International Code of Conduct on the Distribution and Use of Pesticides

Guidance on Pest and Pesticide Management Policy Development

JUNE 2010

The Inter-Organisation Programme for the Sound Management of Chemicals (IOMC) was established in 1995 following recommendations made by the 1992 UN Conference on Environment and Development to strengthen cooperation and increase international coordination in the field of chemical safety. The participating organizations are the Food and Agriculture Organization of the United Nations (FAO), the International Labour Organization (ILO), the Organisation for Economic Co-operation and Development (OECD), the United Nations Environment Programme (UNEP), the United Nations Industrial Development Organization (UNIDO), the United Nations Institute for Training and Research (UNITAR) and the World Health Organization (WHO). The World Bank and the United Nations Development Programme (UNDP) are observers. The purpose of the IOMC is to promote coordination of the policies and activities pursued by the participating organizations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

This publication was developed in the IOMC context. The contents do not necessarily reflect the views or stated policies of individual IOMC participating organizations.

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Table of Contents

ABBREVIATIONS 3

1. INTRODUCTION 4

2. DRIVING FORCES BEHIND PEST AND PESTICIDE MANAGEMENT POLICY DEVELOPMENT 5

2.1 Concerns related to specific sectors 5
2.2 Obligations under international instruments 6
2.3 Donor conditionality 7
2.4 Interaction among driving forces in policy development 7

3. THE ROLE OF PESTICIDES IN THE BROADER CONTEXT OF PEST MANAGEMENT 8

4. PESTICIDE RISK REDUCTION 10

5. POLICY FORMULATION 14

5.1 Development objectives 15
5.2 Data collection and problem identification 16
5.3 Addressing factors that foster unnecessary pesticide use 18
5.4 Policy formulation 20
5.5 Policy Toolbox 21
5.6 Formulation of implementation plans 27
5.7 Policy implementation and evaluation 29

6. COORDINATION 29

6.1 National Coordination 29
6.2 International Coordination 31

REFERENCES 32

ANNEX I FURTHER INFORMATION ON INTEGRATED PEST MANAGEMENT (IPM) 34

ANNEX II NOTES ON THE ECONOMICS OF PESTICIDE USE 37

Abbreviations

BMP	Best Management Practice
CBD	Convention on Biological Diversity
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GAP	Good Agricultural Practice
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IVM	Integrated Vector Management
MRL	Maximum Residue Level
NGO	Non-Governmental Organization
OECD	Organization for Economic Cooperation and Development
POP	Persistent Organic Pollutant
SAICM	Strategic Approach to International Chemicals Management
SPS	Sanitary and Phyto-Sanitary
UNEP	United Nations Environment Programme
US EPA	United States Environmental Protection Agency
WHO	World Health Organization of the United Nations
WTO	World Trade Organization

Guidance on Pest and Pesticide Management Policy Development

1. Introduction

The purpose of this document is to provide guidance on pest and pesticide management policy development in support of pesticide risk reduction and sustainable agricultural production. It aims to encourage governments and other stakeholders to consider the question to what extent current pesticide use is actually justified. It places pesticide management in the broader context of pest management, and elaborates on linkages between sustainable pest management and policy objectives related to environmental protection, human health, food safety and trade.

Whereas most technical guidelines related to the *International Code of Conduct on the Distribution and Use of Pesticides* (hereinafter referred to as the Code of Conduct) [1] elaborate on specific regulatory and technical aspects of pesticide management, this document provides guidance on policy development. Besides regulatory instruments, there is a range of policy tools that can contribute to sustainable pest management and pesticide risk reduction. Countries are encouraged to analyse their pest and pesticide management situation, to identify areas for improvement, and to develop plans to realize these improvements.

Following the stronger emphasis on Integrated Pest Management (IPM) in the revised Code of Conduct, special attention is given to IPM, including biological control, as an approach to sustainable pest management and a means to reduce reliance on pesticides and their associated risks (Box 1).

This guidance document focuses on agricultural pest and pesticide management. It is aimed at policy-makers, government departments and other relevant stakeholders involved in policy development related to agricultural pest and pesticide management in developing countries. Although the main audience would be those working on agricultural policies that directly involve pest and pesticide management, the guidance is also considered important for those working on areas that are potentially affected by pesticide use, such as the environment, public and occupational health, animal health, food safety and trade.

Chapter 2 Reviews the driving forces behind pest and pesticide management policy development.

Chapter 3 Provides background to the role of pesticides in the broader context of pest management and explains the strengthened focus on IPM in the revised Code of Conduct.

Chapter 4 Explains the concept of pesticide risk reduction.

Chapter 5 Discusses aspects of pest and pesticide management policy formulation, provides guidance for a situation analysis, and offers a policy tool box to help prepare implementation plans.

Chapter 6 Discusses coordination in policy formulation and implementation at national and international level.

Annex I Provides further information on IPM, including a brief overview of available IPM tools.

Annex II Provides notes on cost-benefit aspects of pesticide use.

2. Driving forces behind pest and pesticide management policy development

Increasing populations and changes in food consumption patterns are presenting countries with growing challenges to intensify agricultural production to meet increasing demand for food, feed and fibre and to meet the quality standards commanded in international trade. Pesticides play an important role in the production of many crops. At the same time, countries are facing growing domestic and international concerns about pesticide use and associated risks. They are under pressure to change pest management practices to more sustainable approaches with reduced reliance on pesticides, and to strengthen regulatory control on the distribution and use of pesticides to reduce risk of harm to people and the environment. All these factors together are driving forces behind the development of pest and pesticide management policy.

2.1 Concerns related to specific sectors

Agriculture

In many countries, achieving food security is a primary concern in agriculture. Sustainable intensification of production and prevention of post-harvest losses are key elements.

In this regard, there is a need for sustainable responses to outbreaks of endemic and trans-boundary pests and diseases that are affecting agricultural production and food security. With growing global trade in agricultural commodities and produce, it is also important to ensure that transport of agricultural produce does not lead to the spread of pests and diseases.

While pesticides play an important role in plant protection, in many cases, overuse and other inappropriate use has actually exacerbated pest problems through destructive effects on natural control mechanisms and development of pesticide resistance.

Health

In many developing countries there are still reports of high incidences of contamination and poisoning of pesticide users, agricultural workers and bystanders. These incidences are unnecessary and unacceptable. Among the public there are food safety concerns related to pesticide residues. This is reflected in a growing consumer demand for safe food, not only in developed countries, but increasingly also in developing countries. Further, there are concerns about contamination of drinking water resources with pesticides or their breakdown products. Particularly in countries with more advanced regulatory systems, the widespread occurrence of residues of certain pesticides in ground and surface water has become a factor in regulatory action to ban or restrict the use of these products. There is increasing attention to long term health effects, including carcinogenic and endocrine disrupting properties, and for compounded effects of multiple pesticide residues on vulnerable groups.

Environment

The main environmental concerns about pesticides relate to water and soil contamination, negative effects of pesticides on the natural resource base for agriculture (biodiversity, natural pest control mechanisms, pollinators, soil ecology, etc.), and bioaccumulation and its effects on wildlife. Toxicity to fish and bees are often of particular concern.

Trade

The main issues regarding trade are market access constraints related to pesticide residue requirements (related to food safety concerns) and phytosanitary measures (to avoid importation and distribution of pests).

Attention to pesticide residues has significantly increased with the rapid globalization of trade. Exporting countries need to take into consideration the Maximum Residue Limit (MRL) requirements of the country of destination, besides their own national requirements.

MRL requirements are being scrutinized and adjusted in several major export markets, reflecting (i) the removal of certain products from the list of registered pesticides (which tends to lead to MRLs being set at detection level), and (ii) concerns about compounded effects of multiple pesticide residues on vulnerable groups.

Legal requirements regarding pesticide residues (MRLs set by governments) have increased attention to pesticide residues in private sector arrangements between food retailers and their producers, including outsourcing to developing countries. Specific requirements regarding pesticide selection and use, and the reduction of pesticide residues, are increasingly important in Good Agricultural Practice (GAP) protocols that buyers of agricultural produce require their suppliers to adhere to.

2.2 Obligations under international instruments

Several international instruments have been developed in response to increasing knowledge about the health and environmental risks associated with chemicals, including pesticides, and the realisation that these risks often have international dimensions. These include the following instruments.

Binding instruments affecting pesticide use:

- the Stockholm Convention on Persistent Organic Pollutants (POP)[2];
- the Rotterdam Convention On the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade [3];
- the Montreal Protocol on substances that deplete the ozone layer [4];
- the Basel and Bamako Conventions on Control of Transboundary Movements of Hazardous Wastes and their Disposal [5, 6].

Voluntary instruments affecting pesticide use:

- the Code of Conduct [1]
- the Codex Alimentarius [7];

In addition, there are other binding instruments that primarily relate to pest management or trade, but have implications for pesticide use:

- the International Plant Protection Convention (IPPC) [8];
- the World Trade Organization (WTO) Agreement on Sanitary and Phyto-Sanitary Measures (SPS-Agreement) [9];

Furthermore, several international fora and programmes recognised the need for a pro-active approach towards more sustainable crop production, which includes addressing the issues of pesticide dependency, wide-spread prevalence of inappropriate use of pesticides, and their fate and dissipation.

