. This is necessary in order to receive crop insurance. Pesticides are currently a mandatory part of this farm plan. Consequently, a farmer who receives credit through the Landbank has a fixed supply of pesticides to use at the beginning of the season. This creates the incentive to be pro-active instead of reactive when using pesticides.

Pricing policies may also be providing an incentive to misuse pesticides. There is currently a tariff placed on all technical pesticides (unprocessed active ingredient) and formulated pesticides (final product) entering the Philippines. As no pesticide active ingredients are manufactured in the Philippines, 100 percent of all pesticides face an import tax. Currently, about 60 percent of pesticides imports are technical imports while 40 percent are formulated. The tariff on the former is 5 percent and on the later is 10 percent. However, the disincentives for pesticide use provided by these tariffs may be offset by the exchange rate policies which have created an overvaluation of the peso. The effect of any currency overvaluation would be to subsidize pesticide imports. A Value Added Tax (VAT) recently implemented by the Philippine legislature would increase the tax on pesticides by 10 percent. The VAT would reduce the amount of pesticide subsidy, but, on net, pesticides might still be receiving a small subsidy. However, the net effects of all these policies on the degree of pesticide subsidy or tax needs to be systematically examined before a definite conclusion can be drawn.

The Fertilizer and Pesticide Authority (FPA) is the national body in charge of regulating pesticides in the Philippines. All pesticide handlers must be licensed with the FPA and are periodically visited by an FPA agent to inspect their inventory. However, the FPA is not legally equipped to levy fines as a means of enforcing pesticide bans as it was not created by legislative decree. This lack of enforcement may be resulting in significant abuse of pesticide regulations. The FPA can suspend dealer licenses for selling banned pesticides and this policy tool has been used on a regular basis over the past year. In 1994, approximately 120 of the 700 registered pesticide dealers had their licenses suspended for periods averaging from a few weeks to a month, although some suspensions have been as long as a year. The large number of suspensions indicate a high degree of banned pesticide sales. In summary, the combined effect of a lack of information on non-pesticide alternatives for pest management in vegetables, lack of farmer training on the proper use of pesticides, and the economic incentives created by national policies appear to be causing pesticide misuse by vegetable farmers in the Philippines.

The Philippine Department of Agriculture has identified IPM as one of its three priorities by presidential decree. In addition, there is extensive support for the National IPM Program by the Philippine government, the Food and Agriculture Organization (FAO), IRRI, the Asian Development Bank (ADB), the World Bank, and the U.S. Agency for International Development (USAID). The later is supporting IPM through its IPM Collaborative Research Support Program (IPM-CRSP) that is focusing on vegetables in the Central Luzon. For these efforts to be effective, national policy needs to create an environment conducive to IPM adoption. The first step in creating such an environment is to evaluate the information currently received by farmers and the nature and magnitude of the economic incentives they encounter to use pesticides alone versus IPM. This research is a necessary step in understanding current pest management incentives for vegetables in the Philippines.

I.2. Objectives

This thesis has three primary objectives:

1) to determine the relative importance of socio-economic factors influencing the misuse of pesticides by vegetable farmers in the Central Luzon, Philippines,

2) to quantify the net effects of pricing and exchange rate policies on the degree of pesticide subsidy or tax faced by pesticide producers and users, and

3) to describe the direct and indirect effects of these pricing, exchange rate, credit, and pesticide regulatory policies on consumer and producer welfare.

By achieving these objectives this study provides information to decision-makers as they evaluate policies affecting pesticide use. In addition, the analysis identifies a set of steps that might be used to evaluate pest management policies in other countries. It also provides information to decision-makers regarding strategies that may increase farmer adoption of IPM. Finally, this thesis provides policy-makers with information on how their actions may influence producer and consumer welfare.

I.3. Hypotheses

I.3.1. Testable Hypotheses

1) Pesticide misuse is positively influenced by the following factors: the increasing age of the farmer; membership in a cooperative, farmer organization, or village association; receiving credit to produce vegetables from a cooperative/Landbank, friend, or money lender; receiving credit in-kind as pesticides; and using pesticide price,

pesticide dealer advice, and/or chemical company representative advice when deciding which pesticide to use.

2) Pesticide misuse is negatively correlated with the following factors: farmer education; security of land tenure status; increased levels of family labor; access to IPM training; visitation by an agricultural technician discussing non-pesticide means of pest control; using information from an agricultural technician and/or the FPA safety labels when deciding which pesticide to use; agreement with the perception that killing natural enemies hastens pest infestation; agreement with the perception that pesticides can harm water quality; and the belief that either the farmers' own water quality has been harmed by pesticides or a family member has become ill due to pesticide exposure.

I.3.2. Working Hypotheses

1) Current credit policies provide an incentive for pesticide misuse.

2) The powers afforded the FPA are insufficient to fully enforce pesticide regulations and, therefore, contribute to the environmental and health costs of pesticide use on vegetables.

3) Current tariff and exchange rate policies, on net, increase the welfare of pesticide producers and dealers.

4) Current tariff and exchange rate policies decrease the welfare of onion consumers and producers when environmental and human health costs due to pesticide misuse are taken into account.

5) Government policies have tended, overall, to encourage pesticide use in the Philippines.

I.4. Procedures and Data Sources

Regression analysis using survey data from 164 farmers in six villages in Nueva Ecjia province is used to determine the factors influencing pesticide misuse by vegetable farmers. Farmers are categorized as pesticide misusers or non-misusers and a limited dependent variable model employed. The degree of direct or indirect taxation or subsidy of pesticides is calculated using data from the Philippine Bureau of Statistics and other sources with observations for the years 1989 to 1993. Economic surplus analysis is used to estimate the welfare effects of the national policies addressed in this study.

I.5. Organization of Thesis

This analysis is divided into five sections. Chapter 2 presents the relevant production and policy trends in the Philippines in the last decade and summarizes the results of a participatory appraisal and farmer baseline survey conducted by the IPM-CRSP in 1994-95. Chapter 3 describes the methods of analysis used, accompanied by a discussion of salient studies incorporating these methods. Chapter 4 summarizes the results of the regression analysis on factors affecting pesticide misuse by vegetable farmers in the Philippines, the net effects of national policies on the degree of pesticide subsidy or tax, and the direct and indirect effects of national policies on consumer and producer welfare. Finally, Chapter 5 summarizes the results of the analysis and discusses policy implications.

CHAPTER II: Background

II.1 Introduction

The purpose of this chapter is to describe the Philippine economic and pest management setting. It provides background information on the Philippine economy and agricultural sector, a discussion of current pesticide use and IPM activities within the country, a description of national policies affecting pesticide use, and reviews the results of the participatory appraisal and the Baseline and Follow-up Baseline surveys conducted by the IPM-CRSP. Information provided in this chapter is meant to create a foundation for the subsequent analysis.

II.2 The Philippine Economy and Agricultural Sector

The Philippines is comprised of approximately 7,100 islands in Southeast Asia. The islands of Mindanao and Luzon make up two-thirds of the country's land area of 300,000 square kilometers. In 1994 the total population of the Philippines was 64.3 million with an annual growth rate of 2.4 percent.

II.2.1 The Philippine Economy

The Philippine economy has experienced periods of variable growth and decline since the 1950s. Classified by the World Bank as a lower middle-income country, the Philippines experienced GNP growth rates of 8 percent for the years 1950 to 1956, 5 percent from 1957 to 1972, 6.8 percent from 1972 to 1979, but a negative rate from 1980 to 1987 (Intal and Power, 1991). The Gross National Product (GNP) rose steadily from 1988 to 1992, increasing from 652,612 million pesos to 727,115 million in constant prices. However, Gross Domestic Product (GDP) declined for two consecutive years from a peak in 1990. GDP fell from 717,255 million pesos in 1990 to 712,589 in 1991 and 712,332 million pesos in 1992. The GDP growth rate declined from 6 percent from 1970 to 1980 to 1.2 percent from 1980 to 1992. The discrepancy between GNP and GDP in the early 1990s was due to a rise in net factor income from abroad which has become increasingly important to the Philippine economy (Philippine Agribusiness Factbook, 1993-1994). Consequently, unlike many of its Asian neighbors, per capita income in the Philippines has steadily deteriorated. GNP per capita was estimated at $770 in 1994 but experienced an annual average growth rate of negative one percent for the period 1980 to 1992. This negative growth rate has been reversed in the last two years (1993 and 1994).

Economic conditions in the Philippines have not always been so adverse. The Philippines was favored by the international economic environment in the 1950s and 1960s, due in part to U.S. tariff preferences under the Bell Trade Act and Laurel-Langley Agreement which boosted Philippine trade considerably. However, instead of exploiting this propitious trade situation, Philippines policy focused on import substitution. With the advent of the 1973 and 1979 oil shocks and the ensuing global recession, export markets became less stable and export prices varied considerably. The Philippines, which relied heavily on imported oil to satisfy the country's energy needs in the 1970s, found oil to be an increasingly large part of their overall import payments. Decreasing export revenue coupled with increased import obligations created a deterioration in the Philippines' external terms of trade which increased in magnitude through the early 1980s. Intal and Power state that this deterioration is comparable in extent only to the Great Depression.

The Philippines incurred debt in order to finance the rising cost of imports. This increasing reliance on external financing for imports and investment led to the debt crisis of the 1980s. World interest rate hikes during the 1979 to 1982 period increased the Philippines' already large external debt payment, which has variable interest rate terms. The effects of the debt crisis included a significant drop in the growth of production for every segment of the economy. Growth in Agriculture fell from an average annual rate of 4 percent in the 1970s to only 1 percent in the 1980s. The industrial sector experienced a decline from 8.2 percent to negative 0.2 percent for the same two periods; manufacturing fell from 6.1 to 0.7 percent; and the service sector incurred a 5.1 to 2.8 percent drop. The negative effects of the debt crisis were more extensive in the Philippines than for any of its Asian neighbors.

Lagging economic growth in the early 1990s was also blamed on government intervention in the economy (Intal and Power, 1991). Intal and Power, in their World Bank Comparative study on the Philippines (1989), state that intervention worked against basic principles of comparative advantage and, "led to serious misallocation and underutilization of scarce capital and foreign exchange resources" (Intal and Power, 1989, p.150). Most of the interventionist policies began during the balance of payments crisis after World War II. The period of 1949-50 saw the introduction of foreign exchange and trade controls which have continued in various forms to the current day. According to Intal, "It is widely acknowledged that the industrial stagnation of the Philippines during the past two decades is rooted in the inward-looking bias of the industrial policy regime brought about by the high and cascading structure of tariffs, import controls, and the overvaluation of the peso" (RTPAP, 1990, p. 125).

However, new developments in the GATT are challenging the extensive use of trade controls in the Philippines. Under scrutiny are not only import restrictions but export subsidies as well as other direct and indirect protectionist measures. The recent GATT agreement, as ratified by the President Ramos of the Philippines, will instigate a period of tariff restructuring and reduction. These changes in Philippine trade policy will substantially affect the agricultural sector.

II.2.2 The Agricultural Sector

Agriculture accounts for approximately 20 percent of GNP in the Philippines down from 30 percent in 1970. The agricultural sector has experienced steady growth over the past forty years with an annual growth rate of 3.9 percent in the period from the 1950s to late 1980s (Balisacan, 1991). However, the World Bank estimates that the growth rate for the 1980s was only 1 percent. The rapid upward trend in agricultural growth was interrupted in the 1980s as food production on a per capita basis declined to a level 10 percent below that prevailing at the beginning of the decade. This decline is partly explained by the increase in the Philippine population. In 1994, the agricultural growth rate increased to 3.16 percent, an indication of the rapid economic growth in Philippines the last couple of years (BAS, 1995). Farm size in the Philippines has decreased over the last thirty years while the number of farms and the overall area farmed has increased. In 1960, the average farm size was 3.59 hectares covering 7,772,484 hectares for a total of 2,166,216 farms. By 1980, the number of farms had increased to 3,420,323 with an average size of 2.84 hectares covering a total of 9,725,200 hectares. A majority of these farms are owned by their operators although nearly 90,000 farms are leased (Philippine Agribusiness Factbook, 1993-1994). The percentage of total farms owned by the farmer has not changed significantly since 1960.

Although only 3% of the farms are over 10 hectares, these farms cover over one quarter of the agricultural land in the Philippines. This disparity between large land holders and small peasant farms is atypical in Asia and is associated with high instances of poverty (60-80 percent) in rural areas where the majority of the poor are located (Balisacan, 1990). According to Balisacan (1990, p.1), "The incidence of poverty is particularly high for farmers dependent on rice and corn farming. Almost half of the poorest rural farm households are involved in rice production." A study by Balisacan on rural poverty in the Philippines found that the poorest among the rural poor were not only landless or dependent on wage labor but also owner-operators. "The paper shows that the intensity of poverty for the self-employed households, as indicated by their average income shortfall, is as severe, if not more severe, than that for wage-dependent households" (Balisacan, 1991, p.26). These self-employed households include primary lessees and small owner-cultivators.

II.2.3 Vegetable Production

One response by farmers to increased rural poverty has been exploration of alternative crops for income generation. Vegetables have emerged as a high potential crop for this purpose and are the focus of this thesis. In 1980, 47,700 hectares of the total area of farmland were devoted to vegetables (Philippine Agribusiness Factbook, 1993-1994). The vegetables of greatest importance for this study are onion, garlic, cabbage, eggplant and tomato. The Philippines is considered to have a comparative advantage in onions, garlic and tomatoes. Growth rates in onion and garlic were 20.5 and 31 percent respectively in 1994 with an increase in area planted to garlic. The same trend occurred for eggplant and tomato which experienced a growth rate of 10.7 and 11 percent respectively. Gross returns to onions, garlic, tomato and eggplant all increased in 1994 with onions grossing an additional 108.15 percent (BAS, 1995).

These trends were not always so promising. Vegetable production in the Philippines varied considerably in the 1980s but generally declined 0.9 percent over the entire ten-year period. However, vegetables are considered to have great export and import substitution potential and currently contribute roughly 10.5 percent of the total Gross Value Added in agriculture. Vegetables can also be used as raw materials in processed food products and are considered to have good employment potential. Employment generation from vegetables is considered high as it requires 600 person-days per hectare per year (DOA, 1992). According to the Philippine *Fruit and*

Vegetable Development Plan 1992-1995 (p.1), "Increased [vegetable] production will therefore mean more employment opportunities, more efficient utilization of farm resources, and increased incomes for more farmers."

Department of Agriculture calculations predict that domestic demand for onions, garlic and tomatoes will increase by 2.3 percent in the next four years if population and real per capita income increase by 2.4 percent and 1 percent per year, respectively (DOA, 1992). Projections for export demand also indicate increased demand over the next few years given per capita income increases in industrialized countries. These favorable projections explain the goal of the DOA's Vegetable Development Plan for 1992-1995 to help the country attain a more favorable balance of trade through increased vegetable exports.

Many vegetables are protected by trade barriers such as high import tariffs. Importation of onions, garlic and cabbage are banned under the Tariff and Customs Code of the Philippines (TCCP) while import levels of tomatoes are highly restricted. However, with the passage of the GATT, restriction of these imports will be gradually reduced from 100 percent to 40 percent by the year 2004. According to the president of the National Onion Growers Cooperative Marketing Association, the reduction of import restrictions on onions will have a disastrous affect on the Philippine onion industry. "Onion farmers are saddled with high seed cost, high interest cost, high fertilizer and pesticide cost, in short high cost of production" (Guzon, 1994, p. 2). These high costs of production, similar for all vegetables, would impair Philippine producer's competitiveness when compared to U.S, New Zealand, Taiwan, Chile, Thailand and China's producers. However, many of the factors increasing production costs, especially the tariff-ridden costs of agricultural inputs, will experience reduced tariffs because of GATT which could lower vegetable production costs.

II.3 Pesticide Use and IPM Activities

One of the main constraints to increased vegetable production is the problem of pests. In the Philippines, nearly all vegetable producers use a regimen of pesticides to help reduce crop losses and, often, to enhance the appearance of the product for marketing purposes. However, high levels of pesticide use can be detrimental to human health and the environment without necessarily enhancing production levels. Moreover, pest management can be accomplished using a variety of non-chemical, integrated pest management methods in addition to or in place of pesticides.

II.3.1 Pesticide Use

Pesticide use in the Philippines has grown substantially since the mid 1970s. The growth rates of total pesticide imports indicate a 93 percent increase in volume of insecticides imported and a 537 percent increase in the importation of fungicides from 1977 to 1987 (Rola, 1992). As stated by Rola in the *Multi-Agency Task Force on Pesticide Policy*, the increase in fungicide volume is due primarily to increased use on fruits and vegetables. She also indicated that pesticides are most prevalent on three crops: vegetables, banana, and rice. "In terms of pesticide use per unit area, it has been estimated that vegetables have the highest value of pesticide use for the period 1977 to 1981" (Rola, 1992, p.51). Pesticide expenditure on vegetables was valued at US$ 223.83 per hectare in 1981 compared to only $8.23 per hectare spent on pesticides for rice (Rola, 1992). The value of pesticides sales at the distributor level for the years 1985 to 1992 are presented in Table 2.1.

There have been a variety of studies focusing on pesticide use in the Philippines and its impact on health and the environment. One such study concentrated on the impact of pesticides on farmers' health and the rice environment in Leyte, Philippines. The study looked at the misuse of pesticides in that region by analyzing farmers' intended targets and timing of sprays applied. In this instance

Table 2.1 Value of pesticide sales for the years 1985 to 1992 (pesos).

Pesticide\Year	1985	1986	1987	1988
Insecticides	692,537,143	786,944,200	958,383,004	955,056,588
Fungicides	130,016,809	129,041,177	134,234,015	117,650,133
Herbicides	221,289,886	288,232,966	302,269,560	440,645,519
Others	95,672,853	96,687,130	117,206,260	228,712,422
Total	1,139,516,691	1,300,905,473	1,512,092,839	1,742,064,662

Pesticide\Year	1989	1990	1991	1992
Insecticides	1,115,865,365	1,412,384,096	1,685,768,420	1,718,428,679
Fungicides	130,236,628	171,367,895	154,523,498	169,830,887
Herbicides	484,120,627	515,811,415	665,108,417	691,906,770
Others	372,833,878	157,210,457	253,200,789	323,674,309
Total	2,103,056,498	2,256,773,863	2,758,601,124	2,903,840,645

Source: Agricultural Pesticide Institute of the Philippines (APIP).

misuse was defined as the improper or incorrect use. "Thus, when a pesticide is used for the wrong target or at the wrong time or both, it can be considered to be misused" (Heong, Escalada, and Lazaro, 1993, p.6). It was found that more than 80 percent of the sprays applied in Leyte in the 1991 wet season were misused. In addition, some of the pesticides used by farmers were deemed highly hazardous to human health.

According to the authors, farmer's perceptions of pests greatly impact their pest management practices (Tait and Napompeth, 1987; Mumford and Norton, 1984; Rola and Pingali, 1993). Moreover, a majority of farmers believe that pests are a major constraint to higher yields (Litsinger, et al, 1980; Heong, 1984; Heong et al, 1985; Rola and Pingali, 1993). These perceptions lead to pesticide misuse. The study found that, "Improper use was mainly because farmers overestimated crop loss due to injuries caused by highly visible species" (Heong, Escalada, and Lazaro, 1993, p.1). It was noted by the authors that many social and human factors influence the pest management practices of farmers and their perceptions of pests. They include association of pesticides with medicine, risk aversion, media messages, and pesticide promotion campaigns as influencing factors (Escalada and Heong, 1993). Reducing pesticide misuse was considered beneficial to farmers and human health. IPM training through a variety of methods is a necessary approach to eliminating pesticide misuse.

A second study conducted in the Philippines also looked at the impact of pesticides on productivity and human health. In their book, *Pesticides, rice productivity, and farmers' health* (1993), Rola and Pingali found that pesticide use on rice actually reduces productivity, once associated health costs are accounted for. They found that the natural control option (preserving natural enemies) was often the economically dominant pest management strategy. The authors argue that the best way to achieve natural control is by not using pesticides at all. Second, indiscriminate use of pesticides was found to increase pest-related yield loss over that which would have occurred had pesticides not been used at all. Third, this study also found that farmers' perceptions of productivity due to pests were greater than actual losses. Finally, the study indicated that pesticide use on rice will remain lower than other high-value crops as pesticides do not enhance rice quality in any way. However, the authors noted that vegetable farmers are concerned with quality, as the price premium for an unblemished appearance is high. "Risk-averse farmers tend to apply pesticides heavily to capture this price differential" (Rola and Pingali, 1993, p. 4).

The finding in the two studies suggests that if pesticides are creating productivity and health problems for rice farmers, pesticide use could be even more problematic for vegetable producers who tend to use high quantities of pesticides. In general, Antle and Pingali (1991) found chronic exposure to pesticides to contribute negatively toward labor productivity. Also at risk are many consumers who are exposed to pesticide residue left on vegetables or fruit. Environmental effects such as groundwater contamination and danger to wildlife and beneficial insects will also impact productivity and human health. Pesticide misuse on vegetables is a problem with manifold effects. It is the objective of this study to determine those factors influencing pesticide misuse.

II.3.2 Integrated Pest Management

In 1993, the Department of Agriculture implemented the National Integrated Pest Management Program, Kasaganaan ng Sakahan at Kalikasan (KASAKALIKASAN, meaning "one with nature"), in major rice, corn and vegetable growing regions of the Philippines. The National IPM Program, created by presidential decree (Memorandum Order No. 126), was an attempt by the Philippines to pursue sustainable food production practices and to further rural development. The major goal of the program has been to make IPM the standard approach to pest management for target crops including vegetables. Although IPM techniques have been applied to rice in the Philippines since 1978, the National IPM Program seeks to extend the number of crops on which IPM is practiced. KASAKALIKASAN is working with farmer organizations, non-governmental organizations, local government units, and policy makers to realize this goal. According to Department of Agriculture Special Order No. 550:

> "The Program aims at promoting the use of IPM among farmers by direct farmer-training in season-long Farmer Field Schools (FFSs). A cadre of field workers from LGUs and NGOs, including farmer-leaders shall be trained as IPM trainers. The Program shall provide support to IPM research through contract research and studies by research institutions as well as farmer-driven action research activities. In addition, the Program shall conduct training activities to strengthen the capacity and capability of LGUs and NGOs to carry out effective local IPM programs" (DOA, Special Order No. 550, 1993, p.1).

It is the contention of the National IPM Program that IPM adoption has positive social and economic impacts at the farm, village, and national levels. At the farm level, IPM adoption will decrease expenditures on pesticides, increase crop yields, lower production risk, and create a cleaner village environment. Benefits of IPM adoption at the national level include decreases in large pest outbreaks, savings of foreign exchange and reduced environmental damage from the handling, storing, transportation and use of pesticides (Kasakalikasan Program Document, 1993).

II.4 Policies Affecting Pesticide Use

Pesticide use is affected by both direct and indirect government policies. Therefore, it is no surprise that Rola and Pingali argue, "Pesticide import, licensing, and pricing policies are essential components of a national IPM program" (Rola and

Pingali, 1993, p.6). Pesticide policies impact farm production decisions and, consequently, influence a farmer's decision to adopt IPM techniques. Those policies of greatest importance include: pesticide pricing policy, exchange rate policy, credit policy and crop insurance, and regulatory policy.

II.4.1 Pricing Policies

Pesticide pricing policies have a direct effect on pesticide use if price is considered by the farmer when purchasing inputs. Prices in the pesticide market are affected by government policy via tariffs. Technical pesticides are not produced within the country. Therefore, all pesticides sold within the Philippines are subject to tariffs under the TCCP. Formulated pesticides face a 10 percent tariff upon entry while technical pesticides face a 5 percent tariff. Formulated and technical pesticide tariff rates have been at these levels for over a decade.

The Tariff Reform Program (TRP) for the agriculture sector, proposed by the Department of Agriculture, would reduce these tariffs over time. A unitary tariff of 5 percent is scheduled to be in effect in the year 2004. As an interim target, all rates should be at the 3 or 10 percent levels by the year 2000. The tariff on technical pesticides is expected to be reduced to 3 percent immediately. However, it is projected that formulated pesticides will remain at a 10 percent tariff rate until 1998 when they will also be reduced to 3 percent. A tariff on an agriculture input constitutes a tax levied on the producer of a given agricultural good. In this case, pesticide tariffs are in effect taxing vegetable producers in the Philippines. However, other direct or indirect policies, when added to the taxing effect of pesticide pricing policies, can create a greater tax or a net subsidy.

