

Session 1

Introduction

PLANT PROTECTION IN THE DEVELOPING WORLD: PROBLEMS AND NEEDS.
LESSONS FROM ZANZIBAR

M.N. MARSHED-KHARUSY

Plant Protection Division, Ministry of Agriculture, Livestock and Natural Resources, P.O.
Box 1062, Zanzibar, Tanzania

ABSTRACT

Zanzibar is an example of a less-developed country facing a number of issues that affect plant protection. These are the pests and diseases themselves, problems at the farmer level (such as lack of cash, land tenure), traditional resistance to new approaches in plant protection, weak institutions including the quarantine services, and problems of policy formulation. Measures to be taken in order to improve the situation include developing and devising crop protection strategies based on farmers' needs, strengthening institutions, and developing sound policies.

INTRODUCTION

Zanzibar, which is part of Tanzania, consists of two major islands, Unguja and Pemba, and a number of small, sparsely populated islands. The two major islands have an area of 1658 and 985 km², respectively. They lie between 4° and 6° south, 39° east, 40 km (Unguja) and 60 km (Pemba) off the coast of mainland Tanzania. The climate is warm (mean annual temperature of 27°C) and humid (mean humidity of 76-78%), with four seasons, each about 3 months. The average annual rainfall is higher in Pemba (1800 mm) than Unguja (1400 mm). The islands are inhabited by about 800,000 people.

The economy of Zanzibar depends largely on agriculture, which contributes over 70% of the gross domestic product (GDP). More than 90% of the total foreign exchange earnings come from this sector. About 80% of the population depend on agriculture, either directly or indirectly (Wirth *et al.*, 1988). Taking Zanzibar as an example of a less-developed country with limited resources and few qualified personnel, several problems are encountered in developing plant protection strategies. These are both technical and institutional, while sometimes even political interference results in poor execution of recommended activities. Some of the problems encountered are discussed below.

The Agriculture and Livestock policy of 1984 (Ministry of Agriculture and Livestock Development, 1984) states that "The Zanzibar economy will continue to depend on clove industry for many years to come". It is true that Zanzibar still depends on cloves, but low demand for the crop and poor prices have crippled the economy of the islands (Robbins, 1987). However food imports (rice, wheat flour, sugar) have been steadily increasing (FAO/IFAD, 1987). Therefore the government of Zanzibar has had to shift its emphasis from the development of government parastatals and cooperative farms towards encouraging small-holder production. Measures are being taken to diversify the clove-dependent economy by introducing other cash crops, and to promote tourism.

The farming area is mainly divided into three ecological zones, the plantation area (high rainfall) with tree crops like cloves, coconuts and other food crops; coral rag area (low rainfall) with crops like maize, sorghum and pigeon pea; and lowland (valleys) mainly growing rice. In Zanzibar, as in many developing countries, agriculture is at the subsistence level. Farmers own small plots of 0.5-3 hectares. With the exception of few crops like rice, most crops are intercropped, with mixed farming.

PROBLEMS IN PLANT PROTECTION

Pests and diseases

Zanzibar is a typical tropical island with a warm and humid climate which is much favoured by pests and plant pathogens. At any time of the year, different crops can be found in the field, and therefore hosts are present continuously. A typical example is that of the rice hispa beetle (*Trichispa* spp). This beetle was not a pest of any significance a few years ago, but soon after the development of irrigation in the rice valleys in Pemba, farmers started cultivating two crops per year. Within five years, hispa has become a serious pest causing extensive problems in rice, both directly as a damaging pest, and as a vector of rice yellow mottle virus.

Several other pests cause serious damage, although no thorough yield-loss assessment has been carried out on any crop. Usually it is the farmers who sound the alarm before any action is taken. From the farming systems studies carried out by the Zanzibar Cash Crops Farming Systems Project (ZCCFSP) and the Plant Protection Division (PPD), the major pests and diseases identified are shown in Table 1.

Problems at the farmer level

Farming in Zanzibar is typically subsistence, with little produce left over for sale, hence farmers lack cash to buy inputs or hire labour for farming activities (Wirth *et al.*, 1988). Credit facilities are not available to them. Production is low due to low inputs, poor soil fertility, poor agricultural practices and lack of access to information on good farming practices.