These included: Agenda 21 of the Rio Earth Summit; the Johannesburg World Summit of Sustainable Development; the Strategic Approach to International Chemicals Management (SAICM) [10].

Governments that commit themselves to these instruments, for instance through ratification of a Convention, accept the obligation to meet the relevant requirements. This often involves adjustment of national legislation and allocation of human and financial resources to fulfil obligations.

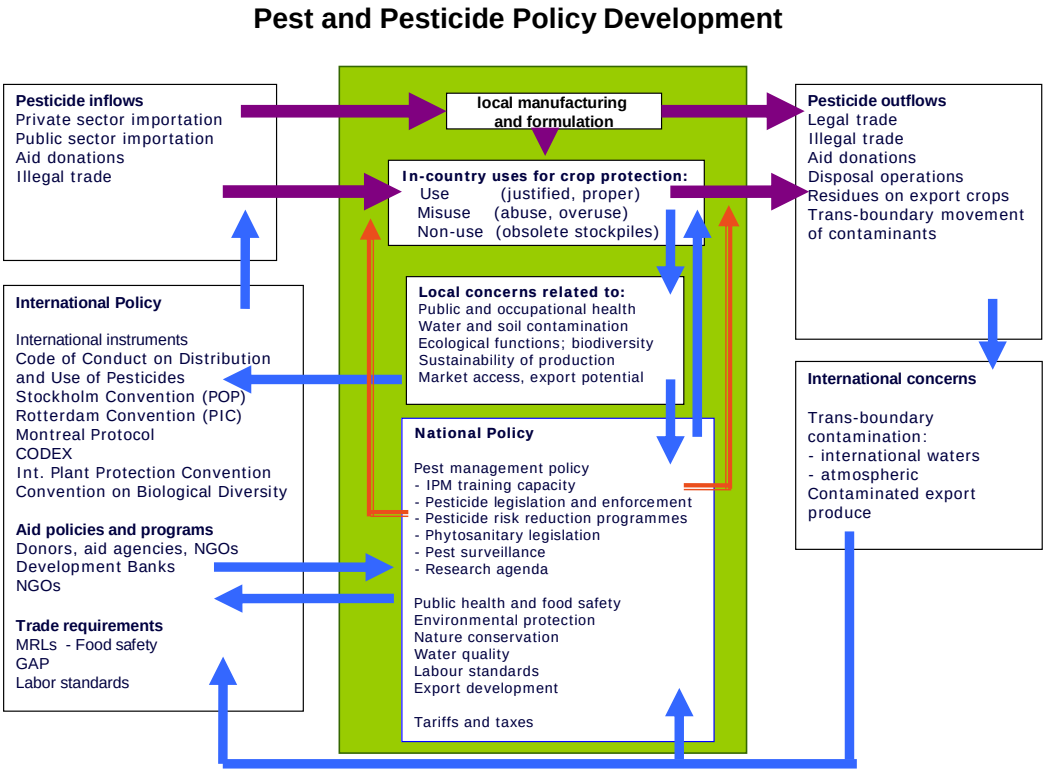
Issues related to food safety, public health and environmental protection, and requirements to fulfil obligations under international instruments, need to be addressed at both the regulatory level and the agricultural producer level. Education of farmers is key to achieving desirable changes in pest management. This involves education on alternative, less pesticide dependent and more sustainable, production practices and the economic and social benefits of such alternatives. It also requires broad stakeholder involvement in the further development and introduction of alternatives.

2.3 Donor conditionality

Several development agencies have a specific policy for assistance involving pest and pesticide management, particularly when provision of pesticides is envisaged. The Food and Agriculture Organization of the United Nations (FAO) encourages IPM approaches to pest management and requires technical data and justification for pesticide use before pesticides can be supplied through FAO projects [11]. The World Bank has a Safeguard Policy on Pest Management [12] aimed at preventing that pesticides financed by the Bank cause harm to people and the environment. The World Bank Procedures require preparation of a Pest Management Plan [13, 14], which demonstrates that pesticides are applied within the context of an IPM approach, that selection of pesticides takes into consideration the ability of users to manage risks, and that adequate measures are being taken to ensure proper use. The Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD) developed special guidelines for aid agencies on pest and pesticide management [15], which emphasize the importance of IPM and provide guidance to projects involving pesticide supply.

2.4 Interaction among driving forces in policy development

The following diagram illustrates the interactions between pesticide use in a country and national and international policy development. It shows common driving forces behind pest and pesticide management policy development, including the development and role of international instruments. The diagram is indicative rather than comprehensive.



The diagram shows how pesticides enter and leave a country (the central box). Besides benefits, pesticide use has unintended negative side effects that represent a cost to health, environment or production. Concerns about such side effects lead to the development of national policies that directly or indirectly affect pesticide use. National policy development and international concerns related to pesticide use lead to international policy development as reflected in conventions and other international instruments, aid policies and programs, and trade requirements. These in turn influence national policy development processes and international trade in pesticides.

3. The role of pesticides in the broader context of pest management

The revised Code of Conduct puts greater emphasis on the role of IPM, which it defines as: “The careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms” [1].

The main reason for the increased attention to IPM is the recognition that pesticide use, and associated risks, can often be reduced considerably without impacting negatively on production or profitability.

Therefore, the question that needs to be asked first is to what extent current pesticide use levels are actually needed in a given situation where pest management is necessary. Modern pest management makes use of the "ecosystem approach", taking into account the life-cycle and ecology of pests and their natural enemies, and pest-host interactions. It then uses this knowledge to minimize pest damage to the crop through agronomic interventions or other non-chemical techniques that suppress the development of the pest or disease. Pesticides are only used in those cases where there are no effective or economically viable alternatives. It is recognised that overuse and other inappropriate use of pesticides can actually exacerbate the pest problem (e.g. destruction of natural enemies of pests, development of pesticide resistance, etc.) and trigger further unnecessary use of pesticides.

IPM is a flexible approach that is being practiced for a wide range of crops in all regions of the world and that helps reduce reliance on pesticide use. Its main principles are the following.

- **Grow a healthy crop**. The focus is on cultural practices aimed at keeping the crop healthy. Selection of varieties that are resistant or tolerant to pests is an important aspect. Site and crop selection, seed bed sanitation and attention to soil, nutrient and water management is part of growing a healthy crop.
- **Manage the agro-ecosystem** to suppress the build-up of pests. Agronomic techniques are used to make the field and the crop inhospitable to insect pest species and hospitable to their natural enemies, and to prevent conditions favorable to the build up of weeds and diseases.
- **Decisions to apply external inputs as supplementary controls are made locally, are based on monitoring of pest incidence and are site-specific**. External inputs may for instance include: beneficial organisms such as pest predators, parasites, parasitoids or pathogens of pests (biological-control); manual removal of pests; physical barriers; mechanical devices; pest attracting lures; pheromones, pest traps, biological or chemical pesticides. The choice depends on the situation. The use of pesticides can also be preferred if economically viable non-chemical pest control techniques or inputs are not available, or failed to control the pest. Normally, pesticides are applied only when field monitoring shows that a pest population has reached a level that is likely to cause significant economic damage and their use is cost-effective in terms of having a positive effect on net farm profits. Selection of products and application techniques should aim to minimize adverse effects on non-target species, people and the environment.

IPM is more knowledge intensive and thus can be more difficult for producers to adopt compared to pesticide selection and use. Promotion of IPM requires resource allocation to extension and research, support for farmers' organisations and an overall policy environment that does not encourage use of pesticides as the primary mode of crop protection. Strategies that are locally developed are often best suited to use of alternative methods.

Generally, the benefits of IPM stretch beyond the agricultural sector and also contribute to policy objectives related to the health, environment and export sectors. Furthermore, the elimination of unnecessary pesticide use tends to reduce production costs. Higher returns and reduced health risks help improve livelihoods of the rural poor. In several countries, it has been recognised at policy-level that IPM can contribute to rural development and poverty reduction.

Annex I provides further information on IPM, including a brief overview of IPM tools.

Box 1 provides an overview of articles in the Code of Conduct related to the promotion of IPM.

Box 1: Code of Conduct articles related to the promotion of IPM

1.7.6. The standards of conduct set forth in this Code are designed to promote Integrated Pest Management (IPM) (including integrated vector management for public health pests);

3.7 Concerted efforts should be made by governments to develop and promote the use of IPM. Furthermore, lending institutions, donor agencies and governments should support the development of national IPM policies and improved IPM concepts and practices. These should be based on scientific and other strategies that promote increased participation of farmers (including women's groups), extension agents and on-farm researchers.

3.8 All stakeholders, including farmers and farmer associations, IPM researchers, extension agents, crop consultants, food industry, manufacturers of biological and chemical pesticides and application equipment, environmentalists and representatives of consumer groups should play a proactive role in the development and promotion of IPM.

3.9 Governments, with the support of relevant international and regional organizations, should encourage and promote research on, and the development of, alternatives posing fewer risks: biological control agents and techniques, non-chemical pesticides and pesticides that are, as far as possible or desirable, target-specific, that degrade into innocuous constituent parts or metabolites after use and are of low risk to humans and the environment.