Anther tax placed on pesticide imports is a Value Added Tax (VAT) of 10 percent. Proposed by the Department of Finance and recently ratified by the Philippine Legislature, the VAT is a measure purely aimed at increasing government revenue. The VAT is added to the tax on pesticides faced by vegetable producers and is levied at the retail level.

II.4.2 The Exchange Rate

One indirect mechanism for subsidizing imports is an over-valuation of the national currency just as a tariff is a direct means of taxing imports. In the case of the Philippines, an over-valued exchange rate could be affecting pesticide use by creating a net subsidy on pesticide imports. The exchange rate in the Philippines is reportedly much higher than the rate which would prevail in the absence of government intervention. One possible reason for this has been the tendency for Philippine governments to delay peso devaluation. Trade and exchange controls have been used periodically in an attempt to maintain an official exchange rate "in the face of an exchange shortage at the prevailing rate" (Intal and Power, 1991, p.153). In their World Bank study, Intal and Power estimated the divergence between the nominal exchange rate and the nominal free-trade equilibrium rate for three year periods between 1960 and 1986. The degree of divergence ranged from 14.31 percent in the 1962-66 period to 24.55 percent in the 1980-82 period. The study performed the same analysis for real exchange rate as compared to the real free-trade equilibrium rate. Estimates of the degree of divergence ranged from 18.58 percent in the 1962-66 to 27.9 percent between 1980 and 1982.

Overall, Intal and Power estimate that, "the Philippine peso would have been about 22 percent higher under free-trade exchange rates than under the actual official exchange rate during 1960-86" (Intal and Power, 1991, p.153). If both a balanced current account and free-trade conditions are assumed, this estimate increases to about 24 percent. This over-valuation has the affect of subsidizing all imports at the rate equal to the estimated degree of divergence. Therefore, a tariff of 10 percent would be offset by an indirect subsidy of approximately 22 to 24 percent. In such a case the net outcome would be a 12 to 14 percent subsidy on pesticides despite direct trade policies aimed at taxing pesticide use. Rola and Pingali argue that it would not be economically sensible for farmers to invest in IPM training if pesticides are subsidized. They insist that, "removing all explicit and implicit subsidies on pesticides is essential to reduce pesticide use on farms" (Rola and Pingali, 1993, p.6).

II.4.3 Credit Policies and Crop Insurance

Credit policies and crop insurance could also be affecting vegetable farmers use of pesticides. Philippine farmers receive credit from a variety of sources including: government credit agencies, cooperatives, private banks, money lenders, traders, friends, neighbors, and family. Government policy has little to do with most of these financial sources. However, the Landbank, created by presidential decree, is the government run credit agency which works through cooperatives as well as with individual farmers. Receiving a loan financed by the Landbank entails compliance with certain regulations which may affect pesticide use. Receiving credit from the Landbank does not itself affect pesticide use but to receive this credit for rice or corn a farmer is required to "purchase" crop insurance. Crop insurance is purchased by forfeiting approximately 5 percent of the value of the loan. It is the insurance program associated with Landbank credit which may impact pesticide use.

The Philippine Crop Insurance Corporation (PCIC) was created by Presidential Decree No. 1467. According to the decree and a subsequent amendment, rice and corn crop insurance is compulsory upon receiving Landbank funds (a production loan under the supervised credit program for the Government) and optional to self-financed farmers. In order to qualify for crop insurance a farmer must,

> "agree in writing that he will apply proven farm practices necessary to conserve the land, improve its fertility and increase its production, and abide by the approved farm plan and budget jointly prepared by him

and the duly accredited supervised credit technician" (PD1467, 1978, p.3).

As many vegetable farmers are also rice farmers, the "farm plan" associated with rice credit and insurance can also affect vegetables. Farm plans may stipulate receiving a certain amount of credit "in-kind" as pesticides or other agricultural inputs. At the very least they apportion a certain amount of the loan for pesticide purchase whether or not the pesticides are needed. This amounts to a production "package" which is developed prior to the growing season. Although the farm plan is flexible after the season begins, it may hinder the use of non-chemical pest management techniques.

The impact of the farm plan is highly variable and dependent on the advice given by the DA or Landbank technician who supervises and approves the plan. However, assigning a portion of the credit to pesticide purchase would be expected in any case. It is the opinion of many experts associated with IPM efforts that "pre-season" or "package" input decisions, such as those promoted by the Landbank's farm plan, are detrimental to IPM adoption and may actually cause pesticide misuse. Package input decisions are in direct conflict with the step-wise decision-making procedures used with IPM.

II.4.4 Regulatory Policies

The regulating body governing pesticide use in the Philippines is the Fertilizer and Pesticide Authority (FPA). Created in 1978 by Presidential Decree 1144, the FPA was originally given control over the, "importation, distribution, sale, transport, storage, labelling, use and disposal of pesticides and fertilizers" (Rola, 1992, p. 52). The primary activities of the FPA are: (1) the registration of pesticide active ingredients and formulated products; (2) licensing of all pesticide distributors and pest control operators; and (3) agro-medical training programs for Department of Agriculture (DA) personnel, health workers, pesticide dealers, and farmers. It is within the power of the FPA to restrict or ban the use of any pesticides or pesticide formulation which is considered dangerous to human health or the environment. In this way, the FPA may help diminish the amount of pesticide misuse by restricting use of the most harmful pesticides.

As recently as June 1, 1994 the FPA banned six pesticides and restricted the use of two others. One of the pesticides which was banned, Methyl Parathion (the active ingredient in 12 brand name products), has been heavily used on vegetables in the past as evidenced by the baseline survey results (see below). Two other widely used pesticides for vegetables, Endosulfan and Monocrotophos, have been restricted from use in paddy rice but are still available for use on vegetables. A list of banned and restricted pesticides is provided in Table 2.2. Support for the efforts of the FPA are widespread as indicated in this statement by Rola (1993, p.6). "More discretion should be used in importing and licensing agrochemicals. Chemicals that persist in the...environment, harm aquatic life, and induce a resurgence of pest populations should be banned in favor of safer chemicals".

Pesticide distribution, from the plant to the retail level, is controlled by the private sector. Registered pesticide dealers sell formulated pesticides to cooperatives and farmers. Chemical companies often sponsor trainings for farmers and DA technicians on use of their pesticides. They have also been known to provide information on IPM and to perform field trials within farming communities to test their products. Many farmers receive their pest management information from chemical company representatives instead of DA technicians. The information source used in pest management decisions could affect a farmer's use or misuse of pesticides.

II.5 Survey and Participatory Appraisal Results

Two surveys and a participatory appraisal were performed in the province of Nueva Ecija between June of 1994 and March of 1995 under the auspices of the

Table 2.2 Banned and restricted pesticides in 1994.

BANNED PESTICIDES

Common Name	Brand Name	Company
Azinphos Ethyl	Bionex 40 EC	Planters Products
	Gusathion 400 EC	Bayer Philippines
	Marsathion 40 EC	Marsman
	Telothion 40 EC	Shell Chemicals
Methyl Parathion	Folidal M50 EC	Bayer Philippines
	Meptox 50 EC	Shell Chemicals
	Methion 50 EC	Marsman
	Methyl Fosferno 50 EC	Jardine Davies
	Parapest M 50 EC	Planters Products
	Penncap M (encap)	Aldiz
	Wofatox 50 EC; 80 EC	Chemie Int'l
	Wofatox Konzentrat 50 EC; 80 EC	Chemie Int'l
Organotin Compounds		
Triphenyltin Acetate	Brestan	Hoechst Philippines
Triphenyltin Chloride	Aquatin 20 EC	Planters Products
Triphenyltin Hydroxide	Telstan 60 WP	Shell Chemicals
Fenbutatin Oxide	Torque 50% WP	Shell Chemicals

RESTRICTED PESTICIDES

Common Name	Brand Name	Company
Endosulfan	Thiodan 35 EC	Hoechst Philippines
	Thiondan 35 WP	Hoechst Philippines
	Endosulfan 35 EC	Marsman
	Endox 35 EC	Planters Products
	Endosulfax 35 EC	Aldiz
Endosulfan + BPMC	Thiocarb 47 EC	Hoechst Philippines
Monocrotophos	Azodrin 168	Shell Chemicals
	Azodrin 202 R	Shell Chemicals
	Nuvacron 30 SCW	Ciba-Geigy
Monocrotophos + Cypermethrin	Azodrin 137	Shell Chemicals
Monocrotophos + Fenvalerate	Azodrin 150	Shell Chemicals
Monocrotophos + Mevinphos	Azodrin 202	Shell Chemicals

Source: FPA Notebook, May 1984.

USAID funded IPM-CRSP. The primary and secondary surveys were used to establish baseline data for further analysis of IPM adoption in the area. The primary survey contained mostly scientific questions while the secondary survey included socio-economic questions (See survey form in Appendix A). A participatory appraisal was also conducted to ascertain the current nature of crop production, pest problems and perceptions, and pest management practices in the province and to elicit the knowledge and opinions of a variety of stakeholders. Included in the participatory appraisal were interviews with farmers, pesticide dealers, Department of Agriculture technicians, hospital personnel, cooperatives, vegetable wholesalers, government officials, pesticide company representatives, and university personnel. It was the objective of the participants in the participatory appraisal to gain a better understanding of the factors influencing pest-management practices on vegetables in Nueva Ecija.

II.5.1 Survey and Participatory Appraisal Area

Within the province of Nueva Ecija is an area called San Jose City composed of 38 barangays or villages of which 33 are primarily agricultural. The total land area in San Jose is 18,725 hectares with a total population of 92,083. Six villages within the San Jose City were targeted for the two surveys and the participatory appraisal activity. Those villages were the following: Saint Tomas, Abar 1st, Sibut, Palestina, Kita-Kita, and Tayabo. Together these six villages composed approximately 44 percent of the total agricultural land in San Jose City.

Fifty farmers from each of the six villages were surveyed in June 1994 (Lazaro et al, 1995). The surveys concentrated on vegetable and rice production in the San Jose area. Vegetable crops produced in this area include: eggplant, string beans, cabbage, pechay, lettuce, squash, tomato, patola, ampalaya, and mustard. Spices such as onion, garlic, sweet and hot peppers were considered as important as vegetables by local producers and were included in the survey.

Within San Jose City there are eight input dealers/outlets and three seed growers providing agricultural inputs. One rural bank exists and there are eight commercial banks in the area. Two types of farmer cooperatives operate in San Jose; those providing multiple services and those providing only credit. There were 29 multipurpose cooperatives with a total membership of 2,834. Only five cooperatives provided credit and had a membership of 706. Considering that the total number of farm families in San Jose is 4,761, it could be inferred that approximately 74% of farm families are connected in some way with a cooperative (all previous data from Mr. R. Bautista, Municipal Agriculturalist, San Jose City, Nueva Ecija).

II.5.2 Baseline Survey Results

The fifty farmers from each of the six villages were chosen with the help of the Department of Agriculture technician assigned to each site. Each survey was translated into Tagalog and then pre-tested on 12 farmers to ensure accuracy. Results of the first survey provided background information on pest perceptions and pest management practices of farmers in the six villages. Of the 300 farmers surveyed, 18 percent produced rice only while 5 percent produced vegetables only. Most (77%) produced both rice and vegetables with rice being grown in the wet season (starting July or August) and vegetables in the dry season (starting November, December, or January). Over 90 percent of respondents producing rice and vegetables identified onions as being their primary vegetable cultivated.

Farmers planted an average of .65 ha (SE = 0.10) of vegetables with an average yield of 10,895 kg/ha (SE = 1872.98). This yield generated an average income of 47,038 pesos/ha (SE=8817.03) compared to an average income of 9,772 pesos/ha (SE=1661.93) generated by rice. Although some yield and income figures reported by farmers may be questionable, vegetables do appear to be a powerful money generator when compared to rice. Most farmers in this area have irrigation while a few rely on rain or hand pumps.

All farmers were able to describe the pest damage in their fields but had difficulty identifying the specific pests that caused the damage. The pests named by farmers were fairly general and included: worms, thrips, hoppers, whiteheads, moths/butterflies. Damping off and bulbrot were also mentioned as fungal diseases affecting onions primarily. The vegetable pests identified by nearly all farmers were worms and thrips. Of those farmers producing vegetables, only 45 percent were aware of natural enemies. Those natural enemies most often mentioned were spiders and dragonflies who were believed to eat the pests.

Pest control was considered important by vegetable farmers and over 98 percent applied pesticides on their most recent vegetable crop (1993). Approximately 50 percent of vegetable farmers believed that pesticides must be sprayed early, before the crop is four weeks old. Another 20 percent sprayed pesticides when pests were identified in the field or at the first sign of pest damage while 12 percent sprayed frequently, at least one a week. For nearly all farmers responding to the survey, the first pesticide application on their vegetable crop occurred by the second week after planting. The average number of applications was between three and four, with a few farmers applying pesticides up to 24 times per season. However, no relationship was found to exist between the number of pesticide applications and vegetable yield.

Several farmers had no particular pests they were targeting with pesticides and used whichever pesticide was available. Over 95 percent of the farmers believed that using pesticides increased vegetable yields. In addition, more than 85 percent were confident that pesticide use would not increase pest infestations. The primary reason given for pesticide use was to control pests (70%), to prevent pests (25%), or to increase yields (2-3%). A few farmers mentioned product quality for the marketplace as their reason for using pesticides. Nearly all farmers believed the chemical they used was effective in achieving their goal.

Only 34 percent of the farmers surveyed reported attending a training session on vegetable production. Of those who did attend training, 35 percent indicated that the training focused on the general topic of vegetable farming. Another 28 percent indicated that pesticide use was the main topic of the training while 22 percent said pest control was the main topic. The report by Lazaro et al (1995) details the extensive findings of the initial survey.

II.5.3 Follow-up Baseline Survey Results

The follow-up baseline survey was intended to supplement the initial baseline survey by incorporating more socio-economic questions. Included in the survey were questions targeting membership in organizations, credit for vegetables, and perception of the affect of pesticides on health and the environment. There were 228 respondents to the follow-up survey, meaning that 74.3 percent of the 300 initial respondents were surveyed a second time. Of the 228 respondents, 41 (18%) were from Sto Tomas, 34 (14.9%) from Tayabo, 36 (15.8%) from Kita-Kita, 42 (18.4%) from Palestina, 40 (17.5%) from Sibut, and 35 (15.4%) from Abar 1st. Nearly 88 percent of those responding were male while only 10 percent were female. A majority of farmers were between the ages of 31 and 60 with 22.4 percent of respondents falling above or below that age bracket. Over 50 percent (120) of the respondents owned the property they farmed while 25 percent (57) were tenants, 13.6 percent (31) were leasees, and the remaining 8.7 percent (20) were either hired laborers or holders of a Certificate of Land Transfer (pre-ownership). Only one respondent had received no schooling while 43 percent (98) had some primary education, 45 percent (102) had some high school education, and 11.5 percent (26) had attended college (See Table 2.3).

A large variety of vegetables were produced by the farmers in San Jose including: onion, eggplant, stringbean, tomato, pepper, and ampalaya. Over 90 percent of farmers cultivated onions with an average plot size of 0.59 hectares (SE = .58) while 84.8 percent produced rice with an average plot size of 1.1 ha. (SE = .94). In contrast, only 10 (4.4%) farmers produced eggplant (AVG = .05), 21

Table 2.3 Socio-demographic profile of farmers interviewed. San Jose City, Nueva Ecija. March, 1995.

	No. of farmers in each Barangay						
	Sto Tomas	Tayabo	Kita-Kita	Palestina	Sibut	Abar 1st	Total Farmers
Number of farmers	41 (18.0)	34 (14.9)	36 (15.8)	42 (18.4)	40 (17.5)	35 (15.4)	228 (100.0)
Age							
Below 31	4 (9.8)	3 (8.8)	1 (2.8)	1 (2.4)	6 (15.0)	2 (5.7)	17 (7.5)
31-40	8 (19.5)	6 (17.7)	8 (22.2)	11 (26.2)	7 (17.5)	12 (34.3)	52 (22.8)
41-50	13 (31.7)	9 (26.5)	9 (25.0)	11 (26.2)	10 (25.0)	13 (37.1)	65 (28.5)
51-60	5 (12.2)	11 (32.4)	10 (27.8)	12 (28.6)	10 (25.0)	5 (14.3)	53 (23.3)
Above 60	11 (26.8)	4 (11.8)	6 (16.7)	6 (14.3)	5 (12.5)	2 (5.7)	34 (14.9)
Tenure Status*							
Owner-operator	22 (53.7)	19 (55.9)	17 (47.2)	19 (45.2)	21 (52.5)	22 (62.9)	120 (52.6)
Leasee	2 (4.9)	3 (8.8)	8 (22.2)	10 (23.8)	5 (12.5)	3 (8.6)	31 (13.6)
Tenant	9 (22.0)	11 (32.4)	9 (25.0)	10 (23.8)	11 (27.5)	7 (20.0)	57 (25.0)
Hired laborer	2 (4.9)	0 (0.0)	1 (2.78)	0 (0.0)	2 (5.0)	1 (2.9)	6 (2.6)
Other**	6 (14.6)	1 (2.9)	1 (2.78)	3 (7.1)	1 (2.5)	2 (5.7)	14 (6.1)
Education							
Primary (1-6)	17 (41.5)	10 (29.4)	18 (50.0)	23 (54.8)	12 (30.0)	18 (51.4)	98 (43.2)
High School (7-10)	20 (48.8)	16 (47.1)	17 (47.2)	17 (40.5)	19 (47.5)	13 (37.1)	102 (44.9)
College (more than 10)	3 (7.3)	8 (23.5)	1 (2.8)	2 (4.8)	9 (22.5)	4 (11.4)	26 (11.5)

* Multiple responses

** Certificate of Land Transfer

Values in parenthesis ( ) represent column percentages

(9.2%) produced stringbean (AVG = 0.17), 5 (2.2%) produced tomato (AVG = .37), 10 (4.4%) produced pepper (AVG = .11), and 10 (4.4%) produced ampalaya (AVG = .1). Of those growing onions, 71.5 percent cultivated less than 0.5 ha while only 11.1 percent cultivated over 1.0 ha. (Table 2.4). The value of these vegetable and rice crops is quite variable. Farmers received an average of 31,774 pesos for their entire onion crop, 2,739 pesos for eggplant, 6,600 pesos for stringbean, 41,590 for tomato, 1,531 for pepper, 3,195 for ampalaya, and 23,186 for rice. Only 35 (15.4%) of farmers derived income from livestock, off-farm labor, or non-farm labor. Farmers sold their vegetables to four main sources: 159 (85%) to a local trader, 50 (26.7%) at the local market, 9 (4.8%) to a non-local trader, and 7 (3.7%) to a cooperative. Respondents could indicate more than one person/place where they sold their vegetable crop.

A large number, 40 percent (91), of those responding reported being the only laborer on their farm. Twenty-nine percent (66) reported having another family member working on the farm, 18.4 percent (42) reported two additional working members, and the remaining 12.7 percent (29) reported three or more additional working family members (Table 2.5). Of the respondents to the follow-up baseline survey 103 (45.2%) farmers belonged to an organization with the remaining 125 (54.8%) holding no membership. Approximately 76 percent (78) of those farmers in organizations were members of a cooperative, 15.5 percent (16) were members of a village association, and 19.4 percent (20) were members of a farmers' association (Table 2.6). Farmers could report membership in more that one organization.

Of the total number of farmers responding 160 (71.8%) received credit with the remainder being self-supporting (Table 2.7). Those receiving credit reported their primary lending source as: a cooperative/Landbank (27.6%), relative/neighbor (33.7%), money lender (52.5%), or trader (4.3%). The total amount borrowed was 5,000 pesos or less for 25 percent of those receiving credit, between 5,000 and 10,000 pesos for 25.6 percent, and between 10,000 and 20,000 for 28.8 percent with

Table 2.4 Distribution of onion area by Barangay. San Jose, N.E. March, 1995.

Total Area	No. of farmers in each Barangay (%)						Total
(ha)	Sto Tomas	Tayabo	Kita-Kita	Palestina	Sibut	Abar 1st	Farmers
0.25 or less	15 (44.1)	13 (40.6)	11 (33.3)	10 (27.0)	10 (25.6)	13 (40.6)	72 (34.8)
0.25 - 0.5	8 (23.5)	13 (40.6)	13 (39.4)	15 (40.5)	14 (35.9)	13 (40.6)	76 (36.7)
0.5 - 1.0	6 (17.7)	6 (18.8)	5 (15.2)	8 (21.6)	7 (18.0)	4 (12.5)	36 (17.4)
1.0 - 2.0	3 (8.8)	0 (0.0)	3 (9.1)	3 (8.1)	8 (20.5)	1 (3.1)	18 (8.7)
2.0 - 3.0	2 (5.9)	0 (0.0)	1 (3.0)	1 (2.7)	0 (0.0)	1 (3.1)	5 (2.4)
Total	34 (82.9)	32 (94.1)	33 (91.7)	37 (88.1)	39 (97.5)	32 (91.4)	207 (90.8)
Mean	0.686	0.435	0.606	0.642	0.665	0.469	0.589
SD	0.801	0.301	0.569	0.626	0.462	0.582	0.578

Values in parenthesis ( ) represent column percentages

Table 2.5 Labor availability within the family. San Jose, N.E. March, 1995.

No. of Labor persons in family besides farmer	No. of farmers in each Barangay						Total Farmers
	Sto Tomas	Tayabo	Kita-Kita	Palestina	Sibut	Abar 1st	
0	17 (41.5)	17 (50.0)	11 (30.6)	14 (33.3)	20 (50.0)	12 (34.3)	91 (39.9)
1	13 (31.7)	10 (29.4)	10 (27.8)	12 (28.6)	11 (27.5)	10 (28.6)	66 (29.0)
2	8 (19.5)	6 (17.7)	10 (27.8)	6 (14.3)	4 (10.0)	8 (22.9)	42 (18.4)
3	3 (7.3)	1 (2.9)	2 (5.6)	4 (9.5)	0 (0.0)	4 (11.4)	14 (6.1)
4	0 (0.0)	0 (0.0)	1 (2.8)	6 (14.3)	2 (5.0)	0 (0.0)	9 (4.0)
5	0 (0.0)	0 (0.0)	2 (5.6)	0 (0.0)	3 (7.5)	1 (2.9)	6 (2.6)

Values in parenthesis ( ) represent column percentages

Table 2.6 Farmer membership in organizations. San Jose, N.E. March, 1995.

	No. of farmers in each Barangay						
	Sto Tomas	Tayabo	Kita-Kita	Palestina	Sibut	Abar 1st	Total Farmers
Membership status							
Member	17 (41.5)	20 (58.8)	18 (50.0)	15 (35.7)	28 (70.0)	5 (14.3)	103 (45.2)
Non-member	24 (58.5)	14 (41.2)	18 (50.0)	27 (64.3)	12 (30.0)	30 (85.7)	125 (54.8)
Name of Organization *							
Cooperative	15 (36.6)	16 (47.1)	10 (27.8)	9 (21.4)	27 (67.5)	1 (2.9)	78 (35.0)
Samahang Nayon**	3 (7.3)	1 (2.9)	7 (19.4)	2 (4.8)	1 (2.5)	2 (5.7)	16 (7.2)
Farmers' Association	2 (4.9)	3 (8.8)	6 (16.7)	6 (14.3)	0 (0.0)	3 (8.6)	20 (9.0)

* Multiple responses are possible as farmers may be members of more than one organization

** Village association

Values in parenthesis ( ) represent percentage of farmers in the barangay who were members of each organization

Table 2.7 Number of farmers receiving credit to finance vegetable production and source of that credit. San Jose, N.E. March, 1995.

	No. of farmers in each Barangay (%)						Total
	Sto Tomas*	Tayabo*	Kita-Kita	Palestina	Sibut	Abar 1st	Farmers
Received Credit							
Yes	28 (68.3)	26 (76.5)	28 (77.8)	27 (64.3)	30 (75.0)	26 (74.3)	165 (72.4)
No	13 (31.7)	8 (23.5)	8 (22.2)	15 (35.7)	10 (25.0)	9 (25.7)	63 (28.2)
Primary Source **							
Cooperative/LB	5 (18.5)	12 (48.0)	8 (28.6)	3 (11.1)	16 (53.3)	1 (3.8)	45 (27.6)
Private bank	0 (0.0)	1 (4.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)
Relative/neighbor	11 (40.7)	6 (24.0)	10 (35.7)	8 (29.6)	8 (26.7)	12 (46.2)	55 (33.7)
Money lender	11 (40.7)	4 (16.0)	8 (28.6)	15 (55.6)	5 (16.7)	10 (38.5)	53 (32.5)
Trader	0 (0.0)	2 (8.0)	2 (7.1)	1 (3.7)	0 (0.0)	2 (7.7)	7 (4.3)
Other	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.3)	1 (3.8)	2 (1.2)
Total responding	27	25	28	27	30	26	163

* One farmer from Sto Tomas and Tayabo did not report their primary source of credit

** Primary source indicates over 50 percent of credit received was from the source indicated.

Values in parenthesis ( ) indicate column percentages.

the remainder borrowing up to 70,000 pesos to finance vegetable production. Only 34 farmers (21%) reported receiving any of their credit "in-kind" as pesticides with the value of those pesticides ranging from under 500 to over 5,000 pesos.

