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Pesticide Policies in Developing Countries

Do They Encourage Excessive Use?

Jumanah Farah

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Foreword

When chemical pesticides started to be used on a large scale, they significantly contributed to the enhancement of agricultural production and the suppression of many insect-transmitted human diseases. Indeed, as the food and fiber requirements of growing populations increased, coupled with the need to generate foreign exchange, increasing agricultural productivity became a vital national concern. Thus, an important component of government strategies to increase agricultural production has been the encouragement of pesticide use since pests and diseases were one of the major causes of yield losses. This was coupled with the adoption of economic policies that facilitated the access to, and the domestic industry of, pesticides.

In the meantime, environmental degradation has become a critical issue worldwide. In this context, the use of chemical pesticides and their impact on the environment has come under close scrutiny, more so, since their use also directly affects human welfare. In fact, when it became evident that pesticide use is often associated with negative and serious side effects, it was realized that pesticide use has been excessive.

This study was initiated in response to the need to analyze the causes of excessive use of pesticides in the developing countries that also hinder the adoption of benign or less harmful pest control methods, such as the integrated pest management (IPM). This study is part of a wider initiative involving the FAO, UNDP and the World Bank, seeking to promote environmentally sound pest management approaches. This report analyzes the different policies, at the country level, which directly and indirectly encourage an excessive use of pesticides. By highlighting the implications of such policies, the report points out obvious reforms which governments need to consider so as to bring about a more rational pest management system.

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Executive Summary

Agricultural pests and diseases increased with the intensification of agricultural production, resulting in a worldwide increase in pesticide use. The rate of increase was greatest in the developing countries, although the bulk of pesticides is still used in the developed countries.

The heavy reliance on chemical pesticides is mainly due to the fact that, in the post-World War II era, synthetic pesticides seemed to provide a quick and easy solution to pests and diseases. Little was known then about their adverse, even dangerous, side-effects and externalities on human welfare and the environment.

When problems associated with pesticide use became obvious and critical, research on alternative methods of pest management was speeded up and has yielded a new approach to pest control, the integrated pest management (IPM) concept which combines several pest control techniques, including adapted crop management practices, and biological, mechanical and chemical pest control measures. By using non-chemical as well as chemical control measures, IPM reduces the extent of use of pesticides. However, although IPM has proved to be successful in several instances and in different areas of the world, it has not been widely adopted by farmers in developing countries.

It is suggested here that an important reason why IPM is not widely in practice in developing countries (the focus of this report), is that the current economic environment and government policies related to pesticides, and to pest management in general, induce an excessive (above the socially optimal level) chemical pesticide use. It is argued here that, the excessive and non-judicious use of pesticides being always associated with negative externalities, governments' interventions through taxation and regulations are needed to minimize these adverse effects.

The paper analyzes the pesticide-related policies of a large number of developing countries (pesticides in crop protection and public health uses) using a conceptual framework which distinguishes between price and non-price factors that encourage the excessive and non-judicious use of pesticides. The price factors include all forms of subsidies provided for pesticide imports, local manufacture and use, e.g. preferential foreign exchange rates for imports, reduced or exempted taxes on imports, sales and domestic manufacture, provision of free pesticides, etc.; while the non-price factors include excessive investments in pesticide research and farmers' training in pesticide use while neglecting alternatives, extension focusing on pesticides, lack of information to officials at the policy level and to farmers on alternative pest management technology, etc.

One of the findings of this report is that the majority of the developing countries are providing financial incentives to farmers to use pesticides and are directly and indirectly subsidizing pesticide imports, domestic manufacture, sales and use with a combination of mechanisms. Similarly, a number of non-price policies encourage pesticide use in some developing countries where relatively little emphasis is placed on research, extension and farmers' training in IPM as against the pronounced emphasis on chemical pesticides.

I. Background

With the intensification of agricultural production to meet the ever increasing global demand for food and fiber and to achieve some countries' food self-sufficiency targets, the incidence of agricultural pests and diseases increased. FAO estimates indicate that up to 40% of harvests in developing countries are lost due to weeds, diseases and insect attacks. Added to this, another 10 to 20% in post-harvest losses implies that more than half of the annual crop production may be destroyed. This figure compares unfavorably to the situation in developed countries, where crop losses total approximately 25%. With pests and diseases being one of the major obstacles to higher agricultural production, much emphasis is put on pest control in the national agricultural programs and strategies.

In the post-World War II era, pest management consisted essentially of the use of chemical pesticides, as DDT and other synthetic chemicals appeared to offer an easy means for pest control. In many instances, pesticides have helped keep relatively stable productivity levels and maintain minimum quality standards, thus permitting the commercialization of agricultural produce (2)[1]. Indeed, pesticides significantly contribute to maintaining world food production and, in general, each dollar invested in pesticide control returns approximately $ 4 in crops saved (32). It is estimated that the current losses to pests would be 10% higher if no pesticides were used at all, with losses reaching 100% for some crops (32). Thus, today, heavy application of pesticides is common in many agriculture and public health programs. However, despite their relative success in controlling diseases and containing disease-transmitting pests when applied at the proper time and in the proper quantities, many chemical pesticides adversely affect human welfare and the environment, and in the long-run, loose effectiveness due to the build-up of pest resistance. In fact, a complete long-term cost/benefit analysis of pesticide use would reduce the perceived profitability of pesticides (32).

The adverse effects of pesticides on human life are several. For example, human pesticide-related poisoning could occur as a result of unguarded or excessive exposure to pesticides, through inhalation, ingestion or contact, such as after spillages or other accidents (the example of Bhopal in 1984, India, where 2,000 to 3,000 people died due to a gas leak at a chemical production plant (34)), while spraying, or after consuming heavily or untimely pesticide-treated crops or livestock products. In 1972, WHO estimated that some half a million cases of pesticide poisoning occur every year, 5,000 of which result in death (14). In the late 80s, it was reported that total world pesticide poisoning could be as high as 1 million cases a year with approximately 20,000 deaths (45). Pesticides can also induce allergies and asthma-like symptoms and can affect body organs such as the liver, kidneys and the nervous system and, based on laboratory tests on experimental animals, pesticides can cause cancer, genetic mutations, birth defects and male sterility (21). Lately, it has been suggested that pesticides could be related to health problems provoked by a deficient immune system, problems similar to those caused by the HIV virus.

As to pesticide residues and environmental contamination, only recently has the full extent of such environmental damage become clear. Some pesticides persist longer than others or break down to even more toxic components, extending the time span in which they could contaminate agricultural crops, surface and underground water, and aquatic bodies. Pesticides affect not only the location of their application but also ecosystems far removed, due to their mobility in air and water. An especially serious

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[1] Numbers in parentheses denote the reference used

problem is the concentration of residues in the breast milk of mothers and the consequent transfer of these toxics to infants who are typically more prone to health problems than adults.

Pesticides usually kill pests and their natural enemies alike. In addition to that, pests are very adept at developing resistance against the chemical pesticides intended to control them. More complicated resistance phenomena are also likely to occur, whereby pest species develop the ability to survive exposure to related chemicals, or what is a more serious problem, the resistance to pesticides with different modes of action. Actually, pest resistance, stimulated by excessive pesticide use, as well as secondary pests' emergence are mechanisms by which pesticide use, initiated to suppress pests in the first place, leads to greater pest outbreaks.

According to entomologist George P. Georghiou, resistance unquestionably "poses a serious obstacle to efforts to increase agricultural production" (39). In 1938, scientists knew of just seven insect and mite species that had acquired resistance to pesticides. By 1984, that figure had climbed to 447 and included most of the world's major pests (34). Resistance in weeds was virtually non-existent before 1970. Towards the late 80s, with the growth of herbicide use, at least 48 weed species had gained resistance to chemicals (34). Another source (39) estimates that from 1930 to 1960, the number of resistant arthropod species (insects, mites, ticks) rose from just 6 to 137, an average increase of 4 resistant species per year. In the period of 1960-80, an average of 13 species per year have developed resistance to chemical pesticides. The most recent assessment of resistance to pesticides (33) a total of nearly 150 plant pathogen species and about 273 weed species are now resistant to pesticides, while in 1990, it was estimated (13) that approximately 504 insect and mite species had acquired resistance. Another critical problem should be considered here, which is the resistance that vectors of serious human diseases can build up, e.g. mosquitoes, the vector of malaria.

In the past decade, a moderate resistance level in cotton pests, worldwide, to one group of pesticides, the pyrethroids, resulted in a cost increase for chemical control of $ 1.4 billion annually (39). The figure would be $ 2.4 billion annually if the analysis were extended to all crops (39). Thus excessive pesticide use can disrupt the natural balance in the ecosystem and engender a vicious cycle characterized by a rapid increase in pesticide quantities and types applied as farmers find themselves forced to spray more frequently, in ever bigger doses, and with a wider assortment and variety of active ingredients just to stay even in the fight against pests (in some parts of Asia, this is apparent in the practice of spraying dosage equivalents of up to 800% of what has originally been recommended (42)). This is best known as the pesticide treadmill. Furthermore, pesticides became costlier to develop, for increasingly more funds must be put into research and it is expensive to produce more intricate and potent chemical compounds. Industry now spends $ 20 to 45 million bringing a new pesticide to market, as compared with about $ 1.2 million in 1956 (34).

II. Introduction

As the negative and dangerous impacts of pesticides on human life and on the environment have become better known in recent decades, scientists developed more natural, cost-effective, and less ecosystem-disruptive and harmful methods to control pests without heavily relying on chemical pesticides as in the case of Integrated Pest Management (IPM). IPM is a pest management strategy combining several benign pest control techniques such as the use of natural predators, biological pesticides and adapted cultural practices, including breeding plants for pest and disease resistance, with a diminished and less frequent utilization of chemical pesticides.

Studies show that three IPM programs have been and still are very successful in pest management: rice in Indonesia, cassava in Africa and soybeans in Brazil. This demonstrates that IPM can work in practice, a conclusion supported by the results of case studies mostly based on experiments in farmers' fields (42). However, despite the demonstrated success of IPM, the acknowledged serious harm that pesticides can cause, and the awareness at the scientific and top policy-making levels that pesticide use needs to be limited, IPM has not been widely adopted. On the contrary, the total world production and consumption of pesticides continue to rise with a sales volume and rate of increase for pesticide use greatest for the developing countries. This trend seems likely to continue in the future in spite of a widening awareness and recognition of the disadvantages of excessive reliance on chemicals. In the late 80s, more than one pound of pesticide for every man, woman and child was manufactured and applied each year (14).

In economists' terms, pesticide use is often associated with negative externalities. That is, the decisions of any one user adversely affect the productivity and well being of others (including the environment). There are no incentives for pesticide users to consider these negative effects unless governments intervene through regulations and taxation. In the absence of intervention, pesticide use will generally be excessive from society's point of view, even though the level of usage of each individual farmer would seem to be perfectly logical from their single perspective. Furthermore, the tendency for excessive use in the absence of true market forces and government corrective action is exacerbated due to international and national institutional and economic policies which directly or indirectly lead to farmers applying more pesticides than they would otherwise.

This review evaluates the pesticide policies of developing countries (pesticides in crop protection and public health uses), as it is conceivable that measures which encourage chemical pesticides use tend to diminish the incentive to utilize the non-chemical elements of an integrated pest management package, or to develop alternative pest control options in the first place.

III. Pesticide Use in Developing Countries

As reported in the last decade, and according to more recent statistics, developing countries use only 20% of the global pesticide production, whereas insecticide imports, including the most poisonous of all pesticides, were estimated at 43% of the world pesticide production (for the first part of the decade). In the late 80s, pesticide use expanded fast in the developing countries, with demand estimated to increase by more than 50% until 1993, over the situation in the early 80s, while pesticide use in developed countries stagnated or, in some instances, declined (12).