5.1.7 Governments should provide extension and advisory services and farmers' organizations with adequate information about practical IPM strategies and methods, as well as the range of pesticide products available for use.

8.1.4 Governments should ensure that any pesticide subsidies or donations do not lead to excessive or unjustified use, which may divert interest from more sustainable alternative measures.

4. Pesticide risk reduction

Although pesticides continue to play an important role in pest management, they also pose risks to human health and the environment. Pesticide risk reduction and risk management are thus essential to proper and responsible use of pesticides.

Distinction is made between hazards and risks. The Code of Conduct defines these terms as follows:

- **hazard** means the inherent property of a substance, agent or situation having the potential to cause undesirable consequences (e.g. properties that can cause adverse effects or damage to health, the environment or property);
- **risk** is a function of the probability of an adverse health or environmental effect, and the severity of that effect, following exposure to a pesticide.

Risk can thus be reduced by using less hazardous products and/or by reducing exposure to the product.

Insufficient measures to reduce risk to acceptable levels can result in adverse effects of pesticide use on agricultural production, health, the environment and trade. This is particularly the case when pesticides are used inappropriately. Examples of such adverse effects are provided in the table below.

Examples of possible adverse effects stemming from inappropriate pesticide use	
Agronomic	- Induced pest outbreaks resulting from adverse effects of pesticides on natural enemy populations. - Pest resurgence through development of resistance or adverse effects on natural enemy populations. - Damage to crops or livestock due to inappropriate pesticide use.
Health	- Acute poisoning or chronic health impairment of pesticide users (e.g.: from exposure while mixing or applying pesticides, or entering treated fields) and accidental poisoning of bystanders or others who get in contact with pesticides. - Acute poisoning or chronic health impairment due to consumption of food or water contaminated with pesticide residues, or other exposure.
Environment	- Contamination of water resources (ground and surface water) and soils affecting aquatic or soil ecology. - Adverse effects on important elements of the natural resource base for agriculture (biodiversity, natural pest control mechanisms, pollinators, soil organisms, etc.) - Adverse effects on nature and ecosystems (food chain, wildlife, plants, etc.).
Trade	- Market access constraints related to pesticide residue requirements related to food safety concerns.

The approach to Pesticide Risk Reduction comprises three main steps:

1. Reduce reliance on pesticides. Determine to what extent current levels of pesticide use are actually needed. Make optimum use of non-chemical pest management and eliminate unjustified pesticide use.
2. Select pesticides with the lowest risk. If use of pesticides is deemed necessary, select products with the lowest risk to human health and the environment from the available registered products that are effective against the pest or disease.
3. Ensure proper use of the selected products for approved applications and in compliance with international standards.

The **first step** in the approach to pesticide risk reduction is to ask the question to what extent pesticide use is actually needed to protect yields. In many crops, there is often considerable scope for pesticide use reduction through prevention of pest development and use of non-chemical pest management techniques. Knowledge of the pest, its life-cycle and its natural control mechanisms, often provides for agronomic interventions that can help prevent the build up of pest populations. Pest management strategies should include such IPM approaches and not solely rely on chemical control.

For developing countries, unnecessarily high levels of pesticide use have been documented particularly for cotton, vegetables, fruit and rice. Lack of knowledge about pests, pesticides and alternative pest management techniques are factors contributing to such overuse. IPM programmes have demonstrated that it is often possible to significantly reduce pesticide use without reducing crop yield or farmer profit.

The **second step** is careful selection of pesticides. If pesticide use is deemed necessary there often may be a range of suitable registered products with varying risk. Pesticide registration provides an important tool to exclude products that pose unacceptable risk under the circumstances of use in the country concerned. As registration is generally based on absolute criteria, there may be scope for further selection from among the approved products, favouring those that are least harmful to health and the environment. As such, preference should be given to pesticides that are target-specific, that degrade rapidly into innocuous metabolites after use and are of low risk to humans and the environment. Formulations that cause the least contamination should be favoured over those whose fate and dissipation can lead to problems in soil, water or air. The choice of formulation and mode of application can have significant effects on volume used and risk of exposure.

In some specific cases larger volumes can be justified if the alternative product is less dangerous and the overall risk level is reduced.

The importance of selection of pesticides as a risk reduction tool is reflected in a number of articles of the Code of Conduct (Box 2). Specific attention is given to the need to replace the World Health Organization (WHO) Hazard Class I, pesticides [16] in countries where it cannot be guaranteed that the product can be handled within margins of acceptable risk to the user. Use of WHO Hazard Class I pesticides, and some in the higher toxicity range of Hazard Class II, continues to be an important cause of pesticide poisoning in many developing countries.

A major factor in the selection of pesticides in poorer countries is the direct cost of pesticides. Older generic products tend to be cheaper than their more modern replacements, but at the same time these older products tend to present higher risk because of higher intrinsic hazard and/or the manner in which they are applied. Particularly in some poorer countries, there may be a tendency to keep these products on the market longer in order to provide affordable pest control options. However, such decisions often do not take into account the additional indirect private and public costs that should be part of the equation in order to estimate and understand the full costs (Annex II).

The **third step** is to ensure proper use of selected products. Clear instructions and training in the proper use of pesticides are required. This should include: handling and use according to label instructions; emphasizing that products should be used only for those crops and pests the product has been approved for; respecting of pre-harvest intervals; appropriate use of adequate protective gear; proper application; cleaning of application equipment and proper disposal of empty containers and left-over product, etc. In many cases, overall volumes of pesticides used can be reduced significantly through better selection, maintenance and calibration of application equipment.

Such training, however, explicitly cannot substitute for step 2 concerning the selection of pesticides. The impact of training in proper pesticide use continues to be questioned and can not be regarded as a solution for risks associated with the use of highly hazardous products, particularly in developing countries where large numbers of small-scale farmers would have access to these products [e.g. 17]. Poor small-scale farmers in particular, generally fail to adopt the use of necessary protective gear after training because of unavailability, costs or discomfort of its use in hot and humid climates [18]. Furthermore, it often proves impossible to reach all potential pesticide users with training, or to restrict pesticide use to only those farmers trained in their use. Therefore, highly hazardous products should be regulated and, where possible, be substituted with less hazardous products. Training, however, remains important to ensure proper use of these less hazardous products.

The three steps as described above concern the main elements of pesticide risk reduction. The hierarchy serves to underscore that considerations regarding selection of pesticides and proper use should not be the primary point of attention in cases where current levels of pesticides use are unjustifiably high and can be reduced. Likewise, as explained above, careful selection of pesticides should precede training in proper use of pesticides. Although there is a hierarchy in the approach to pesticide risk reduction, actual pesticide risk reduction programmes generally should contain all three elements simultaneously.

Pesticide risk reduction should be addressed at both the policy and the field level:

Policy level: governments have a range of tools available to move forward on pesticide risk reduction. A proactive approach to promotion of IPM can help reduce reliance on pesticides and make pest management more sustainable. This may involve targeted investment in research, education, training and certification. Regulatory control of the distribution and use of pesticides is an important tool in pesticide risk reduction that can comprise both (i) restrictions on availability of products to reduce hazards and (ii) specific conduct in pesticide management to reduce exposure. A well functioning pesticide registration scheme is of great importance in this respect.

Other tools include the use of financial instruments (taxes and subsidies) to discourage or encourage use of certain production methods or groups of pesticides. In addition to regulatory action, governments can encourage stakeholders to adopt voluntary measures. Financial instruments could play a role in such encouragement.

Field level: farmers need to know how to adapt production practices if the government wants to halt or discourage the use of certain pesticides, or to achieve pesticide use reduction. This requires access to knowledge about integrated pest management approaches. In many cases, access to alternative pest management products would also be an important factor. Again, policy may be required to create this enabling environment, including, for instance, regarding the allocation of resources to awareness raising and training.

Available policy tools are discussed in Section 5.5. Some examples are provided in the table below.

Steps	**Examples of Tools**
Pesticide use reduction	• Pesticide use reduction targets • Promotion of IPM • Promotion of GAP • Enhancing access to non-chemical alternatives • Farmer education • Financial instruments
Selection of less hazardous products	• Pesticide registration • Comparative risk assessment, substitution principle • Financial instruments • Farmer education
Proper use of these products	• Regulatory control • Life-cycle management • Farmer education

Box 2: Code of Conduct articles related to selection of pesticides as a risk management tool

3.4.3 Pesticide industry and traders should observe the following practices in pesticide management, especially in countries without legislation or means of implementing regulations: pay special attention to the choice of pesticide formulations and to presentation, packaging and labelling in order to reduce risks to users and minimize adverse effects on the environment.

3.5 Pesticides whose handling and application require the use of personal protective equipment that is uncomfortable, expensive or not readily available should be avoided, especially in the case of small-scale users in tropical climates. Preference should be given to pesticides that require inexpensive personal protective and application equipment and to procedures appropriate to the conditions under which the pesticides are to be handled and used.

3.9 Governments, with the support of relevant international and regional organizations, should encourage and promote research on, and the development of, alternatives posing fewer risks: biological control agents and techniques, non-chemical pesticides and pesticides that are, as far as possible or desirable, target-specific, that degrade into innocuous constituent parts or metabolites after use and are of low risk to humans and the environment.