An overwhelming majority of respondents reported being the sole decision-maker regarding expenditures on pesticides (91.2%), pest management actions (91.6%), and purchased the pesticides themselves (88.2%). The annual value of pesticides use on vegetables ranged from zero to over 5,000 pesos. Most farmers, about 56 percent, spent 1,000 pesos or less on pesticides, 33.7 percent spend between 1,000 and 3,000 pesos, and 10.3 percent spend over 3,000 pesos. In comparison, 78.6 percent of farmers valued their annual expenditure on pesticides for rice at under 1,000 pesos.

Approximately 55 percent of respondents reported attending or having a family member who had attended a Farmer Field School (FFS) training which would have addressed IPM although not necessarily on vegetables. In addition, 58 percent reported being visited by an agricultural technician to discuss IPM. Of the 228 respondents, 69.7 percent had been exposed to IPM through the FFS or an agricultural technician (Table 2.8). When reporting the most important sources of information in deciding which pesticide to use on vegetables, 58.3 percent of farmers listed pesticide price as extremely important and 76.4 listed pesticide safety as extremely important. A smaller percentage listed the advice of agricultural technician (20%), chemical company representative (13.7), pesticide dealer (11.8), or neighbor (4.9) as extremely important (Table 2.9). Farmer perceptions regarding pesticides' affect on human health and the environment revealed the fairly pervasive belief that pesticides can harm water quality (77.6%). About 73 percent of farmers believe the water quality on their own farm has been contaminated by pesticides. Only 24.6 percent of farmers attribute health problems of a family member to pesticides (Table 2.10).

Table 2.8 Access to IPM Training. San Jose, N.E. March, 1995.

Training Type		No. of farmers in each Barangay (%)						Total Farmers
		Sto Tomas	Tayabo	Kita-Kita	Palestina	Sibut	Abar 1st	
Family member attended Farmer-Field School training	Yes	26 (63.4)	24 (70.6)	20 (55.6)	14 (33.3)	29 (72.5)	13 (37.1)	126 (55.3)
	No	15 (36.6)	10 (29.4)	16 (44.4)	28 (66.7)	11 (27.5)	22 (62.9)	102 (44.7)
Visit by Agricultural Technician to discuss IPM	Yes	20 (50.0)	26 (76.5)	29 (80.6)	22 (52.4)	26 (65.0)	10 (28.6)	133 (58.6)
	No	20 (50.0)	8 (23.5)	7 (19.4)	20 (47.6)	14 (35.0)	25 (71.4)	94 (41.4)
Received either FFS and/or Ag Tech IPM training	Yes	30 (73.2)	30 (88.2)	28 (77.8)	21 (50.0)	32 (80.0)	18 (51.4)	159 (69.7)
	No	11 (26.8)	4 (11.8)	8 (22.2)	21 (50.0)	8 (20.0)	17 (48.6)	69 (30.3)

Values in parenthesis ( ) represent column percentages

Table 2.9 Most important sources of pest management information for vegetables. San Jose, N.E. March, 1995.

Relative Importance	Sources of Information*					
	Pesticide Price	Agricultural Technician	Pesticide Dealer	Chem. Co. Rep.	Neighbor	Pesticide Safety
Extremely important	133 (58.3)	45 (20.0)	27 (11.8)	31 (13.7)	11 (4.9)	172 (76.4)
Very important	83 (36.4)	151 (67.1)	154 (67.5)	144 (63.4)	79 (34.8)	51 (22.7)
Somewhat important	7 (3.1)	20 (8.9)	38 (16.7)	40 (17.6)	71 (31.3)	0 (0.0)
Not important	5 (2.2)	9 (4.0)	9 (4.0)	12 (5.3)	66 (29.1)	2 (0.9)

* Multiple responses are possible as farmers may consult more than one source of information

Values in parenthesis ( ) represent column percentages

Table 2.10 Farmers' perceptions of pesticides' affect on human health/environment. San Jose, N.E. March, 1995.

Perception	Agree	Disagree	Don't know
Pesticides can harm water quality	177 (77.6)	24 (10.5)	27 (11.8)
Farm's water supply contaminated by pesticides	167 (73.3)	27 (11.8)	34 (14.9)
Attribute health problems of family member to pesticides	56 (24.6)	169 (74.1)	3 (1.3)

Values in parenthesis ( ) represent row percentages

It should be noted that the baseline and follow-up baseline surveys did request some of the same information. The discrepancies in the responses to the two surveys are most likely because they were performed in different production years and attempted to elicit some of the same information using differently worded questions. Information that was disparate between the two surveys or was sensitive to the production year was not used in the logit analysis described in Chapter 3.

II.5.4 Participatory Appraisal Findings

The participatory appraisal included interviews with farmers, pesticide dealers, Department of Agriculture technicians, hospital personnel, cooperatives, vegetable wholesalers, government officials, pesticide company representatives, university personnel and a variety of other stakeholders. Interviews were designed to elicit information on pest problems, incentives for pesticide use, the pesticide market, IPM activities, and policies affecting IPM and pesticide use. Most of the information gathered was descriptive in nature.

Farmer interviews were conducted by teams of researchers from a variety of fields. These farmer interviews revealed the typical farm as being one where both vegetable and rice were cultivated. Vegetables were considered important for income generation. Farmers were quite familiar with the pests attacking their vegetable crops and usually addressed pest management problems with pesticides. Also used, although much less extensively, were a variety of non-pesticide techniques such a covering the field with rice straw. However, the interviews gave indication of high levels of pesticide misuse due to the frequency of sprays, the pest targeted, timing of sprays, mixing of pesticides, and the pesticide used.

The potential importance of regulatory and credit policies were discovered while conducting these farmer interviews. Regulatory policies were of importance due to the amount of banned pesticides farmers were still reported to be using. Some of the farmers surveyed used pesticides that had been banned for a significant period of time. FPA officials later informed the PA team that many banned pesticides still make their way into the Philippines from other Asian countries. The FPA was not able to enforce pesticides bans to the degree desired. Credit policies surfaced as important when farmers mentioned credit requirements as the deciding factor when determining which pesticide to use and how much to purchase. This response was in contrast to baseline surveys which found price to be the deciding factor in most cases. Cooperative representatives informed PA participants of the connection between the credit received from the cooperative and the requirements of the Landbank of the Philippines. Further investigation revealed the "farm plan" required by the PCIC as the means by which credit influences the use of pesticides by farmers. Landbank officials described in detail the connection between the bank and the "farm plan" developed with the help of a Landbank or DA technician.

DA technicians were also interviewed to assess their exposure to IPM training in vegetable production, and contact with other sources of pest management information such as pesticide dealers or chemical companies. It was found that DA technicians did receive some training by chemical companies on how to best use their pesticides as well as receiving pesticide advertisements such as t-shirts and hats. Training was also sponsored by the Landbank, PhilRice, and the DA. IPM training was not emphasized by the DA technicians as being a significant part of their training. DA technicians were rarely asked by farmers to help with pest problems unless they were severe.

Interviews with local pesticide dealers in San Jose identified the details of the pesticide marketing chain. Each pesticide dealer must be licensed by the FPA which requires that they attend a seminar and pass an exam on pesticide and fertilizer use and safety. They must also comply with building code regulations requiring proper ventilation in storage areas. The dealer receives pesticides directly from the chemical companies and sells pesticides to cooperatives, retail stores, and directly to farmers. Chemical company sales representatives provide a one day seminar whenever a new product is introduced and check regularly on the dealer's stocks of their pesticides. Dealers are given free vacations by the chemical companies as an incentive to sell more of their products. The dealers interviewed said very few farmers ever asked them which pesticide to use and, if they did, the dealer would usually refer to the brochures provided by the chemical company.

In order to determine the impact of pesticides on human health, a small PA team visited the local hospital to gather information on illnesses or deaths resulting from pesticide exposure. The hospital estimated that, of the number of deaths linked to pesticides between 1988 and 1990, about 95 percent of them were suicides. However, the records on chronic poisoning were incomplete and officials admitted to having no training in pesticide poisoning.

Interviews conducted in Manila included those with FPA and other government officials, university personnel, and other economic experts. It was during these interviews that the importance of pesticide pricing policies and the Philippines exchange rate became apparent. Government officials indicated that tariffs were imposed on all pesticides entering the country which served to tax those using pesticides and that the VAT would soon add to that level of taxation. University personnel and other economic experts indicated that the Philippine exchange rate was highly overvalued which served to subsidize all imports into the country, including pesticides. The net impact of these pricing and exchange rate policies became a point of interest for the PA team.

By conducting two baseline surveys and a participatory appraisal, the IPM-CRSP team attempted to develop a picture of the current status of pest management and pesticide use in the Philippines. The baseline surveys provided a comprehensive picture of the factors affecting pesticide use and misuse in the study area, while the participatory appraisal brought the most salient policy issues to light.

CHAPTER III: Methods

III.1 Introduction

One objective of this thesis is to identify factors influencing the misuse of pesticides by vegetable farmers in the Central Luzon, Philippines. A logit model is used to determine the relative importance of socio-economic factors and farmer perceptions on the misuse of pesticides by vegetable farmers. Section 2 of this chapter describes the regression analysis. Once the significant factors are established, the analysis proceeds to an investigation of incentives to use pesticides instead of IPM. The methods used to evaluate the degree of government intervention in the pesticide market, via pricing and exchange rate policies, include calculating the Nominal rate of protection (NPR) and Effective Rate of Protection (EPR) for pesticides. The NPR and EPR are figured using both the Philippines' market exchange rate and equilibrium exchange rate to assess the influence of exchange rate policies on pesticide use. Section 3 will introduce the NPR and EPR formulas as well as the method by which the equilibrium exchange rate is calculated. Finally, this chapter addresses the direct and indirect effects of pricing and exchange rate policies on consumer and producer welfare. Section 4 discusses economic surplus analysis and its use in estimating the benefits and costs of government intervention in the pesticide market.

III.2 Factors Affecting Pesticide Misuse

III.2.1 Review of Previous Studies

In this thesis, determination of the factors influencing pesticide misuse follows the methods used in previous studies on technology adoption in agriculture. This limited-dependent-variable approach is appropriate as pesticide use is a technology which, in this case, is adopted in a certain manner: correctly or incorrectly. Incorrect adoption of pesticide technology is referred to as pesticide misuse. Pesticide misuse is determined using a set of observed variables and information from scientific experts on vegetable pest management in Southeast Asia[1].

A variety of studies have used a limited dependent variable model to determine factors affecting technology adoption in agriculture. Previous literature on technology adoption has concentrated on crop/animal specific technologies such as improved varieties (Heibert) or practices associated with those varieties (Byerlee and Polanco); activity-specific technologies such as pest management (Burrows), irrigation innovations (Caswell and Zilberman, 1985, 1986) and reduced-till cultivation practices (Rahm and Huffman); and technological innovations which are neither crop/animal or activity specific including computer use in agriculture (Putler and Zilberman) and use of financial information (Garcia, Sonka and Mazzocco). The analysis of pesticide misuse provides an opportunity to analyze adoption from a totally new perspective; why individuals who adopt a technology use that technology incorrectly. All the literature reviewed in this section focuses on pest management technology adoption as these studies are particularly informative given the nature of this analysis. Determinants associated with pesticide misuse are based on the findings of previous studies and theoretical considerations.

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[1] These experts are associated with the International Rice Research Institute and the Asian Vegetable Research and Development Center, Taiwan.

One of the earliest studies concerning pesticides and integrated pest management was Burrows' 1983 article entitled, *"Pesticide Demand and Integrated Pest Management: A Limited Dependent Variable Analysis"*. In the article Burrows hypothesized that IPM would significantly reduce pesticide use. He found evidence that IPM reduced pesticide use by approximately 31 percent when simultaneous equations bias was accounted for. Expected yield was also a significant factor in determining pesticide demand, as was farm size. Of primary importance to this study was the finding that IPM has a negative effect on pesticide use.

In their study, *"Factors Affecting Peanut Producer Adoption of Integrated Pest Management,"* McNamara, Wetzstein and Douce partitioned determinants of IPM adoption into four categories: producer characteristics, management practices, farm structure, and institutional factors. The three categories found to significantly affect IPM adoption were producer characteristics, management practices, and institutional factors. Within each of these larger categories, the individual variables of greatest significance were: age, education, percent farm income of total income, yield, extension requests, forward contracting, and extension IPM. All the individual variables had a positive impact on IPM adoption. The conclusions offered in the study underline the importance of educational programs in promoting IPM adoption.

Rook and Carlson addressed participation by North Carolina farmers in pest management groups in their 1985 study. Factors of significance regarding the decision to join a pest management group include: acres in a time-competing crop, farm size, low group price, service quality subsidies, high expected cotton yield, and low deviation between individual and group pest control demand. Acres in a time-competing crop served as a proxy for the on-farm opportunity cost of management time and had a positive influence on joining a pest management group. The on-farm opportunity cost of management time is a positive influence because the cost of pest management is shared by a group of farmers, reducing the burden on any individual farmer. The opposite case might prevail if the farmer had to take full responsibility for implementation of pest management techniques.

The significance of socioeconomic factors in the adoption of IPM was also the topic of a 1988 study by Napit, et al. Farmers from nine states were grouped into three levels of IPM adoption: high, low, and non-users. Using a trichotomous logit model, the authors evaluated the relative importance of ten different socioeconomic factors in the level of IPM adoption. The study found that, in five of the nine states, a higher value of farm products sold annually positively influenced the adoption of IPM and was highly significant. Also significant at the 5 percent level was the race variable which predicted that, in four of the states, the probability a farmer would adopt IPM decreased if they were a person of color. Other variable which were significant at the 5 percent level in at least one of the states in the analysis include: frequency of contacts with the extension agent (+), education of the farm operator (+), forward contracting (+), percentage of family income from farming (+ or -), and number of years farming cotton (+) or tobacco (+). The authors conclude that investment in education and extension would help encourage adoption of IPM and that special adoption incentives may be necessary to encourage small farm operators to adopt IPM.

Another IPM adoption study by Harper, et al evaluated the factors influencing the use of certain pest management techniques by Texas rice farmers. The analysis used two separate binary choice models; one to evaluate adoption of a sweep net and treatment threshold and a second to analyze factors influencing farmers to spray for the rice stink bug. In the first model titled SWEEP the significant variables were the following: education, proportion of neighboring land in pasture, proportion of acreage planted to semidwarf rice varieties, location of farm within Texas, and attendance at certain field days. For the SPRAY model the significant variables were: use of sweep net and treatment threshold, age, education, field size, neighboring land in pasture and grain sorghum, location of farm in Texas, nitrogen fertilizer applied, attendance at county extension demonstrations, and different field days attended. The authors stressed the role of extension activities at field days and farmer's perception of the net economic consequences of adopting a certain pest management technology as important factors in IPM adoption.

Thomas, Ladewig, and McIntosh emphasized the importance of different source of IPM information in their study, "*The Adoption of Integrated Pest Management Practices Among Texas Cotton Growers.*" According to the authors, "some of the difficulty sorting out informational effects on adoption behavior is due to researchers' use of too few types of information sources or their lumping of information sources into a single construct" (Thomas, Ladewig, and McIntosh, 1990, p.398). The study identified many potential information sources and asked farmers to rate each using a scale varying from one (no importance) to five (extremely important). Also emphasized by the study were farmers' beliefs regarding IPM and its effect on safe pesticide use, human health, yield and quality, and the environment. Results showed that group meetings and personal contacts were strongly related (99 percent level) with the adoption of a bundle of IPM practices as were favorable beliefs regarding IPM, the importance of the economic threshold to the farmer, and gross farm sales. Also significant were education and the percent of cotton irrigated.

A recent work on IPM adoption is an article by Fernandez-Cornejo, Beach, and Huang focusing on Vegetable Grower in Florida, Michigan, and Texas. This study is of particular interest as it deals with vegetable farmers, the subjects of this thesis. The factors found to be significant in at least two of the three states include: the amount of operator and unpaid family labor per year, the farm's debts-to-assets ratio, percent of acres irrigated, livestock production, and the number of vegetables produced. All factors except livestock production and the debt-to-assets ratio in Michigan were positively associated with IPM adoption. Irrigation was found to be complementary to IPM, "perhaps because the increased profitability that irrigation affords to farms, also makes IPM profitable" (1993, p. 168). The variable for land tenure was dropped from this analysis as it was insignificant in all three states. The authors believe tenure status was insignificant because IPM does not required costly fixed capital but and investment in human capital.

III.2.2 Empirical Model for Pesticide Misuse

Misuse is strictly defined in the regression analysis to be the utilization of pesticides on onions during the seedling stage for thrips (thrips tabaci), worms, and ants. The definition was restricted to onion growers as the survey questions on pesticide use were requested in regards to the farmer's primary vegetable crop and onion was the primary vegetable crop for over 90 percent of the farmers. Pesticide use at the seedling stage for the pests indicated is considered misuse for a variety of reasons. First, thrips are not a threat to onion until after the seedling stage as the plant is too small to protect the thrips from other mortality factors. Second, using pesticides for larvae in the seedling stage is misuse because the leaves of the onion plant are too small and narrow for the moths to lay eggs on. Finally, spraying for ants is also misuse as many species of ants are potential natural enemies.

Using such a narrow definition of misuse is quite limiting as it ignores potential misuse at other stages of plant growth and different types of misuse such as the type or amount of pesticide used. However, the structure of the survey questions and the nature of the data made the definition of misuse used in this analysis the only one that was statistically viable. Further research could certainly explore other types of misuse.

The results of the studies summarized above helped in hypothesizing which factors might affect pesticide misuse. In the category of farmer characteristics, the variables included in the model are: age (AGE), education (EDUCN), access to IPM training (FFS), exposure to pest management information from an agricultural technician (VISAGT), tenure status (TENSTAT), and membership in an organization (MEMBER). It is anticipated that, as the age of the farmer increase, the likelihood of misuse increases. This outcome is expected as older farmers may be slower to change practices and be less concerned about health effects of pesticides, which may not occur for several years. Increasing levels of education are expected to reduce the likelihood that pesticides will be misused. As education increases, farmers are more likely to read pesticide labels and seek out other sources of pest management information.

If the farmer or a member of their family has attended a Farmer Field School training, the farmer is considered to have access to IPM training. IPM training is expected to have a negative influence on pesticide misuse. It is also expected that, if farmer has been visited by and agricultural technician to discuss non-pesticide means of controlling pests, the farmer will be less likely to misuse pesticides. The direction of the effect of land tenure on pesticide misuse is unknown. Membership in a cooperative, farmer's association, or village association might be expected to decrease the likelihood that a farmer misuses pesticides as these organizations can provide information on cultivation practices including IPM. Furthermore, such organizations provide a forum for farmers to discuss pest management problems and solutions which would enhance their ability to effectively deal with pest infestations. However, cooperatives often purchase pesticides in bulk which may encourage excessive pesticide use and these organizations could be providing incorrect or biased information on pesticides. Also, credit sources used by cooperatives may require farm plans that encourage pesticide use.

Farm structure and management is the second category of significant variables affecting pesticide misuse. Pesticide misuse is expected to decrease as the number of working family members besides the farmer increases (LABOR). As the number of laborers on the farm increases, the value of farm management increases making the use of alternative pest management practices more probable as they are often more labor intensive. Irrigation (IRRIG) will have an unknown influence on pesticide misuse as the increased value of the crop could make non-chemical pest management alternatives more profitable (Fernandez-Cornejo, et al) or induce farmers to spray even more to protect the value of their crop. The effect of onion area (ONAREA) on pesticide misuse is uncertain as increased onion area could induce a farmer to intensify pesticide use or seek out more IPM techniques.

Variables dealing with credit are likely to influence pesticide misuse. The effect of receiving credit (BORROW) should increase pesticide misuse as farmers have more pressure to produce a good crop if they must repay a loan. If the source of the credit is a cooperative/Landbank (COOP), the probability that a farmer will misuse pesticides increases due to the requirement of a farm plan. If the source of credit is a friend, relative, neighbor (FRN), or money lender (ML) the likelihood of pesticide misuse will be relatively less than if the source is the cooperative/ Landbank. Receiving pesticides in-kind as part of a loan (KINDPES) will also increase the chance that a farmer will misuse pesticides.

Different sources of information on pesticides, the third category of variables, are anticipated to be significant factors influencing pesticide misuse. Farmers were asked to rank on a scale from one (extremely important) to four (not important), six sources of information on pesticides they use when deciding which pesticide to use. These information sources include: pesticide price (COST), agricultural technician (AGTECH), pesticide dealer (PESTDEAL), chemical company representative (CHEMCO), neighbor (NBOR), and the FPA pesticide safety label (SAFETY). The increased importance of pesticide price and advice from a pesticide dealer or chemical company representative is anticipated to increase pesticide misuse. Information from an agricultural technician and FPA safety label would have the opposite effect and decrease misuse. Advice from a neighbor will likely be insignificant.

Perceptions regarding pesticides and IPM are important in analyzing the factors affecting pesticide misuse. The perception that killing natural enemies will hasten pest infestation (NENEMY) is expected to reduce pesticide misuse. Similarly, the belief that pesticides can harm water quality (WAQUAL) is expected to negatively influence pesticide misuse. Farmers will be less motivated to misuse pesticides if they believed they could harm the water quality on their own farm. Finally, farmers who have been personally harmed by pesticides, with either their farm's water quality being affected or someone in their family becoming ill from pesticides (IMPACT), will be less likely to misuse pesticides. The four categories of factors affecting pesticide misuse and the variable names and definitions are listed in Table 3.1.

III.2.3 Statistical Procedure

The regression analysis in this thesis is based on a general adoption analysis framework with dichotomous dependent variable taking on a value of either 0 or 1. As the adoption analysis is based on survey data, the dependent variable is qualitative in nature. A qualitative dependent variable violates the assumption of zero error mean and constant variance employed by most regression models. Violation of zero mean error creates the possibility of predictions lying outside the [0,1] range. Subsequently, several models have been created under different distributional assumptions which restrict predictions to lie within the appropriate interval and thus create a nonlinear relationship between the prediction and the independent variables.

Of these limited dependent variable models the most widely used are the logit and probit. The logit and probit models differ in the distribution of the error term which is based on the logistic cumulative distribution function and normal cumulative distribution function respectively. There is little statistical difference between the logistic and normal distributions except that the logistic has slightly "fatter" tails. This makes the results of the two models very similar unless the number of observations is large (Maddala, 1988). However, the logit model has been more widely used in economic applications, "because it is quite similar in form to the cumulative normal function but easier to use from a computational point of view" (Pindyck and Rubinfeld, 1981, quoted in Napit, 1985).

Table 3.1 Factors affecting misuse of pesticides.

Variable Name	Definition
Producer Characteristics	
AGE	farmer's age
EDUCN	farmer's educational attainment: 1 for no schooling (0 yrs), 2 for some primary school (1-6), 3 for some high school (7-10), and 4 for some college (11 or more)
FFS	1 if farmer or family member attended FFS training; 0 otherwise
VISAGT	1 if visited by an agricultural technician to discuss IPM; 0 otherwise
TENSTAT	1 if owner/operator; 0 otherwise
MEMBER	1 if member of a cooperative, village association, or farmers' association; 0 otherwise
Farm Structure and Management	
LABOR	number of non-wage labor persons in family besides the farmer
IRRIG	1 if the vegetable acreage is irrigated; 0 otherwise
ONAREA	total onion area on farm
BORROW	1 if farmer receives credit for vegetable production; 0 otherwise
COOP	1 if source of vegetable credit is cooperative/landbank; 0 otherwise
FRN	1 if source of vegetable credit is a friend, relative, or neighbor: 0 otherwise
ML	1 if souce of vegetable credit is a money lender; 0 otherwise
KINDPES	1 if farmer receives a portion of credit in-kind as pesticides; 0 otherwise
Pesticide Information Sources	
COST AGTECH PESTDEAL CHEMCO NBOR SAFETY	relative importance of information source when deciding which pesticide to use: 1 if extremely important, 2 if very important, 3 if somewhat important, and 4 if not important
Pesticide and Pest Management Perceptions	
NENEMY	1 if farmer believes that killing the natural enemies in the field by applying pesticides can hasten pest infestation; 0 otherwise
WAQUAL	1 if farmer believes pesticides can be harmful to water quality; 0 otherwise
IMPACT	1 if farmer believes pesticides have harmed the water on his/her farm or attributes the health problems of a family member to pesticides; 0 otherwise

A logit model can be employed for problems with either two or more choice categories. In this model a bivariate dependent variable is used with a value of 1 indicating pesticide misuse. In the general bivariate logit model, the probability of pesticide misuse by the *i*th farmer is given by

$$P_i = F(B'X) = 1/[1 + \exp(-B'X)], \tag{3.1}$$

where F is the cumulative distribution function which, in the case of a logit model, is logistic. The log likelihood function of the general multinomial logit model is,

$$\log L = \Sigma_{i=1}^{n} \Sigma_{i=1}^{m} Y_{ij} \log P_{ij} \tag{3.2}$$

where Y_{ij} is a dummy variable equal to 1 if individual i falls into the jth category and 0 otherwise.