When there is any outbreak of pests and diseases, farmers become alarmed because their means of survival is threatened. The knowledge that pesticides may be made available by the government free of charge has made farmers reluctant to take any action at an early stage, and has encouraged dependence on the extension service as the provider of pesticides rather than advice on pest management.

Land ownership has also been a serious handicap to the practice of any long-term preventative or control measures. In theory the government owns all the land. This is especially important on rice lands, where the government insists on rice cultivation being maintained. Without ownership rights to the land, the farmer cannot invest in improved soil fertility measures or practise control measures such as fallow, crop rotation etc., for fear of losing that piece of land.

TABLE 1. Major pests and diseases of principal crops in Zanzibar.

Crop	Major problem and causal organism	Extent of damage and control
Cash crops		
Cloves	Sudden death disease Mycoplasma-like organisms (MLOs)	Can kill trees rapidly within a short period. No effective control measures at present (Campbell, 1940; Dabek <i>et al.</i> , 1985; Martin, 1989).
	Acute dieback (fungal disease) <i>Cryphonectria cubensis</i>	A disease related to physical damage. Almost all trees are infected. Pruning has not been an effective control measure (Martin, 1989).
	Termites <i>Macrotermes subhyalinus</i>	Becoming serious even to other tree and forest crops (Martin, 1989; Marshed <i>et al.</i> , 1993).
	Rhinoceros beetle <i>Oryctes monocerous</i>	Serious to dwarf cultivars. Biological control tried but not successful for small-scale farmers (Van Huis, 1991).
Coconuts	Coconut bug <i>Pseudotheraptus wayi</i>	Very serious, may cause up to 100% losses. Biological control by <i>Oecophylla longinoda</i> shows more potential than chemical control (Way, 1953; Brown, 1955; Oswald, 1985, 1988).
	Wilting disorder (cause unknown)	Yellowing and eventual death of the plant. Association with pathogens not confirmed (Black, 1991).
Food crops		
Rice	Black beetle <i>Heteronychus</i> spp	Serious on localised rainfed areas. Losses up to 100%. Research in progress (Van der Weel, 1992; Marshed, 1993a).
	Rice hispa beetle <i>Trichispa sericea</i> and rice yellow mottle virus	Serious in irrigated rice in Pemba island. IPM is now being tested (Van Keulen <i>et al.</i> , 1993).
	Armyworm <i>Spodoptera exempta</i>	Sporadic but can be very serious. Mainly on rice. Chemical control available but not economical.
	Edible grasshopper <i>Homorocoryphus nitidulus</i>	Sporadic but serious to rice, millet and sorghum. No effective control measures (Marshed, 1993b).
Cassava	Cassava mealybug <i>Phenacoccus manihoti</i>	Serious when first introduced to Zanzibar. Biological control has been more effective on Unguja than Pemba island.
	Cassava mosaic virus and green spider mite <i>Mononychellus tanajoa</i>	Very serious. Losses up to 90%. No effective control measures (Begg & Makame, 1983).
Banana	Black Sigatoka <i>Mycosphaerella fijiensis</i>	Very serious. No loss assessment done but drastic national decline in production.
Cowpeas	Aphids Pod borers and others	Serious. No loss assessment. Research in progress.
Maize	Stem borers	Losses up to 30%. Chemical control available but not suitable (van Keulen, 1990).

Approaches in plant protection

For many years the Ministry of Agriculture imported pesticides with little knowledge of their uses. Due to lack of qualified staff, recommendations were made in a haphazard

manner, without proper evaluation of the problem. The solution to any pest or disease problem was considered to be pesticide application. Furthermore, it was the Ministry's responsibility to provide farmers with sprayers and workers to do the spraying. The pesticides were sold at a subsidised rate, or sometimes given free of charge, hence farmers could apply any amount they wished to.