5.2.3.1 Even where a control scheme is in operation, pesticide industry should make every reasonable effort to reduce risks posed by pesticides by making less toxic formulations available;

6.1.3 Governments should conduct risk evaluations and make risk management decisions based on all available data or information, as part of the registration process;

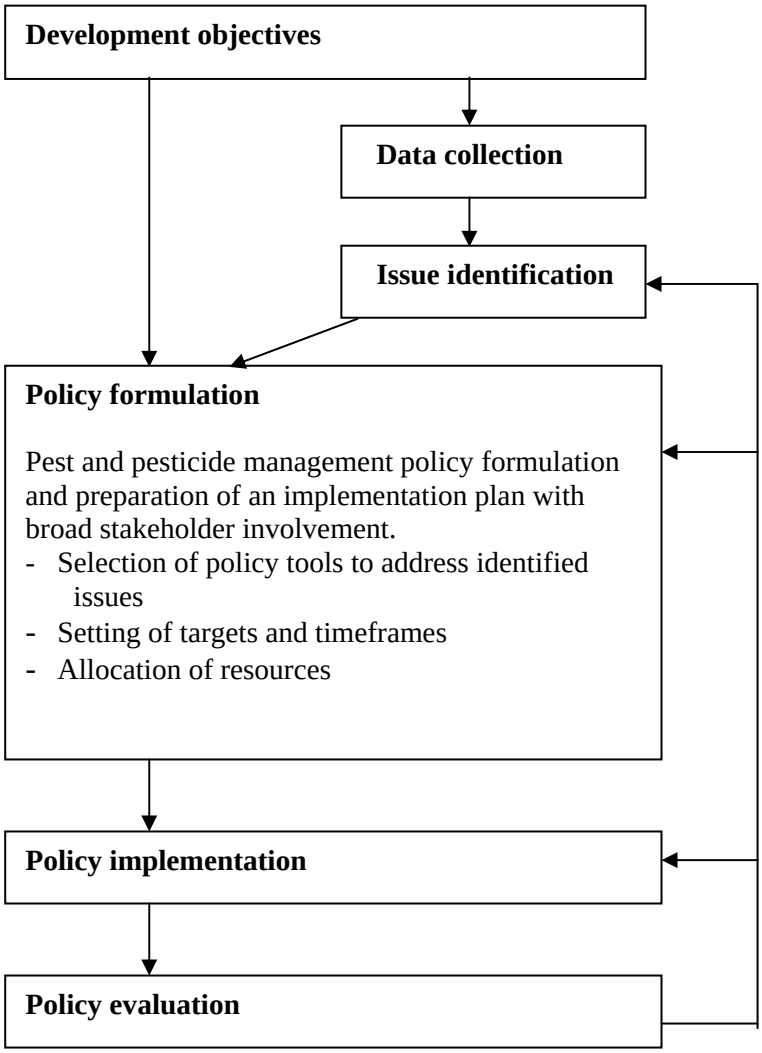
7.5 Prohibition of the importation, sale and purchase of highly toxic and hazardous products, such as those included in WHO classes Ia and Ib, may be desirable if other control measures or good marketing practices are insufficient to ensure that the product can be handled with acceptable risk to the user.

5. Policy formulation

This section provides an introduction to different development objectives that may shape the pest and pesticide management agenda (5.1). It stresses the importance of data collection in support of problem identification (5.2) and briefly reviews factors that may foster unnecessary pesticide use (5.3).

It explains the purpose of policy formulation (5.4) and provides a policy toolbox for the strengthening of pest and pesticide management in response to identified problems (5.5). Countries are encouraged to develop an implementation plan that, based on a situation analysis, determines priority areas for interventions, and selects and employs policy tools to improve pest and pesticide management related to these priority areas (5.6). Finally, the importance of policy evaluation is explained (5.7). The importance of transparency and broad stakeholder involvement throughout the process is emphasised.

These steps in policy formulation and implementation are depicted in the diagram below:



5.1 Development objectives

Pest and pesticide management policy formulation often responds to broader development objectives that stretch beyond crop protection. Examples of such development objectives include:

- enhance crop production and strengthen food security;
- support sustainable intensification of agricultural production;
- enhance sector profitability and export volumes;
- meet export standards (including MRL and GAP requirements);
- reduce public health risks (enhance food safety);
- reduce occupational health risks;

- reduce risk of water contamination;
- reduce risks to the environment and wildlife;
- improve chemicals management in general;
- meet obligations under international instruments and conventions related to export, import, distribution and use of pesticides;
- support rural development and reduce rural poverty (reduce production costs, improve access to markets).

The relative importance of different development objectives can vary from country to country. Meeting donor requirements for the provision of pesticides can be an additional consideration.

There often are opportunities to improve pest and pesticide management within the framework of ongoing programmes related to broader development objectives regarding health, environment, trade, rural development, etc. These, for instance, may include the formulation and implementation of National Implementation Plans for the Stockholm Convention [2]; Quick Start Programmes for SAICM [8]; programmes in support of SPS Capacity building and trade facilitation; rural development programmes and projects to improve farmer livelihoods; etc. In many countries, resources made available under such programmes have been used to strengthen pest and pesticide management.

Likewise, it is important that issues related to pest and pesticide management, and proposed remediation, are high-lighted in broader development policies and action plans, for instance those related to agricultural development, health, environment, trade and export promotion, food safety, GAP, SPS capacity building, etc. A proactive approach of the Ministry of Agriculture to policy development in these areas is important.

5.2 Data collection and problem identification

Data collection and analysis is key to the policy formulation process. It provides a basis for problem identification, selection of means, and monitoring of progress in the application of measures to address these problems. Box 3 lists Code of Conduct articles related to data collection and analysis.

Governments should therefore set up programmes for the systematic collection and storage of data. Sound scientific data serve to improve the understanding of the overall impact of pesticide use, including the actual benefits to production, the actual risks and costs to human health and the environment and the potential to reduce these costs through more effective regulation of pesticide use and promotion of IPM.

Examples of typical areas related to pest and pesticide management for which data collection can contribute to identification of problems and possible solutions:

- crop profile information (production practices; pest complex; available control practices, etc);
- pesticide use patterns for key crops (which types of pesticides are used in what quantities, on which crop);
- pesticide use circumstances (how are pesticides being stored, handled and applied; use of protective gear; disposal of empty containers; etc.);
- availability of illegal and counterfeit pesticides;
- pesticide poisoning incidences;
- pesticide residues in food and drinking water;

- rejections of export consignments due to pesticide residues;
- environmental contamination (soil, ground water and surface water);
- impact on non-target species, including beneficial insects, fish, bees and wildlife;
- spray drift incidences and effects (bystanders, off-site crops, wildlife);
- production, importation and distribution of pesticides and other crop protection products;
- documentation of successful pest management through IPM, including traditional techniques;
- degree to which IPM is being adopted; availability of alternative pest management products;
- evaluation of effects of pesticide use for specific campaigns (e.g.locust control).

Often such data exist at different government departments. Inter-ministerial coordination in bringing together existing information is therefore of great importance. Specific stakeholders, such as Non-Governmental Organizations (NGOs) working in rural areas, food industry, pesticide industry, etc. may also be able to provide valuable data.

Besides assessment of benefits for agricultural production, data analysis also includes assessment of potential impacts of current pesticide use patterns on health and the environment, and economic analysis with specific attention for indirect health and environmental costs to the public (see also Annex II).

Identification of problem areas (e.g. overuse, high incidence of farmer poisoning, water contamination, pesticide residues above MRL) and specification of opportunities (e.g. regulatory action to change selection of products; potential for pesticide use reduction through IPM,) enables the development of targets and specific plans to improve pest management and reduce risk.

Data collection requires programmes to monitor the distribution and use of pesticides, and food and environmental contamination with pesticide residues. Use of risk indicators can point at changes in environmental risk that require attention. Many developed countries are setting up national risk indicator programmes to assess the environmental impact of pesticide use [19].

Monitoring of pesticide residues requires access to a well-equipped and appropriately staffed pesticide residue laboratory. Regional coordination and risk-based sampling strategies can help optimise the use of limited analytical capacity.

Documentation and exchange of information about achievements of IPM regarding efficiency in pest management and its contribution to addressing identified problems related to pesticide use, are important for the promotion of IPM. National IPM programmes are therefore encouraged to conduct impact assessment as part of programme design.

Box 3: Code of Conduct references to data collection and analysis

4.5 Pesticide industry and governments should collaborate in post-registration surveillance or conducting monitoring studies to determine the fate of pesticides and their health and environmental effects under field conditions.

5.1 Governments should:

5.1.2 periodically review the pesticides marketed in their country, their acceptable uses and their availability to each sector of the public, and conduct special reviews when indicated by scientific evidence;

5.1.3 carry out health surveillance programmes of those who are occupationally exposed to pesticides and investigate, as well as document, poisoning cases;

5.1.6 utilize all possible means for collecting reliable data and maintaining statistics on health aspects of pesticides and pesticide poisoning incidents, with the objective of establishing the WHO harmonized system for identifying and recording such data. Suitably trained personnel and adequate resources should be made available to ensure the accuracy of information collected;

5.1.9 utilize all possible means for collecting reliable data, maintaining statistics on environmental contamination and reporting specific incidents related to pesticides;

5.1.10 implement a programme to monitor pesticide residues in food and the environment.

