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Activities to Reduce Pesticide Risks in OECD and Selected FAO Countries

Part I: Summary Report

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Activities to Reduce Pesticide Risks in OECD and Selected FAO Countries

Part I: Summary Report

Environment Directorate
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No. 1, *Data Requirements for Pesticide Registration in OECD Member Countries: Survey Results* (1993)

No. 2, *Final Report on the OECD Pilot Project to Compare Pesticide Data Reviews* (1995)

No. 3, *Data Requirements for Biological Pesticides* (1996)

No. 5, *Activities to Reduce Pesticide Risks in OECD and Selected FAO Countries. Part II: Survey Responses* (1996)

Environmental Health and Safety Publications

Since 1988, many of the technical documents prepared by the OECD Environment Directorate have been available to the public in the form of "Environment Monographs" (see list of publications beginning on page 85). As of mid 1996, however, new titles are no longer being published in the Environment Monograph Series. The Environmental Health and Safety Division is now publishing documents in several different series: Testing and Assessment; Good Laboratory Practice and Compliance Monitoring; Risk Management; Harmonization of Regulatory Oversight in Biotechnology; Chemical Accidents; and Pesticides. Information on how to obtain these documents is provided on page 85.

The Inter-Organization Programme for the Sound Management of Chemicals (IOMC) was established in 1995 by UNEP, ILO, FAO, WHO, UNIDO and the OECD (the Participating Organizations), following recommendations made by the 1992 UN Conference on Environment and Development to strengthen co-operation and increase international co-ordination in the field of chemical safety. The purpose of the IOMC is to promote co-ordination 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.

Foreword

This report presents a summary of the responses of 20 OECD countries and the European Commission, as well as eight non-OECD FAO countries, to a survey on pesticide risk reduction conducted in 1994-95 at the request of the OECD Pesticide Forum.

The purpose of the survey was to provide a starting point for the exchange of information concerning new approaches to pesticide risk reduction. This report is accompanied by *Activities to Reduce Pesticide Risks in OECD and Selected FAO Countries. Part II: Survey Responses,* OCDE/GD(96)121. A copy of the survey questionnaire, which was sent to national governments and the European Commission, is included in that document.

This publication was produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals.

Derestriction of this publication was recommended by the Joint Meeting of the Chemicals Group and Management Committee of the Special Programme on the Control of Chemicals. It has been published on the authority of the Secretary-General of the OECD.

Contents

Executive Summary

This report describes the pesticide risk reduction activities under way in 20 OECD countries, the European Commission (EC), and eight non-OECD countries which belong to the United Nations Food and Agriculture Organization. The report is based on a survey conducted in 1994-95 at the request of the OECD Pesticide Forum. It focuses exclusively on pesticide use in ***plant protection*** (i.e. agriculture, horticulture and forestry) and does not consider other pesticide uses.

The survey respondents were:

OECD countries		FAO countries
Australia Austria Canada Denmark Finland France Germany Greece Hungary Japan The Netherlands	New Zealand Norway Portugal Spain Sweden Switzerland Turkey United Kingdom United States European Commission	Ecuador Jamaica Korea Malaysia South Africa Sri Lanka Thailand Zambia

The report is divided into two parts. Part 1 describes activities under way in OECD countries and the EC. Part 2 describes activities under way in the eight non-OECD FAO countries. Parts 1 and 2 are structured similarly, following the format of the survey questionnaire.

Both Part 1 and Part 2 include chapters on (1) frameworks for risk reduction, (2) activities to reduce risks, (3) activities to reduce pesticide use, and (4) conclusions and recommendations.

Countries' individual responses to the survey questionnaire have been published separately, giving more detail than in this report (see Foreword).

Part 1. Activities in OECD Countries and the European Commission

Frameworks for Risk Reduction

Reasons for Initiating Activities to Reduce Pesticide Risks

OECD countries have initiated pesticide risk reduction activities for a variety of reasons. Generally these have involved: a specific health or environmental problem due to pesticide use; a more general concern about agriculture's dependence on and heavy use of chemical inputs; or a new social mandate to incorporate environmental goals into agricultural policy and practice. Specific issues highlighted by the survey respondents include:

- problems such as development of resistance to pesticides by the target pest, damage to successive crops and/or to crops being protected by herbicides, and contamination of water resources;
- concern about risks to users, the general population, and the environment;
- concern about the increased use of pesticides that has accompanied the intensification of agriculture, and about the development of new products that are highly biologically active;
- compliance with international agreements to reduce chemical emissions to lakes and oceans, and with importing countries' limits for pesticide residues in food;
- interest in following the model for reducing pesticide use provided by some countries.

Risk Reduction Approaches

The survey found that OECD countries had used their well-established programmes for pesticide registration, and for agricultural research and extension, as a starting point for new risk reduction activities. The survey also found that many of these new activities share a key characteristic — the involvement of farmers in projects from the very start — which differentiates them from standard regulatory approaches. This farmer involvement is important to the success of the risk reduction activities. Countries' approaches to risk reduction differ in three main areas: their goals, structure and implementation. However, the survey did not identify one particular approach that was most successful; rather, it found that different approaches work best in different countries. It also found that, in practice, activities carried out using different approaches are often similar.

Activities to Reduce Risks

Product Registration/re-registration

The survey confirmed that pesticide registration has been, and continues to be, the foundation for pesticide risk management in all OECD countries. The survey respondents agreed that registration programmes are successful, although they can be slow and resource intensive. Some countries described new measures they have initiated to make their registration programmes more effective and efficient. In addition, many countries have initiated re-registration programmes for old pesticides.

Reducing Consumer Risks: Setting and Monitoring Residue Levels

The survey respondents noted that regulation of pesticide residues in food has accompanied registration as a long-standing risk management activity. Several countries described their programmes to monitor residues in food and/or drinking water. Some noted that the need to comply with other countries' residue limits had prompted them to initiate risk reduction efforts.

Reducing Worker Risks

The survey showed that OECD countries have increased and expanded their programmes for worker safety, which they have found to be one of their most effective risk reduction tools. The survey respondents described new programmes to: train and educate pesticide users; certify pesticide dealers and distributors; distribute safety information to users; improve labels; improve regulations relating to farm worker safety; develop risk-reducing product packing and formulations; and provide for proper disposal of leftover pesticides and containers.

Protecting the Environment

The survey found that, during the last ten years, many OECD countries have instituted measures to protect both ground and surface water from pesticide contamination. Two of the survey respondents discussed their participation in the North Sea Treaty, and the EC described programmes begun under the 1992 Common Agriculture Policy Reform. Several countries also described programmes to protect sensitive animal species and habitats.

Activities to Reduce Pesticide Use

Increasing Pest Control Efficiency and Effectiveness

All of the survey respondents said their country had begun new activities or expanded existing ones to help farmers increase the efficiency and effectiveness of pest control. Nearly all said that pest forecasting had improved greatly and that treatment thresholds for many crops had been developed, enabling farmers to reduce pesticide use. The survey respondents also described the success of: new programmes to test and certify pesticide application equipment, so as to eliminate waste and spillage; programmes to develop better pesticide application techniques and equipment; and research on the impact of reduced application rates on crop production.

Implementing Integrated Pest Management

Every country responding to the survey had initiated activities to implement integrated pest management (IPM) during the last ten years. Virtually all the respondents described programmes to develop and facilitate the use of biological pest control agents. Several countries also described projects to provide resistant varieties and healthy plants to farmers, and some said they had programmes to develop non-chemical pest-control approaches. Many countries said they had initiated programmes to provide farmers with guidelines, information, advice, and field courses on IPM methods. Five countries described the establishment of model farms that demonstrate IPM methods and provide information on their economic viability and environmental benefits. Several countries also discussed efforts by grower groups to develop and follow IPM methods, so as to receive a green label or other market advantage.

Economic Instruments

The survey responses showed that OECD countries have used three types of economic instruments to encourage the use of IPM and organic methods: subsidies for using "environmentally friendly" farming methods; green labels to give food grown using such methods a market advantage; and taxes on pesticides to increase their price and thereby discourage unnecessary use. Both individual countries and the EC have provided subsidies. Some countries reported that these programmes are successful. A smaller number of countries and the EC described the use of green labels, and some reported that demand for green-labelled products is increasing. Just three countries said they had used a tax on pesticides to try to reduce unnecessary use.