In 1990, developing countries accounted for 26% of the world pesticide market, with pesticide use valued at $ 4 billion per year (37). Of the estimated $ 20 billion spent on 2.5 million tons of pesticides in 1990, about 24% reached developing countries. Of this, about 12% went to Asia, 8% to Latin America and 4% to Africa (37). Thus, pesticide use in developing countries is still very much lower than in industrialized countries when comparing the 26% share of the pesticide market in conjunction with the fact that 55% of the world's agricultural land is located in those countries. It was estimated in 1990 that pesticide use per ha of farmland per year in Japan was 10,790 grams, in Europe 1,870 grams, in the US 1,490 grams, in Latin America 220 grams and in Africa 127 grams (37).

PROBLEMS ASSOCIATED WITH CURRENT PESTICIDE USE

Studies suggest that up to the mid-80s, about half of all pesticide poisonings and 80% of pesticide-related deaths occurred in developing countries, even though this is where only 20% of pesticides were used (30). In Sri Lanka, with a population of 14 million, 2.5 times as many people suffered pesticides poisoning and 5 times as many people died in 1978, when comparing with the United States, which alone, accounted for one third of global pesticide use (14). In another survey, 6 farmers out of 10 using pesticides, in one county of the state of Rio de Janeiro in Brazil, were found to have suffered acute poisonings (34). Generally, in developing countries safe pesticide use is not a common practice, and this is caused by widespread illiteracy, lack of protective clothing and equipment, lack of access to adequate medical care, lack of training in safety procedures, and restrictions on the right to organize for safe working conditions.

It is also reported (34) that in countries such as India and China, where persistent organochlorine compounds, e.g. DDT, are in use, the median concentrations in the fat of mothers' milk samples are sufficiently high that pesticide intakes of many breast-fed infants must exceed the WHO Allowable Daily Intake standard. In fact, residues of DDT and benzene hexachloride, both suspected carcinogens, were found in all samples of breast milk collected from women in India's Punjab region. Through their mothers' milk, babies were daily ingesting 21 times the amount of these chemicals considered acceptable. Similarly, samples of breast milk from Nicaraguan women have shown DDT levels an astounding 45 times grater than WHO's tolerance limits.

Concerning pesticide residues buildup in the food chain, a study (34) conducted in Australia states that pre-sowing pesticide treatments of soils were used for the control of pasture pests. In a long-term trial, it was found that pesticide residues in meat and milk of cattle grazing in the treated fields exceeded in many instances the maximum residue limits (0.2 and 0.15 ppm, respectively). Like residues were found in cattle introduced into the same fields 15 months after treatment. No data was gathered about wildlife, however, other grazers may have accumulated considerable amounts as well.

Similarly, the issue of contaminated drinking water is of rapidly growing concern. The evidence available points toward some serious problems. However, the full extent of contamination is not known as no systematic monitoring was done, but it is known that many of the modern herbicides exhibit strong potential for leaching to ground water.

As for the buildup of pest resistance to pesticides, the consequences are a matter of concern both from the economic and environmental perspective. It is estimated that the cost of extra chemicals used due to resistance were approximately $ 1 billion worldwide, excluding the former Soviet Union and China. This was 10% of the end-user value of all pesticides purchased in 1980 (39). Another study estimated that the total costs due to increased pest resistance in the US were $ 133 million on a total of 2.8 billion expenditure in pest control (39), which reflects the possible economic consequence of pest resistance in other areas of the world. The magnitude of economic losses due to the build-up of resistance and the destruction of natural enemies is confirmed in the example of the brown planthopper on rice in Indonesia, where the loss in rice yields were estimated at $ 1.5 billion over a two-year period (7). The case of the incidence of malaria in India also illustrates how serious and costly pest resistance could be, as it was documented in 1991 as 59 million cases of malaria are reported per year, with the number in 1961 being 41,000 cases (28). This is a common problem in the rest of Asia, Africa, and South America with the total incidence of malaria estimated to be 270 million cases (28).

Not only humans are at risk. Evidence shows that commercial fisheries have been destroyed or became tremendously less productive and bird species endangered by pesticides. Data from South East Asia indicated a general decline in fish production from rice field areas, the decline mainly due to the use of pesticides and other chemicals on high yielding rice varieties. Widespread mortality of fish and frogs in rice fields in Senegal was observed shortly after pesticide applications. In Surinam, several tens of thousands of various varieties of fish were found dead after spraying against Pomacea snails in the rice fields. From other observations, it was concluded that insecticide use on cotton was directly related to reduced numbers and acute mortality of several bird species in Egypt (39).

Neighborly conflicts have been sparked by the destruction of bees and other pollinators, resulting in suits for economic compensation. It is estimated that due to chemical control of the tsetse fly in Somalia, up to $ 6,700 damage could have occurred to 1000 beekeepers on the spray blocks (39). The damages to bees have a snowball effect in the sense that effective pollination enhances both crop yield and quality. Studies on melon, for example, show that, with adequate pollination, melon yields were higher by 10% and quality was raised 25% as measured by the dollar value of the crop (32).

Essential predatory insects have been wiped out, as a result of uncontrolled and excessive pesticide treatments, which have created new pests as the indiscriminate use of pesticides has often increased the variety and severity of pest infestations by helping potential and real pests evade nature's balancing act and allowing for new pests to emerge. The example of cotton production in the Canete Valley in Peru illustrates the latter situation. Spraying to control the tobacco budworm led to the rapid buildup of the cotton aphid. As chemical treatment intensified to counteract resistance buildup in the aphid, leafworms, leafrollers, mealybugs and bollworms became serious pests, because their natural predators were exterminated. Chemicals intended to enhance and stabilize agricultural production have in some cases done just the opposite as illustrated by the example of cotton growing in Northeastern Mexico and Nicaragua. In Mexico, the tobacco budworm developed resistance to all known pesticides and caused the area planted to cotton to drop from more than 280,000 ha to a mere 400 ha in the 60s (34). Little cotton is grown there today. Similarly, in Nicaragua, 15 years of heavy insecticide use on cotton were followed by four years in which yields fell by 30% (34).

CONTRIBUTING CAUSES

The discussion above implies that the extent of negative externalities associated with pesticide use in developing countries is higher than in developed countries, thus giving an even stronger rationale for measures to reduce and restrict their use. However, both global economic factors and national policies combine to induce higher, not lower, use of harmful pesticides in many developing countries.

First, at the global level, the pesticide industry in developed countries has increasingly turned to developing countries' markets to continue sales expansion, especially since pesticide markets in the industrialized countries have become saturated and effectively government-regulated.

Also, the export policies of some pesticide producing countries have often induced higher pesticide use in developing countries through the provision of direct or indirect export subsidies on chemical pesticides. This created an environment where large quantities of pesticides, including hazardous pesticides belonging to the WHO class Ia and Ib, could be exported to developing countries at low prices. In one instance, 60% of all pesticides imported by an Asian country belonged to the hazardous group (41).

However, policies at the national level, the main theme of this report, could play a major role in guarding against an international environment conducive of excessive pesticide use. The objective here is to look in depth at the government policies and interventions that govern pesticide availability, accessibility and use and analyze whether they encourage a more than socially justifiable pesticide use.

COMPLIANCE WITH THE FAO CODE OF CONDUCT

In view of the extensive negative externalities associated with pesticide use, the need for a national regulatory framework to manage and monitor pesticides is obvious. In a move to provide guidelines to regulate some aspects related to pesticide use (trading practices, testing, registration, availability, distribution, labelling, packaging, storage, disposal, advertising, training, residues, periodic assessment, information exchange) and help overcome a number of difficulties associated with pesticide use, FAO published its International Code of Conduct on the Distribution and Use of Pesticides in 1990. The Code was intended to "set forth responsibilities and establish voluntary standards of conduct for all public and private entities engaged in, or affecting, the distribution and use of pesticides, particularly where there is no, or an inadequate, national law to regulate pesticides".

This was followed by a questionnaire sent out to member governments to determine the countries' current situation with respect to the issues addressed by the Code. The purpose was to establish a baseline data set with which to compare future progress of compliance with the Code. An analysis of responses from the developing countries which replied showed the following (11):

- Developing countries lacked compliance with the Code due, in part, to limited resources, experience and range of activities related to pesticide regulation. As per the responses of the various governments, over 80% of the countries did not have adequate resources to effectively manage the availability, distribution and use of pesticides. About 24% of the developing countries responding did not have approved legislative authority to regulate the distribution and use of pesticides. Close to 57% did not posses or have access to facilities to verify and control the quality of pesticides on the market. And, 41% felt that the quality of pesticides as marketed was not consistently the same as that cleared for acceptance.

- Pesticide manufacturers did not, in 85% of the cases, provide trial reports and data for assessment to responsible government authorities. In 87% of the cases, pesticide manufacturers did not ensure that the proposed use pattern, label claims and directions, and advertising truly reflected the outcome of any scientific tests and assessments. Advertising of pesticides is a matter of concern: for example, advertising of unsubstantiated claims and very limited advertising for safe and effective practices on pesticide use was an issue in over 80% of the cases. In 38% of the cases, restricted pesticides were occasionally or frequently publicly advertised. About 82% of the developing countries stated that cooperative advertising between governments and industry on safe and effective use of pesticides was not done.

- In 83% of the cases, educational/training material provided to pesticide users, farmers, farmers' organizations, agricultural workers, unions and other interested parties was insufficient or non-existent. In 82% of the cases, manufacturers/formulators provide partial or no advice and assistance for training technical staff in relevant pesticide analytical work.

- About 62% of the responding developing countries did not have adequate internal systems in operation to handle the processing of data on banned or severely restricted pesticides prior to import. About 70% did not collect statistics on pesticide import, formulation and use. About 20% did not receive information on banned or severely restricted pesticides in the country of export.

- About 50% indicated that they received no assistance from pesticide exporting countries or from international organizations in the training of data evaluators or registrars. About 25% felt that pesticides for export were not subjected to the same quality control by industry as the ones for domestic use (in the developed country doing the exporting).

- In 64% of the responding countries, few or no in-country studies were conducted on the fate of pesticides and environmental effects.

- In 57% of the cases, IPM systems were either at an early stage of development or not known to the concerned parties.

The picture that emerges from the FAO survey is that of an inadequate capacity to set, implement and enforce a regulatory system for pesticide use in many developing countries. Moreover, no analysis of a pesticide pricing policy, which takes into account their negative externality effects, has been undertaken as far as could be deduced from the literature reviewed. Both confirm the general impression that excessive use of pesticides may be a common phenomenon.

Under the circumstances summarized above, an analysis of the contributing factors at the national level is called for to define the areas of concern.

In the following section, a conceptual framework is constructed to facilitate a country-level analysis of the factors that encourage excessive pesticide use, in the absence of appropriate regulations and taxes to mitigate the ensuing externalities.

IV. A Conceptual Framework For Pesticide Policy Analysis

National policies or factors affecting pesticide use can be grouped into two main categories: price and non-price factors, each group consisting of obvious (easily identified) and hidden (less easily recognized) elements, as described in Table 1[2].

The price factors directly affect the profitability of pesticide use and the non-price factors indirectly affect decisions in choosing to apply chemical pesticides rather than other pest management measures. Both kinds of factors create an environment conducive to an excessive use of pesticides.