6.1.8 collect and record data on the import, export, manufacture, formulation, quality, quantity and use of pesticides in order to assess the extent of any possible effects on human health or the environment, and to follow trends in pesticide use for economic and other purposes.

5.3 Addressing factors that foster unnecessary pesticide use

A specific challenge is to identify and address factors that unduly foster pesticide use as the first option for pest control, and are likely to encourage overuse and counter efforts to promote IPM. Such factors include:

- *Free or subsidized distribution of pesticides*

  Free or subsidized supply of pesticides tends to encourage unnecessary use of pesticides and to discourage attention for available non-chemical alternatives.

- *Automatic inclusion of pesticides into input packages*

  Pesticides are sometimes provided to farmers as a fixed part of input supply packages that are made available under agricultural input credit schemes, re-start packages after emergencies or other projects or programmes. Such packages assume a certain need of pesticides that may not reflect the actual pest situation in the field. This may lead to unnecessary use. It also may lead to use on crops other than those for which the products were provided, or selling of the products to others. Examples have been documented where supply of pesticides within the framework of credit packages for cotton growing schemes, or for locust control, eventually were used on vegetables instead.

- *Promotion of calendar-based pesticide application schemes*

  Since IPM is knowledge intensive and requires more educational efforts to implement compared to chemical pesticide application, it is important that pesticide use is not promoted or recommended simply on the basis of its ease of use or availability. Promotion of calendar-based application schemes is an example of an undesirable practice that accepts overuse of pesticides in order to keep instructions simple for farmers.

- *Research focus and funding sources*

  Plant protection departments or agricultural research institutes may habitually focus primarily on pesticide use. Dependency on external funding for research may favour research into the use of pesticides from large companies at the expense of research into alternative pest management techniques that are not supported by external funding.

- *Incomplete cost-benefit analysis of pesticide use*

  In discussions about the extent to which pesticides are needed in protecting crop production levels, unawareness about available non-chemical strategies to prevent or reduce pest problems tends to lead to over-estimation of the benefits of pesticide use. Costs of pesticide use are often under-estimated, if there is a lack of information about adverse health and environmental effects that represent a public cost, or if other indirect costs are not taken into account. Such distortions can be corrected through specific efforts to validate alternative approaches and products, and through research and data-collection to obtain a better understanding of the adverse effects of pesticides on health and the environment and the associated costs to the public. Annex II provides further notes on cost-benefit analysis of pesticide use.

- *Shortcomings in farmer education and extension*

  Awareness about IPM and other possibilities for rationalizing pesticide use require farmer education and well-organised independent extension. Absence of farmer education, or incomplete or incorrect information from extension services, is likely to keep pesticide use levels unnecessarily high. Promotion of locally relevant IPM requires investment in research, education and extension.

- *Possible conflict of interest affecting regulatory authorities, research and extension*

  A conflict of interest can exist when extension services that provide pest management advice are also involved in the sale of pesticides, particularly when extension staff need to supplement their income by sale of inputs, or when a lack of public extension services has resulted in pesticide retailers assuming the role of pest management advisors. In many countries, such conflict of interest has been a root cause of pesticide overuse.

  Similarly, a conflict of interest may arise if the responsible authority for pesticide registration is administratively linked to a government entity that produces and distributes pesticides. This may, but does not necessarily, occur when the registration authority and such a government entity are part of the same ministry or government department.

The following table provides an overview of direct and indirect measures that foster pesticide use, and could be useful in identifying areas for improvement.

Direct and indirect measures fostering pesticide use			
Direct measures		Indirect measures	
Price factors	Non-price factors	Price factors	Non-price factors
• Government price subsidies for pesticides • Public sector production and distribution of pesticides • Cost subsidies to private manufacturers of pesticides • Pesticide sales tax exemption • Subsidized credit and insurance tied to pesticide use • Preferential import duties and exchange rates for pesticide imports • Plant protection outbreak budgets • Donor price subsidies • Donor pesticide grant or aid at subsidized costs	• Public sector policies, such as direct involvement of the public sector in marketing • Weak or inappropriate pesticide legislation • Weak (or lack of) enforcement of pesticide use regulations • Public sector extension service promotion of pesticides • Government pest management policies promoting chemical control or supporting pesticide research due to institutional attitudes or interests. • Pro-chemical bias of industry information and extension advice • Strong pesticide lobby or interest groups	• Indirect public sector subsidies • Overvaluation of exchange rates that facilitate pesticide imports • Pesticide bias in government research investments • Foreign and domestic direct-investment incentives, including for pesticide manufacture • High import duties on alternative pest management technologies	• Public sector policies, such as taxation • Technology policy restricting entry of more environmentally benign technologies (import ban, lack of intellectual property protection) • Weak (or lack of) environmental policy • Farm input trade guarantee • Inadequate curriculums of agricultural extension and education

World Bank [14]

5.4 Policy formulation

Once issues have been identified and quantified, targets and timeframes can be set and policy be formulated to achieve these targets.

Pest and pesticide management policy formulation serves to define specific objectives, to set targets and to select the means to achieve these. Policy objectives reflect a desired outcome that the government aims to achieve within a certain timeframe. Generally, these objectives are the result of a negotiation process in which different interests are balanced and agreements are reached among

various stakeholders. Although this typically involves balancing public interests (health, environment) with private interests (producers, agro-industry), the Government is expected to give overriding priority to the necessary protection of human and environmental health.

The purpose of policy formulation is to provide:

- structural solutions to recognised problems;
- broad consensus on areas of (potentially) conflicting interests;
- stakeholder involvement (elaborated in section 6);
- transparency about objectives, targets and means to achieve these targets;
- clarity about responsibilities;
- indicators to measure progress;
- a framework for resource allocation and application of policy tools;
- a framework for international assistance.

Policy formulation should include a policy implementation plan. This could take the form of a strategy, action plan or other type of implementation plan. Such plans can include a broad range of measures to strengthen control on the distribution and use of pesticides and to promote IPM and organic agriculture. Plans can also be targeted at specific risks in specific crops. In some cases, implementation may involve strengthening of the legal basis for implementation.

Factors to take into account when formulating policy implementation plans:

- time frame;
- stakeholder involvement (see also Section 6);
- feasibility of implementation;
- education and communication;
- public and private sector cost;
- compliance monitoring;
- evaluation.

5.5 Policy Toolbox

This section provides a toolbox for pest and pesticide policy formulation. Policy tools should be selected and employed to address identified issues. The best mix of policy tools will vary from country-to-country and depend on the specific situation and identified priorities.

Establishment of pesticide use reduction targets or schemes

Based on assessments of the difference between actual pesticide use and justifiable pesticide use, targets can be set for pesticide use reduction. These will primarily be based on specific crops, or specific areas with high pesticide use, for which the potential to reduce use has been established. Depending on the situation, such targets could be extrapolated to regional or national targets for overall pesticide use reduction. Targets can also concern reduction in the use of certain pesticides or groups of pesticides.

In the past, pesticide use reduction was often expressed as a reduction of the amount of active ingredient applied (e.g. a xx % reduction in an annual use of xxx tonnes of active ingredient compared

to a reference year). However, because of the development and use of newer products that are active at low doses, this unit of measure has proved increasingly inaccurate, particularly with regard to herbicide use reduction. Reduction in number of pesticide treatments for a certain crop or sector therefore became a preferred alternative unit in setting pesticide reduction targets. In some cases, the measurement units have been further refined to reduction in pesticide load to the environment, or reduction in human risk. Other pesticide reduction targets include: area under IPM or organic production, expressed in hectares or in percentage of the total production area.

Particularly in cotton, fruits, vegetables and rice, there often is a considerable potential for pesticide use reduction. Pesticide use reduction schemes require an assessment of the potential for pesticide reduction for each main category (herbicides, insecticides, fungicides), evidence that such reductions can be achieved, farmer education, availability of alternative approaches and products, and motivation for farmers to change practice (e.g. awareness about potential for cost reduction and health benefits; access to high-value markets; etc.).

Establishment of pesticide risk reduction targets or schemes

The effects of establishing risk reduction targets can be more comprehensive than use reduction targets as they not only consider use intensity, but also selection (to reduce hazard) and the manner in which pesticides are being used (to reduce exposure). Risk reduction, however, is often more difficult to measure and increasingly involves sophisticated risk indicator models. Another possibility is to set targets for actual reduction in impact of pesticides, such as reduction in: the number of poisoning cases; percentages of agricultural produce with pesticide residues above MRL; levels of pesticide residues in water resources; effects on beneficial organisms; etc. Several of the tools described below can contribute to achieving such targets.

Promotion of Integrated Pest Management

IPM adoption serves both the public interest and the direct interest of the farmers concerned. It can help reduce pesticide use and associated health and environmental risks. For farmers it can help improve their livelihoods and the sustainability of their farm. Higher yields from improved production techniques and reduced expenditure on pesticides contribute to higher profitability. In addition, there may be health benefits from decreased exposure to pesticides.