Collecting Data on Pesticide Use

Many of the survey respondents said they have insufficient data on pesticide use, and that this makes it difficult to measure progress in risk reduction. Most countries said they do not actually collect data on use, but rather on sales. A few respondents mentioned new projects to collect crop-specific use data.

National Programme with Use Reduction Targets

During the late 1980s to 1990s, several OECD countries and the EC initiated comprehensive programmes to reduce pesticide use. Sweden, Denmark and the Netherlands, the first countries to adopt such programmes, reported that these programmes have reduced pesticide use considerably (though not reaching their goals in every case), and have increased farmers' awareness about pesticide risks and their commitment to risk reduction goals. Finland, Norway, and the Canadian provinces of Quebec and Ontario have also initiated use reduction programmes.

EC Fifth Environmental Action Plan

In 1992, the EC adopted a "Fifth Environmental Action Plan" that aims to reduce pesticide impacts and make agriculture sustainable through research on pesticide use, subsidies for environmentally friendly farming, and the adoption of new policies and instruments.

IPM Success Stories

Many of the survey respondents said they had not yet developed tools to measure the success of their IPM and risk reduction projects, or that the projects were too new to have measurable results. Nevertheless, examples from five countries show how farmers have used IPM to improve pest control, reduce reliance on chemical pesticides, and reduce production costs.

Conclusions

OECD countries have gained a wealth of experience in pesticide risk reduction over a relatively short time. Based on this experience, the survey respondents identified the activities that have been most successful and the factors that have been important to their success. They also described the difficulties they had encountered, and identified future work at the international level that would be helpful to their national risk reduction programmes.

Part 2. Activities in Selected FAO Countries

Framework for Risk Reduction

Reasons for Initiating Activities to Reduce Pesticide Risks

FAO countries began pesticide risk reduction activities for some of the same reasons as OECD countries, but with a greater emphasis on reducing risks to farmers, farm workers and farm families. FAO countries also reported that their direct experience with the overuse of pesticides and the need for sustainable agricultural development were important motivating factors.

Risk Reduction Approaches

FAO countries have much in common with each other in their approaches to pesticide risk reduction. Although none of the responding countries had a specific programme on risk reduction, all had legislation (generally related to pesticide registration) that covered the development of risk reduction activities. These countries all reported that their pesticide risk reduction activities were characterised by a high degree of co-operation among government ministries, universities, hospitals, non-governmental organisations, international and bilateral aid agencies, and the private sector. Countries also reported similar problems in implementing risk reduction projects, including (1) the difficulty of developing programmes and training materials that are appropriate for subsistence farmers who are often illiterate, speak a range of dialects or languages, and are often very unaware of the risks associated with pesticide use, and (2) lack of extension personnel, inadequate resources, and poor infrastructure. They therefore noted that the only effective way to reduce risks in the short term is often to restrict the availability of the more toxic pesticides — yet this too can be difficult when farmers know the pesticides are being used in other countries.

Activities to Reduce Risks

Product Registration

For all FAO countries responding to the survey, registration was the first step in pesticide risk management. These countries noted that they referred to both international and national hazard evaluations, and that they took account of regulations in other countries when registering products. Countries noted that problems had arisen when older pesticides were deemed too risky and regulatory agencies had to explain to farmers why they could no longer use a product they had used for many years. The countries also noted the importance of linking regulatory action against a product with programmes aimed at changing farmers' attitudes and practices, and with recommendations of alternatives that are available, affordable and practical. Several countries have initiated special programmes to eliminate hazardous pesticides.

Measures to Reduce Worker Risks

All responding countries reported programmes to train farmers in the safe handling and proper and effective use of pesticides. Most often this training was done in co-operation with the pesticide industry, international organisations, and/or non-governmental organisations. Several countries also reported that they have programmes to train and license retailers and applicators. Some have programmes to train medical professionals to recognise and treat pesticide poisoning cases. Countries also reported programmes to distribute information about

pesticide safety; to distribute protective clothing and masks; to control the quality of imported pesticides; and to address the problem of reuse of pesticide containers for household purposes (rather than disposal).

Measures to Protect the Environment

All of the FAO countries reported that reducing levels of pesticides in the environment was a goal, but they gave little information on related projects. One respondent noted that contamination of the environment is more often than not disregarded, even by farmers who take precautions to protect their health. Two countries had implemented licensing and training programmes for aerial application.

Activities to Reduce Pesticide Use

Restricted Distribution or Availability

Sri Lanka reported success with limitations on the distribution of specific pesticides based on need and the availability of alternatives.

Promoting Sustainable Farming Methods

Several FAO countries described programmes to train farmers to stop prophylactic treatments and apply pesticides only when needed, using threshold levels for pest or pathogen damage. For example, South Africa noted that it had reduced the number of cotton insecticide treatments from 14 to five. Two countries described improved application techniques and equipment that reduced pesticide emissions to the environment.

Alternative Pest Control Practices

Research was being carried out on alternatives to chemical pesticides, including natural enemies and pest-resistant crop varieties, in all the FAO countries. Three countries described projects to implement the use of biological controls against specific pests.

Integrated Pest Management

The survey respondents described a wide range of activities to implement IPM in agriculture. One successful programme mentioned by several countries was the FAO Intercountry Programme for IPM in Rice, which has significantly reduced pesticide use and also improved yield. Several countries also described IPM programmes for plants such as cocoa, citrus and other fruit, and vegetables including beans and chillies.

Green Labelling

Korea reported on its green labelling programmes for organic and pesticide free agricultural products.

Conclusions

The survey showed that pesticide registration has been implemented in most of these developing countries, providing a good basis for risk reduction. However, there is a need for improved efficiency and for harmonization of registration procedures and requirements. Training

is used widely, although it is difficult to measure its success in most developing countries. Safety training is not in itself sufficient, but must be accompanied by the availability of alternative products and practices, as well as increased awareness of the need to protect the environment. Promoting a need-based approach to pesticide use has had some success, but has also been problematic because farmers have so much at stake in the success of their crop and are therefore reluctant to reduce pesticide use. Nevertheless, there has been an increased interest in IPM in recent years, and the success with the rice programme in Asia has sparked interest in expanding this programme to other countries and additional crops.

Developing countries still have many problems and needs related to pesticide use, but they also have significant experience in risk reduction. What is lacking is a co-ordinated framework that would allow them to discuss their experiences, share information, and harmonize regulations at least on a regional level. Development of such a framework might be possible through the regional working groups established as part of the Intersessional Group of the Intergovernmental Forum on Chemical Safety. In addition, developing countries need continued assistance and support from developed countries and the private sector in order to address such problems and needs as: container labelling; development of formulations appropriate for different climates; distribution of protective clothing and equipment; training; disposal; and the introduction and enforcement of maximum residue limits.

Résumé

Le présent rapport rend compte des activités de réduction des risques liés aux pesticides engagées par 20 pays de l'OCDE, la Commission européenne et 8 pays de la FAO (Organisation des Nations Unies pour l'alimentation et l'agriculture) non membres de l'OCDE. Il s'appuie sur une enquête réalisée en 1994 et en 1995 à la demande du Forum sur les pesticides de l'OCDE. Sont visés ici les pesticides employés à des fins ***phytosanitaires*** (agriculture, horticulture et sylviculture), à l'exclusion des autres types d'utilisation.

Ont répondu à l'enquête :

Pays de l'OCDE		Pays de la FAO
Allemagne	Japon	Afrique du Sud
Australie	Norvège	Corée
Autriche	Nouvelle-Zélande	Equateur
Canada	Pays-Bas	Jamaïque
Danemark	Portugal	Malaisie
Espagne	Royaume-Uni	Sri Lanka
Etats-Unis	Suède	Thaïlande
Finlande	Suisse	Zambie
France	Turquie	
Grèce		
Hongrie	Commission européenne	

Le rapport comprend deux parties. La partie 1 porte sur les activités engagées par les pays de l'OCDE et par la Commission européenne et la partie 2 sur celles qui ont été entreprises par les 8 pays de la FAO non membres de l'OCDE. L'une et l'autre suivent le plan du questionnaire utilisé pour l'enquête.