More recently, with the inception of a number of agricultural development projects, including a Dutch project to strengthen the Plant Protection Division of Zanzibar, this approach is gradually changing. Farmers now have access to diagnostic services, research and extension, and the concept of integrated pest management (IPM) has been introduced. However, there are initial problems, such as poor collaboration (research and extension are discipline-oriented), conventional approaches to research (researchers and extensionists dictate the programmes) and inadequate coordination of activities.

Although there are no restrictions on the importation of pesticides by external agencies, very few of them do so because they cannot compete with the subsidised pesticides provided by the government. Also, it must be noted that in Zanzibar there is no legislation governing the importation, distribution and use of pesticides. (This is not so for the rest of the East African countries.)

Only the PPD and a few donor-funded projects can afford to provide protective gear to their workers, and generally no safety procedures are carried out by farmers. After the application of pesticides, the remainder is poured into river and stream water when cleaning the equipment. The same water is used by farmers for domestic purposes including bathing.

Institutional weaknesses

There is a shortage of qualified specialist staff to carry out coordinated research and extension activities. Funds for higher level training mainly depend on foreign donors. There is also little access to outside information from journals and bulletins due to a lack of local funds and external contacts. Up-to-date information is only available through the donor-funded projects, and when the donor leaves no further funding is provided by the government. Many less-developed countries have not yet ranked plant protection problems in terms of priorities; so that the limited resources available may be used on unnecessary research and other activities.

Quarantine threats

A lack of facilities for producing disease-free planting material also hampers the development of proper control measures. Therefore, there is pressure to use exotic planting material. The Zanzibar islands have a number of unofficial entry points and people can bring any plant material into the country without being noticed. There are no boats patrolling the coast of the islands, and therefore a number of inhabitants move between the islands, the Tanzania mainland and Kenya by canoes and dhows, and bring in planting materials illegally. Cassava mealybug, which entered the country on planting material, was introduced in this way. The pest was identified when it had already spread to many parts of the island and caused extensive damage. It has now become an established pest.

Politicians, scientists and influential businessmen have also been involved in bringing infected plant materials into the country in good faith, with the intention of helping farmers but with detrimental consequences, as these materials do not go through the local quarantine procedures.

Due to several weaknesses of quarantine in Zanzibar, the country is threatened by many pests and diseases from outside. Pests like the larger grain borer *Prostephanus truncatus* (Horn), and lethal yellowing of coconuts, are present in the Tanzania mainland and could be introduced into the islands. Pests and diseases of rice, legumes and root and tuber crops from South-East Asia and West Africa are also likely to be introduced, as well as pests and diseases of the proposed new cash crops for Zanzibar from different parts of the world, if proper quarantine measures are not followed.

Policy issues

Zanzibar's first agricultural policy was developed in 1984 and took almost three years to receive final approval (Ministry of Agriculture and Livestock Development, Zanzibar, 1984). Most of those who formulated the policy had little experience and hence quite a number of issues were omitted, for example the environmental hazards due to the importation of large quantities of pesticides. The policy was also overambitious and a number of goals could not be realised before its revision in 1991 (Ministry of Agriculture and Livestock Development, 1991).

No consideration was given to the government's financial ability to implement the activities listed in the policy. The question of sustainability of different projects, notably plant protection, was not discussed. Usually the budget allocation from the government for plant protection activities is very small; a large part of the funding comes from donors. When donor funds terminate, most of the activities will stop as well.

The plant protection legislation of 1939 (revised in 1965) which is now in use is old and outdated, and many developments have taken place since then. For example, no consideration is given to issues such as tissue culture and the importation of biological control agents.

CURRENT NEEDS IN PLANT PROTECTION

Based on the above-mentioned problems, there is a need to try to rectify the situation at different levels, as indicated below.

Needs at farmer level

- Formal and informal adult education to enable farmers to read and write, and thus improve the farmers' understanding of extension messages on different aspects of crop husbandry.
- Use of a participatory farming systems approach in problem identification and solution. This will create mutual understanding between researchers, extensionists and farmers.

There will be judicious use of the available resources and the research outcome will be acceptable to farmers.