It is assumed that "each individual's objective function is composed of a nonstochastic portion which is a function of observable characteristics, and a stochastic portion, which is a function of unobservable alternative or individual characteristics" (Rook and Carlson, 1985, p.565). The nonstochastic portion of the model equals *B'X* where *B* is a row vector of parameters and *X* is a column vector of exogenous variables. This non-stochastic portion of the model is given by,

$$\begin{aligned} B'X = {} & \beta_0 + \beta_1 AGE + \beta_2 EDUCN + \beta_3 FFS + \beta_4 VISAGT + \beta_5 TENSTAT \\ & \beta_6 MEMBER + \beta_7 LABOR + \beta_8 IRRIG + \beta_9 ONAREA + \beta_{10} BORROW \\ & + \beta_{11} COOP + \beta_{12} FRN + \beta_{13} ML + \beta_{14} KINDPES + \beta_{15} COST + \\ & \beta_{16} AGTECH + \beta_{17} PESTDEAL + \beta_{18} CHEMCO + \beta_{19} NBOR + \\ & \beta_{20} SAFETY + \beta_{21} NENEMY + \beta_{22} WAQUAL + \beta_{23} IMPACT, \end{aligned} \tag{3.3}$$

where β_k (k = 0,23) are the parameters of the model. The model is estimated using maximum likelihood techniques as OLS gives biased estimates (Burrows, Domenich and McFadden).

The parameter estimates provided by the logit model do not provide the change in probability associated with the change in an explanatory variable. Instead, the marginal effects must be computed using the following equation,

$$\partial P_i / \partial x_{ij} = \beta_j \, P_i (1 - P_i) \qquad \textbf{(3.4)}$$

where β_j is the initial parameter estimate for independent variable j. These probabilities are provided for each variable.

The overall significance of the model will be measured two ways. Goodness of fit will be evaluated using the McFadden R^2 which is defined as 1 minus the log likelihood ratio and is given by,

$$\text{McFadden's } R^2 = 1 - [\text{Log } L(\beta_{ML}) \,/\, \text{Log } L_0] \qquad \textbf{(3.5)}$$

where Log $L(\beta_{ML})$ and Log L_0 are the log likelihood values of the restricted model and unrestricted model respectively. The McFadden R^2 will equal zero when the likelihood function with all parameters is no greater than the likelihood function with the constraint that all parameters equal zero except the constant. The predictive ability of the model will be judged by the number of observations correctly classified by the prediction rule, or the count R^2 (Maddala, 1988). The count R^2 is defined as the number of correct predictions divided by the total number of observations. A variation of this measure is reported for each outcome by dividing the number of correctly predicted misusers or non-misusers by the number observed. Significance levels of the variables will be reported at a variety of levels including 20 percent as is recommended by Manderscheid (1965) when little is known about the relationship of parameters to the dependent variable.[2]

[2] For a good discussion of the choice of significance level see G.S. Maddala's *Introduction to Econometrics*, 1988, pp. 23-24.

A likelihood ratio test will be used to determine the significance of the four categories of factors affecting misuse. The likelihood ratio test is calculated using the equation below.

$$\text{Likelihood Ratio} = -2\,[\text{LLF(R)} - \text{LLF(U)}], \qquad \textbf{(3.6)}$$

where LLR(R) is the value of the log-likelihood function when all variable coefficients in a certain category are assumed to be zero and LLF(U) is the log-likelihood value of the full model. This test statistic follows a chi-squared distribution with *k* degrees of freedom where *k* is the number of coefficients assumed to be zero. The likelihood ratio and significance level of each category of variables will be reported in Chapter 4.

III.3 Measuring the Degree of Government Intervention

III.3.1 Review of Previous Studies

Empirical studies on trade and pricing policies have often used measurements of government intervention such as the nominal and effective rates of protection. These measures provide some insight into the domestic prices that would have prevailed had there been no government intervention in trade and monetary policies. The NPR and EPR measure direct effects on agricultural inputs or outputs. Estimation of the indirect effects of government intervention is more difficult and involves calculating the real equilibrium exchange rate for the given country. Re-estimation of the NPR and EPR utilizing the real equilibrium exchange rate provides some indication of the degree of indirect intervention. A variety of studies have employed the NPR, EPR, and real equilibrium exchange rate to measure the degree of direct and indirect government intervention

A collection of studies edited by Krueger, Schiff, and Valdés use these calculations to analyze the impact of pricing and exchange rate policies in a number of Asian countries. Included in the collection is a study on the Philippines conducted by Intal and Power in the late 1980s. Intal and Power measured price intervention in the rice, corn, sugar, and copra export markets. Using the NPR, direct (NPR_D) and total intervention (NPR_T) were calculated for the listed commodities for a series of three year periods from 1960 to 1986. The rate of total nominal protection (NPR_T), calculated by substituting the market exchange rate with the real equilibrium exchange rate, included both the direct (NPR_D) and indirect (NPR_I) rates of protection. According to Intal and Power, "The NPR_I is the result of industrial protection policies and exchange rate disequilibrium;" (1991, p.157).

For the exportable commodities that were the focus of this analysis, an overvaluation of the exchange rate led to a negative NPR_I or tax. The authors estimated that, "The Philippine peso would have been about 22 percent higher under free-trade exchange rates than under the actual official exchange rate during 1960-1986" (Intal and Power, 1991, p.153). This overvaluation, when coupled with a direct subsidy or tax, offset the subsidy or added to the relative tax. In the study, all the export commodities except corn and few selected periods for rice and sugar were heavily taxed at a rate ranging from 4 to 55 percent over the entire period studied.

In a similar World Bank study conducted by Greene and Roe on the Dominican Republic, the same methods were used to determine the direct, total, and indirect nominal rates of protection. They also found exchange rate intervention to be very influential noting that, if the exchange rate is overvalued, "any price subsidy (tax) given to producers through direct intervention will be greater (less) than the effect of total intervention" (Green and Roe, 1991, p.217). In both the Philippines and Dominican republic, exchange rate overvaluation was significant and substantially altered the effect of direct government intervention as measured by the NRP_D.

Each of the many World Bank studies edited by Krueger, Schiff, and Valdés used the NRP, ERP, and free-trade equilibrium exchange rate to analyze government intervention in agriculture. However, the focus of these studies were primarily agricultural outputs. Although the methods used are similar, this thesis concentrates on a very important input, pesticides. The NRP and ERP, modified to reflect the differences in outputs and inputs, are discussed in the following two sections. Calculation of the free-trade equilibrium exchange rate will follow the methods used by Intal and Power in order to obtain comparable results. Additional exchange rate calculations using Purchasing Power Parity and Interest Rate Parity Theory are also described in order to provide a comparison of estimated currency overvaluation.

III.3.2 Nominal Rate of Protection (NPR)

The nominal rate of protection is one of the most widely used measures of government intervention in output markets. However, it is difficult to find an application of the NPR in estimating the degree of intervention in input markets. While a focus on an input such as pesticides makes measures of intervention such as the producer subsidy equivalent and consumer subsidy equivalent inconsequential, the NPR is still quite informative.

Pesticides are imported in two different forms: as formulated pesticides (finished product) or technical pesticides (active ingredient). Modification of the NPR was necessary so that prices could be compared at the same stage of processing. In order to estimate the NPR for technical pesticides it was necessary to use a conversion ratio so that the prices used were in equivalent units. The two equations are as follows,

$$NPR_{Dfj} = \frac{PPF_j^d - BPF_j^w\ E_o}{BPF_j^w\ E_o} \qquad \textbf{(3.7)}$$

$$NPR_{Dti} = \frac{PPT_i^d - BPT_i^w E_o}{BPT_i^w E_o} \tag{3.8}$$

where,
$PPF_j^d = RPF_j^d - Rmm$ = domestic price at which producer sells formulated pesticide *j* in pesos per liter,
$PPT_i^d = PPF_j^d$ @ = cost to the producer of technical pesticide *i* in pesos per liter,

and,
NPR_{Dfj} = direct nominal rate of protection for formulated pesticide *j*,
NPR_{Dti} = direct nominal rate of protection for technical pesticide *i*,
BPF_j^w = border price of formulated pesticide *j* in dollars per liter,
BPT_i^w = border price of technical pesticide *i* in dollars per amount of grams in each liter of formulated pesticide,
RPF_j^d = domestic (retail) price of formulated pesticide *j* with active ingredient *i* in pesos per liter,
Rmm = marketing margin between the producer and retail levels (PPF_j^d to RPF_j^d) in pesos per liter,
@ = share of the cost of technical pesticide *i* in PPF_j^d, and
E_o = official exchange rate.

Equation (3.7) is the direct nominal protection rate for formulated pesticides (NPR_{Df}) measuring the difference between the domestic and border price of formulated pesticides at the production level. Equation (3.8) is a modified version of (3.7) that adds a conversion ratio that converts the value of technical pesticides into a percentage of the producer price of formulated pesticides and measures the difference in the domestic price of pesticides and the border price of the active ingredient (NPR_{Dt}) at the production level. As the tariff imposed on formulated and technical pesticides is 10 percent and 5 percent respectively, there is likely to be a difference between the two estimations of NPR.

A positive NPR for an agricultural output signals that the producer is receiving a higher price for the commodity than in the absence of intervention and the consumer could very well be paying a higher price for the product. A negative NPR indicates a tax on domestic producers. Technical pesticides are not produced within the

Philippines which means that there are no real domestic producers of formulated pesticides. Therefore, the NPR is actually the nominal rate of disprotection for pesticide producers that import formulated or technical pesticides. In this case, a positive NPR indicates a tax of importing producers while a negative NPR signals a subsidy for importing producers.

In order to capture the indirect effects of exchange rate overvaluation, the equations (3.7) and (3.8) are re-estimated replacing E_o with the free-trade equilibrium exchange rate (E*). The resulting nominal rates of protection reflect the total nominal rate of protection and will be reported as NPR_{Tfj} and NPR_{Tti}. The indirect nominal protection rate is derived by subtracting each direct NPR (NPR_{Dfj} and NPR_{Dti}) from its corresponding total NPR (NPR_{Tfj} and NPR_{Tti}). These indirect nominal protection rates (NPR_{Ifj} and NPR_{Iti}) measure the effect of exchange rate policy on pesticide prices. The direct, indirect, and total nominal protection rates for the top nine pesticides used on vegetables will be calculated and reported in Chapter 4. These top nine pesticides, their active ingredient, formulation, and hazard category are reported in Table 3.2.

III.3.3 Effective Rate of Protection (ERP)

A definition taken from Corden (1985) describes ERP as the percent increase in value-added per unit activity made possible by the tariff structure relative to the situation without tariffs, evaluated at the same exchange rate. Green and Roe describe ERP as estimating "the annual differences between the dominant prices of tradeable agricultural outputs and inputs vis-a-vis their' corresponding border prices" (1989, p. 238). Michaely defines the effective protection rate as, "the proportional change, from a free trade to a tariff-ridden position, of the price of the value added" (Michaely, 1977 ,p.107). However, using the theoretical design developed in Corden's work *The Theory of Protection* (1971), the EPR for an input is given by the following two equations,

Table 3.2 Nine popular pesticides for vegetables in San Jose, N.E.

Brand Name	Active Ingredient*	Concentration	Hazard Catagory**	Company
(1) Azodrin 202 R	Monocrotophos**	285 grams/liter	I	Shell Chemicals
(2) Cymbush	Cypermethrin	50 grams/liter	II	Jarine Davies, Inc.
(3) Endosulfan 35% EC	Endosulfan**	350 grams/liter	II	Marsman & Co., Inc. Aldiz, Inc.
(4) Folidol M 50 EC	Methyl Parathion*	500 grams/liter	I	Bayer Philippines
(5) Lannate 40 SP	Methomyl	400 grams/kilo	n.a.	Du Pont Far East, Inc.
(6) Meptox 50 EC	Methyl Parathion*	500 grams/liter	I	Shell Chemicals
(7) Nuvacron 300 SCW	Monocrotophos**	300 grams/liter	I	Ciba-Geigy Philippines
(8) Parapest M 50 EC	Methyl Parathion*	500 grams/liter	I	Planters Products, Inc.
(9) Thiodan 35 EC	Endosulfan**	350 grams/liter	II	Hoechst Far East

*Single and double asterisks indicate a banned or restricted pesticide, respectively.
**I = highly hazardous, II = moderately hazardous.
Source: FPA, Rola and Pingali, 1993.

$$EPR_{jj} = \frac{1 - a_j^{'}}{\frac{1}{1 + t_j} - \frac{a_j^{'}}{1 + t_i}} - 1 \tag{3.9}$$

$$EPR_{ji} = \frac{1 - a_i^{'}}{\frac{1}{1 + t_j} - \frac{a_i^{'}}{1 + t_i}} - 1 \tag{3.10}$$

where,

$$a_j^{'} = \frac{(BPF_j^w E_o) + t_j (BPF_j^w E_o)}{PPF_j} \tag{3.11}$$

$$a_i^{'} = \frac{(BPT_i^w E_o) + t_i (BPT_i^w E_o)}{PPF_j} \tag{3.12}$$

and,

ERP_{jj} = effective protection rate for pesticide *j* imported in its formulated form,
ERP_{ji} = effective protection rate for pesticide *j* imported as technical pesticide *i*,
$a_j^{'}$ = share of BPF_j in the cost of PPF_j after tariffs have been imposed,
$a_i^{'}$ = share of BPF_i in the cost of PPF_j after tariffs have been imposed,
t_j = nominal tariff on formulated pesticide *j*,
t_i = nominal tariff on technical pesticide *i*,
BPF_j^w = border price of formulated pesticide *j* in dollars per liter,
BPT_i^w = border price of technical pesticide *i* in dollars per amount of grams in each liter of formulated pesticide,
PPF_j^d = RPF_j^d - Rmm = domestic price at which producer sells formulated pesticide *j* in pesos per liter,
RPF_j^d = domestic (retail) price of formulated pesticide *j* with active ingredient *i* in pesos per liter,

Rmm = marketing margin between the producer and retail levels (PPF_j^d to RPF_j^d) in pesos per liter, and

E_o = official exchange rate.

This formula is appropriate for a product, formulated pesticides in this case, with only one imported input. The objective of the EPR is to assess the level of protection given the producers of technical pesticides within the Philippines. A negative EPR indicates a tax on domestic producers. However, technical pesticides are not produced within the Philippines and all pesticide producers import their active ingredients. Therefore, as in the case of the NPR, the EPR can be interpreted as the effective rate of disprotection for the pesticide processing industry with a positive EPR indicating a tax on pesticide producers. A negative EPR indicates that pesticide producers are receiving more for their formulated product than the would in the absence of intervention. Using the equilibrium free-trade exchange rate (E*) in the calculation of a_j' and a_i', in place of E_o, yields the ERP in the absence of exchange rate overvaluation (EPR*). The EPR and EPR* for nine of the popular pesticides for vegetables will be reported in Chapter 4.

III.3.4 Exchange Rate Calculation

The exchange rate calculations performed in each of the studies reviewed above follow a simple three-sector model (exportables, importables, nontradables) based on purchasing power parity theory. Purchasing power parity theory stipulates that currencies be valued by people for what they can buy. Hence, if it takes q dollars to buy a liter of pesticides in the U.S. it should take q dollars to buy the same liter of pesticides in the Philippines. If the liter of pesticides costs $1 in the U.S. and 10 pesos in the Philippines, the exchange rate should be 10 pesos for each dollar or each peso should be worth $0.10. These assumptions are necessary to derive the real free-trade equilibrium exchange rate in the absence of interventions.

Krueger, Schiff and Valdés describe the free-trade equilibrium exchange rate (E*) in the following way.

> "E* is defined as the exchange rate that equilibriates the current account (or leads to a current account deficit that is sustainable in the long run) in the absence of tariffs and quotas on imports (t_m) and in the absence of export taxes and other export restrictions (t_x) for a given price of non-tradeables" (1991, p. 265).

They note that a sustainable deficit may be possible due to foreign investment, long-term foreign aid commitments, workers remittances, and other factors. This is especially important for the Philippines which relies heavily on workers remittances. E* is used in the Greene and Roe in their study of Dominican Republic to capture the exchange rate's affect on nominal prices (1991).

Intal and Power use two estimates of equilibrium exchange rate in their study on the Philippines. First, they assume that the actual current account balance is sustainable, yielding what they term the free-trade exchange rate (E2). Second, they assume that sustainability requires a zero current account deficit which they call the free-trade equilibrium exchange rate (E*). The authors suspect that the actual equilibrium exchange rate may be somewhere between these two estimates. "However, given the record of investment waste in the Philippines during the period, a zero current account deficit probably is more realistic" (Intal and Power, 1991, p.46). For this reason, the authors use E* in their analysis of market intervention. The free-trade equilibrium exchange rate will also be used in this thesis to evaluate the total nominal and effective rate of protection. E* is calculated using the following equation,

$$E^* = \left\{ \frac{CAB + \frac{t_m}{1+t_m} Q_D \eta_D - \frac{t_x}{1-t_x} Q_S \epsilon_S}{\epsilon_S Q_S + \eta_D Q_D} + 1 \right\} E_o \qquad (3.13)$$

where,
E^* = free trade equilibrium exchange rate
E_0 = market exchange rate
CAB = current account (- means a deficit)
t_m = tariff rate for imports
t_x = export tax rate
Q_S = supply of foreign exchange
Q_D = demand for foreign exchange
ϵ_S = elasticity of supply of foreign exchange, assumed to be equal to the supply price elasticity of exports
η_D = elasticity of demand for foreign exchange, assumed to be equal to the price elasticity of demand for imports.

The first step of this calculation is determining what the current account would be in the absence of all import and export interventions. Supply (Q_S) and demand (Q_D)values are multiplied by their elasticities (ϵ_S or η_D) and adjusted for the change that would occur should import tariffs (t_m) and export taxes (t_x) be removed, at exchange rate E_O. The net value of this change is added to the actual current account resulting in the free-trade current account balance. Dividing the free-trade current account by the sum of quantity supplied times its elasticity and the quantity demanded times the elasticity of demand and adding 1 to the result provides the rate at which the actual exchange rate must increase in order for the free-trade current account to equal zero. This rate times E_O results in E^*. By comparing E_O and E^* one can determine the degree to which the actual exchange rate is overvalued or undervalued. Equation (8) takes into account the impact on E^* of changes in monetary and fiscal policy as will other exogenous shocks such as world interest rates and terms of trade.

Alternative exchange rate theories provide a different means of calculating the effective exchange rate. Two such theories are explored in this thesis: strict purchasing power parity and interest rate parity. Strict purchasing power parity stipulates that the difference between the percentage change in the consumer price index of two countries minus the percentage change in their exchange rates when subtracted from 1 and multiplied by the actual exchange rate, is equal to the equilibrium exchange rate. This relationship can be written as follows,

$$E^* = [1-(\Delta CPI_P - \Delta CPI_U - E_0/E_1)] * E_1 \tag{3.14}$$

where,

ΔCPI_P = the change in relative prices in the Philippines from one year to the next,
ΔCPI_U = the change in relative prices in the U.S. form one year to the next,
E_0 = the exchange rate in the initial year, and
E_1 = the exchange rate one year later.

The equilibrium exchange rate can be interpreted as the rate that would have prevailed had the difference in the Philippine and U.S. inflation rates in a given year been fully accounted for. Although the purchasing power parity relationship does not hold perfectly in empirical studies, this relationship does tend to hold on average and is worth comparing to other methods.

A third method for calculating the equilibrium exchange rate relies on interest rate parity theory. Interest rate parity holds that the ratio of the forward and current exchange rates between two countries will equal the ratio of their nominal interest rates. The formal statement is given by,

$$X_f = \frac{1 + R_{P0}}{1 + R_{U0}} (X_0) \tag{3.15}$$

where,

X_f = forward exchange rate expressed in pesos per dollar,
R_{P0} = the current Philippine interest rate,
R_{U0} = the current U.S. interest rate, and
X_0 = the current exchange rate expressed in pesos per dollar.

A comparison of the actual end of period exchange rate and the forward exchange rate predicted using interest rate parity yields the amount of overvaluation that occurred during that year. The percent overvaluation computed using interest rate parity will be compared to the percent overvaluation derived using Intal and Power's methods and strict purchasing power parity theory in Chapter 4.

III.4 Economic Surplus Analysis

Another objective of this thesis is to describe the effects of tariff and exchange rate policies on the supply of and demand for pesticides in order to estimate changes in consumer and producer surplus. These tariff and exchange rate policy effects are illustrated graphically in Figures 3.1, 3.2, and 3.3. A partial equilibrium setting is used for the graphical representation following the methods used by Houck (1986). The Philippines is assumed to be a small importer of pesticides, unable to influence the world price. Changes in supply of and demand for pesticides, presented graphically in this section, will be quantified in Chapter 4.

III.4.1 Graphical Representation of Tariff and Exchange Rate Affects

Figure 3.1 represents the markets for formulated pesticides, pesticide processing, and technical pesticides within the Philippines. These are the three graphs on the left hand side of the figure with the formulated pesticide market being the top graph, the processing sector represented directly below it, and the technical pesticide market at the bottom. To the right of the graphs for the formulated and technical pesticide markets are graphs representing trade between the Philippines and the rest of the world (ROW) for each of those products.