Les différents chapitres sont intitulés comme suit : (1) structures de la réduction des risques ; (2) activités visant à réduire les risques ; (3) activités visant à réduire l'utilisation de pesticides ; et (4) conclusions et recommandations. (Ils sont numérotés de 1.1 à 1.4 pour la première partie et de 2.1 à 2.4 pour la seconde.)

Les réponses fournies par les différents pays, sous une forme plus détaillée que dans le corps du rapport, sont publiées séparemment (voir Foreword).

Partie 1. Activités entreprises par des pays de l'OCDE et par la Commission européenne

Structures de la réduction des risques

Raisons pour lancer des activités de réduction des risques liés aux pesticides

Diverses raisons ont incité les pays de l'OCDE à mettre en route des activités de réduction des risques liés aux pesticides. Le plus souvent, elles sont liées : à un problème de santé ou d'environnement dû à l'utilisation de pesticides ; à l'inquiétude plus générale suscitée par le fait que l'agriculture est tributaire des intrants chimiques et en emploie de grandes quantités ; ou à l'obligation récemment imposée par la société de prendre en compte les objectifs d'environnement dans les politiques et pratiques agricoles. Plusieurs aspects particuliers ressortent des réponses au questionnaire :

- problèmes tels que la résistance aux pesticides développée par l'espèce cible, les atteintes aux cultures en rotation et/ou aux cultures protégées par des herbicides, ainsi que la contamination des ressources en eau ;

- crainte des risques pour les utilisateurs, la population et l'environnement ;

- préoccupations suscitées par l'utilisation croissante de pesticides, à la faveur de l'intensification de l'agriculture, et par la conception de nouveaux produits à haute activité biologique ;

- nécessité de respecter les accords internationaux visant à réduire les rejets de produits chimiques dans les lacs et océans, ainsi que les limites fixées par les pays importateurs pour les résidus de pesticides présents dans les produits alimentaires ;

- souci de suivre l'exemple de certains pays en matière de réduction de l'utilisation de pesticides.

Stratégies de réduction des risques

D'après les résultats de l'enquête, les pays de l'OCDE ont fondé leurs nouvelles activités de réduction des risques sur les programmes établis de longue date pour l'homologation des pesticides, la recherche agronomique et la communication. Par ailleurs, bon nombre de ces nouvelles activités ont en commun une caractéristique essentielle, à savoir la participation des agriculteurs aux projets dès la phase de démarrage, qui les distingue des stratégies réglementaires habituelles et constitue un facteur de réussite déterminant. Les méthodes de réduction des risques retenues par les pays diffèrent sur trois principaux points : les objectifs, la structure et la mise en oeuvre. Toutefois, aucune ne s'avère plus particulièrement concluante ; l'enquête montre même que la diversification des stratégies correspond mieux aux différents pays. On constate également des similitudes de fait entre certaines activités sous-tendues par des stratégies différentes.

Activités visant à réduire les risques

Homologation et renouvellement de l'homologation des produits

Comme l'a confirmé l'enquête, l'homologation des pesticides demeure un élément fondamental de la gestion des risques liés à ces produits pour tous les pays de l'OCDE. De l'avis général, les programmes d'homologation répondent aux attentes, bien qu'ils puissent être lents et exiger d'importantes ressources. Certains pays ont décrit les nouvelles mesures instaurées pour améliorer l'efficacité et l'efficience de leurs programmes d'homologation. Par ailleurs, nombre d'entre eux ont mis en route des programmes de renouvellement de l'homologation pour les pesticides anciens.

Réduction des risques pour les consommateurs : fixation de seuils et surveillance des concentrations de résidus

D'après les réponses, la réglementation applicable aux résidus de pesticides contenus dans les produits alimentaires est une activité de gestion des risques établie de longue date au même titre que l'homologation. Plusieurs pays ont rendu compte des programmes en vigueur pour la surveillance des résidus présents dans les produits alimentaires ou dans l'eau potable. Dans certains cas, les pays ont été conduits à prendre des initiatives de réduction des risques pour respecter les limites de résidus fixées sur d'autres territoires.

Réduction des risques pour les travailleurs

Il ressort de l'enquête que les pays de l'OCDE ont étoffé et élargi leurs programmes sur la sécurité des travailleurs, qui figurent selon eux parmi les moyens les plus efficaces de réduire les risques. De nouveaux programmes ont été signalés dans les domaines suivants : formation et sensibilisation des utilisateurs de pesticides ; habilitation des vendeurs et distributeurs de pesticides ; diffusion d'informations sur la sécurité à l'intention des utilisateurs ; amélioration de l'étiquetage ; aménagement des dispositions relatives à la sécurité des ouvriers agricoles ; conception d'emballages et de formulations contribuant à réduire les risques ; et mise au point de moyens d'élimination adaptés pour les pesticides non utilisés et récipients usagés.

Protection de l'environnement

L'enquête montre que durant les dix années écoulées, de nombreux pays de l'OCDE ont instauré des mesures visant à protéger les eaux souterraines et superficielles de la contamination par les pesticides. Deux des pays intéressés ont évoqué le Traité sur la mer du Nord, tandis que la Commission européenne a décrit des programmes mis en route dans le cadre de la réforme de la Politique agricole commune de 1992. Plusieurs pays disposent également de programmes axés sur la protection des espèces animales et des habitats vulnérables.

Activités visant à réduire l'utilisation de pesticides

Amélioration de l'efficacité et de l'efficience de la lutte antiparasitaire

Tous les pays ont fait savoir qu'ils avaient lancé de nouvelles activités ou développé les activités existantes pour aider les agriculteurs à accroître l'efficacité et l'efficience de la lutte antiparasitaire. D'après la quasi-totalité des réponses, l'amélioration

notable de la prédiction des risques phytosanitaires et la fixation de seuils d'intervention pour de nombreuses cultures ont permis aux agriculteurs de réduire l'utilisation de pesticides. Des résultats concluants ont été par ailleurs rapportés dans les cas suivants : nouveaux programmes d'essai et d'homologation des équipements d'application de pesticides, visant à supprimer le gaspillage et les déperditions accidentelles ; programmes de perfectionnement des techniques et équipements d'application de pesticides ; et recherches sur les conséquences de la réduction des doses appliquées pour la production agricole.

Mise en oeuvre de la lutte intégrée

Tous les pays visés par l'enquête ont engagé des activités concrètes de lutte intégrée durant les dix années écoulées. Des programmes visant la mise au point et l'utilisation d'agents biologiques à cette fin ont été cités dans la quasi-totalité des réponses. Plusieurs pays ont également rendu compte de projets consistant à fournir des variétés résistantes et des végétaux sains aux agriculteurs, certains disposant de programmes axés sur l'élaboration de méthodes non chimiques de lutte contre les ennemis des cultures. Un grand nombre de pays ont instauré des programmes proposant aux agriculteurs des lignes directrices, des informations, des conseils et des stages pratiques relatifs aux méthodes de lutte intégrée. Cinq pays ont évoqué la mise en place de fermes modèles qui assurent la démonstration de ces méthodes et l'information sur la viabilité économique et les avantages environnementaux correspondants. Plusieurs pays ont par ailleurs relaté certaines initiatives prises par des groupes de producteurs pour concevoir et appliquer des méthodes de lutte intégrée qui leur permettent de bénéficier d'un label de l'agriculture biologique ou d'autres avantages commerciaux.

