Impacts of price and exchange rate policies on pesticide use in the Philippines

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Abstract

Pesticide prices can influence producer decisions to apply pesticides as opposed to nonchemical means of pest control. Those prices are in turn influenced by price and exchange rate policies. The effective rate of protection for nine pesticides commonly applied to vegetables in the Philippines was calculated to determine whether government policies are creating incentives or disincentives to adopt more integrated pest management methods. Calculations found that direct price policies, primarily through an import tariff, tax pesticide use while an overvalued exchange rate subsidizes pesticide use. The net effect is a 6 to 8% pesticide subsidy. This subsidy results in economic surplus gains to vegetable producers and consumers when negative externalities associated with pesticide use are not accounted for. However, recent analysis of human health effects of pesticide use on rice in the Philippines demonstrates that these externalities can be substantial. Published by Elsevier Science B.V.

Keywords: Pesticide use; Exchange rate policy; Philippines

1. Introduction

Since World War II, increased use of pesticides has contributed to sizable productivity gains in agriculture worldwide. A number of environmental and human health externalities have also been generated, however, particularly in developing countries where environmental laws tend to be lax and the public is little aware of potential problems. Increased pesticide use has also generated problems with pest resistance to pesticides and pest resurgence. As a result, agricultural scientists have conducted research to develop integrated pest management (IPM) practices that involve biological, cultural, and other practices to enable pests to be managed with fewer pesticides.

Despite efforts to develop IPM practices, pesticides remain the dominant pest management tactic in most countries and usage is increasing. Nowhere is this trend toward increased pesticide use more evident than in Asia where the combination of increased agricultural production in general and the shift in diets toward higher-value fruits and vegetables has created a strong demand for improved pest control. The pesticide market in the Asian-Pacific region exceeds US$2.5 billion (Rola and Pingali, 1993).

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Although the Philippines represents a relatively small portion of the Asian-Pacific market, pesticide usage there has been increasing and creating significant environmental and health externalities (Pinagli and Roger, 1995). The Philippine government has invested in IPM research and training and has imposed an import tariff on pesticides that would appear to discourage their use. However the Philippines also provides an example of how incentives for pesticide use are influenced by the total set of policies and regulations rather than by a single tariff or price policy. In particular, exchange rate policies can influence pesticide use because formulated pesticides or their technical (unformulated active ingredient) components are often imported into developing countries. In the Philippines, all formulated and technical pesticides are imported. In addition, exchange rate policies influence the demand for agricultural products, which in turn influences the demand for pesticides.

The purpose of this paper is to assess the net effects of government policies on the degree of subsidy or tax faced by pesticide producers and users. Calculations focus on the nine most important pesticides applied to vegetables (in terms of quantity) as vegetables currently receive large amounts of pesticides per hectare per season, it appears there is significant pesticide misuse on vegetables (Lazaro et al., 1995), and the Philippine government is currently developing vegetable IPM programs that must be cost effective compared to pure pesticide use if IPM adoption is to occur. Analysis is presented that illustrates the consumer and producer welfare effects of alternative policies affecting pesticide use in the Philippines.

Results indicate that pesticides are currently subsidized at the retail level when all policies are considered. Producers and consumers of horticultural products benefit from these policies if no account is taken of environmental and health effects. However, even if environmental and health effects are relatively small, net benefits are likely to be negative.

2. Background

Tariffs are currently imposed on all technical and formulated pesticides entering the Philippines. Al-though tariff rates have varied over time, tariffs in recent years have averaged 3 to 5% on technical and 10% on formulated pesticides with about 60% of pesticide imports being technical and 40% formulated. In addition, a value-added tax was recently added to most manufactured goods including pesticides. Following the GATT, discussions have centered on the possibility of reducing the tariffs as tariffs on most agricultural imports that compete with commodities produced by Philippine farmers are being phased out.

Previous studies have found the exchange rate in the Philippines to be overvalued in most years. For example, page 153 of Intal and Power (1991) 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." If both a balanced current account and free-trade conditions are assumed, this estimate increases to about 24%. Overvaluation for many years resulted from the tendency of the Philippine government to delay needed peso devaluations. Trade and exchange controls have been used periodically in an attempt to maintain the official exchange rate "in the face of an exchange shortage at the prevailing rate" (page 153 of Intal and Power, 1991).