The tariffs applied to formulated and technical pesticides are both represented on this set of graphs. The effects of the tariff on formulated pesticides are discussed first. Because the Philippines is a small trading nation, a tariff will not affect the world price which is represented by a horizontal supply curve (ES_{Wf}). The 10 percent

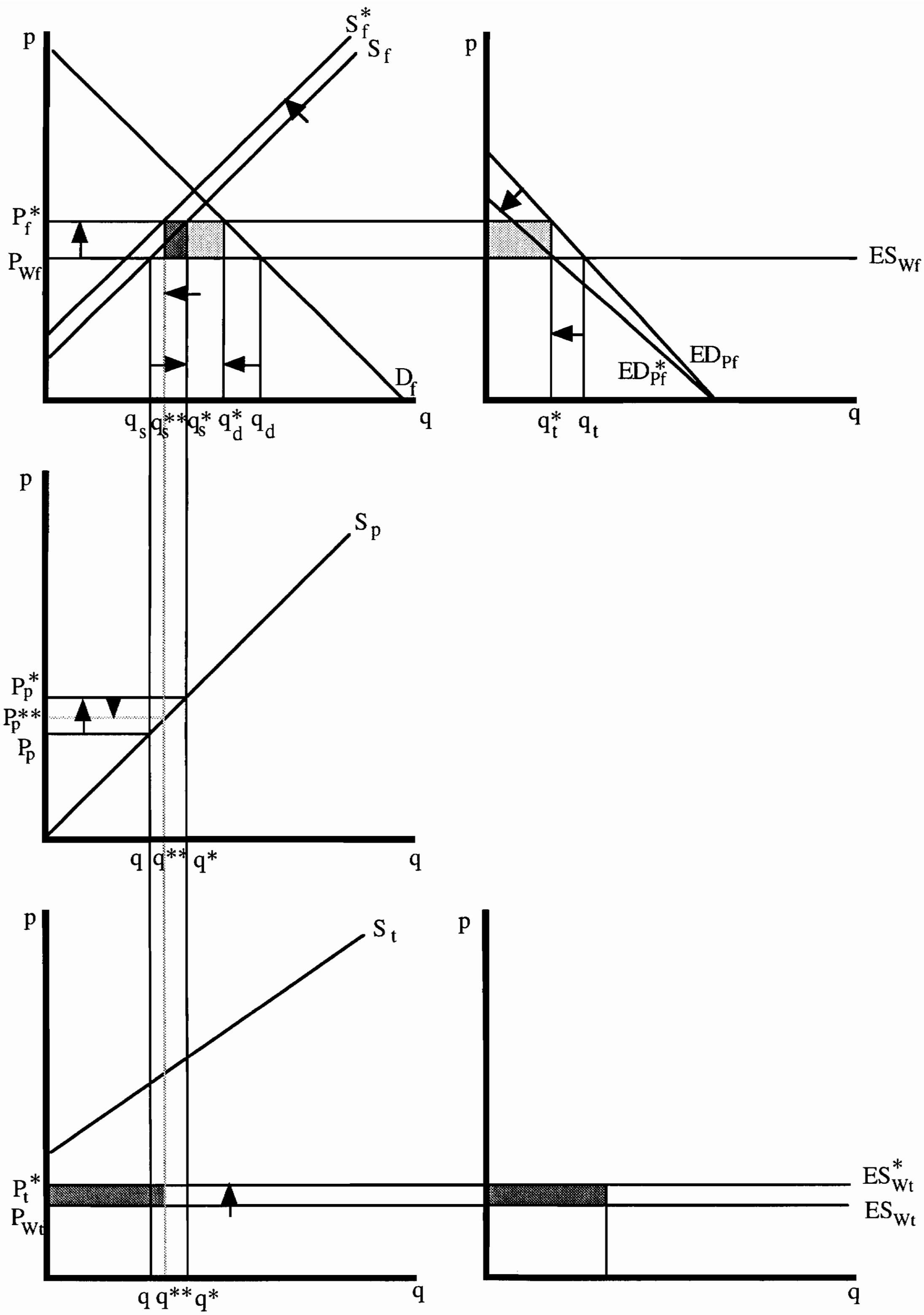

Figure 3.1 Effects of Tariffs on Formulated and Technical Pesticides

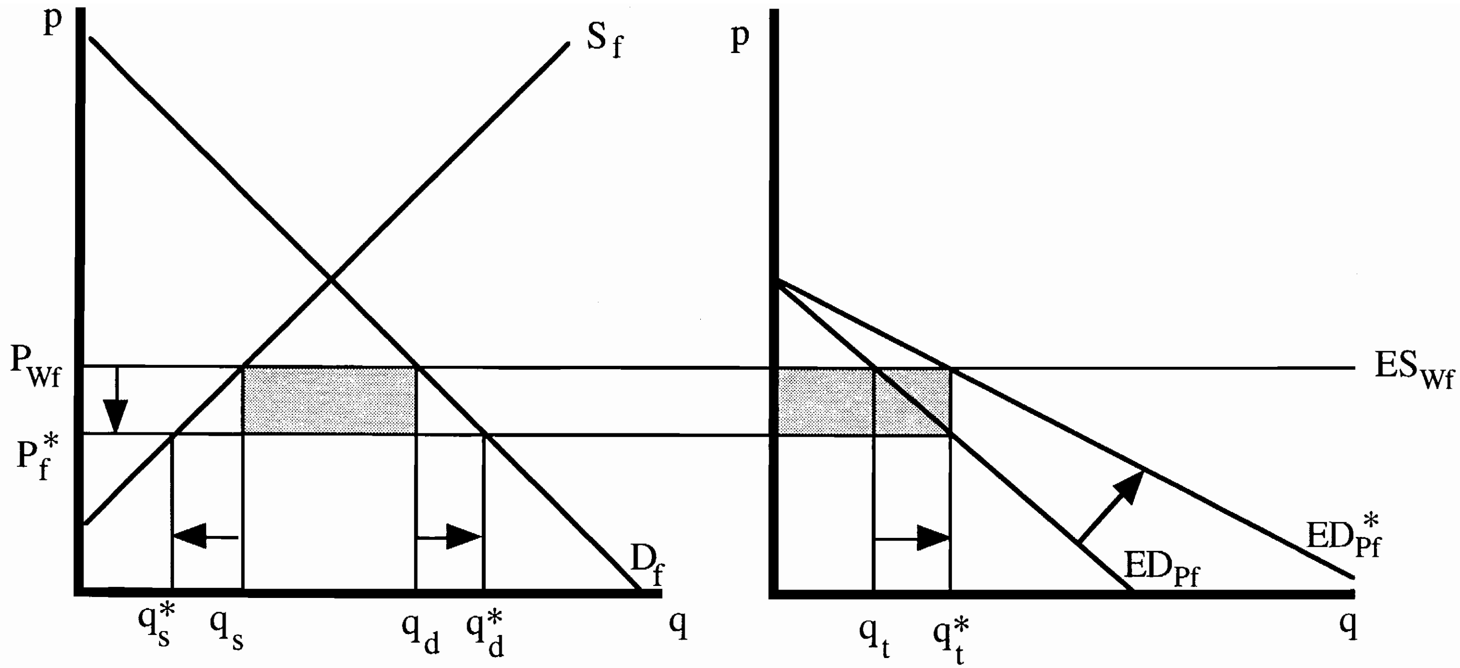

Figure 3.2 Exchange Rate Effects on Formulated Pesticides

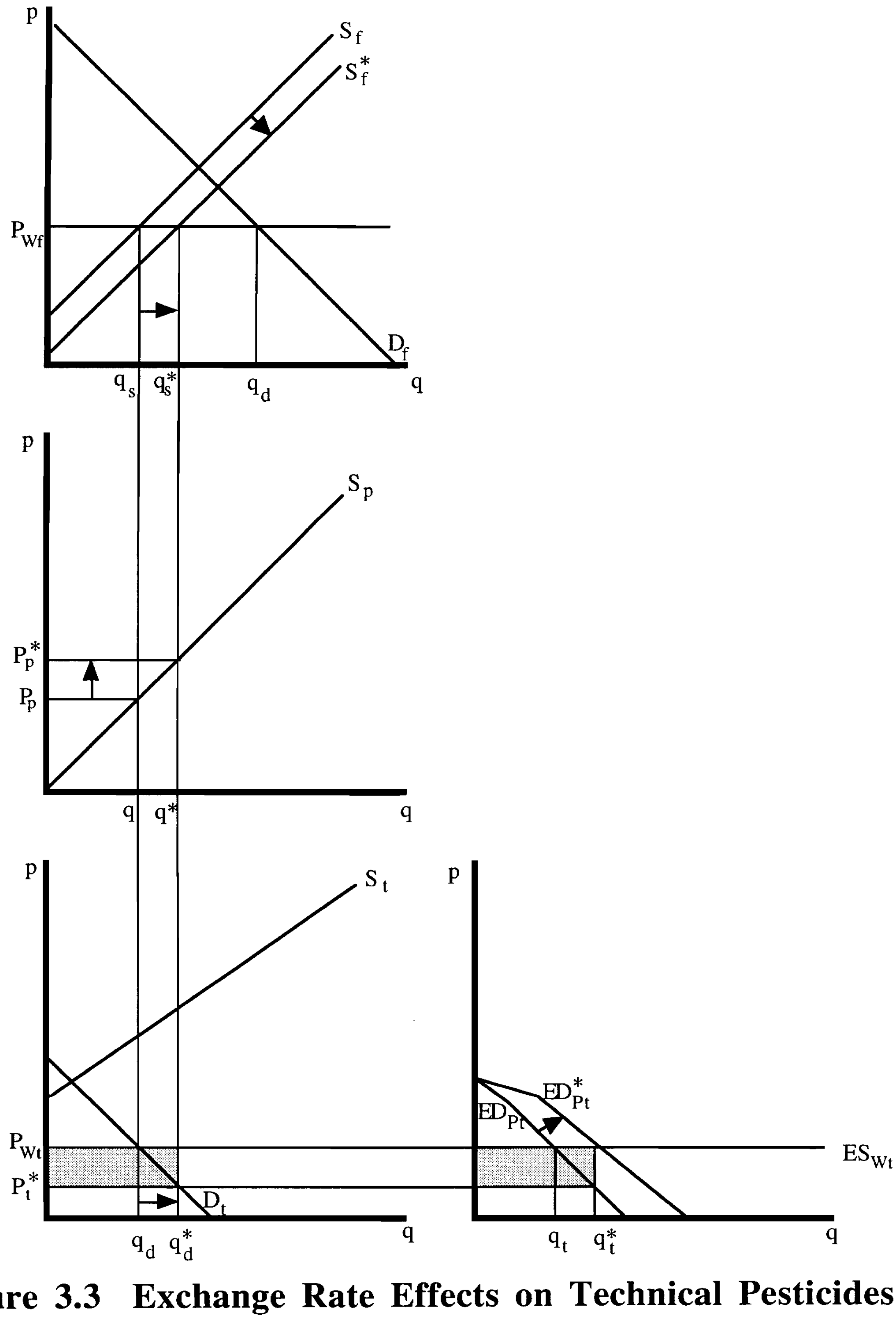

Figure 3.3 Exchange Rate Effects on Technical Pesticides

(ad valorem) tariff will have the effect of shifting down the Philippine excess demand curve for pesticides. The function (ED_{Pf}*) is the excess demand presented to the ROW in the presence of this tariff and vertical distance between ED_{Pf} and ED_{Pf}* is the variable per unit value of the tariff. Extending the point where ES_{Wf} and ED_{Pf}* meet vertically to the original ED_{Pf} gives the Philippine price after the tariff has been imposed. The lightly shaded box, which appears as well in the domestic market graph for formulated pesticides, represents the tariff revenue generated by the Philippines.

Extending this new price line to the Philippine market for formulated pesticides provides the tariff laden price of pesticides, P_f*. In this case, the price has risen exactly 10 percent from P_{Wf} to P_f*. The supply and demand curves in the formulated market (S_f and D_f) are now subject to the higher P_f*. As a result, the amount of formulated pesticides supplied increases from q_S to q_S* and there is a reduction in the amount demanded from q_d to q_d*. The ramifications of the price increase extend to the processing and technical pesticide market as well. The quantity supplied by both markets increases from q to q*. However, the upward sloping processing supply curve coupled with the increased quantity supplied pushes the price of processing up from P_p to P_p*. This is not the case in the technical pesticides market as the Philippines imports all technical pesticides.

The 5 percent tariff imposed on technical pesticides has a very different effect than the one described for the ad valorem tariff on formulated pesticides. As technical pesticides are not produced in the Philippines, the effect of the tariff can be represented by a shift up in the excess supply curve of the ROW (ES_{Wf}*) as viewed by the Philippines. A continuation of the ES_{Wf}* line into the technical pesticides market indicates a price increase from P_{Wt} to P_t*. The actual impact of this price increase is represented by a shift back in the supply curve for the formulated pesticide from S_f to S_f*. This supply curve shift reduces the increase in formulated pesticides supply induced by the previous 10 percent tariff on formulated pesticides. The new quantity of formulated and technical pesticides supplied is q_t**. The quantity processed also decreases to q_p** and the price of processing drops to P_p**. The additional government revenue from the 5 percent tariff on technical pesticides is represented by the darker shaded boxes in both the formulated and technical pesticide markets.

Figure 3.2 depicts the formulated retail and world pesticide market to show the effects of exchange rate policies on the imported formulated pesticides. An overvalued exchange rate is represented by and outward shift in the excess demand curve from ED_{Pf} to ED_{Pf}* for the formulated pesticides. This shift is due to the increased strength of the Philippine peso in comparison to the dollar, which allows Philippine purchases of imports to expand. A vertical line drawn from the intersection of ES_{Wf} and ED_{Pf}* to ED_{Pf} and then over into the domestic market for formulated pesticides indicates the level of subsidy provided by the overvaluation in the formulated market. Prices of formulated pesticides fall (the * indicates a price influence by the exchange rate in this instance). This fall in price decreases the domestic supply from q_S to q_S* and increases demand from q_d to q_d*.

Exchange rate effects on technical pesticides are depicted in Figure 3.3. These graphs follow a similar format to Figure 3.1 but the world market for formulated pesticides is left out. The graphs for the technical pesticide market show an expansion of excess demand in the world market. This is again due to the increased strength of the peso. The shift has the affect of decreasing the price of technical pesticides which causes the quantity of technical pesticides demanded to increase from q_d to q_d*. Increased demand for technical pesticides expands the production of pesticides from q to q* and the cost of processing increases to P_p*. In the retail market, the decrease in the price of technical pesticides causes the supply curve to shift out and supply expands from q_s to q_s*.

The cost of the exchange rate overvaluation is represented by a shaded box in both Figure 3.2 and 3.3. However, who pays for this subsidy is of interest. Houck

(1986) describes government intervention in exchange rate determination as either direct or indirect. Direct intervention would constitute an official exchange rate set by the government which then controls domestic access to foreign currency and foreign access to domestic currency. Direct intervention can also be achieved by buying and selling foreign and domestic currencies in large enough quantities so as to control the value of the domestic currency. The cost of overvaluation, under these direct exchange rate policies, would be paid primarily by the government often using tax revenue. Indirect intervention is defined by Houck (1986) as, "sustained government activity affecting the money supply, inflation, interest rates, or other factors (which lead) to an overvaluation or undervaluation of the nation's currency as a side effect" (p. 169). The Philippine government practices indirect exchange rate determination and the subsidy created by an overvalued exchange rate is paid by the tax payer.

III.4.2 Graphical Representation of Consumer and Producer Surplus

Graphical representation of consumer and producer surplus changes must incorporate both tariff and exchange rate affects in the same graph. This is possible if each of the nine primary pesticides used to calculate the NPR and EPR are also used to estimate welfare changes. These nine pesticides are either imported as formulated or technical pesticides but do not enter the Philippines in both forms. Therefore, the formulated pesticide market for each of the nine pesticides can be represented as a closed economy when viewed at the retail level. At the retail level, the producers of formulated pesticides include the following: importers of technical pesticides, importers of formulated pesticides, producers of formulated pesticides using imported active ingredient, pesticide distributors, and pesticide dealers. Pesticide consumers include: all individuals or companies that purchase pesticides at the retail level (from a pesticide dealer) and all individuals in the Philippines and abroad that purchase the crops on which the pesticide was used.

Under a closed economy assumption, tariffs imposed on either formulated or technical pesticides can be represented by a shift back in the supply curve for formulated pesticides. Similarly, a overvalued exchange rate is represented by a shift out of the supply. A general representation of this closed economy model for the formulated pesticide market can be found in Figure 3.4. The model and the discussion that follows are similar to that presented by Alston, Norton, and Pardey in their book *Science under Scarcity: Principles and Practice for Research evaluation and Priority Setting* (1994).

In this model D_f represents the demand for each formulated pesticides while S_f and S_f**, respectively, represent the supply of pesticide *j* before and after the tariff and exchange rate overvaluation are imposed. It should be noted that the original shift from S_f to S_f* is due to the tariff while the shift from S_f* to S_f** is due the exchange rate overvaluation. As the estimated percentage of currency overvaluation is greater in absolute value than the tariffs on both formulated and technical pesticides, it is projected that the cumulative affect of these policies will shift the supply curve outward. The initial price and quantity before government intervention are P_f and Q_f; after the tariff and exchange rate induced supply shifts they are P_f** and Q_f**.

The total annual benefit from the tariff and exchange rate induced shift out in the supply curve is equal to the area below the demand curve and between S_f and S_f* (ΔTS = I_0abI_2). This change in total surplus can be partitioned into two parts: (a) triangle *abc* which represents surplus due to additional consumption and production of pesticide *j*, and (b) area I_0acI_2 which depicts the savings on the initial quantity. Additional benefits to consumers can be represented by area P_fabP_f**, while the change in producer surplus is the area P_f**bI_2 minus P_faI_0. Due to the nature of the tariff and exchange rate policies, it is assumed that the shift in supply is parallel (the vertical difference between the two supply curves is constant). Under this assumption, area dcI_2 equals area P_faI_0 and the total producer surplus can be

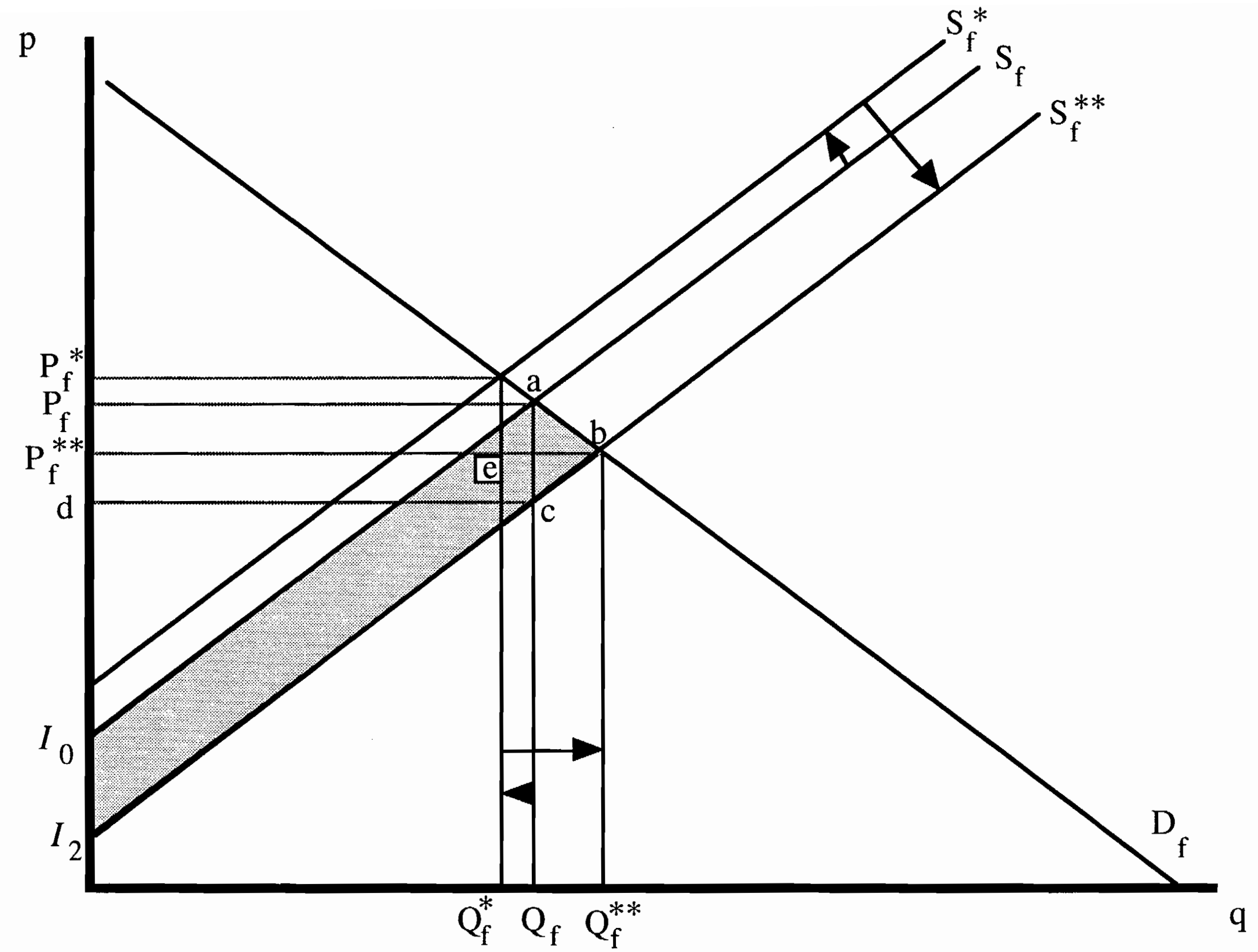

Figure 3.4 Tariff and Exchange Rate Effects on Imported Formulated Pesticides and Formulated Pesticides with Imported Active Ingredient at the Retail Level

represented by area P_f**ecd (the net benefit on the original production) plus area *bce* (the gains from and increase in production from Q_f to Q_f**). Therefore, the total producer surplus change is area P_f**bcd.

III.4.3 Consumer and Producer Surplus Calculations

Calculation of changes in consumer and producer surplus due to tariff and exchange rate policies also follow the economic surplus methods described by Alston, Norton, and Pardey in *Science under Scarcity* (1994). Changes in total, consumer, and producer surplus can be estimated using the following equations when a parallel shift in supply is assumed.

$$\Delta CS = P_0 \; Q_0 \; Z \; (1 + 0.5Z\eta) \qquad \textbf{(3.16)}$$

$$\Delta PS = P_0 \; Q_0 \; (K - Z)(1 + 0.5Z\eta) \qquad \textbf{(3.17)}$$

$$\Delta TS = \Delta CS - \Delta PS = P_0 \; Q_0 \; K \; (1 + 0.5Z\eta) \qquad \textbf{(3.18)}$$

where K is the vertical shift in the supply function as a proportion of the initial price, η is the absolute value of the demand elasticity, ϵ is the supply elasticity, and $Z = K\epsilon/(\epsilon+\eta)$. However, in this case the price (P_f) and quantity (Q_f) data available are those which already reflect the influence of tariffs and exchange rate policy. Therefore, in order to estimate surplus changes from a point where no tariffs or overvaluation exit to the current point, the vertical supply shift will be negative in the calculations. As a result ΔTS, ΔCS, and ΔPS will be negative. By re-interpreting these signs as positive, the change in the surplus from the original point to that in which tariff and exchange rate overvaluation have been imposed can be estimated. This process was used to estimate the change in total, consumer, and producer welfare for each of the nine primary pesticides.

III.4.4 Effects of Price Interventions on Pesticide Consumption and Price

It is also possible to calculate the consumption level and price of pesticides which would have prevailed in the absence of government intervention. The consumption effect is the difference between actual pesticide consumption and the level of consumption that would have prevailed without interventions. The general procedure for estimating the consumption effect is as,

$$C^* = C^A - C^{NI} \quad \textbf{(3.19)}$$

where,
C* = proportionate consumption effect,
CA = actual consumption of formulated pesticides, and
CNI = consumption of pesticides in the absence of interventions.

The consumption of pesticides in the absence of intervention can be estimated in the following manner:

$$Q_1 = Q_0\ (1 + Z\eta) \quad \textbf{(3.20)}$$

where the definitions of the variables are the same as those used in section III.4.3. Using assumed elasticities of pesticide supply and demand, the total consumption effects due to tariffs and exchange rate policy will be estimated in Chapter 4.

Price effects can be quantified using the estimated supply and demand elasticities. The price which would have prevailed without the tariff and exchange rate overvaluation would be,

$$P_1 = P_0\ (1 - Z) \quad \textbf{(3.21)}$$

Therefore, the price effect would be the price in the absence of government intervention minus the current price. Price effects will also be reported in Chapter 4.

CHAPTER IV: Results

IV.1 Introduction

This chapter presents the results of the analyses described in Chapter III in order to fulfill the objectives of this thesis. Section 2 discusses the analysis of pesticide misuse using a logit model. Section 3 presents the results of the nominal rate of protection, effective rate of protection, and exchange rate calculations. Finally, section 4 reports the results of the consumer and producer welfare analysis and the change in pesticide consumption and retail price due to government intervention.

IV.2 Analysis of Pesticide Misuse

The relative importance of socio-economic factors influencing pesticide misuse is assessed using a binomial logit model. Data used in the analysis is from the IPM-CRSP Baseline and Follow-up Baseline Surveys. Of the 300 farmers surveyed in the primary baseline survey, 228 were interviewed a second time to ask additional questions about socio-economic factors relevant to this analysis. The final sample used for the logit analysis included 164 observations as only those farmers who listed onions as their main vegetable crop were appropriate for the analysis. Variables used in the regression are listed in Table 3.1.

Results of the logit analysis are presented in Tables 4.1 and 4.2. The first of these tables shows the results of the initial model using all 23 variables discussed in

Table 4.1 Socio-economic determinants of pesticide misuse in San Jose City (23 variables).