Table 1 - Price and Non-price Factors that Encourage Excessive Pesticide Use at the National Level

Price Factors	Non-price Factors
Obvious Factors	
1. Government sells pesticides with subsidy or provides free pesticides and related services	1. Excessive Government's investments in pesticide research combined with inadequate government research in environmentally benign pest management
2. Foreign aid donors provide pesticides at low or no cost	2. Erroneous government pest management policies, e.g. pest eradication
3. Government subsidizes national pesticide industry	
4. Agricultural credit and crop insurance are tied to pesticide use	
5. Preferential or below market value rates for foreign currency exchange is made available for pesticide imports	
6. Reduced or no import duty and sales tax applied to pesticides, whether as ready-to-use finished product or as intermediate material for domestic pesticide industry	

2/ Adapting from, and elaborating on, reference no. 43

Table 1 - (continued)

Price Factors	Non-price Factors
Hidden Factors	
7. Inappropriate or inadequately executed operational rules govern the Protection Service outbreak budget and surveillance programs	3. Lack of adequate and simple, easy to use, procedures to define pests and crop loss
8. Measures taken by Government to mitigate the consequences of excessive (higher than socially-optimal) pesticide use	4. Lack of adequate information to policy makers/implementors and farmers on alternatives to chemical pesticides, and related emphasis by both governments and external donors on information regarding chemical control methods while neglecting alternative approaches
	5. Pro-chemical bias of information provided to farmers by pesticide industry
	6. Inadequate curricula of agricultural education and extension

PRICE FACTORS

Price factors refer to various direct and indirect forms of subsidies applied to chemical pesticides to lower their supply cost, resulting in market distortions. That would make pesticides cheaper than their real supply cost and would artificially lower the economic pest control threshold as perceived by farmers. Pesticide use being price elastic, the price factors are directly related to the amount of pesticides used. Consequently, farmers are encouraged to use more pesticides than they would have if they had to pay full price. The other side of the coin is the disincentive to implement alternative non-chemical pest control methods.

Developing countries subsidize pesticides by a variety of often simultaneous mechanisms: preferential foreign currency exchange rate for imports, import duty exemption or reduced rates applied, reduced or no sales tax applied, sales below cost, subsidized agricultural credit directly associated with pesticide purchases, provision of free pesticides to farmers, etc. These subsidies imply a significant real cost to developing countries in terms of misallocation of public funds and environmental damages, and an added fiscal strain due to direct budgetary outlays.

Price factors 1 and 2 (governments/donors provide low cost/free pesticides and related services): If pesticides are subsidized or supplied free of charge to the end-user and widely available on the national markets or supplied to farmers as part of a technology package, which does not include non-chemical control elements, pesticides would be used in higher quantities than if such situation did not exist. In the case of external aid, pesticides have often been supplied free by bilateral development agencies to developing countries governments which in turn made these pesticides available to farmers either free of charge or at below market costs. Also, in many instances, governments provide pesticide services such as spraying (equipment and labor) at low cost or free of charge to farmers.

Price factors 3 and 6 (direct or indirect subsidy to domestic industry): The subsidization of national pesticide production ultimately translates into an artificially low pesticide price to the end-user. Governments often provide various forms of tax relief, including subsidization of imported raw or intermediate products, or investment subsidies to local manufacturers of pesticides, either because they are seeking to substitute imports, or encouraging the expansion of pesticide use.

Price factor 4 (pesticide use tied to agricultural credit/crop insurance) refers to a situation whereby access to agricultural credit, whether subsidized (below-market interest rates) or not, is conditional on a specific amount of pesticide use. Often, it is required that an intensive prophylactic pesticide treatment is followed. The rationale behind this tie is risk aversion, to be able to refund the loans to the lending entity.

Similarly, eligibility for crop insurance could be conditional on pesticide use to, hypothetically, reduce the risk of crop loss to pests and diseases.

Price factors 5 and 6 (preferential import and sales treatment) describe those cases where lower import taxes, favorable foreign exchange rates and other preferential tax policies are applied to pesticides versus other imported commodities (whether agricultural inputs or not).

Price factor 7 (availability of pest outbreak budget) refers to the situation when the bureaucratic operational rules of the Plant Protection Service (PPS) are set in such a way that a group of poor farmers with infested lands totalling no less than a certain pre-set area, can petition for assistance in the control of their pests through extension officials who in turn forward the petitions to the PPS, which usually maintain emergency stocks of pesticides in their offices or would have a set annual budget for purchasing pesticides and related equipment to respond to farmers' requests. This special budget would be approved for disbursement on pest suppression during severe outbreaks and ultimately translates into a subsidy.

Price factor 8 (governments' mitigation measures): A consequence of the excessive use of pesticides due to unwarranted subsidies is an increased need for government expenditures on pesticide pollution monitoring programs and the provision of public services aiming to reduce the hazards of pesticides and to protect the integrity of the public health and the environment. Examples of such expenditures include the establishment of pesticide residue laboratories in numbers more than warranted if pesticides were used at a lower or socially-optimal level, expensive environmental clean-up, waste disposal of unused pesticides, pesticide research, etc. Some of these expenditures would not emburden the general public if the polluter-pays principle were applied (i.e. if the domestic pesticide industry and, at the lower end, the pesticide users were held liable for the damages caused). This ultimately translates into a pesticide subsidy.

NON-PRICE FACTORS

Non-price factor 1 (emphasis on pesticide research) includes excessive public investments in support services and knowledge base for chemical control, such as testing different pesticide types, doses, and application methods and dates on different pests and crops, while neglecting alternative pest management approaches.

Non-price factor 2 (erroneous pest management policy) refers to the implementation of a pest eradication policy excessively relying on pesticides as part of government interventions in pest management. The eradication concept is often of questionable cost effectiveness and may often be unsound from an environmental perspective as it entails the disruption of the ecosystem's balance.

Non-price factor 3 (lack of tools to identify pests and economic crop loss) refers to the unavailability of a simple procedure to identify infestation (type of pest) and to determine the extent of crop loss that it would cause. Not all farmers can distinguish pests from beneficial or innocuous organisms and thus, base their decision-making on inaccurate information. Risk-aversion will often give rise to excessive pesticide use when the level of uncertainty is higher than what it could be if crop loss and infestation levels were more precisely and reliably measured for different levels of pesticide used.

Non-price factor 4 (lack of adequate information on alternatives) relates to some lack of information on various pest management measures to policy makers/implementors and farmers, which if available, could reduce pesticide use level. This relates to two kinds of information: that regarding the existence of alternatives to chemical pesticides that are pest-potent but less harmful to humans and the environment, and the other regarding the types and quantities of pesticides allowed per kind of crop in order to preclude any consequential harm and use economically optimal quantities. The effect of better information is similar to that discussed under factor 3.

Non-price factor 5 (pro-chemical bias) regards the dominance of pesticide companies in supplying pest control information and guidance to farmers. These companies are sale and profit-driven and, understandably, focus their information campaigns on chemical control. Their activities range from advertising pesticides in mass media to one-on-one extension visits to farmers. The counterweight to this bias should be government extension which gives due weight to non-chemical pest management, but this is not very common.

Non-price factor 6 (deficient extension and training) relates to the current curricula in agricultural education, training and extension which are heavily biased towards pesticides and largely ignore less harmful or benign pest control and management concepts. More emphasis is put on pesticide effectiveness and versatility, and safe use rather than on the depletion of common property resources, environmental risks and output cost that pesticide use engenders. Thus, trainers, extensionists and students are more informed about pesticide efficacy, and inadequately informed of their hazardous and costly attributes, adversely impacting good judgement. Alternative pest management methods are often not receiving as much attention in training curricula.

All factors described above will result in excessive pesticide use, to a level above the social optimum (where the effects of pesticide use on human welfare and the environment are not taken into account). In the long run, an unfavorable environment for directing technological progress into non-chemical methods of pest control will develop.

V. Review of Pesticide Policies in Developing Countries

It is argued that pesticides are needed in developing countries to feed the rapidly growing populations. However, even though pesticides have contributed to increased agricultural production, the rates of increase in pesticide use and in agricultural production were not directly proportional. In fact, the latter has been well below the former (India, Mauritius). In extreme cases, a negative relationship may be true, as excessive use of pesticides has been associated with disastrous crop losses due to pest resistance, secondary infestations and natural enemy mortality (Indonesia, Sudan). This negative relationship is illustrated in the example of the US, where a tenfold increase in insecticide use from 1945 to 1989 was accompanied by an increase of about 87% in crop loss from insect damages (31). In such situations, gains in productivity and profitability could have been made through reductions in pesticide use such as in the context of IPM (29).

Studies conducted by the International Rice Research Institute (IRRI) over several growing seasons on rice under varying pest pressures showed that insecticides' contribution to yield declined steadily across years (8). Also, through an FAO IPM program in several countries in Asia, it was demonstrated that insecticides do not, in the majority of intensified rice fields, increase yields significantly, and farmers who reduce insecticide by 50-100% after having been trained on IPM technology, achieve lower variance or risk in production than when using more insecticides (8). Thus, it is not necessary to keep up current levels of pesticide use to maintain food production. More so, if pest and disease-resistant crop varieties are grown. Nonetheless, excessive pesticide use has been encouraged due to the price and non-price factors described in the previous section.

No detailed and recent data could be found for all price and non-price factors in all developing countries. Hence, the findings of this report are not all encompassing.

The most recent and comprehensive study (35), done in 1985, on direct and indirect subsidies provided for pesticide use in nine countries in Africa, Latin America and Asia (Senegal, Egypt, Ghana; Honduras, Colombia, Ecuador; Indonesia, Pakistan and China), revealed that pesticide subsidies were widespread and substantial with a total ranging from 19% to 89% of the real retail cost. Subsidies were provided on imported finished products and intermediates, the latter being one form of subsidizing domestic pesticide industry. In large countries that maintained generous subsidies, such as Egypt, total subsidies costs ran into the hundreds of millions of dollars annually. Even in smaller countries, such as Honduras and Ghana, pesticide subsidies costs per person, over the whole population, ranged from $ 1.5 to 3.0 per year. These costs made subsidies the largest government expenditure on pest management. Furthermore, rising pesticide use would eventually increase the costs of these subsidies year after year.

In 1982, Senegal, Egypt and Indonesia maintained subsidies above 80% of real cost, subsidies large enough to significantly affect farmers' costs and incentives regarding pesticide use. For comparison purposes, in 1982, the year for which the population estimates were drawn to get to per capita figures, total central government expenditure for health improvement in Indonesia amounted to $ 2.50 per person, that for housing and water supply was $ 1.50, and that for pesticides was $ 0.80. These figures show that pesticide subsidies can absorb significant amounts of actual and potential government resources for development programs in the developing countries. Of the nine countries studied, only Pakistan had examined the efficacy of its subsidies and, as a result, largely discontinued them in 1980 (35).

As to how subsidies on pesticides affect farmers' decisions to apply pesticides, it should be noted that, often, the use of pesticides is associated with the use of modern agricultural inputs such as fertilizers, high-yielding or disease-resistant crop varieties, irrigation, and mechanization. In the Philippines, a 50% subsidy on pesticides for rice, with chemicals making up 75% of the total costs of application, implying a 37.5% reduction in overall costs at each application level, induced farmers to keep applying pesticides at unwarranted levels and frequency even on disease-resistant rice varieties, for which, the balance of pesticide costs and benefits was narrow to start with (35). Thus, subsidies affected how heavily farmers chose to apply pesticides even though such level of use was not necessary to maximize economic returns.

The previous proposition that pesticide subsidies lead to unwarranted, thus excessive, pesticide use and mismanagement, and misallocation of resources is supported by the results of experiments conducted by IRRI in farmers' fields in the Philippines in the period of 1976-81 (35). The objective was to evaluate the benefits and profitability of the application of different levels of pesticide on disease-resistant and non-resistant rice varieties (duplication of farmers' practices). It was revealed that the marginal real cost of applying pesticides often exceeded the marginal benefits from consequential incremental crop yields, marginal benefits being largest on non-resistant varieties. However, pesticide use, up to a moderate level of application, saved farmers more than it costs on non-resistant varieties, but not on resistant varieties. Marginal real costs exceeded marginal benefits on resistant varieties even though pest losses were further reduced with heavier pesticide applications.