Overvaluation has had the effect of subsidizing imports and taxing exports. This subsidy may have more than offset the tariffs on pesticides and encouraged pesticide use. In a recent survey of vegetable growers in Nueva Ecija in the Central Luzon, Philippines, pesticide price was listed by growers as a significant factor influencing their pest management choice (Tjornhom et al., 1995). In an attempt to assess the degree of net pesticide subsidy or tax, effective rates of protection (ERP) are calculated in this paper that consider both the direct tax policies and the exchange rate effects.

A collection of studies edited by Krueger et al. (1991), supported by the World Bank, used this type of calculation to analyze the impacts of price and exchange rate policies in several countries around the world, including the Philippines. The Philippine study, completed by Intal and Power, measured price interventions in the rice, maize, sugar, and copra markets. They found that despite direct subsidies placed on several of these commodities, all exports were heavily taxed due to an overvalued exchange

rate except for maize and, for a few periods, rice and sugar. However, the focus of this and the other studies supported by the World Bank was primarily on agricultural outputs. The current study focuses on pesticides and calculates price policy and exchange rate effects, as they directly influence pesticide prices and use, for a recent period in the Philippines. The analysis abstracts from the effects of price policy and exchange rate effects on the crops themselves which also could have influenced pesticide use. These effects are likely to be relatively small for vegetables in the Philippines as the amount of trade is small in relation to total production. However, to the extent that the exchange rate has been overvalued, domestic crop production has been taxed, and hence pesticide demand reduced compared to what is would have been.

3. Methods

The ERP includes the effects of distorting policies for both tradable outputs (formulated fertilizer in this case) and tradable inputs (technical fertilizer in this case) by calculating the difference between value-added at the domestic price (including market distortions) and value-added at the border price (excluding market distortions). It can be calculated using a nominal exchange rate, a free trade exchange rate, or a free trade equilibrium exchange rate. The analysis in this study calculates ERPs using both the nominal and the free trade equilibrium exchange rates as discussed below.

Following Corden (1971), the effective rate of protection for pesticide j imported in its formulated form (ERP$_j$) is given by:

$$\text{ERP}_{jj} = \left\{ (1 - a_j) / \left[\left(1/(1 + t_j)\right) - a_j/(1 + t_j) \right] \right\} - 1 \qquad (1)$$

where:

$$a_j = (1 + t_j) \times (\text{BPF}_j \times E_0) / \text{PPF}_j \qquad (2)$$

where: BPF$_j$ = border price of formulated product j in dollars per liter; PPF$_j$ = wholesale domestic price at which pesticide producers sell formulated pesticide j in pesos per liter = RPF$_j$ − M; RPF$_j$ = retail domestic price of formulated pesticide j in pesos per

liter; M = marketing margin between wholesale and retail levels in pesos per liter; t_j = nominal tariff on formulated pesticide j; t_i = nominal tariff on technical pesticide i, and E_0 = market exchange rate.

Likewise, an ERP can be calculated for pesticides imported in just the technical form i as:

$$\text{ERP}_{ji} = \left\{ (1 - a_i) / \left[\left(1/(1 + t_j)\right) - a_i/(1 + t_i) \right] \right\} - 1 \qquad (3)$$

where:

$$a_i = (1 + t_i) \times (\text{BPT}_i \times E_0) / \text{PPF}_j \qquad (4)$$

where BPT$_i$ = border price of technical pesticide i in dollars per kilo in each liter of formulated pesticide.

In other words, the effective rate of production depends on the tariffs for the technical and formulated pesticides (t_i and t_j) and on the ratio of the border to the domestic price. The domestic price, in turn, depends on the marketing margin and therefore the effective exchange rate also depends on the proportion of the retail price that is accounted for by the product itself as opposed to transportation and processing costs.