Instruments économiques

D'après les réponses au questionnaire, les pays de l'OCDE ont employé trois types d'instruments économiques pour dynamiser la lutte intégrée et les méthodes biologiques : aides financières au titre des méthodes de production "écologiquement rationnelles" ; labels de l'agriculture biologique conférant aux produits obtenus selon ces méthodes un avantage sur le marché ; et taxes frappant les pesticides pour en augmenter le prix et en décourager l'utilisation injustifiée. Des aides financières ont été accordées par les pays considérés isolément et par la Commission européenne. Selon certains pays, les programmes en la matière s'avèrent concluants. Un plus petit nombre de pays, de même que la Commission européenne, ont évoqué l'emploi de labels de l'agriculture biologique et signalé parfois une augmentation de la demande en faveur des produits qui bénéficient de ces labels. Seuls trois pays appliquent une taxe sur les pesticides pour réduire les utilisations abusives.

Collecte de données sur l'utilisation de pesticides

Selon un grand nombre de réponses, le manque de données sur l'utilisation de pesticides empêche d'apprécier l'état d'avancement de la réduction des risques. En fait, la plupart des pays recueillent des données non pas sur les quantités utilisées, mais sur les ventes. Dans quelques cas, de nouveaux projets visant à rassembler des données par type de culture ont été évoqués.

Programmes nationaux axés sur des objectifs de réduction

De la fin des années 80 au début des années 90, plusieurs pays de l'OCDE et la Commission européenne ont mis en route des programmes intégrés visant à réduire

l'utilisation de pesticides. La Suède, le Danemark et les Pays-Bas, les premiers à avoir opté pour cette solution, ont fait état d'une forte réduction de l'utilisation (même si les objectifs n'ont pas toujours été atteints), les exploitants étant plus sensibilisés aux risques liés aux pesticides et plus déterminés à réaliser les objectifs en la matière. La Finlande, la Norvège et, au Canada, les provinces du Québec et de l'Ontario ont également amorcé des programmes visant à diminuer l'utilisation de ces produits.

Cinquième programme d'action pour l'environnement

En 1992, la Commission européenne a adopté le "Cinquième programme d'action pour l'environnement" pour réduire les incidences des pesticides et instaurer une agriculture durable par les moyens suivants : recherches sur l'utilisation de pesticides, aides financières au titre des pratiques agricoles respectueuses de l'environnement et adoption de politiques et d'instruments nouveaux.

Exemples concluants de lutte intégrée

D'après un grand nombre de réponses, soit les pays n'ont pas encore mis au point les instruments voulus pour évaluer les résultats des projets de lutte intégrée et de réduction des risques, soit ces projets sont trop récents pour donner lieu à des résultats mesurables. Néanmoins, les exemples donnés par cinq pays montrent comment la lutte intégrée a permis aux agriculteurs de mieux maîtriser les ennemis des cultures, de réduire la dépendance vis-à-vis des pesticides chimiques et d'abaisser les coûts de production.

Conclusions

Dans un délai relativement court, les pays de l'OCDE ont acquis une expérience très riche en matière de réduction des risques liés aux pesticides. A partir de cette expérience, les responsables interrogés ont pu déterminer les activités les plus réussies et les facteurs expliquant les résultats obtenus. Ils ont également décrit les difficultés rencontrées et défini des travaux de portée internationale susceptibles d'étayer ultérieurement les programmes nationaux de réduction des risques.

Partie 2. Activités entreprises par certains pays de la FAO

Structures de la réduction des risques

Raisons pour lancer des activités de réduction des risques liés aux pesticides

Les pays de la FAO ont été incités à lancer des activités visant à réduire les risques liés aux pesticides pour des raisons plus ou moins comparables à celles des pays de l'OCDE, bien qu'ils accordent une plus grande importance à la réduction des risques encourus par les exploitants, par les ouvriers agricoles et par leurs familles. Par ailleurs, ont-ils indiqué, les enseignements directement tirés de l'utilisation de quantités excessives de pesticides et l'impératif d'un développement agricole durable ont été d'importants éléments moteurs.

Stratégies de réduction des risques

Les stratégies de réduction des risques liés aux pesticides adoptées par les différents pays de la FAO présentent de nombreux points communs. Bien qu'aucun des pays visés ne dispose de programme expressément consacré à la réduction des risques, tous sont dotés d'une législation (touchant généralement l'homologation des pesticides) qui s'étend aux activités de réduction des risques. Celles-ci, dans le domaine des pesticides, se caractérisent par une coopération étroite entre les ministères, les universités, les hôpitaux, les organisations non gouvernementales, les organismes d'aide internationale et bilatérale, sans oublier le secteur privé. Les pays ont également signalé des problèmes comparables de mise en oeuvre des projets de réduction des risques, notamment : (1) la difficulté de concevoir des programmes et des matériaux de formation adaptés à des exploitants pratiquant une agriculture de subsistance, souvent illettrés, qui parlent des dialectes ou langues très divers et ne perçoivent guère les risques liés à l'utilisation de pesticides ; et (2) le manque de personnel de formation, l'insuffisance des ressources et la médiocrité de l'infrastructure. Par conséquent, ont-ils noté, le seul moyen efficace de réduire les risques à court terme consiste à limiter la disponibilité des pesticides particulièrement toxiques, bien qu'il puisse être délicat à mettre en oeuvre lorsque les agriculteurs savent que ces produits sont utilisés dans d'autres pays.

Activités visant à réduire les risques

Homologation des produits

Pour tous les pays de la FAO visés par l'enquête, l'homologation constitue la première mesure de gestion des risques liés aux pesticides. Pour l'homologation des produits, ces pays se réfèrent aux travaux internationaux et nationaux d'évaluation des dangers et prennent en compte la réglementation appliquée sur d'autres territoires. Les problèmes rencontrés tiennent au fait que des pesticides relativement anciens ont pu être jugés trop dangereux, les organismes chargés de la réglementation ayant alors dû expliquer aux agriculteurs pourquoi il fallait renoncer à des produits qu'ils utilisaient depuis des années. Les pays ont également noté la nécessité d'articuler les mesures réglementaires prises à l'encontre d'un produit donné avec des programmes visant à modifier le comportement et les pratiques des agriculteurs et avec des recommandations tendant à faire adopter des solutions de remplacement disponibles, abordables et

commodes. Plusieurs pays ont mis en route des programmes particuliers pour éliminer les pesticides dangereux.

Réduction des risques pour les travailleurs

Tous les pays étudiés disposent de programmes de formation des agriculteurs, à la manutention sans danger des pesticides et à l'utilisation adaptée et efficace de ces produits. La plupart du temps, cette formation a été assurée en coopération avec l'industrie phytopharmaceutique, des organismes internationaux ou des organisations non gouvernementales. Dans plusieurs pays, il existe également des programmes de formation et d'autorisation des vendeurs et utilisateurs de pesticides. Certains pays ont cité des programmes de formation permettant aux professionnels de la santé de reconnaître et de traiter l'intoxication due à des pesticides. D'autres ont fait état de programmes visant : la diffusion d'informations sur la sécurité des pesticides ; la distribution de vêtements et masques protecteurs ; le contrôle de la qualité des pesticides importés ; et les moyens de parer à la réutilisation des récipients de pesticides à des fins domestiques (alors que ces récipients sont à éliminer).

Protection de l'environnement

Tous les pays de la FAO ont fait part de leur objectif de réduction des concentrations de pesticides dans l'environnement, bien qu'ils n'aient guère fourni d'informations sur les projets correspondants. Pour l'un d'entre eux, la contamination de l'environnement est le plus souvent ignorée, même par les agriculteurs soucieux de protéger leur santé. Dans deux pays, des programmes d'autorisation et de formation ont été mis en oeuvre pour l'application par voie aérienne.

Activités visant à réduire l'utilisation de pesticides

Mesures limitant la distribution ou la disponibilité

Le Sri Lanka a fait état des résultats concluants de mesures limitant la distribution de pesticides particuliers, compte tenu de la nécessité et de la disponibilité de solutions de remplacement.

Promotion de méthodes pour une agriculture durable

Plusieurs pays de la FAO ont signalé des programmes grâce auxquels les agriculteurs apprennent à renoncer à des traitements préventifs et à appliquer des pesticides uniquement si la situation le justifie, en se référant à des seuils de nuisibilité imputables aux ravageurs et aux agents pathogènes. Par exemple, l'Afrique du Sud a ramené de 14 à 5 le nombre de traitements insecticides dans le cas du coton. Dans deux pays, l'amélioration des techniques et équipements d'application a permis de réduire les émissions de pesticides dans l'environnement.