- Implementation of the principles of IPM at farmer level. This includes training farmers in recognising and quantifying pests, diseases and natural enemies, so they can take their own appropriate pest management measures. The IPM approach is economic, sustainable and appropriate for subsistence farming.
- Provision of credit to farmers, giving them the opportunity to implement plant protection recommendations in the correct way. This will also help the government to implement a policy of removing subsidies and ceasing to provide free services, as it has been clearly shown that the government can no longer afford to do so. Removing all subsidies on pesticides is a first necessary step.

Strengthening of institutions

- Setting priorities for researchers, based on the level and importance of particular problems.
- Training of local staff at different levels according to need is one of the important factors when considering the question of sustainability of any programme. Although different donor-funded projects have trained a substantial number of local staff at Diploma, BSc and MSc levels, further training is still required at higher levels even to PhD in order to have more specialised staff. This is in accordance with government policy.
- Technical advice and short consultancies on specific issues such as IPM are required. The emphasis should be on exchange of ideas to enable local staff to gain experience and to execute activities independently.
- Easier contact with external institutions will provide local institutions with access to useful information concerning plant protection. It is necessary to take advantage of recent developments in information technology.
- Improving the operation of plant quarantine services (together with necessary policy support).
- An interdisciplinary approach in solving plant protection problems is cheaper, more economic and effective.

Development of sound policy

- The plant protection organisation must have a clearly defined policy and objectives. This policy should be able to influence the national policy whenever appropriate. Development projects must be in a position to advise on policy amendment whenever necessary.
- Plant protection legislation must be updated in conformity with existing technological developments.

- Advisory and coordinating bodies should be established to deal with matters concerning plant protection.

CONCLUSIONS

In order to provide sustainable and effective plant protection services, it is necessary to train both farmers and local staff, to follow an IPM approach, and to have sufficient local funds available to run day-to-day activities by providing credit to farmers.

There are no ready-made IPM packages for Zanzibar and other less-developed countries, and the use of high-input agriculture is not suitable. This poses a real challenge to local scientists to develop appropriate IPM packages that are in accordance with the existing farming systems.

In pursuing appropriate technologies for less-developed countries the question arises whether efforts should be concentrated on low-input agriculture, or on high-production agriculture sustained by considerable external inputs. Pulling subsistence farmers into a market economy is a major task in itself.

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PEST MANAGEMENT POLICIES IN LESS-DEVELOPED COUNTRIES

J.D. MUMFORD and J.M. STONEHOUSE

Imperial College Centre for Environmental Technology, Imperial College at Silwood Park,
Ascot, Berkshire SL5 7PY, UK

ABSTRACT

All bodies responsible for social goals (governments, development donors, non-governmental organisations, etc.) need to establish policies by which they can achieve their goals. Problems associated with pests and pest management are of broad concern to society, and therefore warrant policy actions. However, there are several problems in developing pest and pest management policies. It is particularly difficult for groups within developing societies to agree on what their concerns and objectives are, and it is difficult to determine the best compromise policy to achieve the disparate goals of farmers, consumers, industrialists and others with an interest in pest management. The problem is further exacerbated by the imposition of policies on less-developed countries by outsiders who may act out of genuine concern for the environmental wellbeing of these countries, but who do not place the same values on present risk and future costs. It is important to develop baseline information on pest management practices and their impacts so that the consequences of pest management policies in less-developed countries can be evaluated in the future.

INTRODUCTION

Policies about pests and pest management form a small part of the overall responsibilities of governments and international institutions, yet they generate a substantial amount of discussion and agitation. Many deaths, billions of dollars, the preservation of our basic food supply and public health and the overall quality of the environment are at stake. It is not surprising that the subject is taken so seriously, but it may at first glance seem odd that there is so little agreement about what ought to be done and who should do it. This paper firstly discusses why governments are appropriate bodies to deal with pest management policies, then considers the options available to them, and finally suggests some implications for the future.