In relation to research, implementation and training on IPM technology, a major development is the creation and implementation of the FAO "Inter-Country Program for the Development and Application of Integrated Pest Control in Rice-Growing in South and Southeast Asia", and several other bilateral and national programs in the Asia region (41). Other IPM programs are ongoing also in other regions of the world and are in various stages of implementation.

Below is a review of the most recent literature and information on the status of government policies regarding pesticide use in selected developing countries, by region and by country.

AFRICA

Pest management in Africa relies mainly on chemical control. It is estimated that the African countries import $ 500 million worth of pesticides every year, which accounts for about 2.5% of world imports (37). Pesticide use increased five fold during the 15 year period following the mid-60s and was estimated to increase by 200% between 1988 and 1993, compared to a 20% increase for developed and developing countries combined, due to the pressure for increased food production. Although, at present, overall pesticide use in Africa is still lower than elsewhere, it is growing rapidly (37).

Pesticide use has largely been confined to high-value export and industrial crops that are foreign exchange earners (25). Thus, in general, the leading African pesticide users are those with a well developed cash crop sector and in the early 80s, these were in descending order, Sudan, Tanzania, Zimbabwe, Cameroon, Ivory Coast and Kenya (37).

The domestic pesticide industry is almost non-existent in Africa. Pesticide formulation from imported intermediates is undertaken to some extent in few countries (9).

The relatively low literacy and education rates and poorly developed regulatory mechanisms prevalent in most Sub-Saharan African countries make the overall risk of improper and dangerous use of pesticides greater than elsewhere. In general, farmers are ignorant about pesticide use due to poor information about pest control from extension services (9). Moreover, the local constituencies for environmental and public health protection are small and have little influence in comparison with more industrialized countries. In fact, the major impetus for decreasing pesticide exposure or hazards usually comes from international NGOs who collaborate with local groups.

Problems associated with heavy use of pesticides include a) the emergence of secondary pests such as the whitefly in cotton in Sudan, the red spider mite in cotton in Zimbabwe, the mealybug and scale insects in coffee in Kenya, and the coffee leaf miners and other pests in the cocoa-ecosystem in Tanzania (3), b) environmental contamination at a local level causing fish kills and sickness in humans and livestock, although this is not yet a major regional problem, and c) large stocks of excess or obsolete pesticides, which appear to be a serious problem in all of Africa.

As to pesticide legislation, about 76% of the African countries lack pesticide control statutes and where these exist, they are not vigorously enforced (37).

Of the ten South African Development Cooperation Committee (SADCC) countries, only three have established pesticide registration schemes with an appointed registration board (Zimbabwe, Tanzania and Mozambique, with the latter being somewhat obstructed in enforcement) (37). In Namibia and Angola, regulations are in the process of being reviewed. In the other countries of SADCC, drafts are prepared and were at various stages of approval and promulgation as of 1991.

Most West African countries do not have effective mechanisms for regulating the importation, formulation, distribution and use of pesticides. Except in Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia and Senegal, there are neither legislation nor comprehensive registration and control schemes. In Benin, Cameroon, Ghana, Guinea, Guinea-Bissau, Sierra Leone and Togo, legislation is being drafted (9), with Niger's in place since 1993[3].

The status of pesticide legislation in East Africa and much of Southern Africa is in a rudimentary stage of development, with the exception of Kenya, where pesticide legislation is in an advanced stage of enactment (37).

Price Factors

Subsidies

In Africa, the current prevailing agricultural development philosophy and the availability of government subsidies encourage pesticide use. Some African governments subsidize pesticide use in the belief that heavy use of pesticides is necessary to maintain high yields of crops which are the main source of foreign exchange. On the other hand, subsistence farmers, although suffering significant losses to pests, can afford few purchased inputs of any kind, including pesticides. These farmers are usually obliged to wait for government assistance when it can be extended (depending on the national crop protection services to spray their crops). However this assistance is severely limited.

3/ Knausenberger, Walter. 1993. Personal communication. Africa Bureau, USAID, Washington, DC, USA

Up to 1989, all West African governments provided subsidies and tax reductions on inputs for industrial and export crops, and in some instances, on food crops, which enabled farmers to purchase pesticides at comparatively low prices. In several of these countries, the crop protection services and government agricultural projects distributed pesticides directly to farmers (9).

However, structural adjustment programs have been introduced around 1989-90 in some of these West African countries, whereby improved agricultural production was encouraged through the provision of financial incentives in the form of higher producer prices while subsidies on pesticides were removed. Yet, notwithstanding the higher prices of pesticides, their consumption continued to rise (9).

On the other hand, the six UDEAC (Union of Central African Countries) countries share the same import and excise duty structure, consisting of import duties and a complementary tax. Farmers are exempt of this levy but not pesticide importers (17).

External donors

Foreign aid donors have introduced pesticides, often including inappropriate materials, for use in research or in campaigns for the control of disease vectors or migratory pests such as locusts and grasshoppers, Africa armyworms and grain-eating birds (37). In particular, one donor supplied large quantities of a variety of pesticides to many African countries as aid grants (8). Often donors insist on pesticides donated by them to be provided free of cost or at low cost to farmers.

Also external donors have introduced and promoted the use of more pesticides, as was the case with millet in Mali. In Sudan, foreign aid contributed to 0%, 29%, 75% and 100% of financing of pesticide procurement before 1980, in 1982-83, in 1984-85 and 1985-86 till 1990, respectively (25).

It is not mentioned whether governments provide these pesticides free or at a cost to farmers. However, the general impression is that if pesticides are given free, the cost is recovered from the farmers through setting ceiling prices on output crops, or if sold to farmers, it is at below-cost prices.

Mitigation measures

Some East African countries have surpluses of outdated pesticide stocks in need of disposal (about 30,000 to 60,000 tons). A large part of these stocks are unused donations provided for the emergency locust control operations by external donors. None of these countries has appropriate disposal facilities for obsolete stocks and empty drums. Only one country is documented to have a limited incineration capacity (37). Here it should be mentioned that the cost of disposing of 1 kg of pesticide is estimated at $ 10 (42), which would have to be provided by the governments through loans or grants, straining their budgets or contributing to misallocation of funds.

Pesticide residue monitoring is generally limited to those export commodities which will be penalized if containing unacceptable residue kinds or levels (37).

Non-price Factors

IPM issues

Although IPM is not a new concept to Africa, Sudan and Kenya setting well documented

examples, the IPM approach to pest management has too often been overlooked or dismissed as too academic, impractical, unproven or technically demanding for African farmers. Thus, integration of alternative pest control measures with chemical control is rare. Only passive or less extension dependent tactics including the use of disease-resistant crop varieties and the introduction or augmentation of natural enemies are being utilized to a limited extent (25).

The problem with a stagnating IPM practice is a strong orientation toward pesticides in both research and practice (25). Also, an adequate recognition and awareness by policy-makers of IPM as a tool for controlling pests is somewhat lacking (9).

Emphasis on chemical control

In the African locust control program, funded by external donors, a total of DM 700 million has been spent in three years, a large proportion of which is allocated to pesticide purchases and the maintenance of pest surveillance units despite the fact that the probability of a locust outbreak was estimated at only 5%. It is interesting to note that only DM 11 million was spent on researching non-chemical methods to control the locust (42).

Extension and farmer's training

Much of the pesticide misuse in Africa is due to the farmer's inadequate knowledge base, a problem which could be overcome by training (37). However, up to 1990, extension and farmer's training concentrated on the subject of safe and efficient use of pesticides and not on alternative pest control methods (9).

Country Information

Benin

Benin imports its pesticides for post-harvest protection through its Plant Protection Service to encourage small-scale farmers to protect their stored food crops. Retail prices are fixed by the Ministries of Agriculture and Commerce. Until 1988, pesticides were subsidized, but more recently, were sold to farmers at cost price (9).

Burkina Faso

Pesticides are reported to be exempt from import duty (37).

Cameroon (17)

Currently, Cameroon's pesticide use is low, compared to world figures, and ranks low even by African standards, except on cotton, which is extremely high.

Pesticide sales declined dramatically, with the collapse of the cocoa and coffee export markets, from a high of $ 44 million in 1986 to a low of $ 16.8 million in 1991, a reduction of 62%. It is believed that this level of pesticide demand will be maintained in the near future. Cocoa, which used to be the largest consumer of pesticides, with around 40% of the total used, is now the smaller user. Cotton and bananas are the current leaders with 28% each.

Cameroon, like the other UDEAC (Union of Central African Countries) countries, provides pesticide subsidies in the form of exemptions from import duties and taxes only to farmers and not to pesticide importers. However, small farmers are not taking full advantage of these exemptions because of the long, costly and time-consuming processing formalities. Interestingly, customs refuses to classify herbicides as pesticides and charges 26.5% in import duties. Products intended for resale to smallholders are penalized heavily, by as much as 67.75%. Importers' gross margins for direct sales vary from a minimum of 7-8% on large quantities ordered in advance and delivered to one up-country location, such as to a parastatal, to 30-32% on much smaller orders.

The government heavily subsidized pesticide use on some crops, including cocoa, with a subsidy rate of 100% at times. With the collapse of the cocoa export market, cocoa and coffee pesticide subsidies were abruptly reduced in 1990. In addition, a plan was set to phase out pesticide subsidies on cocoa, with a projected total elimination in 1995, whereby cocoa growers will, by then, buy their pesticides at the market price. In the meantime, insecticides are receiving preferential treatment as compared with fungicides. Insecticides' subsidy will be reduced at a lower rate than that for fungicides.

SODECAO, the cocoa parastatal, distributes and sells pesticides that it purchases through a new World Bank loan of $ 7.2 million and other foreign aid funds over the pesticide subsidy phasing-out period.

Credit is available for purchases of agricultural inputs for cotton, whereby pesticides are sold on crop credit, at cost, to registered cotton growers and for 25% markup to others. Also, some cocoa buyers are providing pesticides on credit.

No manufacturing or formulation of pesticides is undertaken in Cameroon. All pesticides are imported and only repacking is done when necessary.

The national agricultural research institute operates a pesticide analytical laboratory.

As to research in pest management, neither basic nor applied agrochemical research is conducted in Cameroon. Some work has been done on developing pest-resistant crop varieties for maize, coffee and cocoa.

The stated policy of the crop protection authorities is to avoid the use of pesticides whenever an alternative is available. It is not known to what extent this principal is applied.

SODECAO provides training to farmers to become fully self-reliant to perform all necessary pesticide applications that it used to carry out on their behalf. Thus, training is oriented only toward the mechanics of pesticide use.

Cote d'Ivoire

Prices of pesticides are fixed by the government and benefit from a reduced tax rate (37).

Cote d'Ivoire has a pesticide analytical laboratory for pesticide residue analysis (9).

Ghana

The most recent detailed information on Ghana dates to 1985 (35). The only indication of change is that concerning pesticides used on export crops, especially cocoa, for which subsidies were recently reduced or removed (9).

Up to 1985, pesticide use in Ghana was subsidized mainly through granting a) preferential foreign exchange rates for importation of intermediate and finished products, b) concessionary commercial loans to pesticide importers at a rate of 9% compared to the standard 22%, and c) exemption from a 20% sales tax. However, pesticide imports were liable for the 30% duty just like all other imported commodities (35).

The government attempted to ensure that subsidies were passed through to farmers by setting price controls at wholesale and retail levels to minimize distribution and marketing margins, which were, reportedly, generous as compared to other countries (35).