Autres pratiques de lutte antiparasitaire

Dans tous les pays de la FAO, des recherches ont été entreprises sur des solutions aptes à remplacer les pesticides chimiques, passant par l'introduction d'ennemis naturels et de variétés de cultures résistant aux organismes nuisibles. Trois pays ont signalé des projets de lutte biologique contre des ravageurs particuliers.

Lutte intégrée

L'enquête fait ressortir un large éventail d'activités axées sur la lutte intégrée en agriculture. Plusieurs pays ont notamment cité les résultats concluants du Programme inter-Etats de la FAO pour la lutte intégrée sur le riz, qui a fortement contribué à réduire l'utilisation de pesticides et à augmenter le rendement. Dans un certain nombre de pays, il existe également des programmes de ce type pour le cacao, pour les agrumes et d'autres fruits et pour des légumes tels que le haricot et le piment fort.

Labels de l'agriculture biologique

La Corée a rendu compte de ses programmes d'attribution de labels de l'agriculture biologique aux produits agricoles obtenus par des méthodes biologiques sans application de pesticides.

Conclusions

Il ressort de l'enquête que l'homologation des pesticides, mise en oeuvre dans la plupart des pays en développement considérés, constitue une base solide pour la réduction des risques. Toutefois, l'efficience et l'harmonisation des modalités et conditions d'homologation sont à améliorer. La formation est largement répandue, bien que ses résultats soient difficiles à apprécier dans la majorité de ces pays. La formation à la sécurité, insuffisante par elle-même, doit aller de pair avec l'offre de produits et pratiques de remplacement et avec une sensibilisation accrue à la nécessité de protéger l'environnement. Les initiatives en faveur d'une utilisation des pesticides fondée sur les besoins s'avèrent relativement fructueuses, mais entraînent également des difficultés car les agriculteurs, qui misent sur la réussite de leur production, hésitent à diminuer l'emploi de ces produits. On note néanmoins depuis quelques années un intérêt croissant pour la lutte intégrée, tandis que les résultats du programme appliqué au riz en Asie incitent à étendre celui-ci à d'autres pays et à des cultures différentes.

Les problèmes et les besoins liés aux pesticides demeurent préoccupants dans les pays en voie de développement, qui ont cependant acquis une expérience non négligeable en matière de réduction des risques. Manque encore un mécanisme de coordination permettant à ces pays d'échanger leurs expériences, de mettre en commun les informations utiles et d'harmoniser les réglementations, du moins à l'échelle régionale. La mise en place de ce mécanisme pourrait être assurée par les groupes de travail régionaux créés dans le cadre du Groupe inter-sessions du Forum intergouvernemental sur la sécurité chimique. Par ailleurs, les pays en voie de développement ont besoin de l'assistance et du financement permanents des pays développés et du secteur privé pour remédier aux problèmes et répondre aux besoins dans les domaines suivants : étiquetage des récipients ; mise au point de formulations adaptées à différents climats ; distribution de vêtements et d'équipements de protection ; formation ; élimination des pesticides ; et instauration et respect de limites maximales de résidus.

Introduction

During the last ten years, OECD and FAO countries have initiated a wide variety of activities to reduce the risks associated with pesticide use. These activities have added a new dimension to national pesticide policies and programmes. Whereas countries previously concentrated on the assessment and management of risks associated with individual chemicals, the new activities aim to reduce risks associated with pesticide use in general. And whereas countries previously relied on regulatory action to achieve their goals, they have begun using co-operative approaches that engage pesticide users as partners. These changes have broadened both the scope and the method of national pesticide programmes, and have created new opportunities for risk reduction.

This report describes the pesticide risk reduction activities under way in 20 OECD countries, the European Commission,[1] and eight non-OECD FAO countries. It also discusses the countries' accomplishments and summarises their views on what is needed to make a risk reduction project successful. The report focuses exclusively on pesticide use in ***plant protection*** (i.e. agriculture, horticulture and forestry) and does not consider other pesticide uses.

The report is based on a survey conducted in 1994-95 at the request of the OECD Pesticide Forum.[2] Its purpose was to provide a starting point for OECD and FAO countries to share information about ways to reduce pesticide risks. The survey questionnaire was sent to national governments and the European Commission (EC). The questionnaire did not attempt to define risk (an issue that is addressed in other OECD studies), but simply asked countries to describe all the activities they were engaged in that contributed to pesticide risk reduction. Countries were asked to describe activities initiated by government authorities, by non-governmental organisations such as farm and environmental groups, and by the pesticide industry.

The countries which responded to the survey are identified in the table below. It should be noted that the smaller number of FAO countries does not reflect a lack of interest in the survey. Rather, the intention was to include only a selection of developing countries so as to obtain an idea of their activities and the issues with which they were most concerned while keeping the survey a manageable size.

OECD countries			FAO countries
Australia	Hungary	Turkey	Ecuador
Austria	Japan	United Kingdom	Jamaica
Canada	The Netherlands	United States	Korea
Denmark	New Zealand		Malaysia
Finland	Norway	European Commission	South Africa
France	Portugal		Sri Lanka
Germany	Spain		Thailand
Greece	Sweden		Zambia
	Switzerland		

[1] The European Commission participates in the work of the OECD.

[2] Most countries responded to the survey in 1994, but several did so in 1995. All the respondents had the opportunity to review drafts of the survey report produced in 1995.

The report is divided into two parts. Part 1 describes activities under way in OECD countries and the European Commission. Part 2 describes activities underway in the eight non-OECD FAO countries. Parts 1 and 2 are structured similarly. Both include chapters on (1) frameworks for risk reduction, (2) activities to reduce risks, (3) activities to reduce pesticide use, and (4) conclusions and recommendations. These chapters are numbered 1.1 through 1.4 and 2.1 through 2.4, respectively.

With regard to chapters 1.2 and 2.2 (activities to reduce ***risks)*** and chapters 1.3 and 2.3 (activities to reduce pesticide ***use***), it should be noted that this division was used in the interest of clarity and simplicity, notwithstanding the fact that risk- and use-reduction activities are often not easily differentiated (most activities that reduce risk also reduce use, and vice-versa), and that reducing use is not always the express goal of the activities addressed in these chapters. This division nevertheless provided a useful way to separate the activities that address specific risks from those aimed at pesticide use in general.

It should also be noted that the report describes many specific activities in countries. Readers should be aware that these activities are just examples drawn from a few countries' experiences, and that they do not represent all such activities under way. Other countries which took part in the survey may also have activities in a given area; there was simply not enough space to include them all.

Finally, readers should note that countries' individual responses to the survey questionnaire have been published separately and in greater detail (see Foreword).

Part 1

Activities in OECD Countries and the European Commission

Respondents:	
Australia	New Zealand
Austria	Norway
Canada	Portugal
Denmark	Spain
Finland	Sweden
France	Switzerland
Germany	Turkey
Greece	United Kingdom
Hungary	United States
Japan	
The Netherlands	European Commission

1.1 Framework for Risk Reduction

Reasons for Initiating Activities to Reduce Pesticide Risks

OECD countries have initiated pesticide risk reduction activities for a variety of reasons. Some countries reported that a particular problem caused by pesticide use had been a catalyst for action. Others described a more general concern that agriculture had become overly dependent on chemical inputs and used them to excess, posing a variety of potential risks to human health and the environment and reducing the efficacy of the chemicals themselves. Finally, some countries said they embarked on pesticide risk reduction in response to a social mandate to incorporate the goal of environmental protection into agricultural policy and practice.

The survey respondents noted specifically:

the need to address problems such as:

- development of resistance to pesticides by the target pest
- damage to successive (rotational) crops and/or to the crop being protected by herbicides
- contamination of water resources;

a general concern about possible adverse effects of pesticides, particularly:

- user risks
- unknown ecological effects (notably on non-target plants and wildlife)
- effects of exposure to residues in food, water, soil and air;

concern about trends in pesticide use and agriculture, such as:

- the increased use of pesticides that has accompanied the intensification of agriculture
- the development of new products that are highly biologically active;

response to international trends or obligations to:

- reduce chemical emissions to lakes and oceans
- reduce pesticide use generally
- comply with national or international maximum residue levels for food.