A negative ERP indicates a tax on domestic producers of technical pesticides and a subsidy to domestic producers of the formulated product. However there are no domestic producers of technical pesticides as all Philippine pesticide producers import their active ingredients. The effects of tariffs on formulated and technical pesticides are presented graphically in Fig. 1. A tariff (t_f) on formulated pesticides (Fig. 1a) increases the domestic price of formulated pesticides to PF′ and reduces import demand and increases domestic supply for those pesticides. The effect is to increase the demand for technical pesticides (Q to Q′ in Fig. 1c) and for pesticide processing (Q to Q′ in Fig. 1b). A concurrent but smaller tariff (t_T) on technical pesticides increases the price of technical pesticides (to PT′ in Fig. 1c); however the Philippines still does not produce any technical pesticides domestically. The effect of the technical pesticide tariff is to shift back the supply curve for formulated pesticides which reduces the demand for pesticide processing and technical (to Q″) and increases the tariff revenue on formulated pesticides (by the dark shaded area in Fig. 1a). It also generates tariff revenue on technical
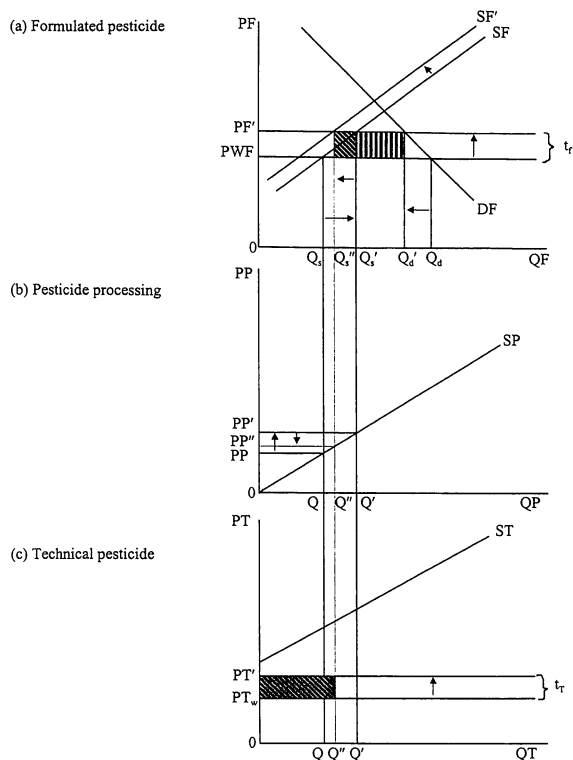
(a) Formulated pesticide

(b) Pesticide processing

(c) Technical pesticide

Fig. 1. Effects of tariffs on formulated and technical pesticides.

Therefore in the analysis in this study, E^* is employed as presented in Eq. (5).

$$E^* = \{[(\mathrm{CAB} = Q_d n_d t_m / (1 + t_m) - Q_s e_s t_x$$
$$/(1 - t_x))/(e_s Q_s + n_d Q_d)] + 1\}E_0 \qquad (5)$$

where CAB is the current account balance, Q_s and Q_d are the supply and demand for foreign exchange, e and n are the supply and demand elasticities of foreign exchange (assumed equal to the price elasticities of supply and demand for exports and imports), and other variables are as defined above. In other words, the equilibrium exchange rate is determined by taking into account the current account balance, the supply and demand for foreign exchange, import and export restrictions, and the responsiveness of foreign exchange to price changes. The supply and demand for foreign exchange and its price responsiveness is measured by the supply and demand for exports and imports and their price elasticities.

An overvalued exchange rate acts as an import subsidy. The effect on the formulated pesticide market can be illustrated graphically by reversing the effects of the import tariff on formulated pesticides illustrated in Fig. 1. Pesticide price would be reduced, imports would increase, and pesticide processing and use of technical pesticides would decrease. The effects of this implicit subsidy on technical pesticides can also be illustrated by reversing the effects of the import tariff on technical pesticides illustrated in Fig. 1. The price of technical pesticides would decrease and the supply curve for formulated pesticides would shift down to the right. The result would be an increase in domestic production of formulated pesticides and an increase in pesticide processing. However the implicit subsidy on technical pesticides does not affect the price of formulated pesticides.