Here, it is worth mentioning the situation that prevailed with respect to pesticides used on cocoa and coffee. The Cocoa Services Division of the Cocoa Marketing Board (CMB) had responsibility for importation of active ingredients, formulation of finished products by contract with local formulators, and distribution to farmers. The distribution of pesticides and sprayers was done with a heavy direct subsidy, but the costs recovered directly from farmers covered only 10-20% of the CMB's own costs, despite the fact that CMB's costs were themselves subsidized by preferential access to foreign exchange and exemption from sales taxes. The ensuing shortages in funds coupled with weak distribution and extension services, and a low profitability of cocoa farming at the low prices set by CMB, have limited pesticide use despite all the subsidies provided by the government (35).

Guinea

Subsidies in the form of tax reductions on pesticides imports are provided on pesticides imported through the state company SEMAPE. Thus, retail prices of pesticides sold by SEMAPE differ from those sold by private companies (37).

Guinea-Bissau

Subsidies on pesticides are provided for use on food crops (37).

Kenya

In kenya, agricultural inputs, including pesticides, are available at cooperative stores on interest-free credit (37).

Some work has been done on IPM research and biological and cultural control measures on coffee and a resistant coffee variety has been developed. Economic injury levels have been established as well, to minimize insecticide use (25).

Mali

A graduated subsidy/tax reduction system is applied to pesticide sales, benefitting small-scale farmers producing food crops (37).

Senegal

The most detailed information on Senegal also dates to 1985 (35), with the exception of subsidization of local pesticide industry (37). There is no indication as to whether the situation has changed in relation to other subsidies since 1985.

Up to the mid-80s, the government provided direct and indirect subsidies on pesticides in the form of a) an exemption from import duties and fiscal taxes, a total of 25% of cif value, on imported intermediate and finished products, b) exemption from sales tax, which amounted to 20%, on purchases made by official agencies, and c) distribution of pesticides to farmers free of charge (about 90% of all agricultural pesticides, by crop marketing boards and other agricultural agencies). In few instances, pesticide (fungicide)-coated seeds were supplied to farmers (35).

Part of the pesticides were obtained through bilateral external assistance. The Japanese foreign aid program, for example, provided considerable quantities of organophosphate insecticides for use on food crops (35).

The budgetary costs of subsidized pesticides and other inputs were recovered from farmers through low prices paid by crop marketing boards, though the effects of the input subsidies and implicit output tax on farmers' demand for pesticides were estimated not to balance each other. It was estimated that the demand for pesticides (at the subsidized price) was about five-fold greater than supply (35).

The domestic pesticide industry consists in pesticide formulation, which benefited from exemptions on import and sales taxes on intermediate products (35). Locally formulated pesticides are charged considerably less tax than pesticides imported as finished products (37).

Senegal has a pesticide analytical laboratory for pesticide residue analysis (9).

Sudan

In Sudan, the use of IPM components or elements, such as resistant varieties, date to the 1920s and the use of economic thresholds levels (ETL) and pest scouting were introduced in the 1950s (25).

Tanzania

Up to 1991 at least, Zanzibar provided subsidies for pesticide use by selling pesticides at low prices and with generous credit facilities to farmers and importers. For example, a particular herbicide used by rice growers was sold for $ 2.60 per liter, which was 1/3 of the commercial price (25).

Also, pesticides are provided free to rice farmers on the island of Pemba[4].

Togo

Until 1989, pesticides were subsidized, through distribution free of charge to farmers, along with cotton seeds, through the extension service (25). At present, subsidies on pesticides are still provided for

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4/ Zadoks, J.C. 1993. Personal communication. Landbouwuniversiteit, Wageningen, the Netherlands

use on food crops (37).

However, in response to the 1985 drop in world market prices for cotton, SOTOCO (cotton parastatal) introduced a phased reduction of the subsidy level for insecticides from 75% in 1989 toward complete elimination in 1993. Here, it should be noted that SOTOCO determines the level of pesticide inputs and charges the farmers for the recommended amount and the costs are subtracted automatically from the price paid for their cotton (25).

In a measure to reduce pesticide use, and hence the value of subsidies, SOTOCO reduced the dosage of pesticides (by 33%) in some of the recommended applications, on the recommendation of the Research Institute for Cotton and Textiles. This has contributed to government savings of between $ 11,000 and 13,000 (3.4 and 4 million F CFA) per year (25).

ASIA AND THE PACIFIC[5]

Most of the countries in the Asia-Pacific Region have agriculture-based economies and the trends in the early 80s pointed towards further development of the agriculture sector aiming at self-sufficiency, import substitution and increased exports (12). Rice is currently the major crop as it is the staple food in Asia.

With the prospect that 60% of the world population will be in Asia by the year 2000, demand for food and fiber will increase. By the same token, the usage of pesticides is projected to increase as well.

In 1989, Asia's share of the world pesticide market was 25%, amounting to a value of $ 5.4 billion. A major expansion of pesticide usage is currently taking place in Asia as a whole and is expected to continue in the foreseeable future. Much of that expansion will be in herbicide use as rural labor for weeding is becoming scarcer (22).

Most countries of the Asia-Pacific Region have domestic pesticide manufacture, formulation or both, while some of them maintain a policy of self-sufficiency in pesticide production, e.g. China and India.

Up to the mid-80s, the emphasis on agricultural development has focused the attention on the problem of yield losses due to complex pest situations (12) and the need for effective pest control, which was mainly based on a chemical approach. Although IPM has been introduced since then, pesticide use remains the most common pest control method in practice. Insecticides accounted for the biggest share of the pesticide market, 62.5% in 1985, with the bulk of insecticides used on rice, cotton and vegetables.

The vast majority of small-scale farmers have for decades, and still do, indulge in gross overuse and misuse of pesticides. In many Asian countries, pesticides that are toxic to humans, environmentally damaging, or both, are still in use.

Problems identified as a result of mishandling and misuse of pesticides include: poisoning and

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5/ Drawing on reference no. 22, unless otherwise indicated

health hazards to applicators and workers in pesticide production plants; residues in food and export crops; adverse effect on fish, livestock, wildlife, soil and water; and a growing problem of pest resistance in most countries, particularly on post-harvest pests (Pakistan) and cotton and vegetables' pests (China and India).

On the other hand, rice being the major crop in the Asia-Pacific Region, much emphasis has been put on studying pest problems and developing IPM programs on rice to reduce pesticide use and avoid pests' outbreaks similar to that of the brown planthopper.

One major step towards better pest management in the Region was the establishment of the "FAO Intercountry Program for Integrated Pest Control in Rice in South and Southeast Asia" (an IPM demonstration and training program) since the early 1980s. As of 1992, 400,000 farmers and 40,000 extension workers have been trained in IPM. This has resulted in reduced pesticide use with subsequent reductions in governments' subsidies on pesticides, with national savings totalling over $ 150 million and farmers' savings on pesticides purchases exceeding $ 15 million. At the same time, rice production was said to have increased by as much as 5% annually, though not all of which should be exclusively attributed to improved pest management. Efforts are being made to develop similar IPM programs on other crops in the Region. In parallel, a "GIFAP Safe Pesticide Use Project" was recently inaugurated in the purpose of improving pesticide use standards.

Two studies conducted on rice (the Philippines) and cotton (India) are worth mentioning here, in support of the IPM concept and its economic justification.

First, a recent IRRI evaluation of production and input data over 25 to 36 seasons in Philippine farmers' rice fields with varying pest pressures, showed that insecticide's contribution to yield declined steadily across years, being not significant for the last 5 to 15 years. It was found that insecticides did not significantly reduce risk, measured as the variance in production across seasons, and contributed to yields less than 10% of the contribution of either fertilizers or improved varieties. These results were confirmed in the FAO Intercountry Program's field demonstrations in the late 1980s in India, Indonesia, the Philippines and Sri Lanka (8).

Second, another study (24) estimated that, during the 1989/90 season, $ 27 million worth of pesticides were used on cotton in the district of Guntur in the state of Andhra Pradesh. With an average overuse of 20% (also estimated by the same study), $ 5.4 million of pesticides were wasted, which could have been avoided through better pest management. The yield losses due to pest resistance were estimated at $ 39.7 million. To demonstrate that IPM would have been economically justified in that particular case, it was computed that if IPM technology was applied, there would have been need for additional labor to scout the fields for pests and to harvest the additional yields. Additional labor was estimated at $ 6.9 million. That meant savings of $ 38.2 million, an enormous return to better pest management if adopted on a district-wide scale. In addition, an externality cost of about $ 30 million would have been saved due to better management of pest resistance of cotton pests that were also pests of other crops.

Pesticide legislation in the Asia-Pacific countries, as in other regions of the world, is in various stages of enactment and enforcement. In 1986, pesticide regulations were reported to be modelled according to the FAO Guidelines for the Registration and Control of Pesticides, and incorporated the concepts of registration data and label requirements, formation of a Technical Advisory Committee, appointment of inspectors to monitor and enforce the law, control of imports, and restrictions on availability of pesticides (12). It was recently reported that pesticide legislation, when exists, regulates

various aspects related to pesticides, the number of aspects varying from one country to the other. Up to 1987, Burma, China (up to 1992), Laos (up to 1990), Nepal, Papua New Guinea and Western Samoa did not have any form of pesticide legislation (1, 12, 18, 22, 26, 40 and 44).

The enforcement of existing pesticide regulations is also reported to be inadequate in many countries. Cases of pesticide adulteration, false labelling and smuggling were also documented.

Price Factors

Subsidies

Up to 1987, the provision of different forms of pesticide subsidies has been a major aspect of plant protection policies of most countries in Asia (1). A quantification of the extent of subsidies is often difficult because of the different ways in which subsidies were given. However, almost all forms of pesticide subsidization, whether directly targeting the end-user or the domestic pesticide industry, were represented.

External donors

External aid is documented to be channeling funds into national IPM programs in several Asian countries, e.g. Bangladesh, China, India, Indonesia and the Philippines (8).

However, in at least one instance, foreign aid programs have been cited to supply pesticides and, at times, the wrong materials. It is not known whether governments deliver these pesticides at subsidized prices to farmers or not.

National outbreak budgets

This represents a substantial indirect pesticide subsidy in a number of countries, e.g. Thailand.

Mitigation measures

Some Asian countries have established residue monitoring programs, while the remainder had neither the expertise nor the equipment to conduct residue analysis. Few countries have established legal limits for residues on food and food crops.

Also, some Asian countries face the need to dispose of surplus or unwanted pesticides supplied through foreign aid programs, as in the case of Laos (44), or of large stocks of outdated pesticides procured by the government before a better pest management philosophy was adopted, as in the case of Pakistan.

Non-price Factors

Pesticide research

Although many Asian countries have started research programs on IPM, pesticide research still benefits from heavy public funding in at least one country (Thailand).

Extension and farmer's training

Both extension and farmers' training incorporate IPM technology in their agenda. The FAO Intercountry Program for Integrated Pest Control in Rice in South and Southeast Asia which was implemented in the early 80s, is but one example.

Also, in some countries, extension officials recommend the use of IPM components, such as scouting for pests and applying pesticides at set thresholds, and substitution of pesticides with less harmful products or, eventually choosing pesticides that could be incorporated in an IPM program.

Country Information

Burma (1)

The stated government policy regarding agricultural production is to attain self-sufficiency in all food crops, and promote the export of agricultural products.

Burma's pesticide requirements are said to be modest. One reason for that being the abundance of predator insects and low levels of crop losses caused by pest damage (except in potatoes). When pesticides are applied, the majority is used on rice, cotton and groundnut.