The extent to which IPM can be successfully promoted and adopted depends on a variety of enabling and inhibiting factors.

Key enabling factors include:

- investment in IPM education and extension capacity, and orientation of training;
- investment in IPM research;
- availability of alternative crop protection products or techniques;
- demonstration that alternatives work to the satisfaction of the farmer;
- market demand for agricultural produce that is less likely to contain pesticide residues (e.g. GAP requirements, safe vegetable schemes, etc.);
- incentives in favour of IPM and organic products;
- removal of direct or indirect subsidies for pesticide use; taxation of pesticide use;

In some of the more developed countries there also have been:

- direct monetary incentives to IPM growers by government (e.g. grants, payments etc);

- linkage or alignment of IPM programs to broader Best Management Practice(BMP) programming including environmental farm plan legislation, or business risk management programs.

Inhibiting factors have been described in section 5.3 and included free or subsidised pesticides, pest management advisors with an interest in sale of pesticides, etc.

Policy reform to support enabling factors and to reduce or remove inhibiting factors can be expected to have a significant effect on the effectiveness of efforts to promote IPM.

As mentioned above, tools to promote IPM generally include resource allocation in support of IPM under agricultural extension and research budgets. Studies to demonstrate the benefits of IPM for sustainable production, food safety and farmer income and meeting export requirements, may help generate broader political support for justification of such budget allocations.

IPM can be a target in its own right (percentage of production area under IPM), or a means to achieve pesticide reduction targets, or pesticide risk reduction targets. The same applies to organic agricultural production.

Annex I provides further information about IPM.

Promotion of Integrated Vector Management

Pesticide use for the control of vectors of human or animal diseases can often be reduced through Integrated Vector Management (IVM) following the same principles as those that underpin IPM. Environmental management to reduce possibilities for vectors to breed (e.g. removal of standing water to prevent breeding of malaria mosquitos) often can reduce pest-vector densities and distribution. WHO provides guidance on use of available IVM strategies. [20]

Strengthening of plant quarantine

Plant quarantine policies and their effective implementation can avoid the spread of pest problems and the resulting use of pesticides. Implementation of measures agreed under the IPPC will help prevent the spread of pests [9].

Reorientation and strengthening of education and extension

Both IPM and IVM require awareness raising and training. Allocation of human and financial resources to awareness raising and training is therefore an important factor, as well as the orientation of contents and methodology of education and extension programmes.

Reorientation and strengthening of research

Support for IPM research and/or re-alignment of IPM research to better address needs identified by farmers and extension services may be required. Strengthening of research-extension-farmer linkages may need to be part of this. Programs that encourage innovation and discovery research may help adapt existing technologies to local conditions.

Development of commodity specific IPM strategies can also be a useful tool for establishing research and innovation priorities. All stakeholders, including researchers, producers, processors and buyers, would together determine what pest control actions are needed for a specific crop and what technology is available or needs to be developed.

In addition, research on the economics and the environmental and health impact of different plant protection approaches may help provide a better picture of the cost and benefits of the various approaches for policy makers, extension staff, farmers and the public at large (see Annex II, for more

information). Of particular importance are (i) validation of the effectiveness and viability of non-chemical pest management techniques, and (ii) research to assess potential negative externalities of pesticide use, such as: pesticide residue levels in food crops and drinking water resources; health implications of such residue levels; frequency and impact of occupational exposure to pesticides; costs of pest resurgence and pest resistance, etc.

Enhancing access to non-chemical pest management products and low-risk pesticides

Access to alternative pest management products, such as biological pesticides, biological control agents, pheromones, traps, lures, screens, etc is often a limiting factor to reducing reliance on the use of chemical pesticides. Pro-active approaches to enhance availability of such products would contribute to pesticide use and risk reduction. IPM education or extension should include guidance on when and how to use these alternatives.

Access to low-risk pesticides is important for pest problems that are likely to continue to need chemical control. Farmers need to have access to alternatives and information about their use in order to be able to move away from the more hazardous types of products they are accustomed to.

Promotion of good agricultural practice

Many governments and private sector entities in agribusiness and the food industry are developing GAP schemes and protocols. GAP provides a process approach aimed at better production practices that are expected to result in agricultural products with less pesticide residues and less environmental contamination during production. The process approach is regarded as a risk management tool to reduce the chances that agricultural products exceed MRLs or would not meet other national and international quality standards. The drawing up of GAP requirements or protocols offers an opportunity to promote IPM and better selection of pesticides where use of pesticides is justified. Current examples of GAP schemes indicate that crop specific requirements offer better opportunities to actually reduce risk compared to sector specific requirements, such as, for instance, requirements that apply to the whole fruit and vegetable sector. Adoption of GAP tends to be higher if there are incentives, such as price premiums or long-term supply arrangements, and if there are programmes to help farmers adopt GAP.

Many of the more advanced countries are developing comprehensive sets of BMPs that include BMP description and implementation. IPM is regarded as a BMP, and is integrated and implemented along with other BMPs, such as manure management practices, water management, nutrient management programs and erosion control. Many of these countries have introduced policy measures to develop Environmental Farm Plans that determine the extent of environmental risks in farm practices and match these risks with an action program using BMPs, including IPM, to reduce the risks of negative impact of on-farm practices on the environment.

Enhance effectiveness of regulatory control of the distribution and use of pesticides

Effective regulatory control of pesticides involves up-to-date legislation and sufficient capacity for its enforcement. Countries should assess their regulatory and institutional capacity and further develop these where necessary. Lists of registered pesticides should be regularly reviewed and updated. This offers a possibility to exclude high-risk products when lower risk alternatives become available. A licensing system for pesticide sellers can help prevent illegal sale of non-registered products. Market surveillance and quality control may be required to prevent sale of sub-standard, fake or counterfeit products that pose several risks, including risk to production. Operating an effective regulatory scheme requires allocation of sufficient human and financial resources.

Support risk reduction through better selection of products

There are several mechanisms to ensure or encourage risk reduction through selection of products:

- withdrawal or restriction of high risk pesticides based on environmental and health criteria (e.g. WHO Class I products and other products that, in the country concerned, are a recognised cause of frequent acute farmer poisoning; products that have given rise to concerns about chronic health effects such as carcinogenic or endocrine disrupting properties; products that are found to be a significant cause of groundwater contamination; environmentally persistent products that are found to bioaccumulate along the food chain, etc.). Registered pesticides should be regularly reviewed against new information about environmental and health effects. Compounded effects of multiple pesticide residues and effects on vulnerable groups should, as much as possible, be taken into consideration. See box 4;
- some countries are applying Comparative Risk Assessment and the Substitution Principle which favours the least hazardous products within groups of similar products. New products would be registered only if these are less hazardous than pesticides already registered for the same purpose. If less hazardous products get registered, an older and more hazardous product may be taken off the list of registered pesticides. This approach has been successfully applied for some years in the Scandinavian countries;
- other: Besides regulatory control there often are other avenues to encourage better selection of pesticides in order to reduce risk. These, for instance, include lists of preferred pesticides under GAP schemes or controlled crop production schemes, and financial incentives as explained below.

Box 4: Code of Conduct articles related to the review or withdrawal of problematic pesticides

5.2.4 Even where a control scheme is in operation, pesticide industry should halt sale and recall products when handling or use pose an unacceptable risk under any use directions or restrictions.

6.1.6 Governments should establish a re-registration procedure to ensure the periodic review of pesticides, thus ensuring that prompt and effective measures can be taken if new information or data on the performance or risks indicate that regulatory action is needed;

7.5 Prohibition of the importation, sale and purchase of highly toxic and hazardous products, such as those included in WHO classes Ia and Ib, may be desirable if other control measures or good marketing practices are insufficient to ensure that the product can be handled with acceptable risk to the user.

8.2.5 Pesticide industry should recognize that a pesticide may need to be recalled by a manufacturer and distributor when its use, as recommended, represents an unacceptable risk to human and animal health or the environment, and act accordingly.

Employment of financial instruments

Financial instruments can be used to encourage or discourage certain practices. For instance, direct or indirect subsidies could be used to encourage use of non-chemical pest management methods (use of pest resistant crop varieties, biological control agents, traps, etc.).

Financial instruments can also be employed to encourage a shift from use of pesticides with relatively high risks to health and the environment towards use of pesticides with relatively low risks. Taxes, levies or subsidies are among the possibilities. Banded taxation systems distinguish between different

categories of potential negative effects on health and environment, allowing for higher taxation of the least desirable products. The economic justification for the application of such instruments is to adjust the price for indirect public costs in order to avoid situations where farmers choose a certain product because of its low purchasing price, while the product concerned is likely to represent an indirect health or environmental cost to the public (Annex II).

In some of the more developed countries, systems are being developed to link more general subsidies to acceptance of certain production practices that contribute to environmental objectives, for instance, as the Environmental Farm Plans described above.