3.2. Economic surplus and retail price effects

The net benefits or costs and net retail price effects of market distortions in the pesticide market are illustrated in Fig. 2. One can view Fig. 1a as the wholesale level for formulated pesticides and the market represented in Fig. 2 as the retail level lying above Fig. 1a. Eight of the nine pesticides analyzed

pesticides (dark shaded area in Fig. 1c). The price of pesticide processing is reduced to PP″.

3.1. Free-trade equilibrium exchange rate

Calculating a_j and a_i using the free-trade equilibrium exchange rate (E^*) in place of E_0 yields the ERP in the absence of exchange rate distortions. The E^* represents the exchange rate that equilibrates the current account 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 nontradables. It may be possible for the Philippines to sustain a current account deficit because of a large amount of remittances from workers living and working abroad, implying a free trade exchange rate with a current account deficit may be the appropriate one to use in assessing the degree of overvaluation. However, as Intal and Power note, the Philippines have a significant amount of wasted investment, implying that E^* is the appropriate rate to use.
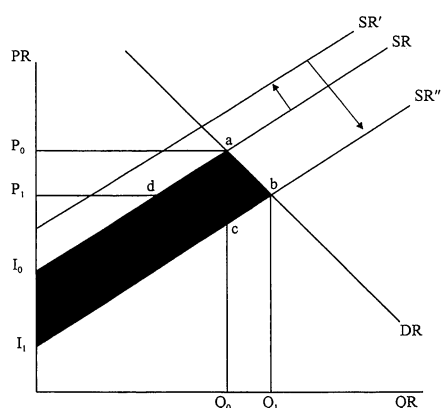
Fig. 2. Economic surplus effects of direct and indirect policy distortions in the pesticide market.

in this study are imported only as technical pesticides, and once formulated, these pesticides are not exported. The one pesticide, Cymbush®, that is imported in formulated form (and is not imported as technical) can also be analyzed at the retail level, as in Fig. 2, with the slope of the supply curve dependent on nature of domestic marketing costs.

At the retail level, the tariffs on either formulated or technical pesticides shift the supply curve back from the free market equilibrium at P_0, Q_0, but the exchange rate overvaluation shifts it down to the right, resulting in a policy distorted equilibrium at P_1, Q_1. The change in producer and consumer surplus, assuming no environmental externalities would be $I_0 ab I_1$, made up of the change in consumer surplus, $P_0 ab P_1$ and the change in producer surplus, $I_0 db I_1 - P_0 ad P_1$. In this case, 'producer' surplus includes benefits to importers of technical pesticides, importers of formulated pesticides, producers of formulated pesticides using imported technical, pesticide distributors, and pesticide dealers. 'Consumer' surplus includes benefits to individuals and companies that purchase pesticides at the retail level from pesticide dealers and individuals that purchase the crops on which pesticides are used.

The change in consumer, producer, and total economic surplus can be calculated as:

$$CCS = P_0 Q_0 Z(1 + 0.5Zn) \tag{6}$$

$$CPS = P_0 Q_0 (k - Z)(1 + 0.5Zn) \tag{7}$$

$$CTS = P_0 Q_0 k(1 + 0.5Zn) \tag{8}$$

where k is the vertical shift in the supply function as a proportion of the initial price, n is the absolute value of the price elasticity of demand, e is the supply elasticity, and $Z = ke/(e + n)$. Because the initial prices and quantities already reflect the influences of tariffs and exchange rate policies, the vertical shift will be negative in the calculations and the surplus will reflect the benefits of removing the policies.

The effects of the policies on pesticide consumption and prices can be calculated and presented as well. The consumption of pesticides in the absence of intervention can be estimated as:

$$Q_0 = Q_1/(1 + Zn) \tag{9}$$

and the price that would have prevailed without the tariffs and exchange rate overvaluation as:

$$P_0 = P_1/(1 - Z) \tag{10}$$

3.3. Data and data sources

Tariff rates for calculation of ERPs were obtained from the Philippine Bureau of Agricultural Statistics (1995). The tariff rates for formulated and technical pesticides for the years 1987 to 1993 were 10% and 5%, respectively. No other restrictions were placed on pesticide importations. Border prices of formulated pesticides in dollars per liter and technical pesticides in dollars per kilogram were obtained from the *Monthly Descriptive Arrivals Report* of the Business Statistics Monitor (1989–1995). 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 used was the C.I.F. level where all transportation costs to the Philippines are included but no import taxes or tariffs have been levied.