Risk Reduction Approaches

OECD countries had a common starting point for pesticide risk reduction, in that nearly all had well-established pesticide registration programmes that provided comprehensive data on pesticide risks and procedures for evaluating them. In addition, virtually all these countries operated agricultural research programmes and well-developed networks with the farming community through agricultural extension services that advise farmers about pest control and offer training on the use of new technologies. All countries had used their experience and existing programmes in these areas as a basis for their new risk reduction activities.

Many risk reduction activities share a characteristic that differentiates them from standard regulatory approaches, and that countries reported was key to their success: the involvement of farmers in projects from the very start, so that they can help set goals and determine how to reach them. The importance of this involvement was reflected in statements made by many of the survey respondents that the sharing of responsibility between government and pesticide users will be essential to solving environmental problems in agriculture in the future.

Despite these general similarities, the survey found that countries' approaches to risk reduction differed in three areas:

1) **Goals:** Some countries have set a goal of ***reducing the total quantity of pesticides used*** and consider this goal as a starting point for a wide variety of activities aimed at introducing new pest control methods, improving pesticide application equipment, etc. Other countries believe that use reduction is not a valid goal because reducing use does not necessarily reduce risk (e.g. if smaller quantities of a more toxic pesticide are used). These countries have therefore set such goals as ***minimising pesticide use***, ***reducing reliance on chemical pesticides***, or ***increasing the use of integrated pest management***, which have similarly been used to launch projects and activities.

2) **Structure:** Some countries have instituted a comprehensive ***national pesticide risk reduction programme*** as a way to set national goals and to co-ordinate the various projects involved. Others have initiated ***ad hoc risk reduction projects*** within their existing pesticide and agriculture programmes.

3) **Implementation:** Some countries favour ***mandatory*** participation by farmers in their risk reduction projects, saying this contributes to project success. Other countries' experience has been just the opposite — they have had better success when participation was ***voluntary***. Many countries use a combination of the two, for example requiring all farmers to meet a certain goal but allowing them freedom to choose the method. In addition, a growing number of activities have been initiated on a voluntary, co-operative basis by farmers, food retailers, the pesticide industry and environmentalists.

The survey did not point to one particular approach to risk reduction that is most successful; rather, it found that different approaches appear to work best in different countries. The survey also showed that, in actual practice, activities carried out using different approaches are often similar.

1.2 Activities to Reduce Risks

Product Registration/re-registration

Pesticide registration has been, and continues to be, the foundation for pesticide risk management in all OECD countries. Registration programmes are based on an evaluation of test data, showing the pesticides' possible health and environmental risks as well as their efficacy in controlling the target pest or disease. In general:

- Products whose risk is judged to be reasonable in light of their benefits can be registered. Label directions, which are legally enforceable, list approved uses and describe safety measures to be followed.

- Products judged unsafe are not registered, or are registered with restrictions to minimise their risks. These restrictions — allowing use only by specially trained people, or only with protective equipment, etc. — are indicated on the product label.

- Registered products that are subsequently found to be unsafe (e.g. based on new information) can be restricted or banned, with their registration modified or cancelled.

Many countries have now supplemented their registration programmes with ***re-registration*** programmes to bring the test data on older pesticides up to modern standards. Re-registration has been given high priority in many countries because knowledge about possible adverse effects has grown considerably during the last two decades, and data requirements and hazard evaluations have become much more comprehensive. Several countries have instituted a continuous re-registration system, whereby every pesticide must be reviewed and its registration renewed on a regular basis, such as every five years. Products may be re-registered with their new, complete databases or, if important new risks are identified, they may be banned or restricted.

OECD countries reported that registration and re-registration programmes have been successful. The survey respondents noted that these programmes have generated a tremendous body of information about pesticide risks, and have been used to ban pesticides like DDT, aldrin and dieldrin that were once widely used.

Nevertheless, several survey respondents identified problems or inefficiencies in their registration programmes. Most importantly, some noted that these programmes are slow and resource intensive for both registrants and government authorities. Registration of new products can take years, even when a product is safer than existing alternatives and could contribute to risk reduction. Cancellation of high-risk products can also be slow and extremely expensive for government authorities if the registrant contests the cancellation in court, as often occurs.

Such problems have prompted a number of OECD countries to change or supplement their registration programmes in order to achieve more effective and efficient risk reduction. For example:

Measures to Encourage Development and Registration of Safer Products

- Most countries have required registrants to use inert ingredients of low or no toxicity in pesticide formulations.

- Some countries apply reduced data requirements for low-risk biological pesticides (or biopesticides), or have established entirely new requirements, to facilitate registration and allow these products to be placed on the market more quickly.

- Sweden and Norway have created a product substitution programme that allows safer new products to replace older products, registered for the same purpose, that exceed set levels of risk to health or the environment. Sweden also has the authority to refuse registration if equally effective, non-chemical methods are already available for the same purpose.

- Switzerland has a reduced registration fee for biopesticides which are shown to have no adverse side effects.

- The United States has begun two new programmes that give priority treatment in the review process to pesticides that are safer than other products already on the market for the same purpose. Under the Reduced-Risk Pesticide Initiative, which deals with chemical pesticides, the US has received 18 applications for new active ingredients. Three of these have been approved and products containing them have been registered; eight have been approved for priority review; eight have been rejected; and two others are under consideration. Meanwhile, the creation of a new Biopesticides and Pollution Prevention Division (see information provided by the US in Chapter 1.3) has permitted the rapid registration of many new biological products.

Measures to Eliminate Hazardous Pesticides More Quickly

- Austria adopted strict conditions for approval in 1991 that have greatly reduced the number of pesticides registered.

- The Canadian province of British Columbia is working to develop a pesticide classification system to serve as a basis for reducing or eliminating high-risk products and identifying lower-risk pesticides for use on public lands, especially forests.

- Denmark has passed a law prohibiting the use of products containing any of seven named active ingredients and has altered procedures in order to make cancellation of high-risk products easier. This step was taken after legal proceedings, possible under the old system, blocked the removal from the market of products containing some 25 active ingredients whose re-registration had been refused.

- Germany can use a special Plant Protection Use Ordinance, passed in 1971, to ban or restrict pesticides quickly without having to prove risk or face a court case. To date, the German Parliament has used the ordinance to ban 44 active substances. This is done by a vote to amend an annex to the ordinance which lists banned or restricted substances. The German ministries as well as Parliamentary representatives can propose such amendments, and the ministries can provide expert advice to be used in the decision.

- Sweden and Finland use phase-out plans for products identified as posing unacceptably high risks, for which there are no available alternatives and which are therefore difficult to cancel.

- The United States has begun using voluntary "settlement agreements" with pesticide registrants as a faster and less expensive alternative to regulatory action. Under such an agreement the registrant might, for example, phase out some or all uses of a product over a period of a few years.

Reducing Consumer Risks: **Setting and Monitoring Residue Levels**

Regulation of pesticide residues in food has accompanied registration as a long-standing risk management activity in OECD countries. Maximum residue levels of a pesticide on food crops or animal feed — representing the highest permissible levels of a pesticide that can occur — are generally set at the time of registration, based on the levels that would be expected to occur and that pose an acceptable risk to consumers. Some of the survey respondents referred to their use of internationally agreed levels; others use levels set nationally. Several countries noted that the need to comply with other countries' residue limits caused them to initiate risk reduction efforts for export crops.

Several survey respondents described their programmes to monitor pesticide resides in food. These include programmes like those found in Australia, which has: (i) a National Residue Survey under which raw food and other agricultural commodities are regularly tested for a wide range of chemicals used in production, (ii) a Market Basket Survey under which food eaten in typical diets, purchased from retail stores and prepared for eating, is sampled and analysed; (iii) an Export Residue Testing programme used to ensure that food for export does not contain high residues; and (iv) State Residue Surveys, which use random surveys of raw agricultural produce to complement the national survey or to identify specific problems. In addition to the food monitoring programmes, a few countries mentioned programmes to monitor pesticide residues in drinking water.