The existence of government is something that most people all over the world simply take for granted. Yet any discussion of the policy options of government may do well to begin by considering exactly why we have governments -- in general, what are they for? Ideally, a government is no more than a tool with a social purpose. Just as, say, a stock market is a tool for providing commerce with access to private capital, a government is a tool to allow society to regulate its affairs. Its core function is the provision of security, be it economic, legal, environmental, social, health, police or military. It is fitted to these functions because it is the best level of organization to control externalities. Externalities arise when the costs and benefits to the agent of a particular action are not the same as those to society at large. This imbalance may work either way. For example if a private trading

company were to raise a navy to protect its vessels from pirates, other merchant ships would enjoy some protection from it without having contributed to it, as "free riders": the private benefits are less than the social ones. On the other hand, if an industrial company pollutes the surrounding air or water, society bears costs greater than those of the company itself. Governments are a good way to organize activities to bring these differentials into line -- the suppression of piracy and the restraint of pollution are generally carried out by governments.

It follows that governments inevitably seek to control the behaviour of individuals. As this is understandably resented by the individuals concerned, government activity by its nature invites resistance, and societies generally are engaged in a perpetual debate over the relative pros and cons of a specific level of government control, as strong arguments for and against the powers of individuals enforce a fluid and shifting balance, with resulting compromises. This paradoxical property of government was well expressed by one of the first and greatest men to consider the question of what governments are for:

"Some writers have so confounded society with government, as to leave little or no distinction between them; whereas they are not only different, but have different origins. Society is produced by our wants, and government by our wickedness; the former promotes our happiness positively by uniting our affections, the latter negatively by restraining our vices. The one encourages intercourse, the other creates distinctions. The first is a patron, the last a punisher.

Society in every state is a blessing, but government even in its best state is but a necessary evil.... Government, like dress, is the badge of lost innocence; the palaces of kings are built on the ruins of the bowers of paradise.... Here then is the origin and rise of government; namely, a mode rendered necessary by the inability of moral virtue to govern the world...." (Paine, 1776).

Some may argue, however, that the control of pesticides, unique chemicals introduced into the environment specifically to kill organisms, is so crucial because of its implications for health and conservation of the environment, that it is not a suitable subject for the level of compromise inherent in much government policy formulation.

OBJECTIVES

The use of pesticides and agrochemicals is not the only source of concern within crop protection. There may be worries about the impact of plant breeding (Berry, 1990) and even biocontrol (for instance, legal action by environmentalists concerned with damage to non-target organisms, seen in the release of viruses at Oxford in 1994 for example, as recounted in almost all British newspapers daily during June, 1994). However, this paper concentrates mainly on the issues involved in pesticide management and policy.

In the field of pest management policy there are three major influence groups at work in the formation of policy.

- The public. The public has at least two interests in pest management policy. (a) It consumes the products which pest management protects, generally requiring that these products (most obviously food) be in sufficient supply and as cheap as possible. (b) It

is also potentially exposed to the detrimental consequences of injudicious pest management -- particularly to pesticide residues in foods and the environment. In consequence, the public's requirement tends to be for reliable pest control, largely entailing pesticide use, tempered with strict controls to limit damaging use. (It is necessary, however, to distinguish the primary requirements in developed and less-developed countries.)

- Farmers. Like the public, farmers tend to have two different and not wholly compatible interests. (a) To protect their profits and livelihoods, farmers require pest control which is as effective and sustainable as possible. This tends to argue for the use of pesticides, but not necessarily the maximization of use. The susceptibility of pests to pesticides is a "common property resource" which individuals may exploit more heavily than is optimal for society as a whole, as the stimulation of resistance by pesticide overuse by a few farmers will have damaging effects on all. This is a classic case of differing private and social costs, and one where government intervention has brought clear benefits. (b) Farmers themselves are particularly at risk from the health consequences of injudicious pesticide use, from application processes and work in treated crops. Although these risks are generally personally borne, many farmers tend to take inadequate precautions, either because they lack information or on the principle that "familiarity breeds contempt", and many governments use their own tools, such as legislation, to encourage farmers to protect themselves.
- Manufacturers and traders of pesticides and pest control. These industries often form coherent and powerful political lobbies. Much has been written about the desirability and reality of the slow metamorphosis of the pesticide manufacturing industry into a service industry, providing and charging for integrated pest control, rather than making money solely from pesticide sales (Urech, 1990). If and when this process is complete, the interests of this industry may broadly coincide with those of farmers. Until it is complete, however, elements within the industry will tend to have their own agenda -- the maximisation of profits by the maximisation of pesticide sales. This and similar interests can manifest themselves in complex ways. For example, the governments of many less-developed countries have subsidised pesticide use in the past, in the interests of "agricultural development" (for example in Zanzibar, as described by Marshad-Kharusy, this volume). These subsidies are no longer as well-favoured as they once were, and many countries are withdrawing them, but an obstacle to this process is that the market distortions of subsidies, while they were in place, stimulated the pesticide manufacturing, distribution and retailing industries beyond the dictates of the free market, and these sectors sometimes face retrenchment and losses as subsidies are withdrawn, prompting their political resistance to the withdrawals (Repetto, 1985).