Variable	Coefficient	Mean	Standard Deviation	T-ratio	Significance Level	Probability Effect
Constant	4.1596			1.913	0.05581	0.64088
AGE	-3.33E-02	47.073	12.37	-1.65	0.09902**	-5.14E-03
EDUCN	-0.71278	2.7012	0.67542	-1.906	0.05661**	-0.10982
FFS	-0.97947	0.59756	0.49189	-1.872	0.06114**	-0.15091
VISAGT	0.82425	0.62195	0.48639	1.648	0.09942**	0.127
TENSTAT	-0.17411	0.57927	0.49519	-0.393	0.69403	-2.68E-02
MEMBER	1.2743	0.5122	0.50138	2.33	0.01982***	0.19633
LABOR	0.1672	1.1098	1.3107	0.874	0.38212	2.58E-02
IRRIG	0.38677	0.57927	0.49519	0.814	0.41548	5.96E-02
ONAREA	-0.2063	0.60107	0.59072	-0.498	0.61863	-3.18E-02
BORROW	1.3306	0.7622	0.42704	1.412	0.15797*	0.20501
COOP	-1.8004	0.23171	0.42322	-1.855	0.06355**	-0.27739
FRN	-1.2003	0.2378	0.42704	-1.321	0.18634*	-0.18493
ML	-1.1298	0.26829	0.44443	-1.32	0.18686*	-0.17408
KINDPES	1.3352	0.17073	0.37743	1.64	0.10092*	0.20572
COST	-0.36494	1.5122	0.65987	-1.047	0.29533	-0.056227
AGTECH	0.3765	1.9451	0.6851	0.984	0.32491	5.80E-02
PESTDEAL	0.33731	2.122	0.66259	0.71	0.4777	5.20E-02
CHEMCO	-1.0607	2.128	0.73606	-2.674	0.00751****	-1.63E-01
NBOR	0.13003	2.811	0.91054	0.489	0.62495	2.00E-02
SAFETY	0.27159	1.2256	0.41926	0.485	0.62763	4.18E-02
NENEMY	-0.81804	7.93E-02	0.27098	-1.123	0.26135	-0.12604
WAQUAL	-0.19641	0.7561	0.43075	-0.253	0.80049*	-3.03E-02
IMPACT	0.84319	0.78049	0.41518	1.078	0.28112	0.12991

McFadden R Squared	0.214		
Log Likelihood	-72.49		
Log Likelihood, restricted	-92.22		
Chi-squared	39.45	**p-value**	0.017
Restrictions	23		
Likelihood Ratio Test:		**Test Statistic**	**Significance Level**
Producer Characteristics (7):		15.86	0.0264
Farm Structure and Management (9):		13.81	0.1294
Pesticide Information Sources (7):		14.45	0.0437
Pesticide and Pest Management Perceptions (4):		9.80	0.044
Correct prediction (%)	Total: 79.88	Misusers: 91.87	Non-misusers: 43.90

* Single, double, triple, and quadruple asterisks indicate that the corresponding coefficients in the logit model are significant at 20 percent, 10 percent, 5 percent, and 1 percent, respectively.

Table 4.2 Socio-economic determinants of pesticide misuse in San Jose City (15 variables).

Variable	Coefficient	Mean	Standard Deviation	T-ratio	Significance Level	Probability Effect
Constant	4.6773			2.524	0.01161	0.74569
AGE	-2.85E-02	47.073	12.37	-1.532	0.12564*	-4.54E-03
EDUCN	-0.76969	2.7012	0.67542	-2.193	0.02828***	-0.12271
FFS	-0.87785	0.59756	0.49189	-1.775	0.07589**	-0.13995
VISAGT	0.8632	0.62195	0.48639	1.834	0.06669**	0.13762
MEMBER	1.1177	0.5122	0.50138	2.223	0.02623***	0.17819
IRRIG	0.46337	0.57927	0.49519	1.043	0.29715	7.39E-02
COOP	-0.88176	0.23171	0.42322	-1.38	0.1675*	-0.14058
KINDPES	1.4466	0.17073	0.37743	1.938	0.05258**	0.23063
COST	-0.36963	1.5122	0.65987	-1.123	0.26149	-5.89E-02
AGTECH	0.38278	1.9451	0.6851	1.043	0.29675	6.10E-02
PESTDEAL	0.49273	2.122	0.66259	1.076	0.2819	7.86E-02
CHEMCO	-1.0755	2.128	0.73606	-2.829	0.00466****	-0.17146
NENEMY	-0.91062	7.93E-02	0.27098	-1.285	0.19865*	-0.14518
WAQUAL	-0.2471	0.7561	0.43075	-0.334	0.73833	-3.94E-02
IMPACT	0.71313	0.78049	0.41518	0.966	0.33429	0.11369
McFadden R Squared		0.195				
Log Likelihood		-74.25				
Log Likelihood, restricted		-92.22				
Chi-squared		35.94		p-value	0.0018	
Restrictions		15				
Correct prediction (%)		Total: 79.27	Misusers: 93.50	Non-misusers: 36.59		

* Single, double, triple, and quadruple asterisks indicate that the corresponding coefficients in the logit model are significant at 20 percent, 10 percent, 5 percent, and 1 percent, respectively.

Chapter III. Included in the table are the coefficient, mean, standard deviation, T-ratio, significance level and probability effect of each variable. Summary statistics for the model are at the bottom of each table. The initial model had a log-likelihood value of (-72.49) and a McFadden R^2 of 0.214. A McFadden R^2 of between 0.2 and 0.4 is typical for logit models (Sonka, Hornbaker, and Hudson, 1989). The model's chi-squared value is 39.45 which is significant at 1.77 percent. Of the 164 total observations, 79.88 percent were predicted correctly. A total of 91.87 percent of misusers and 43.9 percent of non-misusers were correctly predicted by the model. The likelihood ratio was significant at the 5 percent level for three of the categories of factors affecting misuse. Only the catagory of Farm Structure and Management failed to be significant at this level.

Variables in the model that were significant at either the 20 percent, 10 percent, 5 percent, and 1 percent levels include: AGE, EDUCN, FFS, VISAGT, MEMBER, BORROW, COOP, FRN, ML, KINDPES, CHEMCO, and WAQUAL. The only variable significant at 1 percent was CHEMCO. According to the model, as the farmer reduces the level of importance given information from a chemical company representative when deciding which pesticide to use (e.g. from extremely important to very important, etc.), his/her probability of misusing pesticides decreases by 16.3 percent. MEMBER was significant at the 5 percent level. As expected, the model predicted that membership in a cooperative, village association or farmers' association would increase the probability of pesticide misuse by 19.6 percent.

Significant at the 10 percent level were the variables AGE, EDUCN, FFS, VISAGT, and COOP. The model predicted that, as age increased, the probability that the farmer would misuse pesticides decreased. Similarly, as the farmer's education level increased, there was a predicted decrease in misuse. Access to IPM training (FFS) had the effect of decreasing misuse by 15 percent according to the model. Conversely, a visit by an agricultural technician to discuss non-pesticide means of pest management had a positive influence on misuse; the probability that a farmer would misuse pesticides increased by 12.7. According to the model, receiving credit from a cooperative had the effect of reducing the probability of pesticide misuse by 27.7 percent.

Five variables were significant at the 20 percent level. If a farmer received credit for vegetable production the model predicted that farmer would be 20.5 percent more likely to misuse pesticides. Receiving credit from a friend decreased the likelihood that a farmer would misuse pesticides by 18.5 percent while receiving credit from a money lender decreased the likelihood of misuse by 17.4 percent. If a farmer receives credit in-kind as pesticides the probability that the farmer misuses pesticides increases by 20.6 percent. Finally, a farmer that agrees with the perception that pesticides can harm water quality is 3 percent less likely to misuse pesticides.

Of the eleven significant variables in the model, five coefficients did not influence pesticide misuse as expected. Instead of increasing the likelihood of pesticide misuse as hypothesized, an increase in farmer age actually reduced the probability of misuse. This result is not inconceivable as an increase in farming years could also create a greater familiarity with pest problems and successful pest management treatments which would decrease misuse. More surprising was the finding that a visit by an agricultural technician to discuss non-pesticide means of pest management actually increased the probability of pesticide misuse. However, this result could be due to the influence of pesticide dealers or chemical companies on the advice given by agricultural technicians. Finally, the influence of receiving credit from a cooperative/Landbank, money lender, and friend had a negative effect on pesticide misuse which was not expected, especially as receiving credit in general has a positive influence on misuse. It could be that the type of credit received, such as receiving pesticides in-kind, induces the negative effect of borrowing while the source of the credit remains a positive influence.

The findings of this initial model indicated that many of the variables whose direction of influence was unknown were also insignificant. Consequently, these variables were dropped and the model was re-estimated using 15 variables. The results of the reduced model are presented in Table 4.2 which also includes the model's summary statistics. McFadden's R^2 yielded a value of 0.195 for the reduced model. The chi-squared value for the model was 35.94 which was significant at 0.18 percent. Therefore, despite the lower McFadden R^2, the reduced model is more significant. Of the 164 observations, the model predicted 79.27 percent correctly. This percentage correctly predicted is less than a percentage point lower than in the full model. More misusers were correctly predicted by this model (93.5 percent) while less non-misusers were correctly predicted (36.59 percent). The similarity in the coefficients of the two regressions is an indication that the overall model is fairly robust.

Nine of the 15 variables in the reduced form model were significant. Again, CHEMCO was the only variable significant at 1 percent. The model predicted that, by reducing the importance of information from a chemical company representative by one level, the probability that the farmer will misuse pesticides decreases by 17 percent. Two variables were significant at the 5 percent level. According to the model, increasing by one the level of a farmer's education will produce a 12.3 percent decrease in misuse. As in the previous model, membership in a cooperative, village association, or farmers' association increases the likelihood of misuse by 17.8 percent.

Variables significant at the 10 percent level include: FFS, VISAGT and KINDPES. Access to IPM information via the Farmer Field School (FFS) decreased the likelihood that a farmer would misuse pesticides by 14 percent. Conversely, a visit by an agricultural technician to discuss IPM increased by 13.8 percent the probability that a farmer would misuse pesticides. According to the model, receiving credit in-kind as pesticides increased the probability of misuse by 23 percent. AGE, COOP, and NENEMY were significant at 20 percent in the reduced form model. As the age of the farmer increase one level the likelihood of pesticide misuse decreased by 0.5 percent. Receiving credit from a cooperative reduced the probability of misuse by 14 percent. Finally, if a farmer agreed with the perception that killing natural enemies could hasten pest infestation his/her the model indicated that the farmer would be 14.5 percent less likely to misuse pesticides. In this model AGE, VISAGT, and COOP have the opposite direction of influence than that expected. The potential reasons for this divergence were discussed above. The implications of the results of both models are discussed in Chapter 5.

IV.3 Government Intervention

IV.3.1 Nominal Rate of Protection

The price data necessary for the NPR calculations came from a variety of sources. Border prices of formulated pesticides in dollars per liter and technical pesticides in dollars per kilogram were obtained using data from the Business Statistics Monitor's *Monthly Descriptive Arrivals Report*. The monthly report for pesticides was obtained for the years 1989 to 1995 and lists the quantity, description of the product, name of consignee, and the value of the quantity imported. Import values were listed as C.I.F. (cost, insurance, and freight), C.F. (cost and freight), D.V. (dutiable value), and L.C. (local currency value). The value of importance for this study is at the C.I.F. level where all transportation costs to the Philippines are included but no import taxes or tariffs have been levied. However, the C.I.F. value was not reported for all quantities imported. Table 4.3 summarizes total annual quantity and value data using C.I.F, C.F., and D.V. values (non-C.I.F. values are indicated and only used when necessary). Table 4.4 lists only quantities and value reported as C.I.F.

By dividing the quantity imported by the C.I.F. value, a border price of technical and formulated pesticides were derived for each year. Quantities associated with C.F. and D.V. values were not used to determine the border price. Border price

Table 4.3 Total quantity and value of imported pesticides or active ingredient.

	Pesticide\Year		1989	1990	1991	1992	1993	1994
(1)	**Azodrin 168/202-R**	**Quantity (kg)**	53,820	70,880	136,914	171,406	104,460	0.00
	(Monocrotophos)	**Value ($)**	466,037.64	523,848.00	974,494.00*	1,179,020.00*	749,274.00*	0.00
	Shell Chemical Co, Inc.							
					*c.f. (2/4)	*c.f. (1/4)	*d.v (2/4)	
(2)	**Cymbush**	**Quantity (ltr)**	86,400	159,048	259,280	230,400	244,800	305,600
	(Cypermethrin)	**Value ($)**	604,800.00	1,164,240.00	2,022,624.00	1,900,800.00	2,077,200.00	2,660,496.00
	Jardine Davies, Inc.							
(3)	**Endosulfan 35% EC**	**Quantity (kg)**	28,000	54,000	54,000	87,000	10,000	0.00
	(Endosulfan)	**Value ($)**	208,600.00	376,600.00	437,400.00	713,400.00	81,500.00	0.00
	Marsman & Co., Inc.							
	Aldiz, Inc. (1993)**							
(4)	**Folidol M 50 EC**	**Quantity (kg)**	85,000	54,000	124,334	107,777	35,200	35,200
	(Methyl Parathion 94%)	**Value ($)**	343,718.00*	234,900.00	599,698.00*	518,500.00*	200,180.00	195,057.00*
	Bayer Philippines							
			*d.v. (1/5)		*c.f. (3/7)	*d.v. (1/6)		*d.v. (1/1)
(5)	**Lannate**	**Quantity (kg)**	12,000	21,000	36,800	2,400	14,800	27,000
	(Methomyl)	**Value ($)**	206,018.00	360,348.37	627,333.00*	51,840.00	272,552.00*	623,410.00*
	Du Pont Far East, Inc.							
					*c.f. (1/4)		*c.f. (1/3)	*d.v. (3/3)
(6)	**Meptox 50 EC**	**Quantity (kg)**	0.00	78,000	21,216	43,000	61,932	0.00
	(Methyl Parathion)	**Value ($)**	0.00	308,100.00	84,825.00	187,250.00	253,075.00*	0.00
	Shell Chemical Co., Inc.							
							*d.v. (1/3)	
(7)	**Nuvacron 300 SCW *****	**Quantity (kg)**	44,088	88,000	104,280	97,680	146,520	16,280
	(Methyl Parathion)	**Value ($)**	311,190.09*	494,468.00	798,036.00*	758,674.00	1,012,824.00*	150,509.00
	Ciba-Geigy Philippines							
			*d.v. (1/4)		*d.v. (3/5)		*d.v. (2/3)	
(8)	**Parapest M 50 EC**	**Quantity (kg)**	19,500	19,500	19,500	0.00	39,000	0.00
	(Methyl Parathion 80%)	**Value ($)**	76,050.00	76,050.00	76,050.00	0.00	152,100.00	0.00
	Planters Products, Inc.							
(9)	**Thiodan 35 EC**	**Quantity (kg)**	255,000	316,902	345,846	416,146	250,000	50,000
	(Endosulfan)	**Value ($)**	2,054,418.00	2,698,646.00	2,688,182.00	3,067,008.00*	2,054,447.00*	415,000.00*
	Hoechst Far East							
						*c.f. (1/9)	*d.v. (1/5)	*d.v. (1/1)

* Values expressed as C.F. or D.V. in the trade data are indicated by a ratio of non-C.I.F. values to total values [c.f. (non C.I.F./total)] below each individual entry. All other entries are C.I.F.

** Trade data for Aldiz, Inc. were used in 1993 as their product is nearly identical and trade data did not exist for Marsman.

*** Trade values could not be translated for 22,000kg in 1990, 40,700kg in 1991, 16,280kg in 1992, and 32,560kg in 1993. These quantities are recorded but not used to calculate price.

Source: Business Statistics Monitor, Monthly Descriptive Arrivals Report, various issues.

Table 4.4 Import price of pesticides or active ingredient using C.I.F. data.

Pesticide\Year		1989	1990	1991	1992	1993	1994
(1) Azodrin 168/202-R	Quantity (kg)	53,820	70,880	92,000	139,436	58,811	0.00
(Monocrotophos)	Value ($)	466,037.64	523,848.00	672,101.00	957,079.00	395,307.00	0.00
Shell Chemical Co, Inc.	Price ($/kg)	8.66	7.39	7.31	6.86	6.72	0.00
(2) Cymbush	Quantity (ltr)	86,400	159,048	259,280	230,400	244,800	305,600
(Cypermethrin)	Value ($)	604,800.00	1,164,240.00	2,022,624.00	1,900,800.00	2,077,200.00	2,660,496.00
Jardine Davies, Inc.	Price ($/ltr)	7.00	7.32	7.80	8.25	8.49	8.71
(3) Endosulfan 35% EC	Quantity (kg)	28,000	54,000	54,000	87,000	10,000	0.00
(Endosulfan)	Value ($)	208,600.00	376,600.00	437,400.00	713,400.00	81,500.00	0.00
Marsman & Co., Inc.	Price ($/kg)	7.45	6.97	8.10	8.20	8.15	0.00
Aldiz, Inc. (1993)*							
(4) Folidol M 50 EC	Quantity (kg)	68,000	54,000	70,619	90,261	35,200	0.00
(Methyl Parathion 94%)	Value ($)	275,718.00	234,900.00	346,523.00	430,920.00	200,180.00	0.00
Bayer Philippines	Price ($/kg)	4.05	4.35	4.91	4.77	5.69	0.00
(5) Lannate	Quantity (kg)	12,000	21,000	27,800	2,400	4,800	0.00
(Methomyl)	Value ($)	206,018.00	360,348.37	472,168.00	51,840.00	103,680.00	0.00
Du Pont Far East, Inc.	Price ($/kg)	17.17	17.16	16.98	21.60	21.60	0.00
(6) Meptox 50 EC	Quantity (kg)	0.00	78,000	21,216	43,000	42,432	0.00
(Methyl Parathion)	Value ($)	0.00	308,100.00	84,825.00	187,250.00	168,250.00	0.00
Shell Chemical Co., Inc.	Price ($/kg)	0.00	3.95	4.00	4.35	3.97	0.00
(7) Nuvacron 300 SCW	Quantity (kg)	27,728	66,000	16,940	81,400	32,560	16,280
(Methyl Parathion)	Value ($)	198,333.06	494,468.00	137,381.00	758,674.00	283,574.00	150,509.00
Ciba-Geigy Philippines	Price ($/kg)	7.15	7.49	8.11	9.32	8.71	9.25
(8) Parapest M 50 EC	Quantity (kg)	19,500	19,500	19,500	0.00	39,000	0.00
(Methyl Parathion 80%)	Value ($)	76,050.00	76,050.00	76,050.00	0.00	152,100.00	0.00
Planters Products, Inc.	Price ($/kg)	3.90	3.90	3.90	0.00	3.90	0.00
(9) Thiodan 35 EC	Quantity (kg)	255,000	316,902	345,846	366,146	200,000	0.00
(Endosulfan)	Value ($)	2,054,418.00	2,698,646.00	2,688,182.00	2,657,072.00	1,639,447.00	0.00
Hoechst Far East	Price ($/kg)	8.06	8.52	7.77	7.26	8.20	0.00

* Trade data for Aldiz, Inc. were used in 1993 as their product is nearly identical and trade data did not exist for Marsman.

Source: Business Statistics Monitor, Monthly Descriptive Arrivals Report, various issues.

per liter of formulated pesticide was calculated by taking the price per gram of technical pesticide and multiplying that value by the number of grams in each liter of formulated pesticide. This calculation was not necessary for Cymbush which is imported as formulated pesticide.

Retail price of each of the nine pesticides was determined by surveying pesticide dealers in San Jose City. The average annual retail price of each formulated pesticide is reported in Table 4.5. To derive the price at which the pesticide producer sells the formulated pesticide to the distributor, the marketing margin between the producer and retail level (Rmm) was subtracted from the retail price. After interviews with the Director of FPA and the President of the Council on Pesticides for Agriculture in the Philippines (CPAP), the marketing margin was estimated at 30 percent of the retail price of the formulated pesticide. These sources indicated that, on average, the pesticide distributor buys the formulated pesticides at approximately a 30 percent savings off the suggested retail price and the distributor sells to the pesticide dealer at a 15 percent reduction off the suggested retail price. This translates into an total mark-up of 30 percent from the producers price. This rule of thumb was used for each pesticide to determine the producer's price of formulated pesticide (PPF).

In order to reduce the PPF to the same stage of processing as the border price for technical pesticides, it was necessary to multiply the PPF by a conversion ratio. This ratio is the value of technical pesticide in the PPF. The ratio has the effect of subtracting all the costs of the producer not related to the cost of the formulated or technical pesticide. To get the conversion ratio, an estimate of the producers' costs was necessary. However, the FPA and each chemical company representative that was approached refused to give access to this information explaining it was confidential. Therefore, it was not possible to estimate the NPR for the imported technical and formulated pesticides. Without the producer cost data, the amount of tax incorporated in the PPF could not be determined.

4.5 Retail price of the top 10 pesticides for years 1989-1994 (pesos per liter).*

Pesticide/year	1989	1990	1991	1992	1993	1994
1) Azodrin	190	200	260	260	275	312
2) Cymbush	340	350	535	500	522	480.5
3) Endosulfan			217.5	255	262	312
4) Folidol	170	150		225	260	251
5) Lannate	270			298	312	300
6) Meptox				190		192
7) Nuvacron		175	272.5	270	297	322
8) Parapest	170			250	220	222
9) Thiodan	180		245	254	264	266

* Data obtained from interviews with pesticide dealers in Nueva Ecija

IV.3.2 Effective Rate of Protection

Estimation of the ERP for both technical and formulated pesticides was possible given the available data. Tariff rates were obtained from the Bureau of Agricultural Statistics. The tariff rate for formulated and technical pesticides for the years 1989 to 1993 were 10 percent and 5 percent, respectively. The BAS also confirmed that there are no other restrictions placed on pesticide importations.

The prices described for the NPR were used to determine the share of the border price of both formulated (BPF) and technical pesticides (BPT) in the producer's price of formulated pesticide (PPF), after tariffs were imposed. There was no need to subtract producer costs in this calculation. The estimates of EPR and EPR* appear in Table 4.6 and the values used to calculate the EPR and EPR* appear in Appendix B. The EPR and EPR* were not calculated for years in which an average retail price was not available.

The results of the EPR and EPR* calculations reflect an average rate of disprotection for all nine pesticides of about 12 to 25 percent. The rate of effective disprotection on Cymbush, the only imported formulated pesticide, was much higher than for the pesticides which used imported active ingredient. Lannate reflected a positive rate of protection for two of the three years estimated because the border price of Methomyl (BPT) was greater than the producer price of formulated pesticides (PPF). Therefore, a_j', the share of BPT in PPF was greater than one. This result is most likely due to an incorrect estimation of the border price of Methomyl, the retail price of Lannate, or the retail marketing margin. When using the equilibrium exchange-rate in the EPR formula, the level of disprotection increases in every case. For Lannate, the positive rate of protection became less positive when the equilibrium exchange rate was used. These results indicate that pesticide producers within the Philippines are being taxed but that the tax is mitigated by an overvalued exchange rate.

4.6 EPR and EPR* of the 9 top pesticides for the years 1989-1993.*

Pesticide/year		1989	1990	1991	1992	1993
1) Azodrin	EPR	13.99%	13.37%	12.65%	12.16%	12.11%
	EPR*	15.97%	15.05%	13.63%	12.88%	12.92%
2) Cymbush	EPR	24.00%	35.68%	19.69%	21.28%	23.23%
	EPR*	57.05%	-104.51%	30.16%	36.12%	55.79%
3) Endosulfan	EPR			16.44%	14.11%	14.33%
	EPR*			20.81%	16.03%	16.80%
4) Folidol	EPR	13.43%	16.21%		13.69%	14.37%
	EPR*	14.98%	21.23%		15.30%	16.88%
5) Lannate	EPR	43.17%			-26.06%	-22.56%
	EPR*	-70.68%			-7.31%	-5.69%
6) Meptox	EPR				14.24%	
	EPR*				16.26%	
7) Nuvacron	EPR		14.81%	13.14%	13.55%	13.00%
	EPR*		17.91%	14.40%	15.06%	14.36%
8) Parapest	EPR	13.22%			12.27%	13.04%
	EPR*	14.63%			13.05%	14.42%
9) Thiodan	EPR	16.81%		15.33%	13.80%	14.98%
	EPR*	22.09%		18.41%	15.49%	18.15%

*See Appendix B for calculations

IV.3.3 Free-Trade Equilibrium Exchange Rate Estimation

The free-trade equilibrium exchange rate estimations using the methods of Intal and Power (1991) are presented in Table 4.7. All relevant data and data sources are included in the table. As reported in the table, the degree of divergence between the official exchange rate and the equilibrium exchange rate vary from -13.67 to -19.95 percent. A negative degree of divergence indicates an overvalued exchange rate. The average amount of overvaluation for the years 1984 to 1993 was 17.66 percent.

Alternative estimations of the free-trade equilibrium exchange rate produce very different results. The free-trade equilibrium exchange rate estimates using strict Purchasing Power Parity theory appear in Table 4.8. Using this method, the degree of divergence is actually positive some years signifying an undervalued currency. However, over the ten year period from 1984 to 1993 the average degree of divergence indicates an annual overvaluation of the peso of only 2 percent. Similarly, the free-trade equilibrium exchange rate estimates using Interest Rate Parity indicate two years in which the currency was undervalued but the average degree of divergence had the currency overvalued by an average of 2.79 percent annually (Table 4.9). The similarity of the average overvaluation calculated using Purchasing Power and Interest Rate Parity provide strong evidence that the estimated overvaluation using the Intal and Power method is too high. Yet, estimates using the PPP and IRP methods are highly variable from year to year while the Intal and Power method produced estimates that only varied by 7 percent. To provide some continuity between this thesis and previous studies, all calculations using the free-trade equilibrium exchange rate (E*) will employ the estimates derived from the Intal and Power method.