Rationalisation of pesticide application to reduce health risk and environmental contamination:

Certain modes of application can be banned or restricted on the basis of risk reduction considerations, such as, for instance, aerial application of pesticides. Buffer zones can be required to prevent drift or run-off into vulnerable areas or water bodies. Availability of formulations can be restricted to those that require application techniques that cause least risk. Use of application equipment can be regulated in order to ensure use of the correct type of application equipment and its maintenance, and to prevent overdosing.

Promotion of farmer education in proper pesticide use:

This refers to what formerly has been called “safe use training”. The latter term has been discontinued in the revised Code of Conduct because it incorrectly led to the perception that training would make the use of highly hazardous products safe. Research has raised questions about the long-term impact of such training and reported that removal of highly hazardous products from the market in many cases is the only effective mechanism for risk reduction. It was found that knowing the risks does not necessarily lead to a change in practice [17]. If use of protective gear is expensive or uncomfortable (for instance in hot and humid climates), farmers will be inclined not to use it despite knowledge about the risks. To address risks associated with the use of highly hazardous pesticides, and the more problematic moderately hazardous products, it therefore appears more effective to show farmers alternatives for use of these products than to demonstrate the use of protective gear. Furthermore, it is often impossible to train all users of the product concerned.

Nevertheless, it remains important to train farmers in the proper use of pesticides, including:

- reading, understanding and following label instructions,
- the use of protective gear,
- selection, calibration and maintenance of application equipment to prevent operator exposure and over-use due to inefficient application techniques,
- respecting pre-harvest intervals or re-entry intervals,
- pesticide storage and disposal of empty containers and leftover product,
- pesticide resistance management.

Promotion of the life-cycle concept in pesticide management:

The life-cycle concept calls upon stakeholders to help reduce risk at all stages of the life-cycle from development-to-disposal. It extends responsibilities of pesticide suppliers beyond the sale of pesticides. Important areas where the pesticide industry can contribute include the search for less hazardous products, proper packaging and labelling, safe transportation and storage, provision of training in the proper use, ensuring availability of recommended protective gear, container management and preventing accumulation of pesticide stocks that may become obsolete and require disposal as hazardous waste.

Restraint in acceptance of donor support in the form of pesticide donations:

Pesticide donations should only be accepted if these are based on adequate assessment of actual requirements. These should be supported by field data that demonstrate the extent of the pest problem and provide justification for the proposed type and quantity of pesticides. Such assessments should include a review of non-chemical alternatives. The proposed pesticides should be the least hazardous product that can provide the required control. Provision of pesticides should be accompanied by provision of adequate quantities of appropriate protective gear and application equipment, unless it is explicitly confirmed that required protective gear and application equipment are already available in the quantities needed for responsible use. Products must be registered in the recipient country, be of good quality and have an adequate remaining shelf-life. In order not to distort national markets and not to encourage unnecessary pesticide use, governments may, depending on the situation, consider to charge farmers for pesticides that the government received as donations.

5.6 Formulation of implementation plans

Countries are encouraged to develop policy implementation plans, or action plans, to strengthen pest and pesticide management.

The scope for such a plan can vary depending on the situation. Possibilities include:

- a specific commodity or crop that is subject to pesticide abuse or overuse (e.g. cotton or vegetables);
- a specific pesticide, or group of pesticides, that is a recognised cause of health or environmental issues;
- a specific geographical area that presents pesticide issues (e.g.: intensive vegetable production area, or a watershed area);
- a national scope (e.g. pesticide use reduction targets, pesticide risk reduction targets, IPM targets, organic production targets, etc.).

Preparation of an implementation plan would involve the following steps:

1. conduct a situation analysis with broad stakeholder involvement. This could for instance be done through a national workshop or by a pesticide advisory committee (see Section 6). The box on the next page provides examples of points that can be considered as part of a situation analysis for agricultural pest and pesticide management;
2. based on the situation analysis, identify priorities areas or issues for intervention;
3. determine what interventions would be required to address the identified priority areas or issues;
4. determine what policy tools and resources are required and available to support the interventions;
5. determine responsibilities and ensure the necessary level of cooperation;
6. determine time frames and establish a mechanism to monitor progress;

Involvement of key stakeholders is important for all steps of the process.

Situation Analysis

Examples of points that can be considered as part of a situation analysis for agricultural pest and pesticide management:

Role of agriculture

- Agricultural production and policies.
- Main crops and production constraints.
- Common pest problems, current pest management practices and their effectiveness.

Pesticide availability and use:

- Pesticide importation and distribution.
- Pesticide usage (commonly used pesticides and purpose of use).
- Pesticide use practices.

Issues related to pesticides

- Circumstances of use and ability of users to use products according to instructions and within acceptable margins of risk (e.g.: language on labels; availability of proper protective gear and application equipment; etc.).
- Incidence of pesticide poisoning (human, livestock, wildlife).
- Environmental contamination.
- Pesticide residues above MRL.
- Stockpiles of obsolete pesticides and container management.
- Pest resistance.
- Lack of awareness about hazards and risks among users and the public.

Adequacy of regulatory control

- Is legislation up-to-date?
- Is capacity for its enforcement sufficient?
- Is a functioning registration scheme in place that effectively evaluates applications?
- Can pesticides be de-registered or replaced by less hazardous products?
- To what extent are pesticides being sold or used that are not legally permitted?
- Is the quality of pesticides being monitored?
- What is the situation regarding fake, substandard and counterfeit products?
- Is pesticide use/misuse being monitored, including poisoning incidence and environmental contamination?
- Have MRLs been established?
- Is a surveillance scheme for pesticide residues in place?

Alternatives

- Is there an IPM strategy and programme, and are these effectively being implemented?
- Is the potential offered by alternative pest management approaches sufficiently being captured?
- Availability of alternative products (biological control agents, bio-pesticides, pheromones, insect traps, reduced-risk pesticides etc.)?
- Have GAP or BMP schemes been developed and introduced?

Note: Specific guidelines on situation analysis for public health pesticide management have been published by WHO [21]

5.7 Policy implementation and evaluation

Implementation schedules depend on the nature and contents of the policy and its implementation plan. Allocation of adequate human and financial resources to enable implementation is crucial.

Awareness raising, effective stakeholder involvement and coordination are also important, as further described in section 6.

Progress towards the achievement of policy objectives or targets should be regularly reviewed or evaluated. Findings would enable a change in course of action if results are not satisfactory. Impediments can be identified and addressed, and policy tools selected to achieve the desired result may be adjusted.

Audit and review of pest control programs by independent agencies or departments can help ensure that government policies in pest and pesticide management are best meeting public needs in terms of efficiency and delivery.

6. Coordination

Pest and pesticide management is complex with different ministries and different levels of government being responsible for different aspects. Coordination is therefore important, both at the national and international level, within government and among the broad range of stakeholders.

6.1 National Coordination

Coordination at national level is important to enhance exchange of information and collaboration among relevant ministries and to enhance stakeholder involvement. Transparency and public access to information are important elements.

National workshops on pest and pesticide management that bring together relevant ministries and other stakeholders to jointly conduct a situation analysis have proven to be a useful tool for exchange of information, identification of issues, development of action plans and discussion on collaboration.

Consideration can also be given to the establishment of stakeholder advisory groups on sustainable pest management and/or pesticide risk reduction that comprise relevant government agencies and other stakeholders. Such a group could provide recommendations to the responsible government departments or agencies.

Coordination and collaboration with private sector stakeholders may enhance compliance and implementation. This is particularly important where government capacity for monitoring and enforcement is weak. Voluntary measures can make a useful addition to regulatory control, but should not be a substitute for government responsibilities regarding the control of pesticides to protect human health and the environment.

Coordination and collaboration with civil society groups may help provide feedback on the effectiveness of regulatory measures and may help expand capacity for IPM training. In several

countries NGOs now play a major role in conducting IPM field programmes. NGOs can also play a role in reaching larger numbers of the population with efforts to raise awareness about pesticide risks and alternatives.

Governments should seek advice from all stakeholders, but should take care to maintain independence in their decision-making and should not feel unduly obligated to satisfy or meet the interests of any specific group. Participation as stakeholder should be subject to proper conduct and fair behaviour. Private sector stakeholders may have large commercial interests at stake which directly relate to specific pesticide use situations, such as pesticide manufacturers or distributors, commodity companies, agricultural export companies, large farming enterprises, pesticide application manufacturers, etc. They may attempt to exercise pressure on the government to protect these interests. Governments can reduce or better manage such potential pressure by dealing with national associations representing private sector stakeholder groups, rather than with individual stakeholders. Further it may help to ensure that private sector stakeholder participation is adequately balanced with participation of civil society stakeholders.

The UN agencies FAO, WHO and the United Nations Environment Programme (UNEP) each have their own activities on pesticide risk reduction. These agencies typically interact with the ministry relevant to their sector of work. For instance, pesticide risk reduction activities rooted in international programmes that are being implemented by UNEP (e.g. implementation of the Stockholm Convention or SAICM) would generally be implemented at the national level by the Ministry of Environment, even when most of the knowledge in this area would be vested in the Ministry of Agriculture. A pro-active approach towards coordination and collaboration is therefore essential to capture the potential that these international programmes have to offer. The formation of inter-ministerial working groups can be a useful instrument in this regard.