By dividing the quantity imported by the C.I.F. value, a border price of technical and formulated pesticides was derived for each year. Border price per liter of formulated pesticide was calculated by

multiplying the price per gram of technical pesticide by the number of grams in each liter of formulated pesticide. This calculation was not necessary for Cymbush® which is imported as a formulated pesticide.

Retail price of each of the nine pesticides was determined by surveying pesticide dealers in San Jose City in Nueva Ecija. 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 (M) was subtracted from the retail price. Through interviews with the Director of the Fertilizer Pesticide Authority of the Philippines and representatives of pesticide companies in the Philippines, the marketing margin was estimated at 30% of the retail price of the formulated pesticide. The pesticide distributor buys the formulated pesticides at approximately 30% savings off the suggested retail price and the distributor sells to the pesticide dealer at approximately 15% reduction off the suggested retail price, but the total mark-up between the pesticide producer and the pesticide dealer is 30%. This figure was used as a rule of thumb to back off the retail price to estimate the producer's price of the formulated pesticide.

Data for the equilibrium exchange rate calculations were obtained from the *International Financial Statistics Yearbook* of the International Monetary Fund (1995) and from Intal and Power (1991). IMF statistics for the trade balance, service balance, income balance, and private and official unrequited transfers were totaled annually from 1984 to 1993 to obtain the current account balance (CAB). Statistics on the Philippine demand for and supply of foreign exchange and the actual market exchange rate (E_0) were also obtained from the IMF. The import tax rate (T_m) was assumed to be 0.44, export tax rate (T_x) to be 0.02, supply of foreign exchange (e_s) to be 1.4, and the demand for foreign exchange (n_d) to be -2.7, based on Intal and Power (1991).

Initial price estimates needed for economic surplus calculations were derived by averaging retail prices reported for 1989 to 1993. Initial quantity estimates were obtained by averaging the kilograms imported annually from 1989 to 1993, transforming them to grams, and dividing by the number of grams of technical pesticide used per liter of formulated pesticide. In the case of Cymbush®, a five-year

average of liters imported is used as the initial quantity.

4. Results

The effective rate of protection under the actual market exchange rate and under the free trade equilibrium exchange rate are summarized by pesticide by year for a recent five-year period (Table 1). The results indicate an average rate of disprotection for pesticide producers of 12 to 25%. The rate of effective protection for Cymbush®, the only formulated pesticide, was higher than for the pesticides imported as technical. Lannate demonstrated a positive ERP for two of three years because the border price of Methomyl, its active ingredient, was greater than the producer price of the formulated pesticide. This result is most likely due to incorrect border price data for Methomyl or incorrect retail price data for Lannate.

Table 1
Effective rates of protection for the top nine vegetable pesticides in the Philippines, 1989–1993

Pesticide		Effective rate of protection by year (percent)[a]				
		1989	1990	1991	1992	1993
Azodrin	ERP[b]	14.0	13.4	12.7	12.2	12.1
	ERP*	16.0	15.1	13.6	12.9	12.9
Cymbush®	ERP	24.0	35.7	19.7	21.3	23.2
	ERP*	57.1	−104.5	30.2	36.1	55.8
Endosulfan	ERP			16.4	14.1	14.3
	ERP*			20.8	16.0	16.8
Folidol	ERP	13.4	16.2		13.7	14.4
	ERP*	15.0	21.2		15.7	16.9
Lannate	ERP	43.2			−26.1	−22.6
	ERP*	−70.7			−7.3	−5.7
Meptox	ERP				14.2	
	ERP*				16.3	
Nuvacron	ERP		14.8	13.1	13.6	13.0
	ERP*		17.9	14.4	15.1	14.4
Parapest	ERP	13.2			12.3	13.0
	ERP*	14.6			13.1	14.4
Thiodan	ERP	16.8		15.3	13.8	15.0
	ERP*	22.1		18.4	15.5	18.2

[a] Blanks imply data for average retail price not available.
[b] ERP is the effective rate of protection calculated with the actual market exchange rate. ERP* is the effective rate of protection calculated with the free-trade equilibrium exchange rate.