IV.2 Consumer-producer surplus analysis

This section presents the estimates of the change in aggregate consumer and producer welfare for nine pesticides due to government intervention in the pesticide

Table 4.7 Data for Equilibrium Exchange Rate Calculation*

Year	Trade Balance (1)	Service Balance (2)	Income Balance (3)	Donation Transfers (4)	CAB (5)	Qd (6)	Qs (7)	Eo (8)	E* (9)	DD (10)
1984	-679	474	-1475	386	-1298	9,697	8,403	16.7	20.69	-19.28
1985	-482	1385	-1317	379	-35	8,331	8,296	18.61	22.25	-16.36
1986	-202	2036	-1321	441	954	8,120	9,074	20.39	23.62	-13.67
1987	-1017	1221	-1221	573	-444	10,191	9,747	20.57	24.85	-17.22
1988	-1085	1132	-1212	775	-390	11,831	11,441	21.1	25.42	-16.99
1989	-2598	1698	-1386	830	-1456	14,693	13,237	21.74	26.67	-18.49
1990	-4020	1520	-909	714	-2695	16,437	13,742	24.31	30.37	-19.95
1991	-3211	1906	-556	827	-1034	16,324	15,290	27.48	33.38	-17.68
1992	-4695	2489	390	817	-999	19,137	18,138	25.51	30.90	-17.44
1993	-6222	1643	591	699	-3289	22,891	19,602	27.12	33.69	-19.50

(1) Trade Balance, Source: IMF International Financial Statistics Yearbook 1994
(2) Service Balance, Source: IMF International Financial Statistics Yearbook 1994
(3) Income Balance, Source: IMF International Financial Statistics Yearbook 1994
(4) Private and Official Unrequited Transfers, Source: IMF International Financial Statistics Yearbook 1994
(5) Current Account (Column 3+4+5+6)
(6) Demand for Foreign Exchange, Source: IMF International Financial Statistics Yearbook 1994
(7) Supply of Foreign Exchange, Source: IMF International Financial Statistics Yearbook 1994
(8) Actual Market Exchange Rate, Source: IMF International Financial Statistics Yearbook 1994
(9) Free-Trade Equilibrium Exchange Rate (see formula in text p. xx)
(10) Degree of Divergence between Actual and Free-Trade Equlibrium Exchange Rate: {(Eo/E*)-1}*100

* Import tax rate (Tm) was assumed to be 0.44 and the Export tax rate (Tx) was assumed to be 0.02, Intal and Power, 1991
The Supply elasticity of Foreign Exchange (Es) was assumed to be 1.40 and the Demand Elasticity (nd) -2.70, Intal and Power, 1991.
See text for further comments on these assumptions

Table 4.8 Data for Equilibrium Exchange Rate Calculation using Purchasing Power Parity*

Year	Philippine CPI (1)	U.S. CPI (2)	Eo (end of period) (3)	E* (4)	DD (percent) (5)
1983	137.10	120.89	14.00	n.a	
1984	206.06	126.09	19.76	19.80	-0.20
1985	253.66	130.63	19.03	22.67	-16.05
1986	255.69	133.11	20.53	18.81	9.13
1987	265.41	138.04	20.80	20.55	1.22
1988	288.77	143.56	21.34	21.71	-1.71
1989	324.00	150.45	22.44	22.75	-1.35
1990	369.68	158.57	28.00	24.47	14.44
1991	438.81	165.23	26.65	31.12	-14.38
1992	477.86	170.19	25.10	27.97	-10.27
1993	514.18	175.30	27.70	26.25	5.54
		Averages:	23.13	23.61	-2.01

(1) Philippine Consumer Price Index, Source: IMF International Financial Statistics
(2) U.S. Consumer Pirce Index, Source: IMF International Financial Statistics
(3) End of Period Nominal Exchange Rate, Source: IMF International Financial Statistics
(4) Predicted Nominal Exchange Rate using Purchasing Power Parity
(5) Degree of Divergence between Actual and PPP Exchange Rate: {(Eo/E*)-1}*100

* CPI index (1980 = 100)

Table 4.9 Data for Equilibrium Exchange Rate Calculation using Interest Rate Parity*

Year	Philippine T-bill (1)	U.S. T-bill (2)	Eo (end of period) (3)	E* (4)	DD (5)
1983	14.23	8.62	14.00	n.a	
1984	28.53	9.57	19.76	14.73	34.19
1985	26.73	7.49	19.03	23.18	-17.89
1986	16.08	5.97	20.53	22.44	-8.50
1987	11.51	5.83	20.80	22.49	-7.51
1988	14.67	6.67	21.34	21.92	-2.65
1989	18.65	8.11	22.44	22.93	-2.16
1990	23.67	7.51	28.00	24.63	13.70
1991	21.48	5.41	26.65	32.21	-17.26
1992	16.02	3.46	25.10	30.71	-18.29
1993	12.45	3.02	27.70	28.14	-1.57
		Averages:	23.13	24.34	-2.79

(1) Philippine Annuall Treasury Bill Rate, Source: IMF International Financial Statistics
(2) U.S. Annual Treasury Bill Rate, Source: IMF International Financial Statistics
(3) End of Period Nominal Exchange Rate, Source: IMF International Financial Statistics
(4) Predicted Nominal Exchange Rate using Interest Rate Parity
(5) Degree of Divergence between Actual and Interest Rate Parity Exchange Rate: {(Eo/E*)-1}*100

market. Changes in consumer, producer, and total social benefits are estimated separately for each of the nine pesticides. Considered in the analysis are the effects of tariffs on formulated and technical pesticides and exchange rate policies on consumer and producer surplus. The results of this analysis are used to provide evidence for the working hypothesis that both consumers and producers are receiving positive economic gains from government intervention in the pesticide market.

The procedure used in this analysis assumes that there are no imports or exports of formulated pesticides when the pesticide market is analyzed at the retail level. Under this assumption, pesticide producers are all those who import technical or formulated pesticides, process technical pesticides, distribute or sell formulated pesticides. Consumers include those who purchase pesticides at the retail level and/or purchase the agricultural products on which pesticides are used. This assumption is justified for these particular nine pesticides as they are either imported as formulated product and no technical product is imported, or all imports are in the form of technical pesticides and there are no imports of formulated pesticide. Cymbush is the only formulated pesticide imported while all others are imported in their technical form. Consequently, the effects of tariffs and the exchange rate policies are represented by shifts in pesticide supply as both forms of government intervention will impact the importers of technical and formulated pesticides and producers of formulated pesticides. The analysis is also based on parallel shifts in the supply curve and assumes that there is no demand shift. Price elasticities of supply and demand were assumed to be 1.0 and 0.5 respectively. However, this demand elasticity was varied in the analysis in order to assess the impact of changes in pesticide demand on consumer and producer welfare.

VI.4.1 Estimation of the initial price and quantity

Calculation of the change in consumer and producer surplus is analyzed at the retail level. Initial price estimates necessary for these calculation were derived by averaging retail prices reported between 1989 and 1993. Estimation of initial quantity of pesticides sold required averaging the number of kilograms imported annually from 1989 to 1993, transforming the average into grams, and dividing the number of grams imported by the number of grams of technical pesticide used in each liter of formulated pesticide. This assumes that the average number of kilograms of technical pesticides imported annually were all used in the production of formulated pesticide and sold that year. In the case of Cymbush, a five year average of liters imported is used as the initial quantity. Price and quantity averages used in the surplus estimation are presented in table 4.10.

VI.4.2 Estimation of the vertical shifts in the supply curve

Aggregate consumer and producer surplus calculations also require an estimated vertical shift in the pesticide supply curve. As the initial price and quantity used in the calculations were actually the average price and quantity prevailing after tariffs and exchange rate distortions have been imposed, the supply shift was negative reflecting a retraction of supply in the absence of government intervention. The vertical shift in the supply curve was estimated at being the average percentage overvaluation in exchange rate between 1989 and 1993 (18.6 percent) less the tariff imposed on that particular pesticide (5 percent for technical pesticides and 10 percent for formulated pesticides) multiplied by negative one. For the eight pesticides with imported active ingredients, the estimated supply shift was -13.6 percent which the supply shift for the one imported formulated pesticide was -8.6 percent.

VI.4.3 Benefits from government intervention in the pesticide market

The total change in economic welfare resulting from pesticide tariffs and an overvaluation of the exchange rate are presented in Table 4.10. Distribution of those economic benefits to both pesticide producers and consumers are shown in Table 4.11. The change in total economic surplus was positive for each assumed elasticity

Table 4.10 Average benefits of government intervention for pesticides (pesos).

Pesticide	Average Price*	Average Quantity*	CTS n=.25	CTS n=.5	CTS n=.75	CTS n=1
1) Azodrin	237	377,179	12,001,459	11,891,055	11,812,195	11,753,050
2) Cymbush	449	195,986	7,512,233	7,468,734	7,437,662	7,414,359
3) Endosulfan	245	133,143	4,379,477	4,339,189	4,310,412	4,288,829
4) Folidol	201	162,524	4,385,841	4,345,495	4,316,676	4,295,062
5) Lannate	293	43,500	1,711,178	1,695,436	1,684,192	1,675,759
6) Meptox	190	102,074	2,603,796	2,579,843	2,562,734	2,549,902
7) Nuvacron	254	320,379	10,925,355	10,824,850	10,753,061	10,699,220
8) Parapest	213	48,750	1,394,095	1,381,271	1,372,110	1,365,240
9) Thiodan	236	905,082	28,677,304	28,413,496	28,225,061	28,083,735

*Price (pesos per liter or kilo) and quantity are averages of available retail price and import quantity data from 1989-1993.

Table 4.11 Average benefits of government intervention for pesticides to consumers and producers (pesos).

Pesticide	CCS n=.25	CPS n=.25	CCS n=.5	CPS n=.5	CCS n=.75	CPS n=.75	CCS n=1	CPS n=1
1) Azodrin	9,601,167	2,400,292	7,927,370	3,963,685	6,749,826	5,062,369	5,876,525	5,876,525
2) Cymbush	6,009,787	1,502,447	4,979,156	2,489,578	4,250,093	3,187,570	3,707,179	3,707,179
3) Endosulfan	3,503,581	875,895	2,892,793	1,446,396	2,463,093	1,847,319	2,144,415	2,144,415
4) Folidol	3,508,673	877,168	2,896,996	1,448,498	2,466,672	1,850,004	2,147,531	2,147,531
5) Lannate	1,368,942	342,236	1,130,291	565,145	962,396	721,797	837,880	837,880
6) Meptox	2,083,037	520,759	1,719,896	859,948	1,464,420	1,098,315	1,274,951	1,274,951
7) Nuvacron	8,740,284	2,185,071	7,216,567	3,608,283	6,144,607	4,608,455	5,349,610	5,349,610
8) Parapest	1,115,276	278,819	920,847	460,424	784,063	588,047	682,620	682,620
9) Thiodan	22,941,843	5,735,461	18,942,330	9,471,165	16,128,606	12,096,455	14,041,867	14,041,867

of demand. However, as demand became more inelastic, moving from 1.0 to 0.25, the change in total surplus increased in value slightly for each of the nine pesticides evaluated. The value of the total surplus change and the magnitude of change due to altering the demand elasticity were dependent on the projected quantity sold of each particular pesticide.

Distribution of total economic surplus gains to both consumers and producers reflect a larger positive change in consumer surplus. As the demand elasticity is increased, the position of producers improves relative to consumers. When the demand elasticity is one consumer and producer benefits are equal. These results make it clear that the current policy environment benefits the producers and consumers of pesticides. However, the supply curve shifts in this model do not reflect the externalities associated with pesticide production and use. If the costs to human health and the environment are considered, the benefits to consumers and producers could be reduced or even negative.

VI.4.4 Estimation of the change in pesticide consumption and retail price

Tables 4.12 and 4.13 present the average annual change in quantity consumed and the retail price of the nine pesticides used in the analysis of consumer and producer surplus. The increase in quantity consumed is largest if the assumed elasticity of demand is one. As the demand elasticity decreases there is also a decrease in the divergence between the quantity consumed in the absence of government intervention and the actual quantity consumed. The change in price as a result of intervention is, on average, negative 6 percent for pesticides which import their active ingredient and negative 4 percent for the imported formulated pesticides. This decrease in price is the motivating factor behind the increased consumption of pesticides.

Table 4.12 Average change in quantity of pesticides sold (liters).

Pesticide	Initial Quantity*	Quantity n=.25	Quantity n=.5	Quantity n=.75	Quantity n=1
1) Azodrin	377,179	370,762	364,344	357,927	351,510
2) Cymbush	195,986	193,876	191,767	189,657	187,548
3) Endosulfan	133,143	130,878	128,612	126,347	124,082
4) Folidol	162,524	159,759	156,994	154,229	151,464
5) Lannate**	43,500	42,760	42,020	41,280	40,540
6) Meptox	102,074	100,337	98,601	96,864	95,127
7) Nuvacron	320,379	314,928	309,477	304,026	298,575
8) Parapest	48,750	47,921	47,091	46,262	45,432
9) Thiodan	905,082	889,683	874,285	858,886	843,487

*Five year averages of import quantity data from 1989-1993.

**The quantities of Lannate are in kilograms.

Table 4.13 Average annual change in the retail price of pesticides (pesos).

Pesticide	Initial Price*	Price w/o Intervention	Change in Price	Degree of Divergence
1) Azodrin	237	253	-16	-6%
2) Cymbush	449	468	-19	-4%
3) Endosulfan	245	262	-17	-6%
4) Folidol	201	215	-14	-6%
5) Lannate	293	313	-20	-6%
6) Meptox	190	203	-13	-6%
7) Nuvacron	254	271	-17	-6%
8) Parapest	213	227	-14	-6%
9) Thiodan	236	252	-16	-6%

*Five year averages of retail price data from 1989 to 1993.

CHAPTER V: Summary and Policy Implications

V.1 Summary

There are three primary objectives of this thesis. First, to determine the relative importance of socio-economic factors influencing pesticide misuse by vegetable farmers in Central Luzon, Philippines. Second, to quantify the net effects of pricing and exchange rate policies on the degree of pesticide subsidy or tax faced by pesticide producers and consumers. Third, to describe the direct and indirect effects of pricing, exchange rate, credit, and regulatory policies on consumer and producer welfare.

To achieve these objectives a variety of methods were employed. A logit analysis was used to assess the relevant factors affecting pesticide misuse by vegetable farmers. Two models were estimated incorporating 23 and 15 variables, respectively. Predicative ability of the two models was evaluated using the McFadden R^2 and the percentage of correct predictions of the total sample, misusers, and non-misusers. The effective rate of disprotection and equilibrium exchange rate were calculated in order to assess the amount of subsidy or tax faced by pesticide producers who import technical or formulated pesticides. Data constraints made estimation of the nominal rate of disprotection impossible. Consumer and producer surplus methods were used to quantify the net effect of pricing and exchange rate policies on the degree of subsidy or tax faced by pesticide consumers and producers. These methods were also employed to describe the direct and indirect effects of pricing and exchange rate policies on consumer and producer welfare. The potential effects of credit and regulatory policies on consumer and producer welfare were discussed in Chapter II.

The results of the two pesticide misuse regressions were very similar indicating a fairly robust model. As expected, the importance given the information from a chemical company representative when deciding which pesticide to use increased the probability of misuse. This variable was highly significant in both models. Other highly significant variables include membership in a cooperative, village association, or farmers' association which decreased the likelihood of misuse and education, which is also associated with a decrease in misuse. Unexpectedly, an increase the age of the farmer actually reduced the likelihood of pesticide misuse. Access to IPM information had the effect of reducing the probability of misuse while a visit from an agricultural technician to discuss IPM had the opposite affect and increased the likelihood of misuse. As expected, receiving credit for vegetable production increased the probability of misuse. However, the finding that receiving credit from a cooperative/Landbank, money lender, or friend is negatively associated with misuse was surprising. Not surprising was the positive relationship between pesticide misuse and receiving credit in-kind as pesticides. As hypothesized, farmers who agreed with the perception that pesticides can harm water quality were less likely to misuse pesticides. Similarly, farmers who believed killing off natural enemies could hasten pest infestation were less likely to misuse pesticides.

The restrictive definition of the dependent variable was a limitation when trying to describe the socio-economic factors affecting misuse. A more complex definition of misuse including the choice and amount of pesticide and incorporating misuse at different stages of plant growth would more comprehensively examine the phenomena of misuse. An extension in the definition of misuse could be explored using a multinomial logit model. Data constraints necessitated the use of a restrictive definition of misuse in this analysis.

Data on nine popular pesticides for vegetables was used when calculating the effective rate of disprotection for pesticide producers. A calculation of the EPR for pesticide producers within the country is also the effective rate of disprotection for those producers that import technical or formulated pesticides. As there are no chemical companies within the Philippines that produce active ingredients, all pesticide producers are subject to this rate of disprotection. The results indicated that the EPR for eight of the nine pesticides is positive indicating a negative rate of protection for Philippine pesticide producers. This effective rate of disprotection is generally in the range of 12 to 25 percent. If the calculations for the EPR are made using the equilibrium free-trade exchange rate, the effective rate of disprotection increases in every case.

The free-trade equilibrium exchange rate (E*) was calculated using three methods. When E* was defined as the exchange rate that equilibriates the current account in the absence of import and export restrictions and taxes, the average amount of overvaluation for the years 1984 to 1993 was 17.66 percent. However, alternative estimations of the free-trade equilibrium exchange rate produce much different results. The free-trade equilibrium exchange rate estimates using strict Purchasing Power Parity indicate an annual overvaluation of the peso of only 2 percent. Similarly, the free-trade equilibrium exchange rate estimates using Interest Rate Parity had the currency overvalued by an average of 2.79 percent annually. Despite the similarity of the average overvaluation calculated using Purchasing Power and Interest Rate Parity there is no strong evidence that the estimated overvaluation using the Intal and Power method is too high. The first method of estimation was used for E* in order to provide some continuity between this thesis and previous studies on the Philippines, but its potential over-estimation should be kept in mind.

Results of the consumer-producer surplus analysis performed for each of the nine pesticides show an average increase in both consumer and producer surplus due to price and exchange rate policies. The total value of the surplus increases and consumer surplus increases relative to producer surplus as the estimated demand elasticity becomes more inelastic. The change in quantity consumed and produced because of pricing and exchange rate policies becomes larger as the demand elasticity becomes more elastic. The effect of government intervention on retail price indicates a 6 percent subsidy on pesticides whose active ingredient are imported and a 4 percent subsidy on pesticides that are imported in their final form. However, these gains to pesticide producers and consumers are calculated without considering the costs to human health and the environment of increased pesticide use.

V.2 Policy Implications

A variety of conclusions can be drawn from the analyses performed in this thesis. First, there is a definite need for farmer education on the proper and judicious use of pesticides and the health and environmental consequences of pesticide misuse. The need for farmer training and awareness is evident in the reduced instances of pesticide misuse by farmers who attended the season long Farmer Field School and farmers who viewed pesticides as harmful to water quality and natural enemy populations. Furthermore, as farmers belonging to cooperatives, farmer organizations and village organizations are more likely to misuse pesticides, targeting these groups with training in the proper use of pesticides could be beneficial. Similarly, targeting farmers who receive credit would reduce the amount of pesticide misuse on vegetables. The type of IPM training received may also be important. Results of the logit analysis suggest that longer-term training in IPM by the Farmer Field School is more beneficial than visits by an agricultural technician to discuss IPM. Consequently, support of the National IPM program and its Farmer Field Schools is a positive step toward reducing the amount of pesticide misuse on vegetables.

Second, it is evident from the analysis of factors affecting pesticide misuse that IPM needs to become a priority in the training of Department of Agriculture technicians. The analysis indicates that a high value placed on an agricultural technician's advice increased the probability of pesticide misuse. In order to curtail this trend, further training of DA technicians would be necessary as would an examination of the relationship between DA technicians and pesticide dealers. Furthermore, as the influence of chemical company representatives increases the probability of pesticide misuse by farmers, chemical company trainings may also be inducing agricultural technicians to recommend pesticide use when it is unnecessary. The advice of an agricultural technician on a farm plan, which is often necessary to receive crop insurance, could actually promote misuse. A firm commitment to responsible pesticide use and IPM by the extension system in the Department of Agriculture could go a long way in decreasing the instances of pesticide misuse.

Third, the results of this thesis also indicate that pesticide producers are receiving less for formulated pesticides than they would if they were manufacturing all ingredients in the Philippines. However, this tax on pesticide value-added is not excessive and is experienced by all pesticide producers. Therefore, tariff and exchange rate policies offer little deterrent to the importation of formulated and technical pesticides. Yet, the value of their production is greater under the current policy environment than it would be in the absence of tariffs and exchange rate overvaluation.

Fourth, and of greater consequence, is the impact of government intervention on retail price and production levels. Assuming an overvaluation of the exchange rate of approximately 18 percent, retail prices have been subsidized and the amount of pesticides produced have increased. If 18 percent is an overestimate, the benefits to pesticide producers and consumers would decrease in magnitude and could actually be negative. However, it is very likely that the overvaluation of the peso is causing a net subsidy on the retail price of pesticides and increasing pesticide use.

With the recent implementation of the 10 percent Value Added Tax (VAT) on pesticides this situation could change somewhat. It is expected that some of this tax will be transferred to pesticide users via an increase in the retail price of pesticides. If this is the case, the VAT could offset any subsidy on pesticide price and, potentially, create a net tax. However, if pesticide demand is fairly inelastic as many Philippine officials believe, it is likely that the VAT will have little impact on the current level of pesticide use.

Determining the costs to human health and the environment associated with pesticide use and misuse was beyond the scope of this thesis. Yet, if these costs were taken into account they would certainly reduce the benefits accruing to both pesticide producers and users. Forcing vegetable producers to pay for heath and environmental costs may also have the effect of reducing vegetable supply in the Philippines as the private costs of production would increase. The cost to human health and the environment can be reduced by regulating the most harmful pesticides and encouraging the use of IPM. The Philippine government is attempting to do both. However, these activities will be less successful if the current policy environment encourages pesticide use and if the factors influencing pesticide misuse are not addressed.

Although it is apparent that government policies are affecting pesticide use, the impact of these policies on retail pesticide price is relatively small. Additional exploration of these policies may not be necessary. Further research into the socio-economic factors affecting misuse may have a larger impact on health and the environment by providing information to help reduce pesticide misuse in the Philippines. Research should focus particularly on extending the definition of misuse to include more aspects such as application of the correct pesticide, amount of pesticide applied, and timing of pesticide applications.

Future studies should also examine the relationship between pesticide price and incentives to misuse pesticides. The insignificance of the price variable in this study was primarily due to the lack of variation in the variable: every farmer considered price extremely important when deciding which pesticide to use. However, there could be a point at which price would not only impact the amount of pesticide use but decrease the probability of pesticide misuse as well. The price of pesticides can also be important as vegetable producers weigh the costs of pesticide use versus adoption of IPM techniques. The lower the cost of pesticides the more likely farmers will use pesticides instead of IPM. Further exploration of the threshold at which farmers choose IPM over pesticide use would be informative.

As this thesis has made evident, there are a variety of factors influencing the use of pesticides in the Philippines. However, pesticide misuse can be largely explained by a lack of non-pesticide alternatives, a lack of farmer training, and economic incentives created by tariff and exchange rate policies for both pesticide producers and consumers. If attention is paid to these areas of potential policy impact, a great deal could be done to ensure that vegetable production in the Philippines promotes judicious pesticide use and utilizes all available IPM resources. Such steps could only have positive social, economic, and environmental effects.