With regard to pesticide subsidies, in the late 80s, pesticides were made available to farmers at concessional prices, i.e. landed cost with no sales tax or distribution expenses.

Research on pest management is conducted with the cooperation of FAO for the development of biological control and integrated pest management.

A modified pest surveillance/IPM program was reported to be in place on cotton.

China (PRC)

The major approach in crop protection remains the use of pesticides. China is one of the larger users of pesticides in the world. Only 13% of the pesticides used are imported, the rest being produced domestically.

The main crops are rice, wheat and maize, which, in addition to cotton account for the majority of pesticides used.

The official policy of the government and the Ministry of Chemical Industry (MCI) is self-sufficiency in pesticide production. Also, surplus pesticide production is encouraged for export purposes to balance the importation of intermediates.

The most detailed information on pesticide subsidies dates to the mid-80s (35), which mentions that, for a long time, China had a policy to keep pesticide prices low. In fact, many important pesticides were priced considerably below estimated production costs as China subsidized both pesticide imports and domestic pesticide industry.

Various subsidy mechanisms were used: a) provision of foreign exchange quota for pesticide

imports (31), b) a favorable tax and tariff treatment on imported pesticides, c) reduced sales tax from the regular 10% to 3% (35), d) intermediate and finished products sold at below costs, e) controlled pesticide market prices, whereby the margin over direct costs for pesticides was only 15%, compared to 31% for other chemical industries and the industrial sector as a whole (35), and f) commercial distribution agencies sell pesticides below cost and absorb the losses (35).

It is reported that, recently, the prices of the raw materials used by the domestic pesticide industry have been liberalized.

There is a large domestic pesticide industry in China (387 facilities in 1986). In 1990, not all the foreign exchange quota allotted to pesticide imports was used as domestic production was close to the set goals.

Pesticide analytical facilities exist, although their number may not be adequate for the proper monitoring of pesticide residues (22).

As the extension service is aware of alternative or less harmful methods of pest management, and is keen on promoting a "no public harm" farming, equivalent to organic farming, research on IPM is being undertaken and pilot IPM programs have been developed for cotton, rice and apple. It is not known, however, if the implementation of IPM in cotton and the consequent successful results claimed are widespread.

China, with the collaboration of FAO, has started a program to train farmers in IPM technology on rice.

Fiji (1)

In 1987, the use of pesticides was reported to be quite low but the pesticide market was projected to increase as a result of increased emphasis on rice production to meet the self-sufficiency target. Sugar cane, rice, cocoa and ginger are the main crops.

The information available states that, up to 1987, pesticide subsidies amounted to 30%, while pesticide imports were subject to a duty of 17%.

An IPM program was at an advanced stage of development on ginger as of 1987, while a similar program was planned for rice.

India

Currently, with the annual pesticide use of 68,000 tons which translates into an average use of 486 g active ingredient per ha, India's average pesticide use rate is amongst the lowest in the world.

No information on whether pesticide use is subsidized or not could be found.

The government has a long-standing policy of encouraging self-sufficiency and local production of many industrial products, including pesticides. The local production of technical grade is high which accounts for the fact that less than 10% of the country's requirement is imported.

Systems for integrated pest management on rice are the best developed and efforts are being made to extend IPM to wheat, rapeseed, mustard, cotton and sugar cane.

The government has adopted an IPM strategy as the main plank of its crop protection policy and is implementing it through few schemes, although reported not to be rigorous on cotton.

India conducts a farmers' training and demonstration IPM program on rice with the collaboration of FAO.

Concerning the extension services message, the IPM concept is kept in mind and extension agents recommend to farmers to use pesticides only when pest populations reach economic threshold levels.

Indonesia

By 1990, the pesticide market that had shrunk after the elimination of subsidies on pesticides in 1986, had expanded again. Now, pesticides are mostly used on rice, plantation crops and vegetables.

Both manufacturing and formulation of pesticides are undertaken in Indonesia. The government subsidizes domestic pesticide manufacture by extending a tariff protection at 43% for locally manufactured active ingredients.

Pesticide residue analysis is carried out and residues are monitored in rice, vegetables and milk.

In government circles there is strong support for the development and implementation of IPM.

A program for the training of farmers in, and the implementation of, IPM on rice has been established with the collaboration of FAO.

Malaysia

Pesticides still play a major role in agricultural production. The majority of pesticides are used on plantation crops, with rice accounting for the remainder.

Pesticide residue monitoring is carried out on food crops, especially vegetables and fruit.

Agronomists have always been conscious of the need for an integrated approach to pest management as monoculture of large blocks of rubber, oil palm, cocoa and rice is in practice. The choice of insecticides, for example, is often strongly influenced by IPM considerations.

With respect to pest management research, some is being carried out on IPM in vegetables.

Also, the Department of Agriculture has a program for training farmers in IPM techniques on rice. Thousands of farmers are being trained with successful results.

It is reported that, as a result of the efforts to implement better IPM practices in rice on a wide scale, farmers' understanding of pest problems and control practices has improved.

Pakistan

In Pakistan, the pesticide market has been growing since 1988 and insecticides account for the biggest proportion of crop expenses, as high as 40%, with cotton being the major pesticide user.

In recent years, subsidies for agricultural inputs have been significantly reduced (37). In the early 80s, pesticide imports were slightly favored by exemption from a minimal custom duty of 5%. Nevertheless, this was substantial when compared to the average effective import duty of 28% of cif value in 1983. A 10% sales tax applied, but waived when sales were not marked up by more than 80% (35). However, the domestic pesticide industry was at a cost disadvantage relative to importers of finished products as imports of intermediate products were subject to an import duty ranging from 20% to 30% (35).

One pesticide analysis laboratory at the Agricultural Research Institute undertakes residue monitoring.

The government is well aware of the threats posed by excessive pesticide use. To combat the threat posed by a growing pest resistance problem, systems to monitor resistance development are now being set in place by a government agency with international help.

Many individual IPM components are in practice on cotton but a cohesive IPM program has not yet been developed.

The extension service is active in promoting IPM and recommends to cotton farmers to scout their crop for pests and spray when an indicated insect threshold has been reached.

The Philippines

Over 55% of all insecticides used in the Philippines are applied on rice (36).

Pesticide retail prices are significantly affected by taxation, tariffs, import levies, and other regulatory financial instruments including exchange rates. High tariff rates apply to pesticide imports because they are not classified as essential agricultural items (10%, 5% and 10% of cif value for raw material, intermediate product and finished product, respectively, as of 1991), while pesticide sales are exempted from a sales tax (36).

Both pesticide manufacturing and formulation are carried out locally for selected pesticides. The domestic pesticide industry is protected against competition with imports of finished product by the Fertilizer and Pesticide Authority (FPA) by prohibiting imports of any product manufactured locally (as long as it is price-competitive with world market prices) to encourage local pesticide manufacture. The only FPA-protected technical material manufactured domestically is 2,4-D (36).

Pesticide residue monitoring is mainly carried out on vegetables.

In 1986, the Philippines government issued a directive to make IPM technology the core of its pest control policy in agriculture (36).

However, primary conclusions from KAP (knowledge, attitudes and practices) studies on rice farmers in the Philippines indicate that, generally, farmers cannot differentiate between pests and predators; are unskilled in using knowledge-based pest control techniques in an economically optimal

manner; and overuse pesticides and apply them at the wrong time (36).

With respect to government activities in pest management, the Philippine Rice Research Institute is active in research, extension and farmers' training in IPM (36). Also, the government, with the collaboration of FAO, is training rice farmers in IPM practices.

Sri Lanka

No information on pesticide subsidies, if any, could be found.

A laboratory for pesticide residue analysis exists, although reported not to be operational.

Regarding the pest management policy, the Registrar of pesticides is actively seeking products such as insect growth regulators to replace insecticides, that could be incorporated into IPM programs. Also, the government has restricted the importation of pyrethroids to a maximum of 1,000 l per year per product in a move to avoid the occurrence of pest resistance.

A government program in collaboration with FAO to train farmers in the concepts and practice of IPM, especially on rice, has been set in place.

Also, farmer education in appropriate pest management technology is being carried out to avoid occurrence of pesticide resistance.

Thailand

It has been argued recently that most government policies affecting pesticides still support a continued increase in pesticide use (15).

Rice accounts for 35% of pesticides used on all crops, with an estimated average amount of pesticide used per hectare of rice at about three times that per hectare of agricultural land (15).

Pesticides are a favored agricultural input commodity. The government is extending subsidies on pesticide use in a variety of mechanisms.

The taxation structure, including import duties, a standard profit rate, a business tax and a municipal tax, has been highly favorable to pesticides, keeping prices low relative to other agricultural inputs. For example, estimates of the total effective tax of agricultural pesticides prior to 1988 indicate that it was at 6.9% of cif value, while those of fertilizers (urea) and agricultural machinery were 32.4% and 27.6%, respectively. The preferential treatment is in that a) the pesticide import duty was 1/6 of that on urea and 1/4 of that on agricultural machinery, and b) the business tax was the same on pesticides and urea, but 20% of that on agricultural machinery (41).

As of 1991, pesticides are exempted from import duty, business and municipal taxes (15), which were 5.0%, 1.5% and 10.0%, respectively, prior to 1988 (41).

At least up to 1990, the pest outbreak budget was the dominant type of pesticide subsidy (41). For example, the Thai government spends $ 10 million annually as pest outbreak budget, which amounts to roughly 10% of the national pesticide market, but is a substantial share of the insecticide market as

most of the support is given to rice farmers and rice is the major user of insecticides (42). Another source (15), states that the Pest Control and Prevention Unit has an annual budget of about $ 4 million for regular purchases of pesticides and equipment to respond to farmers' requests.

The government's analytical laboratory services carry out pesticide residue monitoring.

The government is actively involved in pesticide research, whereby the vast majority (98%) of the government budget for activities related to pest management was set aside, in 1992, for chemical pesticides, leaving only 2% for activities aiming at reducing pesticide use through alternative pest control measures (22). Researchers in several government agencies regularly conduct a large research program related to pesticides each year, including residues in crops, the human body and the environment, decomposition of active ingredients in pesticides, etc. (15), which may be considered as a misallocation of resources.

The annual budget allotted to alternative pest management methods did not increase since 1990, where it was equivalent to 0.3% of the total value of pesticide imports (15), while another source (42) quotes the meager figure of $ 10,000, just 1% of the pesticide budget. However, investments in alternative pest management technology were made in the form of the establishment of a center for biological control research at Kasetsart University in Bangkok.

Also, in the past, the government endorsed a pest eradication policy and released the sizable amount of $ 20 million for the eradication of the brown plant-hopper (42). It is not known if a pest eradication policy is still in effect.

Despite the emphasis on pesticides, the government is cited to have encouraged local IPM programs on rice, fruit crops, vegetables, cotton and sugar cane and a GTZ-sponsored IPM project in fruit crops was implemented in 1989.

Western Samoa (1)

Western Samoa is largely dependent on coconuts, cocoa and taro, coconut being the major export crop until the mid 80s.

At least up to 1987, the government provided subsidies on imports of selected pesticides to end users, ranging between 33% and 50%, excluding local and international organizations.

Research in pest management was being conducted on both pesticides (dose rates and application methods) and IPM (to develop biological control programs on selected pests).

LATIN AMERICA AND THE CARIBBEAN (LAC)[6]

In general, pest control management in Latin America and the Caribbean has been heavily reliant on chemical pesticide use. In 1990, the LAC region's share of the world pesticide market (1st distributor level) was 8% of a total of $ 23.7 billion. There was no growth in LAC's pesticide market from 1989,

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[6] Drawing on reference no. 47, unless otherwise indicated

although within the region, some markets grew while others shrank as in the case of Brazil and Colombia, respectively. Nevertheless, general pesticide usage is expected to increase as agriculture develops, with herbicides in the lead. The domestic pesticide industry consists of pesticide manufacturing, formulation and repacking with many international pesticide companies having subsidiaries in LAC or operating through local affiliates.