Table 2
Difference between actual and free trade equilibrium exchange rates

Year	Actual exhange rate (E_0)	Free trade equilibrium exchange rate (E^*)	Percent difference
1984	16.7	20.7	−19.3
1985	18.6	22.3	−16.4
1986	20.4	23.6	−13.7
1987	20.6	24.9	−17.2
1988	21.1	25.4	−17.0
1989	21.7	26.7	−18.5
1990	24.3	30.4	−19.9
1991	27.5	33.4	−17.7
1992	25.5	30.9	−17.4
1993	27.1	33.7	−19.5

For all pesticides, using the equilibrium exchange rate increases the level of disprotection, indicating that the direct tax is being mitigated by the overvalued exchange rate. The degree of divergence between the actual and the equilibrium exchange rate varied from −13.7 to −19.9% for 1984 to 1993 with a negative divergence indicating an overvalued exchange rate (Table 2). The average amount of overvaluation was 17.7% (18.6 from 1989 to 1993). However the overvaluation increases the effective rate of disprotection by a smaller percentage than the percent overvaluation.

In the retail market, the vertical shift in the supply curve, taking into account both the overvaluation and the 5% tariff for technical pesticides, was estimated

to be −13.6%. For the one imported formulated pesticide, it was −8.6%.

4.1. Price, quantity, and economic surplus changes

The average annual changes in retail pesticide prices and quantities consumed (purchased) are presented in Table 3. On average, retail price is 6% lower and the quantity purchased 3.5% higher than they would be without the distortions. These changes are based on an assumed pesticide supply elasticity of one and demand elasticity of −0.5. When the demand elasticity is varied from −0.25 to 1, quantity purchased varies from about +2% to +7%. The price and quantity changes for Cymbush® were smaller, averaging −4% for price and +2.1% for quantity, with a quantity range of +1% to +4.3%.

The change in economic surplus benefits to producers and consumers are presented in Table 4. Assuming a parallel shift in the supply curve and allowing the demand elasticity to take on values from −0.25 to −1.0, the changes are positive for both producers and consumers if environmental externalities are not considered. The overvalued exchange rate more than offsets the tariff effects resulting in a greater quantity consumed at a lower price and the cost of producing the pesticide is reduced by more than the price reduction. Larger surplus values are associated with pesticides consumed in greater quantities such as Thiodan, Azodrin, and Nuvacron.

Table 3
Average pesticide price and quantity with and without tax and exchange rate distortions

Pesticide	Average price 1989–1993 (pesos/1 or pesos/kg)	Undistorted price (pesos/1 or pesos/kg)	Change in price (pesos)	Percent change in price	Average quantity 1989–1993 (in thousand liters)	Undistorted quantity (in thousand liters)	Change in quantity (in thousand liters)	Percent change in quantity
Azodrin	237	253	−16	−6	377.2	364.3	12.7	3.5
Cymbush®	449	468	−19	−4	196.0	191.8	4.2	2.1
Endosulfan	245	262	−17	−6	133.1	128.6	4.5	3.5
Folidol	201	215	−14	−6	162.5	157.0	5.5	3.5
Lannate (kg)	293	313	−20	−6	43.5	42.0	1.5	3.6
Meptox	190	203	−13	−6	102.1	98.6	3.5	3.4
Nuvacron	254	271	−17	−6	310.4	309.5	10.9	3.4
Parapest	213	227	−14	−6	48.8	47.1	1.7	3.5
Thiodan	236	252	−16	−6	905.1	874.3	30.8	3.4

Table 4
Benefits to producers and consumers of pesticide policy distortions (in million pesos)[a]