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Appendix A

FARMERS' PERCEPTIONS AND ATTITUDES TOWARDS PESTICIDE USE IN SAN JOSE, NUEVA ECIJA

Interview Questionnaire

Respondent ____________________ Date of Interview ______________
Interviewer ____________________ Municipality ______________
Barangay ______________

I. **Background Information (Rice)**

1. Last cropping season (wet season 1993), what rice varieties did you plant?

   ____

2. What month did you plant?

   ____ 1) June
   ____ 2) July
   ____ 3) August
   ____ 4) September
   ____ 5) Others (specify) ___________

3. What is your source of rice seeds?

   ____ 1) Private seed grower
   ____ 2) Department of Agriculture
   ____ 3) Self
   ____ 4) Neighbor/Friend
   ____ 5) Others (specify) ___________

4. What type of rice farm do you manage?

   ____ 1) Irrigated
   ____ 2) Rainfed
   ____ 3) Others (specify) ___________

5. How is rice grown in your field?

   ____ 1) By direct seeding
   ____ 2) By transplanting

6. What cropping pattern do you follow?

   ____ 1) Rice-Fallow
   ____ 2) Rice-Rice
   ____ 3) Rice-vegetables
   ____ 4) Rice-Other crops (specify)__________

7. What is your total rice area? ________ ha.

8. What was your rice yield last season? Yield/ha ____________

[Note: RECORD ACTUAL UNIT GIVEN BY FARMERS AND LATER CONVERT IT TO KG]

9. What was your income from rice last season? ________ pesos

II. Knowledge of Rice Pests and their Natural Enemies

A. Knowledge of Rice Pests

10. What are the rice pests that you know?

____

11. How do they damage the rice plant?

____

12. Which of these rice pests do you think cause severe damage to the rice crop?

____

13. Which of these rice pests do you think cause yield loss?

____

14. In what way(s) do you think these rice pests reduce rice yield?

____

15. Do you think it is necessary to use chemicals to control these rice pests?

_____ 1) Yes
_____ 2) No (GO TO Q.16)
_____ 3) Don't know (GO TO Q.16)

15a. **If YES**, when do you think should you apply pesticides for these rice pests?

____

B. Knowledge of Natural Enemies of Rice Pests

16. Are there insects/animals that do not cause damage to your rice crop?

____ 1) Yes
____ 2) No (GO TO Q.17)
____ 3) I don't know (GO TO Q.17)

16a. **If YES**, what are they? Name as many.

____

16b. What do these insects/animals do in your field?

____

16c. What do you think happens to these insects/animals when chemicals are applied on your rice crop?

____

Please indicate whether you agree, have no opinion, or disagree with the following statements:

17. Applying pesticides to the rice crop will make the yield go up:

____ 1) Agree
____ 2) Disagree
____ 3) No opinion

18. Killing the natural enemies in your ricefield by applying chemicals can hasten pest infestation:

____ 1) Agree
____ 2) Disagree
____ 3) No opinion

18a. <u>If **AGREE**</u>, in what way will a reduced natural enemy population make your rice crop more prone to pest attacks?

____

III. Rice Pest Management Practices

19. What rice pest(s) did you have last cropping season?

____

20. How did you control these rice pests?

____ 1) Pesticide application
____ 2) Water management
____ 3) Use of resistant variety
____ 4) Others (specify) ________________

21. What rice pest causes the biggest damage to your rice crop?

No. 1 ____________________________________

What is your second most important pest problem?

No. 2 ____________________________________

22. What do you do to control these rice pests?

For your most important pest:

____ 1) Pesticide application
____ 2) Water management
____ 3) Use of resistant variety
____ 4) Others (specify) ________________

For your 2nd most important pest:

____ 1) Pesticide application
____ 2) Water management
____ 3) Use of resistant variety
____ 4) Others (specify) ________________

23. Did you apply pesticides in your ricefield last season?

_____ 1) Yes
_____ 2) No (Go to Q.31)

23a. **If YES**, last cropping season how many weeks after planting did you first apply pesticides?

______ weeks

23b. All in all, last cropping season how many times after planting did you apply pesticides?

______ times

24-26. Please tell me at what stage(s) of the rice crop did you apply pesticides last season. What chemicals did you apply at these stages? For what rice pests?

Time of application (crop stage) (Q.24)	*Pesticides applied* [specify formulation] (Q.25)	*Target rice pests* (Q.26)
____ Seedling	________________	____________
____ Early tillering	________________	____________
____ Late tillering	________________	____________
____ Panicle initiation	________________	____________
____ Booting	________________	____________
____ Flowering	________________	____________
____ Milking	________________	____________
____ Soft dough	________________	____________
____ Ripening	________________	____________

27. Can you tell me the reason why you applied pesticides at these times?

______ 1) To prevent pest infestation
______ 2) To control pest infestation
______ 3) Other (specify) ________________

28. How effective were these chemicals?

_____ 1) Effective
_____ 2) Not effective
_____ 3) Don't know

29. How much did you spend on these chemicals last season? ______ pesos

30. Did you apply the pesticides yourself?

______ 1) Yes
______ 2) No

30a. If NO, how much did you pay for labor? ____________ pesos

31. Do you have a sprayer?

______ 1) Yes
______ 2) No

31a. If YES, what kind of sprayer do you have?

______ 1) Knapsack
______ 2) Hand sprayer
______ 3) Other (specify) ________________

31b. If NO, how do you get hold of a sprayer when needed?

______ 1) Borrow
______ 2) Rent
______ 3) Hired labor provides sprayer
______ 4) Other (specify) ________________

32. From where do you get rice pest control advice?

____ 1) Neighbor
____ 2) DA Technician
____ 3) Relatives
____ 4) Pesticide sales agents
____ 5) Others (please specify) ___________

32a. **If more than one response in Q.30**, which of these sources of rice pest control advice is most credible to you?

____ 1) Neighbor
____ 2) DA Technician
____ 3) Relatives

____ 4) Pesticide sales agents
____ 5) Others (please specify) ____________

32b. Why? ____

33. Have you attended any training on rice pest control?

____ 1) Yes
____ 2) No

33a. **If YES**, what were these trainings about?

____

IV. Background Information (Vegetables)

34. Did you plant vegetables last cropping season (dry season 1993)?

____ 1) Yes
____ 2) No (GO TO Q.66)

35. **If YES**, what vegetables did you plant after rice?

____ 1) Onion
____ 2) Garlic
____ 3) Tomato
____ 4) Eggplant
____ 5) Squash
____ 6) Others (specify) ____________

35a. **If more than one response in Q.35**, which of these vegetables do you usually grow [GIVE ONLY ONE]?

____ 1) Onion
____ 2) Garlic
____ 3) Tomato
____ 4) Eggplant
____ 5) Squash
____ 6) Other (specify) ____________

[Interviewer: Take note of farmer's answer as his **main vegetable crop**]

36. What month did you plant this vegetable?

____ 1) October
____ 2) November
____ 3) December
____ 4) January 1994
____ 5) Other (specify) ____________

37. What is your source of vegetable seeds?

____ 1) Private seed grower
____ 2) Department of Agriculture

____ 3) Self
____ 4) Neighbor/Friend
____ 5) Others (specify) ____________

38. What type of vegetable farm do you manage?

____ 1) Irrigated
____ 2) Rainfed
____ 3) Others (specify) ____________

39. How do you plant vegetables?

____ 1) By direct seeding
____ 2) By transplanting

40. What is your total area for planting vegetables? ________ ha.

41. What was your total yield (for your main vegetable crop) last season?

Yield/ha ____________ [Note: CONVERT IT LATER TO KG]

42. What was your income from this vegetable last season? ________ pesos

V. Knowledge of Vegetable Pests and their Natural Enemies

A. Knowledge of Vegetable Pests

43. What are the pests of this vegetable (main vegetable crop) that you know?

____

44. How do they damage the plant?

____

45. Which of these pests do you think cause severe damage to the vegetable crop?

____

46. Which of these pests do you think cause yield loss?

____

47. In what way(s) do you think these pests reduce crop yield?

____

48. Do you think it is necessary to use chemicals to control these pests?

_____ 1) Yes
_____ 2) No (GO TO Q.49)
_____ 3) Don't know (GO TO Q.49)

48a. <u>If YES</u>, when do you think should you apply pesticides for these pests?

____

B. **Knowledge of Natural Enemies of Vegetable Pests**

49. Are there insects or animals that do not cause damage to your main vegetable crop?

____ 1) Yes
____ 2) No (GO TO Q.50)
____ 3) I don't know (GO TO Q.50)

49a. <u>If YES</u>, what are they? Name as many.

____

49b. What do these insects/animals do in your field?

____

49c. What do you think happens to these insects/animals when chemicals are applied on your vegetable crop?

____

Please indicate whether you <u>agree</u>, have <u>no opinion</u>, or <u>disagree</u> with the following statements:

50. Applying pesticides to the vegetable crop will make the yield go up:

____ 1) Agree
____ 2) Disagree
____ 3) No opinion

51. Killing the natural enemies in your field by applying chemicals can hasten pest infestation:

____ 1) Agree
____ 2) Disagree
____ 3) No opinion

51a. <u>If AGREE</u>, in what way will a reduced natural enemy population make your vegetable crop more prone to pest attacks?

____

VI. Pest Management Practices for Vegetables

52. What pest(s) did you have for your main vegetable crop last season?

____

53. How did you control these pests?

____ 1) Pesticide application
____ 2) Use of resistant variety
____ 3) Others (specify) ________________

54. What pest causes the biggest damage to your main vegetable crop?

No. 1 ________________________________

What is your second most important pest problem?

No. 2 ________________________________

55. What do you do to control these pests?

For your most important pest:

____ 1) Pesticide application
____ 2) Use of resistant variety
____ 3) Others (specify) ________________

For your 2nd most important pest:

____ 1) Pesticide application
____ 2) Use of resistant variety
____ 3) Others (specify) ________________

56. Did you apply pesticides in your vegetable field last season?

_____ 1) Yes
_____ 2) No (Go to Q.64)

56a. If YES, last cropping season how many weeks after planting did you first apply pesticides?

______ weeks

56b. All in all, last cropping season how many times after planting did you apply pesticides?

______ times

57-59. Please tell me at what stage(s) of your main vegetable crop did you apply pesticides last season. What chemicals did you apply? For what pests?

Time of application (crop stage) (Q.21)	*Pesticides applied* [specify formulation] (Q.22)	*Target pests* (Q.23)
____ Seedling	________________	____________
____ Vegetative	________________	____________
____ Flowering	________________	____________
____ Fruiting	________________	____________

60. Can you tell me the reason why you applied pesticides at these times?

_____ 1) To prevent pest infestation
_____ 2) To control pest infestation
_____ 3) Others (specify) ____________________

61. How effective were these chemicals?

_____ 1) Effective
_____ 2) Not effective
_____ 3) Don't know

62. How much did you spend on these chemicals last season? ______ pesos

63. Did you apply the pesticides yourself?

______ 1) Yes
______ 2) No

63a. **If NO**, how much did you pay for labor? ____________ pesos

64. From where do you get pest control advice for vegetables?

____ 1) Neighbor
____ 2) DA Technician
____ 3) Relatives
____ 4) Pesticide sales agents
____ 5) Others (please specify) _________

64a. **If more than one response in Q.64**, which of these sources of pest control advice is most credible to you?

____ 1) Neighbor
____ 2) DA Technician
____ 3) Relatives
____ 4) Pesticide sales agents
____ 5) Others (please specify) __________

64b. Why? ____

65. Have you attended any training on pest control for vegetable crops?

____ 1) Yes
____ 2) No

65a. **If YES**, what were these trainings about?

____

VII. Socio-Demographic Profile

66. What is your age? _________ years

67. Please tell me your tenure status.

_____ 1) Owner-operator
_____ 2) Leasee
_____ 3) Tenant
_____ 4) Hired laborer
_____ 5) Others (specify) __________

68. What is the highest grade/year you have completed?

____

69. What farmers' organizations are you a member of?

____

70. How many labor persons are there in your family?

____

71. In your household, who decides how much money to spend for pesticides?

_____ 1) Male farmer/brother/father
_____ 2) Woman farmer/sister/mother
_____ 3) Both husband and wife
_____ 4) Others (specify) _________________________

72. Who buys the pesticides?

_____ 1) Male farmer/brother/father
_____ 2) Woman farmer/sister/mother
_____ 3) Both husband and wife
_____ 4) Others (specify) _________________________

73. When pest problems occur, who decides what to do in the family?

_____ 1) Male farmer/brother/father
_____ 2) Woman farmer/sister/mother
_____ 3) Both husband and wife
_____ 4) Others (specify) _________________________

Thank You.

Follow-up Baseline Survey

Respondent: ____________________ **Date of Interview:** __________________

Barangay: ____________________ **Municipality:** ____________________

Interviewer: _______________________ **Gender (circle): M or F**

I. Socio-Demographic Profile

1. What is your age? _______ years

2. Please tell me your tenure status.
   _________1) Owner-operator
   _________2) Leasee
   _________3) Tenant
   _________4) Hired laborer
   _________5) Others (specify)____________

3. What is the highest grade/year in school you have completed?
   ____

4. What farmers' organizations are you a member of?

   ____

5. How many working persons are there in your family?

   ____

6. In your household, who decides how much money to spend for pesticides?
   _________1) Farmer
   _________2) Spouse
   _________3) Both husband and wife
   _________4) Son
   _________5) Daughter
   _________6) Others (specify) ______________________________

7. Who buys the pesticides?

__________1) Farmer
__________2) Spouse
__________3) Both husband and wife
__________4) Son
__________5) Daughter
__________6) Others (specify) ___________________________________

8. When pest problems occur, who decides what to do in the family?

__________1) Farmer
__________2) Spouse
__________3) Both husband and wife
__________4) Son
__________5) Daughter
__________6) Others (specify) ___________________________________

II. Factors affecting pesticide use

9. Specify the area for each vegetable crop planted on your farm last year?

Onions __________ hectares
Eggplant __________ hectares
Stringbeans __________ hectares
Ampalaya __________ hectares
Others __________ hectares

10. What was your total value of vegetable products sold last year?

Onions __________ hectares
Eggplant __________ hectares
Stringbeans __________ hectares
Ampalaya __________ hectares
Others __________ hectares

11. To whom (where) did you sell your vegetable crops?
(Check all that apply)

__________ Cooperative
__________ local trader
__________ non-local trader
__________ local market

12. How many cavans of palay did you sell last year?___________________________

13. At what price did you sell your palay?______________________________

14. How many cavans did you store for home consumption?__________________

15. How much income did you derive from the following?

    Livestock __________ pesos
    Off-farm labor __________ pesos
    Non-farm labor __________ pesos

16. How much did you spend on pesticides (insecticides, fungicides, herbicides) for vegetable
crops? __________________________

17. How important were the following factors to your choices of pesticides (insecticides, fungicides, and herbicides) for vegetable crops?

	Not Important	Somewhat Important	Very Important	Extremely Imp.
a. Pesticide cost	_______	_______	_______	_______
a. Agr'l technician advice	_______	_______	_______	_______
a. Pesticide dealer advice	_______	_______	_______	_______
a. Chemical company rep advice	_______	_______	_______	_______
a. Neighbor's advice	_______	_______	_______	_______
a. Safety	_______	_______	_______	_______
a. Others (specify)__________	_______	_______	_______	_______

18. Did you borrow to finance your vegetable production?

    Yes__________ No__________
    (f no, go to question 24)

19. What proportion of your borrowing came from each of the following sources?

    a. Cooperative / Landbank ____________________
    b. Other banks ____________________
    c. Friends, relatives, neighbors ____________________
    d. Money lenders ____________________
    e. Traders ____________________
    f. Others ____________________

20. How much was your total borrowing for vegetable production last season?_______

21. How many pesos borrowed were received in cash?__________________________

22. How many pesos borrowed in cash were spent on pesticides?________________

23. What was the value of the part of the loan that was delivered in kind as pesticides?___________

24. Have you or any member of your family ever participated in Farmer Field School

Training?______________

25. Have you ever been visited by an agricultural technician who discussed non-pesticide means of controlling crop pests?__________________

III. Perceptions of the effect of pesticides on human health and the environment

26. Using pesticides to control pests can harm water quality on the farm.
_________ Agree
_________ Disagree
_________ Don't know

27. Do you think your farm's water supply has been negatively affected by pesticide use?
_________ Yes
_________ No
_________ Don't know

28. Do you attribute any health problems you or one of your family members may have experienced to pesticides?
_________ Yes
_________ No
_________ Don't know

THANK YOU.

Appendix B

Table Appendix B.1 Effective Rate of Protection Calculations.

Effective Rate of Protection: Azodrin (285 g/l)

Year	BP $/kg	BPT $/l	BPT*Eo+T	BPT*E*+T	RPF	MM	PPF	@ at Eo	@ at E*	Eo	E*	EPR	EPR*
1989	8.66	2.47	56.34	69.12	190	57	133	0.42	0.52	21.74	26.67	13.99%	15.97%
1990	7.39	2.11	53.76	67.16	200	60	140	0.38	0.48	24.31	30.37	13.37%	15.05%
1991	7.31	2.08	60.11	73.02	260	78	182	0.33	0.40	27.48	33.38	12.65%	13.63%
1992	6.86	1.96	52.37	63.43	260	78	182	0.29	0.35	25.51	30.90	12.16%	12.88%
1993	6.72	1.92	54.54	67.75	275	82.5	192.5	0.28	0.35	27.12	33.69	12.11%	12.92%
1994					312	93.6	218.4						

Effective Rate of Protection: Cymbush (formulated)

Year		BPF $/l	BPT*Eo+T	BPT*E*+T	RPF	MM	PPF	@ at Eo	@ at E*	Eo	E*	EPR	EPR*
1989		7.00	167.40	205.36	340	102	238	0.70	0.86	21.74	26.67	24.00%	57.05%
1990		7.32	195.75	244.54	350	105	245	0.80	1.00	24.31	30.37	35.68%	-104.51%
1991		7.80	235.81	286.43	535	160.5	374.5	0.63	0.76	27.48	33.38	19.69%	30.16%
1992		8.25	231.50	280.42	500	150	350	0.66	0.80	25.51	30.9	21.28%	36.12%
1993		8.49	253.13	314.46	522	156.6	365.4	0.69	0.86	27.12	33.69	23.23%	55.79%
1994		8.71			480.5	144.15	336.35						

Effective Rate of Protection: Endosulfan (350 g/l)

Year	BP $/kg	BPT $/l	BPT*Eo+T	BPT*E*+T	RPF	MM	PPF	@ at Eo	@ at E*	Eo	E*	EPR	EPR*
1989	7.45	2.61	59.52	73.02		0	0			21.74	26.67		
1990	6.97	2.44	62.27	77.79		0	0			24.31	30.37		
1991	8.10	2.84	81.80	99.36	217.5	65.25	152.25	0.54	0.65	27.48	33.38	16.44%	20.81%
1992	8.20	2.87	76.87	93.12	255	76.5	178.5	0.43	0.52	25.51	30.9	14.11%	16.03%
1993	8.15	2.85	81.23	100.91	262	78.6	183.4	0.44	0.55	27.12	33.69	14.33%	16.80%
1994	0.00	0.00			312	93.6	218.4						

Table Appendix B.1 (Continued).

Effective Rate of Protection: Folidol (500 g/l)

Year	BP $/kg	BPT $/l	BPT*Eo+T	BPT*E*+T	RPF	MM	PPF	@ at Eo	@ at E*	Eo	E*	EPR	EPR*
1989	4.05	2.03	46.22	56.71	170	51	119	0.39	0.48	21.74	26.67	13.43%	14.98%
1990	4.35	2.18	55.52	69.36	150	45	105	0.53	0.66	24.31	30.37	16.21%	21.23%
1991	4.91	2.46	70.84	86.05		0	0			27.48	33.38		
1992	4.77	2.39	63.88	77.38	225	67.5	157.5	0.41	0.49	25.51	30.9	13.69%	15.30%
1993	5.69	2.85	81.01	100.64	260	78	182	0.45	0.55	27.12	33.69	14.37%	16.88%
1994	0.00	0.00			251	75.3	175.7						

Effective Rate of Protection: Lannate (400 g/kg)

Year	BP $/kg	BPT $/kg	BPT*Eo+T	BPT*E*+T	RPF	MM	PPF	@ at Eo	@ at E*	Eo	E*	EPR	EPR*
1989	17.17	6.87	156.78	192.33	270.00	81	189.00	0.83	1.02	21.74	26.67	43.17%	-70.68%
1990	17.16	6.86	175.21	218.88		0	0.00			24.31	30.37		
1991	16.98	6.79	195.98	238.05		0	0.00			27.48	33.38		
1992	21.60	8.64	231.43	280.32	298.33	89.5	208.83	1.11	1.34	25.51	30.9	-26.06%	-7.31%
1993	21.60	8.64	246.03	305.64	311.67	93.5	218.17	1.13	1.40	27.12	33.69	-22.56%	-5.69%
1994	0.00	0.00			300.00	90	210.00						

Effective Rate of Protection: Meptox (500 g/l)

Year	BP $/kg	BPT $/l	BPT*Eo+T	BPT*E*+T	RPF	MM	PPF	@ at Eo	@ at E*	Eo	E*	EPR	EPR*
1989	0.00	0.00	0.00	0.00		0.00	0.00			21.74	26.67		
1990	3.95	1.98	50.41	62.98		0.00	0.00			24.31	30.37		
1991	4.00	2.00	57.71	70.10		0.00	0.00			27.48	33.38		
1992	4.35	2.18	58.26	70.57	190	57.00	133.00	0.44	0.53	25.51	30.9	14.24%	16.26%
1993	3.97	1.99	56.52	70.22		0.00	0.00			27.12	33.69		
1994	0.00	0.00			192	57.60	134.40						

Table Appendix B.1 (Continued).

Effective Rate of Protection: Nuvacron (300 g/l)

Year	BP $/kg	BPT $/l	BPT*Eo+T	BPT*E*+T	RPF	MM	PPF	@ at Eo	@ at E*	Eo	E*	EPR	EPR*
1989	7.15	2.15	48.96	60.07		0.00	0.00			21.74	26.67		
1990	7.49	2.25	57.36	71.65	175	52.50	122.50	0.47	0.58	24.31	30.37	14.81%	17.91%
1991	8.11	2.43	70.20	85.27	272.5	81.75	190.75	0.37	0.45	27.48	33.38	13.14%	14.40%
1992	9.32	2.80	74.89	90.72	270	81.00	189.00	0.40	0.48	25.51	30.9	13.55%	15.06%
1993	8.71	2.61	74.41	92.43	297	89.10	207.90	0.36	0.44	27.12	33.69	13.00%	14.36%
1994	9.25	2.78			322	96.60	225.40						

Effective Rate of Protection: Parapest (500 g/l)

Year	BP $/kg	BPT $/l	BPT*Eo+T	BPT*E*+T	RPF	MM	PPF	@ at Eo	@ at E*	Eo	E*	EPR	EPR*
1989	3.90	1.95	44.51	54.61	170	51.00	119.00	0.37	0.46	21.74	26.67	13.22%	14.63%
1990	3.90	1.95	49.77	62.18		0.00	0.00			24.31	30.37		
1991	3.90	1.95	56.27	68.35		0.00	0.00			27.48	33.38		
1992	3.90	1.95	52.23	63.27	250	75.00	175.00	0.30	0.36	25.51	30.9	12.27%	13.05%
1993	3.90	1.95	55.53	68.98	220	66.00	154.00	0.36	0.45	27.12	33.69	13.04%	14.42%
1994	0.00	0.00			222	66.60	155.40						

Effective Rate of Protection: Thiodan (350 g/l)

Year	BP $/kg	BPT $/l	BPT*Eo+T	BPT*E*+T	RPF	MM	PPF	@ at Eo	@ at E*	Eo	E*	EPR	EPR*
1989	8.06	2.82	64.39	79.00	180	63.00	117.00	0.55	0.68	21.74	26.67	16.81%	22.09%
1990	8.52	2.98	76.12	95.09		0.00	0.00			24.31	30.37		
1991	7.77	2.72	78.47	95.32	245	85.75	159.25	0.49	0.60	27.48	33.38	15.33%	18.41%
1992	7.26	2.54	68.06	82.44	254	88.90	165.10	0.41	0.50	25.51	30.9	13.80%	15.49%
1993	8.20	2.87	81.73	101.52	264	92.40	171.60	0.48	0.59	27.12	33.69	14.98%	18.15%
1994	0.00	0.00			266	93.10	172.90						

Vita

Jessica Delores Tjornhom was born in Wayzata, Minnesota in 1969. She attended Minnetonka High School and worked at various after school jobs before making her way to the University of Minnesota. Jessica was an honors student in the College of Liberal Arts at the University of Minnesota and received her bachelors in International Relations with a minor in Chinese in 1993. During her undergraduate years Jessica was fortunate enough to spend time studying in London and traveling in the countries of Turkey, Syria, Jordon, Israel and Egypt. These travels helped expand her interest in developing nations. Jessica also spent the last year of her undergraduate program working for Winrock International in Morrilton, Arkansas. Her experiences in the Asia and Africa Divisions of Winrock, including a three month consultancy in Senegal, confirmed her desire to pursue a masters in Agricultural and Applied Economics. As a masters student at Virginia Tech, Jessica received the Virginia Association of Economist's Crestar Award in Economics and presented papers at both regional and national conferences. After completion of her masters, Jessica will again attend the University of Minnesota to pursue a Ph.D. in Applied Economics.