Concerns associated with pesticide use in LAC are several and vary in magnitude from one country to the other. Environmental pollution has been very serious in the past and continues still, however, with the banning of the worst compounds the problem is decreasing.

The standards of pesticide usage vary widely. Rate cutting, using doses lower than recommended, rather than overdosing, is common among poorer farmers. Pesticides are often applied at the wrong time or too often, and farmers do not always choose the most appropriate products. It is common to spray pesticides on crops for which they are not prescribed. Also, there is a serious problem of mishandling of pesticides and failure to wear protective clothing.

Also, a significant proportion of pesticides is applied by air. This causes two serious problems. First, there is not the slightest attempt to observe good practice in the avoidance of watercourses. Second, there are very high concentrations of pesticides around airstrips, where the washings from aircraft spray tanks, etc. are allowed to run straight into the nearest stream. A further matter of concern is the presence of dumps of old pesticide drums around such sites. As a consequence, wells are reported to be heavily polluted in some areas. Moreover, the regular mishandling of pesticides is not the only source of environmental contamination, as fishermen have been reported to use pesticides to poison lake waters to catch fish and shrimp.

Pesticide residues in crops are known to be a problem, but its extent and impact are not fully identified. Some studies suggest that residues are regularly in excess of acceptable levels in a wide range of food products, especially in the case of Nicaragua, where residues are said to be of enormous proportions.

Examples of human pesticide poisoning abound. Livestock and animal pets are reported to be severely affected as well.

The build-up of pest resistance has been noted in several countries of the region. Examples include, resistance in two species of mites and scab on citrus in Brazil, in the cotton bollworm in colombia and Nicaragua, in the coddling moth, spider mite, leafhopper and fireblight on apples, and possibly in maize's weeds in Mexico, and in Jamaica.

In addition, concerns exist in relation to the low standards of local manufacture and formulation, transportation, handling, storage and disposal of pesticides. No quantitative evaluation has been done of the consequential harm caused to human welfare and the environment, but it can be assumed to be significant.

The legal framework regulating the use of pesticides varies among LAC countries. Some have established clear-cut controls and efficient regulations while others lack adequate legislation and the resources to enforce it. Norms and regulations were adopted from developed countries with little success, mainly due to inadequate or inexistent support in terms of scientific research and technological strategies. Up to the present, expanded pesticide use in Latin America and the Caribbean has not been accompanied

with adequate institutional and regulatory arrangements.

The enforcement of pesticide legislation or the control of fraudulent, dangerous or otherwise illegal activities presents considerable problems in LAC. Such illegal activities include adulteration or dilution of pesticides, false labelling and repacking into unsuitable containers. One of the worst forms of repacking takes place at retail shops, where pesticides are poured in drink bottles and sold with only the most rudimentary label or none at all. Furthermore, badly run repacking operations result in effluents from leaks and washings that cause further harm to the environment. In the present situation, fines have often been inadequate to deter illegal activities. Heavier fines are being encouraged by industry.

Price Factors

Subsidies

The subsidies were mostly indirectly provided through a variety of mechanisms such as preferential allocations of better foreign exchange rate and reduced or exempted import tariffs and domestic sales taxes. This applied to imported ready-formulated pesticides and intermediates.

Pesticides have also been subsidized through a) subsidized agricultural credit on the condition to use pesticides, b) credit debt forgiveness, c) provision of agricultural input packages by governmental rural development banks in a program of supervised credit as in Colombia and Honduras, d) distribution of free (in eradication programs, as in Colombia) or largely discounted pesticides for export crops as in Honduras. The examples of Colombia, Ecuador and Honduras (below) show how large the compounded magnitude of these indirect subsidies could be.

Although there are strong indications to the effect that pesticide subsidies are mostly benefiting larger growers and distributors, little analysis has been done on the consequences of pesticide subsidies, or of alternative policies to promote pest management. In reality, substantial development revenues are being foregone for dubious benefits or, in other words, government's funds spent as direct and indirect subsidies on pesticides could have been better spent elsewhere. Recently, some LAC countries such as Chile, Ecuador and Mexico, as a matter of economic policy to reduce spending and budget deficits, are phasing out all subsidies in general[7]. This will undoubtedly cause a reduction in pesticide availability and use.

Mitigation measures

Several LAC countries operate poison centers to monitor and treat all cases of poisoning, including pesticide poisonings.

Monitoring of residues is carried out in governmental or privately owned laboratories mainly on export agricultural products.

Disposal of empty pesticide containers is inadequate. The local pesticide industry is currently developing programs for the collection, reuse, recycling and destruction of pesticide containers.

7/ Plaza, Cezar. 1993. Personal communication. LAC Technical Environment Division, the World Bank, Washington, DC, USA

Non-price Factors

IPM issues

Until now, IPM has not been adequately promoted and the principle of spraying pesticides on economic loss thresholds (ETL) is not widely practiced even among the more sophisticated farmers.

Erroneous pest management policy

The pest eradication concept has often been applied.

Information to farmers

National extension services are often limited in the remote rural areas. As a result, pesticide users rely heavily on pesticide retailers for information, which, in any case, needs to be improved in the area of safe and effective pesticide use.

Extension and farmer's training

Farmer education and training, the principal approach to achieve better pest management practices is lacking or deficient. In reality, more emphasis is put on safe and effective pesticide use rather than judicious pesticide use and IPM techniques. However, there is an increased awareness of the need for training on the latter two topics and the International Group of National Associations of Manufacturers of Agrochemical Products (GIFAP) has started financing farmer training in both.

Country Information

Brazil

In 1991, the pesticide market shrank as compared to 1990 mainly due to high interest rates with a consequent reductions in investments, and to poor credit availability. Nevertheless, growth in pesticide usage is expected to average 3-5% per year over the coming five years.

The majority of pesticide usage, especially herbicides, is on cash crops for exports such as soybeans, fruits and vegetables.

Pesticide use has always been subsidized but, following a recent government decision, the import tariffs that were in effect until recently were reduced. The new tariffs could go from 0% to 20% on cif value, while previously, they ranged from 30% to 40%.

Government also puts price controls on the pesticide retail market to ensure that subsidies are passed through to farmers. Thus, the reseller's price is set at a maximum of 35% above the 1st distributor's price. However, a significant proportion of sales is not marked up as high to encourage sales and in practice, the end-user market value is around 14-15% above the 1st distributor level.

The domestic pesticide industry benefits from several subsidies as well, such as generous tax and credit incentives, cheap labor and few pollution control requirements. All the major multinational agrochemical companies now have manufacturing facilities in Brazil, where a total of 50 pesticides are

produced locally. Although the reduction of import tariffs has suspended many developments in local production it may not have affected total pesticide use.

Brazil has 26 poison centers to monitor and treat all cases of poisoning, including those that are pesticide-induced.

IPM is emphasized in the research programs for cotton and is in practice in soybean cultivation, whereby pest populations are monitored and biological and selective insecticides are used. Much effort is put into breeding cotton varieties with multiple disease-resistance/tolerance and a pest management program has been developed, relying on better crop management practices and the spraying of pesticides on thresholds. However, as in many other countries, the poorer cotton farmers pay little attention to such pest management programs and are still heavily dependant on pesticides.

Chile

Following changes in national agricultural strategies in 1983, there was a considerable increase in pesticide use in Chile. Pesticide use became extensive in 1987-88, especially on export fruits, until the grape crisis (cyanide-contaminated shipment to the US) in 1989 led to a major shift in attitude and awareness which, in turn, led to a more rational use of pesticides. Partly due to that, pesticide use did not increase significantly in the early 90s, although important shifts in the pesticide market composition occurred, e.g. herbicide use increased significantly due to rising labor costs.

Thus, pest management tends to be largely based on pesticides, except for export crops such as grapes and other fruits where there is need to keep pesticide residues at levels acceptable to foreign markets.

The government supports research on IPM for export crops and invests rightly in efforts to preserve beneficial and predatory insects and mites, and a quarantine effort to control the movement of a pest found in the North of Chile and Argentina. As to other crops, IPM was developed on wheat but is not widely practiced.

Local NGOs have developed training programs in the safe use, disposal, handling, transportation and storage of pesticides at the distributor and farmer levels. Also, the Chilean Exporters Association compiles an annual product manual on pre-harvest intervals and residue thresholds in the main countries that import chilean produce, though it is not mentioned to what extent this is made available to farmers.

Colombia

The pesticide market has shrunk by 3% in the early 90s partly due, it is said, to the wider acceptance of IPM which has begun to impinge on pesticides sales. Nevertheless, growth is expected to continue in the foreseeable future. Rice, cotton and vegetables are among the heaviest users of pesticides.

Most of the information on pesticide subsidies dates to the mid-80s (35).

At least up to the mid-80s, Colombia maintained a general policy of subsidizing agricultural inputs, including pesticides. Pesticide use benefited from several forms of subsidization such as preferential access to favorable foreign exchange rates, way reduced import tariffs and, in some instances, tariff rebates, and sales tax exemptions (35).

In 1983, the average effective parallel rate of foreign exchange stood 50% over the rate which pesticide importers paid. That year, pesticide imports exceeded $ 60 million and the preferential treatment represented a considerable implicit subsidy. As to tariffs, pesticide imports were subjected to a rate of 1.0 to 1.25%, while the average effective tariff rate was 26% for other commodities in 1982 and has since risen to 42%. Moreover, farmers who imported over $ 2 million in pesticides directly each year, as in the case of large growers of coffee and other export crops, were eligible for duty rebates under Plan Vallejo. Their tariff payments were refunded when their crop was exported. In reality, the combined effect of the preferential access to foreign exchange and favorable tariff treatment, implied about 50% reduction on the market price that farmers had to pay. In addition, pesticides were exempt from Colombia's sales tax which averaged about 6% across all commercial commodities (35).

With regard to distribution of pesticides, the importance of private commercial channels had increased, mostly at the expense of Caja Agraria, a government rural development bank that provided agricultural input packages in a program of supervised credit. By 1983, the share of private distributors of pesticide sales had risen to 60% while that of Caja Agraria had fallen to 10%. Farmers' associations, e.g. coffee and rice growers, also provided agricultural inputs at marginally lower prices than private distributors, made possible by their profits on crop marketing as they provided marketing and other services for their members (35).

The government imposed wholesale and retail price controls on pesticide sales, in an attempt to ensure that the price benefits pass through to farmers and to limit the inflation of trading margins. Apparently, price controls were well enforced (35).

At present, domestic pesticide manufacture and formulation has largely replaced imports of finished products in response to the export incentives and internal price controls provided and set by the government to encourage exports of locally produced agricultural chemicals.

In the mid and late 80s, when outbreaks of the coffee rust disease occurred, the Coffee Authority distributed free fungicides to farmers and trained them in their use. This subsidy was removed in 1990 and fungicides use plummeted to a mere 12% of what it was in 1989. The provision of free pesticides was made in the context of a pest eradication policy.

Some research is being carried out on IPM. The national rice program includes resistance to insects and diseases among the objectives of its breeding program. A good IPM program has been developed for cotton although the degree of its adoption varies greatly. And much progress has been also made in IPM on soybean.

The authorities and producers are keenly aware of the need to keep pesticide residues at acceptable levels in export products, thus, to use pesticides more judiciously or even adopt alternative pest management techniques.

The large multinational pesticide companies have farmer training programs for the safe and effective use of pesticides.