Reducing Worker Risks

Farmer Training and Education

Signs of an increased focus on risk reduction can be found in countries' pest control training and education programmes for farmers. Generally run by field offices of the agriculture ministry, these programmes have existed for decades. However, survey respondents noted that in recent years the programmes have devoted much more time to safety and environmental protection than ever in the past. The following examples show this risk reduction focus:

- Australia offers farm chemical users' courses focusing on the safe handling of pesticides, in addition to its extension programmes which concentrate on cost-effective pest and disease management. The chemical users' courses are usually run by agricultural colleges and developed in association with the state departments of agriculture, farmers' organisations, and the chemical industry. More than 30,000 farmers have completed a course, and there is evidence that farmers are more aware of the need to use chemicals safely.

- In July 1995, Canada completed a new national standard for pesticide education, training and certification. The standard was developed by a federal-provincial task

force, and will be implemented through the provinces as resources permit. All provinces are currently training and certifying applicators and vendors.

- Denmark, Germany, the Netherlands, Norway, Sweden and Switzerland require all people who use pesticides, and in some cases who supply, sell or store them, to be trained and certified. Sweden says its requirement, established in 1990 and covering all farmers and farm workers who spray, is one of the country's most successful risk reduction activities. All professional users of spray equipment (roughly 30,000 people) have completed the three- to four-day training course required to obtain the certificate. Switzerland also notes that its training and certification programmes (required since 1971 for those involved in trade in pesticides) have greatly reduced poisoning incidents.

- France conducts training courses for pesticide handlers/applicators aimed especially at increasing acceptance and use of protective clothing and equipment. The courses also cover safety rules for handling pesticides before, during and after crop treatment, including storage, preparation of mixtures, and equipment cleaning.

- Japan's National Federation of Agricultural Co-operative Association holds training meetings for farmers, distributes pamphlets and videos, and certifies pest control instructors who have sufficient knowledge to instruct farmers on safe pesticide use. Japan produces an annual report, with input from each of the 47 prefectures, on the number of poisoning cases that year. The number of pesticide poisonings has decreased since an agricultural chemicals safety campaign was begun in 1953.

- In New Zealand, primary producer groups established an organisation in 1992 called the New Zealand Agrichemical Education Trust, or NZAET, with the objective of educating both farmers and the general public about the safe, responsible and effective use of pesticides. To date, NZAET has established a one-day standard course (taken by 5,000 people) and a three-day advanced course (taken by 200) covering pest management, the properties and mode of action of common chemicals, principles of application, potential impacts, and obligations of users. NZAET has also produced an education kit for schools. New Zealand's agricultural ministry has a representative on NZAET.

- Spain initiated a farmer/farm worker programme in 1987, aimed at promoting the use of personal protective equipment to be worn when applying pesticides. The programme used a variety of communication systems including television, videos, radio, and on-the-farm demonstrations to convey its message. It also supplied farmers with protective material like masks and gloves. Spain finds that farmers and farm workers are using the material and that reports of poisoning incidents have decreased.

- Many countries require users of the most toxic pesticides to be trained and certified, or to work under someone who is. Some countries also restrict pesticide sales based on the buyer's level of training. In Hungary, for example, category I pesticides can be sold only to experts with a university degree; those in category II can be sold to training farmers; and those in category III are available to all.

- The agrochemical industry, often working with state extension services, has provided training on safe use, handling and disposal of pesticides in many OECD countries.

Accreditation of Dealers and Distributors

Licensing of pesticide dealers and distributors has also been a part of many OECD countries' pesticide regulatory programmes. Several countries described regulations that require pesticide dealers and distributors to have on their staff a certain number of employees who have taken a special training course and can provide guidance to sellers and clients. A number of countries have improved their programmes or added new requirements, as in the following examples:

- In Australia, the industry has established an accreditation programme for chemical retailers, under which participating companies will supply chemicals only to retailers and retail staff who have completed a training programme and whose facilities meet approved standards. Australia notes that more than 1,000 premises have already been accredited, and that the safety standard of retailers has improved noticeably.

- In Canada, the pesticide industry led an initiative to institute national warehousing standards covering building construction, employee training, documentation of hazards associated with products, a maintenance programme, insurance, and an emergency response plan. Companies supported a "no certificate, no ship" clause, refusing to ship products to dealers and distributors who were not in compliance with the standards. By mid-1995, 1,260 warehouses across Canada were in compliance.

- In France, regulations and a training programme for pesticide distributors and professional applicators, similar to those used in Canada, have recently been initiated.

Distributing Information to Users

To supplement their farmer training and education programmes, many OECD countries have developed written and audio/video materials on using pesticides safely. In one of the largest efforts mentioned in the survey, the US distributed nearly 2 million pesticide handbooks for users and 500,000 safety posters as part of a new federal regulation on farm worker protection. Switzerland has also distributed widely, and used in its farmer/farm worker training courses, a set of brochures developed in a government-industry co-operative effort. Several countries also mentioned materials aimed at pesticide users other than farmers. In Denmark, for example, there is a handbook for gardeners on non-chemical pest control in green areas. The U.S. Environmental Protection Agency brochure on environmentally friendly lawn care is one of its most popular publications on pesticides.

Improving Labels

All OECD countries have depended on pesticide labelling, with it use directions and hazard warnings, to ensure that farmers and others use pesticides (and store and dispose of them) properly. Yet they acknowledge that labelling is a less than perfect risk-management tool: users are prone not to read labels thoroughly, and labels can be so crowded with information that they are difficult to decipher. Improving labels is not a simple task, however, because their format and content are generally governed by regulations and are set during the registration procedure. Several countries have nevertheless taken on the task. For example:

- Australia, Japan, New Zealand, Turkey and the US are working to make labels easier to read and directions easier to follow.

- Denmark prohibits the sale of a pesticide if the label gives the impression that the product poses no risks (Denmark also requires product advertising to draw attention to the product's danger category).

- The Netherlands and the US are developing better labelling with respect to worker protection.

- Switzerland requires labels to be written in at least two of the country's three official languages.

- The United States is developing labels for non-agricultural products that will help people make an informed choice.

Farm Worker Safety Regulations

Three countries responding to the survey discussed new regulations to protect farm workers from risks associated with pesticide contact. Switzerland issued new regulations in the early 1990s governing safety standards for pesticide use and handling. During the same period, the US issued new regulations that mandated longer waiting periods before farm workers could enter treated fields, required employers to supply protective equipment and to make soap and water available to workers in the field, and mandated distribution of information to workers via safety posters, handbooks, etc. (see “Distributing Information to Users” above). Hungary is also preparing new worker protection regulations.

Product Packaging and Formulation

Innovations in pesticide product packaging have helped reduce worker risks in some OECD countries. Canada and the US described the following closed-system mixing strategies developed by the agrochemical industry to reduce, or eliminate altogether, user exposure:

- *Soluble packaging:* This system uses pre-measured packages containing dry chemical formulations that are sealed in a dissolvable pouch. The pouch is dropped into the spray tank where it dissolves. The product is never touched, and there is no leftover packaging to discard. The pouches are carried in a moisture-proof bag or box that can be easily discarded since it never comes in contact with the product.

- *Effervescent tablets:* Tablets containing the pesticide are dropped into the spray tank where they dissolve completely. As with the soluble packaging, the worker does not come into contact with the product, nor is there any dust or leftover debris or pesticide container to rinse.

Canada also noted that industry has developed new formulations, including gels, dry flowables, and water-dispersible granules, which reduce occupational exposure through inhalation. In addition, Canada said some companies are supplying protective equipment such as gloves in the packaging of more toxic products.

Japan described several improvements in application technology that have reduced applicator exposure, including more protective and comfortable protective clothing and masks, operatorless pesticide application machines for use in greenhouses, and an application system for rice paddies, in which the pesticide formulation is poured in at the water inlet of the paddy field and then spreads uniformly over the field.

Finland noted that although packaging and formulation generally fall into the domain of product development by manufacturers, governments can nevertheless influence such developments by setting requirements for making products more user-friendly or encouraging the use of closed-system mixing methods.