This list is not complete, as other interests sometimes impinge on the pest management debate. Inputs may also come from, for example, wildlife conservation enthusiasts, fishermen and hunters whose prey are affected by pesticides, financial institutions who have invested in farming or the pest control industry, and the operators of medical pest control programmes, whose actions may be undermined by pesticide resistance stimulated by agricultural pesticides.

These influences work to affect policy in two ways. Firstly, they may seek to influence government itself, by voting, agitation or lobbying. Secondly, they may seek to influence the

government's supporters, and particularly its sources of finance. In the developing world these latter are of particular importance, as many governments there rely heavily on financial resources abroad, in the form of aid donors and capital lenders, be they foreign governments, foreign private banks or multilateral lenders such as the Bretton Woods organizations. These outside agencies wield considerable influence in less-developed countries, and have constituent interests of their own. In particular, answering largely to political influences in the developed world, they often tend, in the balancing of issues of "development" and "the environment", to favour the latter more than the political influences in the developing world itself.

There is, therefore, a need for efficient **pest** management with relatively low immediate costs and risks to producers and minimal long-term costs to the environment and consumers. There is also a need for management of **pest management**, to prevent adverse external effects that would otherwise be borne by society at large. Society has two major problems in achieving these objectives: it is not clear what they want (Mumford, 1993); and it is not clear what is the best way of achieving these goals (Ramirez and Mumford, 1994).

There are two main reasons for disagreement about what society wants from a policy on pest management (Norton & Mumford, 1993). The first is the complexity of many pest and pesticide problems. They can involve many different groups of organisms and reactions and interactions in the soil and water, which are difficult to understand and predict. This complexity can make it difficult to determine what the likely result of changing a management activity will be. The second problem involves the fact that there are different groups involved, with different objectives, and it is not merely a case of accepting an average objective for the groups. This is particularly important when pressures for policies to be implemented come from outside a country, based on value judgements that are legitimate and widely held in one place, but not in another.

Some problems arise in the management of pesticides and pests because of the imposition of objectives determined by outsiders, some of which may conflict with local values (Dahlberg, 1993). International organisations have generally promoted production-oriented agricultural systems which require substantial risk-reducing inputs, such as pesticides, rather than more sustainable, lower risk systems. More recently, "sustainability" has become the focus for many international agricultural development programmes, but often with definitions supplied by developed country agencies. There is further tension caused by environmentalists in developed countries, on the one hand, demanding strict adherence to, for example, US Environmental Protection Agency guidelines on pesticide use and, on the other hand, free trade interests who are trying to reduce costs through abolition of non-tariff barriers to trade (such as environmental and health standards). The immediate problems of income generation to keep up with rising populations and aspirations in less-developed countries often result in a short term view of environmental risks, which are often long term by nature.

Further complications are introduced by the issues of time scale and social discount rates, for example in the management of pesticide resistance. Individuals tend to discount the possible loss of a resource (such as susceptible pests) in the future, putting greater value on control in the present. However, society as a whole can take a much longer term view and has a much lower discount on future value. In this case the sum of the individual responses to a future need to reduce resistance is much less than the social optimum, and a strong

political decision may be needed to overcome that difference.