Pesticide	Change in consumer surplus			Change in producer surplus			Change in total surplus		
	$n = 0.25$	$n = 0.5$	$n = 1$	$n = 0.25$	$n = 0.5$	$n = 1$	$n = 0.25$	$n = 0.5$	$n = 1$
Azodrin	9.6	7.9	5.9	2.4	4.0	5.9	12.0	11.9	11.8
Cymbush®	6.0	5.0	3.7	1.5	2.5	3.7	7.5	7.5	7.4
Endosulfan	3.5	2.9	2.1	0.9	1.4	2.1	4.4	4.3	4.3
Folidol	3.5	2.9	2.1	0.9	1.4	2.1	4.4	4.3	4.3
Lannate	1.4	1.1	0.8	0.3	0.6	0.8	1.7	1.7	1.7
Meptox	2.1	1.7	1.3	0.5	0.9	1.3	2.6	2.6	2.5
Nuvacron	8.7	7.2	5.3	2.2	3.6	5.3	10.9	10.9	10.7
Parapest	1.1	0.9	0.7	0.3	0.5	0.7	1.4	1.4	1.4
Thiodan	22.9	18.9	14.0	5.7	9.5	14.0	28.7	28.4	28.1

[a] Excluding health and environmental costs and deadweight losses associated with taxes.

The demand elasticity has little effect on the total economic surplus, but does substantially affect the distribution of benefits between producers and consumers, with higher demand elasticities benefiting producers.

5. Discussion and conclusion

Results of the analysis indicate that pesticide producers receive less for formulated pesticides than they would if all ingredients were manufactured in the Philippines. However, this tax on pesticide value-added does not appear 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. In fact, the value of pesticide production is greater under the current policy environment than it would be in the absence of tariffs and exchange rate overvaluation. It should be noted however, that the overvalued exchange rate has put downward pressure on pesticide demand through its effects on reducing crop exports and increasing crop imports.

Of greater consequence is the impact of government policies on retail pesticide price and production levels. Assuming an overvaluation of the exchange rate of approximately 18%, retail pesticide prices have been subsided in net, and the amount of pesticides produced and consumed have increased. Implementation of the recent 10% value-added tax (VAT) will reduce this subsidy but should not have a major effect on pesticide use.

Determining the health and environmental costs associated with pesticide use was beyond the scope of this study. If these costs were considered they would reduce the policy benefits accruing to consumers and producers and very well might turn them negative. Research is currently underway in the Philippines to estimate the size of the gap between the marginal social cost curve and the private social cost curve for pesticides applied on vegetables. Results of this research will permit more refined conclusions. In the meantime, the Philippine government has recently regulated several of the most harmful pesticides, although enforcement of the regulations has proven difficult.

Two key policy conclusions emerge from the analysis. First, the relatively low level of net subsidies on pesticides in the Philippines (which likely would have been measured to be even lower if the analysis had included the exchange effects on crop imports and exports) implies that such subsidies are providing little deterrent to the adoption of IPM in the Philippines. This is a significant conclusion given the current emphasis in the Philippines on generating new IPM practices for vegetables. This study was undertaken in part because of a concern that if significant pesticide subsidies exist, that biological researchers, currently developing IPM approaches, would be wasting their time unless the polices were changed.

Second, given the expressed concerns over health and environment effects of pesticides in the Philippines, if a reduction in pesticide tariffs occurs under the GATT, some other policy tools may need to be

implemented to offset the resulting increased pesticide subsidy. Currently, several of the most toxic pesticides are banned in the Philippines (not the ones evaluated in this study). Enforcement of the ban has proven difficult, however, as is often the case with such regulations in developing countries. And, it is unlikely that a complete ban is desirable for the less toxic chemicals. The import tariff on pesticides has involved relatively low transaction costs, and it raises revenue for the government. One might argue that it makes sense as a 'green tax' designed to raise the marginal private cost of pesticides up to their marginal social cost. If such a green tax is not allowed under the GATT, the government might alternatively impose a domestic sales tax on pesticides to serve the same purpose. Clearly, the exchange rate policy will be little influenced by pesticide issues and therefore the optimal policy tool is likely to be some sort of tax (tariff if allowed, because of the low transaction costs, or a domestic sales tax). Direct subsidies for IPM adoption is likely to be less advisable due to difficulties in defining IPM, government budget implications, and high transaction costs.

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