Pest control and pesticide management can also be a shared jurisdiction among municipalities, provinces, states and the national government. Many developed countries have established stand-alone departments, agencies or offices to be the lead organization in pest management and reduced-risk pesticide use. In this way, departments other than Agriculture that may also participate in pest control activities such as rights-of-way weed control in transportation (Transportation Department), pest control on government owned parks or public places (Natural Resources Department) or impact of pesticides in water on fish (Fisheries Department) can coordinate their programs across government. Formal agreements among the various departments and agencies are often beneficial in ensuring adequate exchange of information and integration of work plans and deliverables in establishing policy in pest control.

Examples of common coordination mechanisms at national level

- Involvement of all relevant ministries in the pesticide registration board.
- Inter-ministerial working group on pesticide risk reduction.
- Advisory group on pesticide risk reduction, involving relevant ministries and other stakeholders.
- National workshops on pest and pesticide management.

6.2 International Coordination

International collaboration and information exchange is important to enhance consistency in approaches and efficiency in implementation. Examples of areas where international coordination can contribute to national policy and programme development include:

Pesticide registration:

Harmonisation of pesticide registration requirements among groupings of countries can help enhance the registration process. Some groupings of countries established joint registration schemes, which enable them to pool resources and expertise.

The FAO pesticide specifications provide quality criteria for pesticides.

The Rotterdam Convention provides useful information regarding regulatory actions taken against certain products for health or environmental reasons.

Risk assessment:

The outcome of research and surveys on the impact of certain pesticides on health and environment would often also be relevant to neighbouring countries. Risk assessment is expensive and exchange of information is therefore useful.

Countries or groupings of countries with major investment in risk assessment programmes can be useful sources of information. Examples include the risk assessment programmes of the OECD Working Group on Pesticides [19], the European Union (EU) and the United States Environmental Protection Agency (US EPA). Nevertheless it is important that countries evaluate risks against local conditions and use practices that may require lower levels of acceptable risk.

Monitoring of fake, substandard and counterfeit products:

Information exchange among neighbouring countries concerning identified fake, substandard and counterfeit products can help stem the spread of such products.

MRLs:

Coordination in the establishment of MRLs is important for reasons of consistency and efficiency. Codex Alimentarius provides a framework [5]. Some groupings of countries work together in establishing MRLs that then apply to the participating countries.

Pest management and the development of IPM programmes

Exchange of information on the behaviour and spread of pests and diseases (including invasive alien species) and exchange of experience in dealing with pests contribute to preparedness and effective pest management programmes. Regional exchange of information on IPM approaches for specific pests problems has helped the development of national IPM programmes.

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Annex I Further information on Integrated Pest Management

Current attention for Integrated Pest management (IPM) developed in response to steadily increasing pesticide use that resulted in pest control crises due to development of resistant pests and outbreaks of secondary pests. Another important factor that contributed to the development of IPM was increasing evidence and awareness of the cost to health and the environment of intensive use of pesticides.

Introduction of IPM does not necessarily involve sophisticated information gathering and decision-making. As a problem solving approach to pest control, IPM can be introduced at any level of agricultural development. For example, improvement of basic crop management practices, such as planting time and crop spacing, can often be effective in reducing pest attack. A useful beginning can be made with relatively limited specialized information or management input. Later, additional information, technologies, and mechanisms can be developed to enhance its effectiveness. IPM is a dynamic process that makes use of a systems approach and encourages the user to consider and use the full range of best pest control options available given economic, environment and social considerations

The following main steps can be considered as typical for an IPM approach.

(1) Prevention and/or suppression of harmful organisms. This should be achieved or supported among other options especially by:

- crop rotation; inter-cropping;
- use of adequate cultivation techniques (e.g., stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing);
- where appropriate, use of pest resistant/tolerant cultivars and standard/certified seed and planting material;
- balanced soil fertility and water management;
- prevent spreading of harmful organisms by field sanitation and hygiene measures (e.g., by removal of affected plants or plant parts, regular cleansing of machinery and equipment);
- protection and enhancement of important beneficial organisms, e.g. by the utilisation of ecological infrastructures inside and outside production sites.

(2) Harmful organisms must be monitored with adequate methods and tools, where available. Such adequate tools should include observations in the field and where feasible warning, forecasting and early diagnosis systems (e.g. traps).

(3) Based on the results of the monitoring it is decided whether and when to use what pest management inputs. Sustainable biological, physical and other non-chemical methods must be given priority over chemical methods if they provide satisfactory pest control.

(4) Pesticides should only be applied when threshold values indicate that pesticide use is justified.

(5) The pesticides applied shall be as specific as possible for the target and shall have the least side effects on human health, non target organisms and the environment, while their use should be kept at minimum levels, e.g. by partial applications.

(6) Monitor the success of the applied pest management measures.

Examples of available techniques in the IPM toolbox

There is a wide variety of techniques that can be applied under IPM approaches. Applicability of individual techniques depends on various factors, including: the crop, the cropping system, the pest complex, the climate, the agro-ecological conditions, etc. Generally, IPM involves a combination of techniques. Some examples of such techniques:

Population monitoring

- Trapping (pheromone trapping, sticky traps, water traps, etc.)
- Counts of eggs, larva/nymphal instars, pupae, adults (sweep nets) etc.

Cultural practices that can help prevent build up of pests or decrease their pest status

- Use of pest-resistant or highly competitive crop varieties
- Field sanitation, use of quality seeds and seed bed sanitation
- Crop rotation
- Inter-cropping
- Managing sowing, planting or harvesting dates
- Water/irrigation management
- Soil and nutrient management (including mulching, zero/low tillage, fertilizer management)
- Practices to enhance the build up of naturally existing populations of natural enemies
- Hand-picking of pests or hand-weeding
- Use of traps or trap crops
- Mechanical/physical controls (including barriers, crushing devices and use of heat)
- Post harvest loss prevention

Biological inputs that can help manage pest populations

- Biological control through release of predators, parasites or pathogens
- Biological control through fish, ducks, geese, goats, etc.
- Release of sterile male insects
- Bio-pesticides
- Biological preparations (e.g. natural plant extracts)

Chemical inputs

- Chemicals that disrupt insect behavior (e.g.: pheromones)
- Induced resistance activating compounds
- Growth-regulators
- Conventional pesticides

Further technical information about IPM can be found at:

http://www.epa.gov/pesticides/factsheets/ipm.htm

http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html

http://www.oisat.org/

http://ipmworld.umn.edu/

http://nysipm.cornell.edu/

http://www.aglearn.net

http://www.vegetableipmasia.org

http://www.ipm-neareast.com

Annex II Notes on the economics of pesticide use

The economics of pesticide use are determined by its cost and benefits. As both are often difficult to quantify, the economics of pesticide use are often not very clear.

Benefits may include higher yields, less post-harvest losses, labour saving (herbicides), etc., which in principle can contribute to food security, better food quality and higher profit for farmers. However, in order to assess such benefits properly, one also would need to compare these to alternatives. Alternatives could include non-chemical pest management, but also IPM approaches with reduced use of chemicals. Such comparisons also would need to take into consideration the effectiveness and reliability of alternatives. Absence of knowledge about alternatives tends to lead to over-estimation of the benefits of pesticides.

Unavailability of data on the social costs of pesticide use to public health and the environment often makes it difficult to assess the overall costs. As a result, the overall costs are often under-estimated.

Costs of pesticide use comprise a broad range of direct and indirect cost elements that make it difficult to arrive at an overall cost figure. Examples of cost elements are provided in the table below.

Examples of costs of pesticide use
1. Obvious private costs at the user's level
o Cost of pesticides (farm gate price) o Farmer's cost of transport, storage and disposal o Cost of application (hired labour, opportunity cost of family labour, spraying equipment) o Cost of protective gear and other risk reduction measures
2. Hidden private costs
o Acute and chronic health effects of pesticide poisoning (medical treatment, labour productivity loss) o Contamination of on-farm water resources o Reduction of beneficial organisms and other functions of the agro-ecosystem o On-farm production loss due to negative side effects (crop damage due to pesticide drift, losses in animal, honey bee, fish populations) o Decreased marketability of produce due to high pesticide residue levels

3. External costs (Social costs)

- Health damage to the public through consumption of pesticide residues and exposure to contaminated material
- Damage to natural resources (ground and surface water, natural habitats, biodiversity)
- Off-farm losses in crop and animal production
- Costs of preventative measures to avoid damage (e.g. residue monitoring and control in food and water; mitigation of contamination, such as removal of pesticide residues from drinking water (at drinking water utility plants)
- Impaired export potential for sector or country if consignments get rejected because of pesticide residue issues
- Disposal of obsolete pesticide stocks

Source: World Bank [18]

Further information about the economics of pesticide use can be found at:

-World Bank, Determining Justification for Pesticide Use: http://go.worldbank.org/3BBC90JJ30

-Univ. of Hannover, PPP01, Guidelines for Pesticide Policy Studies:

http://www.ifgb.uni-hannover.de/2699.html

-R.G. Bowles and J.P.G. Webster, 1995, Some problems associated with the analysis of the costs and benefits of pesticides, Crop Protection, Volume 14, Issue 7.