Throughout the formation of pest and pest management policies there will be conflict and a need to compromise. Some issues involve moral responsibility (say to protect others from poisoning), while others could be resolved by economic means, such as compensation for groups whose immediate objectives are not met.

OPTIONS

The tools by which a government may carry out its functions are inherently of two sorts: activities whose social benefits are higher than their private ones may be encouraged; and those for which social costs are higher than their private ones may be discouraged. The use of pesticides is particularly paradoxical in this context. In some states and cases, their use is considered to be a social good and is stimulated by financial incentives. In others it is considered to be socially undesirable and is restrained, by bans or other limitations on use. This contradictory aspect of the use of pesticides, combined with imprecise thinking about exactly what their social benefits and costs are, has led to confusion in some cases of government pesticide policy, whereby some government actions may even counteract others.

In general terms, governments have five policy options (Stonehouse and Mumford, 1994): command, manipulate, direct, process and inform. Relatively little use is made of commands, such as pesticide bans, because of inadequate bureaucratic control to enforce them in many places. Farah (1993), in a review of pesticide policies in less-developed countries, considered that most less-developed countries have policies that actually encourage pesticide use, mainly by manipulating prices through subsidies, and through imbalances in the way they inform farmers and other pesticide users. Direction, that is simply stating what the objective of government is (for instance, the establishment of integrated pest management and the reduction of pesticide use) is increasingly being used, as in Indonesia and the Philippines, and even the USA. However, this appears to be most successful when it is backed up by a ban on undesirable pesticides and clear information widely disseminated on how to practise alternative pest management. Process-related policies, such as legislation to establish ways for resolving conflicts between groups favouring or opposing pest control, appear to be relatively infrequent.

Much of the attention to existing policies has been directed at pesticide subsidies (Farah, 1993; Waibel, 1989). The general principle is that pesticide use is determined by price, and that in countries where pesticide use is low it is often necessary to subsidise pesticides to encourage farmers to begin to use them. This may be caused by a particularly devastating pest outbreak, or may simply be part of an agricultural modernisation programme. Many argue that increasing pesticide prices will have the converse effect, and could be used to reduce use where it is deemed to be excessive. This is largely unproved, however, and is not necessarily intuitively likely. The dramatic reduction of pesticide use in Indonesia in the late 1980s (Waibel, 1989; Farah, 1993) arose through a combination of mechanisms: bans, a strong official proclamation of social direction, reduced subsidies, and farmer education on alternatives. The impact of eliminating the subsidies component may have been minimal.

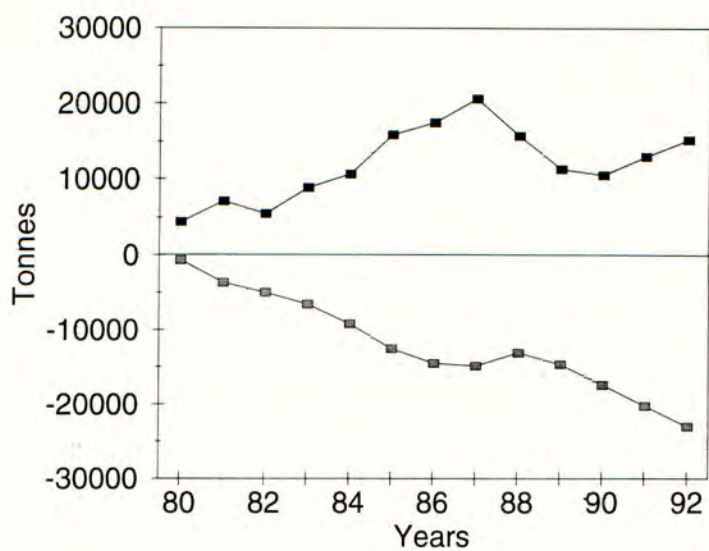


Figure 1. Pesticides imports (above) and use (below) in Pakistan.