Costa Rica

Pest control in Costa Rica is heavily dependant on pesticides, with very little integration of other pest control methods. Tobacco and papaya production rely almost exclusively on pesticides, and

herbicides are the highest used pesticides on all major crops, i.e. coffee, papaya, mango, cocoa, tobacco and plantain.

The government provides indirect subsidies to end-users and local pesticide industry by exempting pesticide finished products and intermediates from import duties. Only a 0.5% cif levy is charged for servicing the import applications and monitoring the regulations.

Agricultural credit is extended to farmers on the condition that they use specific types and amounts of pesticides set by the banks' credit officials. In 1988, it was required that an average of 48% of the total expenses on agricultural production materials be spent on pesticides. The range was from 21% in corn to 76% in cotton (38).

Several government laboratories are engaged in residue analysis on export crops. A new laboratory will be set up for residue analysis on crops for the domestic market.

There is hardly any national strategy for IPM. In fact, basic data and infrastructure needed for IPM research and adoption are lacking, particularly in the field of biological control and use of disease-resistant varieties. The Ministry of Agriculture (MAG) has no IPM research program on its own.

In relation to training in pest management, foreign aid (GTZ) is being channeled to the Extension Service of MAG's Plant Protection Department to promote IPM.

As to extension, farmers depend mainly on MAG's extension officers. Training programs were developed on IPM, alternative methods, and the judicious use of pesticides.

Ecuador

Pesticide use in Ecuador is relatively low compared to other LAC countries, whereby, for example, it is half (by value) that of Costa Rica's which has a cropped area covering 10% of that in Ecuador.

Maize followed by coffee, cocoa and rice are the main crops grown, however, maize, rice, banana, soybean, potato and horticultural crops are the major users of pesticides.

Import data for the past 10 years does not indicate dramatic increases in pesticide use parallel to the increases in crop production. Imports have fluctuated, with no steady trend, as a result of changes in exchange rates and other economic factors.

The most detailed information on pesticide subsidies dates to the mid-80s (35), whereby, pesticide subsidies were provided through preferential foreign exchange rates, reduced import tariffs and sales tax exemptions.

In the early 80s, the subsidy provided through a better exchange rate applied to pesticide imports (lower than the market rate by 32%), amounted to about $ 10 million per year. That resulting from reduced tariffs represented a government revenue loss of $ 12.5 million per year, as pesticides' tariffs were 5% nominally but 1.75% effectively of their cif value, compared with tariffs on other goods ranging from 3% for agricultural machinery to 300% for consumer durables, the weighted average tariff being

53% as of 1981. Tax exemptions resulted in sales tax on pesticides of around 2% when the nominal tax was 5% (35).

The government operated a set of price controls to ensure that the price benefits are passed through, at the retail level, to farmers. The Ministry of Agriculture allowed for 30% mark-up on cif value plus transport and administrative costs. However, the actual premia on official prices ranged, in 1984, from 10 to 102%. Thus, larger farmers and farmers' associations who could import pesticides directly, captured the benefits of government subsidies, while small farmers, who bought from commercial dealers, paid relatively high retail prices and the dealers absorbed the subsidies. In fact, the larger pesticide users enjoyed a low price while higher prices depressed pesticide use among small farmers (35).

Here, it should be mentioned that, per more recent information, an import duty of 3% to 5% cif value applies to pesticides, and importers and distributors are limited to a mark-up not to exceed 30% of cif value. The same source mentions that there are no direct subsidies provided on pesticide use (47).

As to foreign aid, USAID provided financial support of $ 3 million in 1983 to agricultural associations involved in pesticide distribution for the direct importation of pesticides. There is no information on whether these pesticides were given free or sold to farmers (35).

The Ministry of Agriculture operates a laboratory for pesticide analysis.

Only fragmented crop-specific IPM research has been undertaken until now.

It is reported that there is a general awareness, both in the public and private sectors, to promote safe and sound use of pesticides. And it is interesting to note that the pesticide legislation, in one clause, encourages the consideration of alternative pest control measures.

Honduras

The most detailed information on Honduras dates to 1985 (35). There is no indication as to whether changes have occurred and in which direction.

Up to 1985, pesticide use in Honduras was relatively heavy: insecticides use averaged 3 kg/ha of cropped area in 1983, very close to the US figure. Pesticide imports increased by about 25% in 1983 over imports in 1979. The majority of pesticides are used on large plantations of export crops (35).

The government of Honduras offered subsidies to pesticide importers, suppliers and users through a variety of mechanisms and pesticides were included in the most favored category of imports (35).

The variety of mechanisms in which subsidies were provided for pesticide use could be summarized as follows: a) foreign exchange allocations at a favorable exchange rate for pesticide imports (about 1/4th less than the market rate), b) protecting pesticides against the ever increasing import duties (to reduce import demands in general) by allowing pesticides import duties to rise from 8 to 13.6%, in 1980 and 1984 respectively, while for other commodities, the weighted average tariff rose from 33 to over 60%, c) exemption from sales tax with an average effective rate of 6%, d) through pesticides credit, although more through widespread debt forgiveness than preferential interest rates (assuming that most of the arrears represent loan defaults, and applying an average share of 8% of agricultural loans for purchase of pesticides, the subsidy conveyed through credit losses amounted to almost 10% of the actual

retail cost of pesticides), e) giving or selling pesticides to farmers at below-market price by various government agencies (35).

Government agencies such as IHCAFE, a government agency that provides technical services and credit to coffee growers was selling pesticides at below-market prices. When this function was transferred to APROCAFE, a private institution of coffee farmers, in 1984 a government donation of $ 0.4 million was made to supply its working capital, representing a further pesticide subsidy. The Ministry of Natural Resources disbursed $ 2.2 million worth of free pesticides to banana growers in 1979-83, partly coming from a loan made to it. In similar programs, the same ministry gave pesticides or sold them at large discounts to small bean and coffee growers (35).

However, a large share of the subsidies did not translate to lower farmgate prices due to distribution markups, and thus, their impact was somewhat smaller than the magnitudes imply (35).

Jamaica

Most pesticides are used on traditional export crops such as sugar cane, banana, coffee and citrus.

The government provides an indirect subsidy by not charging import duties on pesticides as compared to an import duty of around 30% cif value on other industrial chemicals. Only a small fixed fee is charged for registration and issuance of import permits. However, the government does not facilitate access to pesticide-related hardware, such as spraying equipment, by lending programs to farmers.

The infrastructure for research on IPM exists and work on alternative pest control methods is being carried out. It is reported that there is little appreciation for IPM by farmers, regardless of their educational background or farm size. However, some biological control and mechanical weeding is passively and inadvertently practiced by poor farmers.

Most of the information on the usage of pesticides is passed on by fellow farmers (75% of the cases). Occasionally, salesmen with visiting trainers sent by multinationals conduct farmers' training for few hours, in collaboration with the area's extension officers. This induces more pesticide use as compared to a situation where proper and unbiased guidance is given to farmers.

Nicaragua

Nicaragua is one of the main users of pesticides in LAC and pest control is based almost exclusively on a chemical approach. Farmers practice a traditional indiscriminate use of pesticides and tend to use the most toxic insecticides available at the highest dose and frequency, influenced by the commercial advertisement of pesticides.

The main crops on which pesticides are used are cotton, coffee, maize and rice.

The general impression is that government does not subsidizes pesticide use. In fact it is interesting to note that excessive pesticide use is hindered by high market retail prices as a result of high importation costs.

The local pesticide industry focuses on formulation and repacking activities for cotton. All other

crops needs in pesticides are imported ready-to-use. Infrastructural limitations prevent the formulation of good quality pesticides (lack of local good quality adjuvants, containers and spare parts which have to be imported at high costs, and for which, the government does not seem to provide any price relief).

Pesticide analytical equipment is available through a contribution from foreign aid.

The serious problem of pesticide poisoning and ensuing fatalities in Nicaragua has prompted the initiation and implementation of a "Pesticide Health and Safety Program" aiming at researching pesticide application methods to reduce health risks and monitoring of farmers' health problems, primarily, in one cotton-growing area of Nicaragua, where pesticide use is heaviest. Several funding sources were involved, in particular, the government foreign aid programs (27). The Ministry of Health in cooperation with the Ministry of Labor maintains a program for the monitoring and prevention of such poisonings.

It is reported that old and probably unusable stocks of pesticides are kept in stores around the country. The only documented case is that of a government store maintaining about 2.5 t of DDT. However, no proper campaign for an adequate disposal of pesticides is undertaken.

In few instances, alternative pest management activities are carried out such as the release of natural predators (on 15% of the cotton area), the limited use of bacterial pesticide in cotton, different planting dates for maize, and disease-resistant varieties in cotton and rice.

Farmers' training in the safe and efficient use of pesticides is lacking. No training and extension on alternative pest management technology, such as IPM, is reported.

THE MIDDLE EAST AND NORTH AFRICA

Egypt

In Egypt, cotton is the major user of pesticides, whereby, 70% of all pesticides used are cotton-specific (6). Pesticide registration is reported to be handled professionally. However, inadequate monitoring of the proper use of the chemicals once they are registered is reported (23).

Subsidized pricing of major agricultural inputs has been a part of Egypt's overall agricultural development strategy (23). But the intention of the government, as of 1992, was to completely phase out most agricultural subsidies by 1993. Pesticide subsidies are reported to have been reduced and pesticide prices have been increased to end-users (6).

In the past (at least up to the mid-80s) (35), the government interfered heavily with markets and prices through taxes, price controls, rationing, subsidies, etc. A total subsidy amounting to 83% of the full economic price of pesticides was made available.

For example, the allocation of foreign exchange at a preferential rate was a substantial indirect subsidy, implying an implicit subsidy of 30% on pesticide imports. Pesticides were also exempt from import duties (an effective average of 17%) and from a sales tax that averaged 5% (35).

Also, the Ministry of Agriculture used to spray pesticides directly onto farmers' fields to protect the main crops. Farmers were charged 50% of the government costs of pesticide applications, up to a pre-defined ceiling. The subsidy was actually higher than 50%, because the Ministry of Agriculture costs

understated the true costs to the economy.

Moreover, the government-controlled cooperatives were the sole distributors of agricultural inputs, including pesticides, and credit. Farmers were charged an interest of 8-9% for delayed payments on their credit arrears, while the minimum market for rural credit was 14-15%. These policies further lowered the effective costs of pesticides to farmers (35).

The government operates a pesticide analysis laboratory. However, no factual control of pesticide usage or residues existed in 1990, on agricultural crops, whether destined for domestic consumption or export (23).

Development of IPM programs for all crops and biological control measures are often-cited goals, yet funds in each area are extremely limited (23). IPM on cotton was successfully developed since the mid-80s (35).

Iran (46)

Various aspects of pesticide use are regulated and controlled by different governmental agencies, such as the Pesticide Advisory Board, which approves the list of permitted pesticides. PDRI is responsible for research on, and testing of, new products, and the Plant Protection Organization is responsible for public interventions to control pests, for controlling imports, local formulation and distribution of pesticides.

The government subsidizes pesticides in different ways, including a) the setting of very low price controls in the pesticide retail market by the Producers and Consumers Protection Organization, and b) the provision of subsidized services for crop spraying and common pest control (including locusts) by the governmental Special Aviation Services Company (SASC), which operates on a cost recovery basis. In 1992, SASC lost Rls 100 million, on a turnover of Rls 1.5 billion, which was made up by a subsidy from the Ministry of Agriculture.

It is understood that the government intends to free prices of pesticides and to remove all subsidies during 1993.

Iran has facilities for pesticide residue analysis.

IPM is still at an embryonic stage. The Pests and Diseases Research Institute (PDRI) is reported to have a research program on IPM, however, little is being promoted yet in the field by the extension service.

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Paper Number 238

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