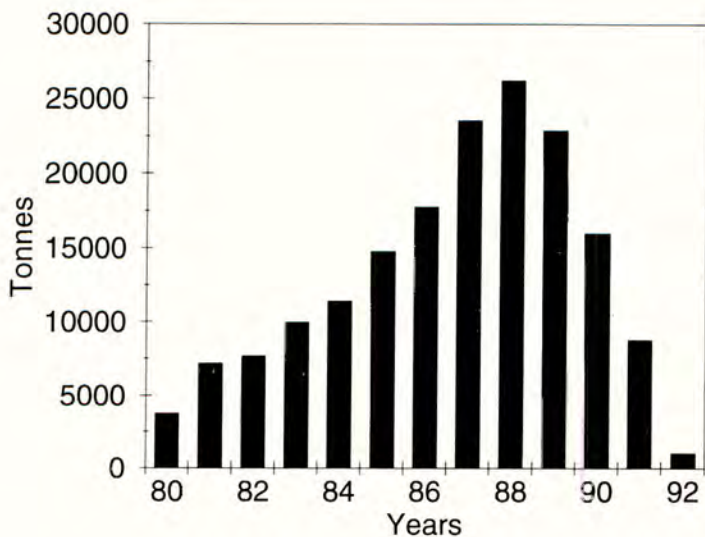


Figure 2. National pesticide balance in storage in Pakistan. Pesticide subsidies were reduced in 1988.

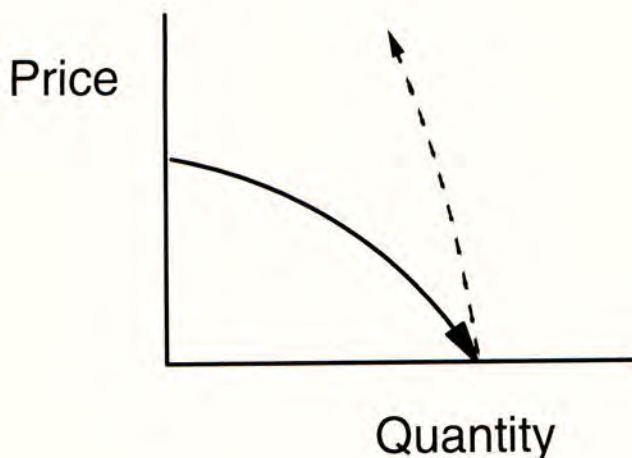


Figure 3. Proposed demand curves for novice pesticide users (solid) and experienced users (dashed).

In the case of Pakistan, eliminating pesticide subsidies in 1988 had no long-term effect on the trend in use (Figure 1), but it did have an effect on imports and the overall pesticide balance in the country (Figure 2). The effect of the subsidies, mainly of cotton insecticides during the 1980s, was to produce pesticide mountains in storage, not fields awash with sprays. A similar situation existed in Tanzania recently, as drums of subsidised pesticides piled up in remote villages. Subsidies may do more to distort markets at the level of government purchasing agencies than at the farm.

Why might higher prices not reduce use, after low prices have introduced farmers to pesticides? Pesticides, and indeed all pest control, are perceived to be risk-reducing inputs. They may, therefore, be perceived to be "essential", and be relatively inelastic in their demand. How many people would stop taking out insurance if the price doubled? We can hypothesise that the demand curve for pesticide use changes as users become more experienced (Figure 3). There is one curve for novices, quite sensitive to price, and another for experienced users, that is quite insensitive. Small price reductions stimulate initial use, but even large increases may not reduce established use.

IMPLICATIONS

Several implications arise from these issues. Firstly, there must be mechanisms to establish how trade-offs between interest groups can be reached. Without such effort pest and pest management policies will either continue to be avoided or will continue to be *ad hoc*.

Secondly, subsidies alone should not be the targets of pest management policy. Integrated policies, such as have been adopted in Indonesia, with a mixture of command, manipulation, direction and information, are much more likely to be successful than any individual response. The same is true for policies that involve farmer training alone. Unless

training is backed up by other policy instruments it is unlikely to be adequate to achieve IPM implementation.

Finally, there is a need for baselines and indicators by which changes actually effected by new policies can be measured. Without such measures it will not be possible to determine how effective particular policies have been in various circumstances. They would also be essential in helping to predict the costs and likely effects of new pest and pest management policies.

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