Disposal of Leftover Pesticides and Containers

During the last five years, many OECD countries have initiated programmes to deal with both pesticide containers and stocks of old products whose registrations have been cancelled or expired, but which are still stored on the farm because farmers had no good way to dispose of them. These programmes are generally organised at the state level, especially in the larger countries.

Some countries have also tried to reduce disposal problems by advising farmers not to stock pesticides in the first place, and by allowing leftover products and empty containers to be returned to the supplier or, in the case of waste products, to the appropriate authorities for disposal.

Protecting the Environment

Protecting Water Resources

Protecting water resources from pesticide contamination has become an important concern in many OECD countries. The widespread discovery of residues in both ground and surface waters during the late 1980s and early 1990s — suggesting that existing risk management measures were insufficient in this area — prompted actions at the local, national, and international levels. Countries reacted by:

- tightening their restrictions for filling and cleaning sprayers near water sources;
- establishing protective "buffer" zones between crops and waterways, where spraying is prohibited (in Germany, for example, more than 2,200 kilometres of bordering strips are under protection); and
- prohibiting the use of pesticides known to leach, either in general or in areas where ground water is vulnerable.

Countries also initiated actions such as the following:

- Austria has established ground and surface water monitoring programmes, with 2,050 ground water surveying sites (1,500 now operating) and 243 surface water sites.
- The national government of Canada in 1994 began regional projects with Quebec, to reduce pollution of the St. Lawrence ecosystem, and with Ontario, to restore and protect species, populations and habitats in the Great Lakes Basin Ecosystem. Under the St. Lawrence project, the goal for agriculture is to reduce pesticide use by 50 per cent. The Great Lakes project sets goals and targets to reduce or eliminate pesticides that are persistent and bioaccumulative. Some elements of these projects are voluntary, others mandatory.

- Finland has made a commitment to reduce emissions of pesticides (and other chemicals) under the Baltic Sea Treaty, and has prohibited ground water pollution by law, setting special restrictions on the use of pesticides in areas where ground water is vulnerable. No-spray safety zones of 5-25 metres are set to protect surface waters, and no pesticides are registered for use in Finnish waters.

- France initiated both regional and national water resource protection projects, beginning in 1990. The first was a regional effort in Brittany prompted by the discovery of pesticide residues in surface water. Studies were carried out on the state of the water contamination, the impact of pesticide treatments on crops near watercourses, the importance of runoff from transfer sites, and the importance of non-agricultural pollution. Since then, projects have begun in several other regions, combining research, monitoring of contamination, and actions to encourage farmers to use recommended practices.

  A national effort to protect water resources from agricultural pollution, directed by an interministerial committee, was initiated in 1992. The committee has established lists of active substances that must be monitored in water sources, based on the probability of their presence and potential risks. A second committee, which includes industry and farm organisations as well as government ministries, is publishing general recommendations on farming practices that will protect both crops and water resources. Next, the committee plans to publish methods for diagnosing pollution and its causes which can be used for a water basin or region.

- Germany has prohibited spraying on or near surface and coastal waters. Germany and Switzerland have prohibited the use of certain products in water catchment areas.

- Germany and the Netherlands have used two different approaches to conform to the European Union drinking water regulation that sets limits for chemical contaminants. Germany has initiated a voluntary activity involving 35 special advisors, farmers, public water suppliers, and an institute for water chemistry and technology. The goal is to raise consciousness about risks and the impact of farm practices. The Netherlands has adopted a policy of cancelling any pesticide found to leach at concentrations exceeding 0.1 μg/litre after a transport time of four years, at a depth of 10 metres below ground level. Also at 10 metres below ground level, the sum of pesticide concentrations must not exceed the limit of 0.5 μg/l.

- Japan has established directions for the proper use of agricultural chemicals so as to prevent damage to aquatic animals, prevent water pollution, and minimise risks from aerial application. It has also set limits for levels of pesticides in paddy water, established guidelines and monitoring for pesticides used on golf courses, and identified pesticides that pose water pollution risks and cannot be used in vulnerable areas without special permission.

- The Netherlands has restricted the use of soil disinfectants to once every four years, with a prescription for use required. It is also pursuing a policy to get greenhouse crops out of the soil and into substrate cultivation, as a way to halt contamination of surface water. In these substrate cultivations, water will be circulated in closed systems and waste water will be treated either on the premises or in a treatment plant before being discharged.

- The United Kingdom monitors ground and surface water for pesticides and is now developing a policy for water management on a catchment area basis. The idea is to identify local problems involving pesticide contamination and develop strategies to address them. The UK also monitors pesticides at a network of estuarine, intermediate and offshore sites, in line with its commitment under the North Sea Treaty to reduce emissions of certain pesticides (see below).

- The United States initiated a national ground water protection strategy in the early 1990s, beginning with a survey of pesticide residue levels in wells and followed by development of state plans for managing or, if necessary, eliminating pesticide use in areas where ground water is vulnerable. Outreach to farmers, and development of a model to estimate the leaching potential of pesticides and criteria to determine the likelihood of ground water contamination, are also parts of the strategy.

  The US also has special projects to prevent pesticide runoff into the Great Lakes and the Chesapeake Bay. Environmental organisations play a leading role in both cases, co-ordinating efforts with local farmers and with local, state and national authorities. For example, the Great Lakes Agricultural Pollution Prevention Project, begun in 1993 by the World Wildlife Fund, includes demonstration farms managed by local farmers who have reduced their reliance on pesticides. Information is collected on the farms' costs and yields.

International or regional water protection projects have also been initiated, including these two which were mentioned by survey respondents:

- The European Commission has established programmes under the 1992 Common Agriculture Policy Reform which offer subsidies to farmers who create unsprayed buffer zones. One type of subsidy provides a payment per hectare, with pesticide treatments allowed only in exceptional cases, such as to control certain weeds. The other type is for establishing unsprayed zones at least 12 metres' wide at especially sensitive areas.

- France, Norway and the United Kingdom all noted their commitments to reduce emissions of certain pesticides under the North Sea Treaty, an agreement which has prompted the nine participating countries to consider ways to protect this sensitive resource and has given them an opportunity, at meetings held approximately every three years, to evaluate their progress and refine their objectives. Among other things, the Treaty has called for countries to (1) ban or restrict 18 pesticides, and (2) reduce by 50 per cent emissions near ocean water of 36 other pesticides. The participating countries have also recommended a variety of other measures to protect the North Sea, including developing codes of practice for environmentally friendly farming, applying economic instruments that encourage environmental protection, increasing water monitoring, cancelling dangerous products, and collecting data on pesticide use and sales.

  Since 1985, when the Treaty was first signed, France has reduced by 50 per cent or more the use of several pesticides targeted by the agreement: HCH (lindane), simazine and atrazine, azinphos-methyl, fenitrothion, fenthion, malathion, and dichlorvos. The UK similarly notes reductions in the use of atrazine (50 per cent) and azinphos-methyl (60 per cent). France has also achieved smaller reductions in the use of three other listed pesticides: trifluraline, endosulfan, and parathion-methyl.

Protecting Sensitive Species and Habitats

By comparison with the increased attention to water resources, activities to protect vulnerable species and habitats seem less common among OECD countries. Several activities were reported, however, including the following:

- Several countries have placed tighter restrictions on pesticides that are toxic to honey bees, and/or to fish or other aquatic organisms. Japan restricts chemicals that are toxic to silkworms.

- Several countries have restricted or banned aerial spraying. For example: Denmark and Switzerland have placed such severe restrictions on aerial spraying, including the need to obtain a special authorisation, that it seldom occurs (in Switzerland only about 2,000 hectares of vineyards are aerially sprayed every year). Finland allows aerial spraying in forests only in very exceptional cases, and aerial spraying in general seldom occurs. Sweden has banned aerial spraying altogether.

- Japan prohibits aerial spraying for pine bark beetles in pine forests that are habitats for endangered plants and animals.

- The United Kingdom has begun funding farmers to practice traditional farming techniques for the benefit of the environment, under its Environmentally Sensitive Area Scheme. This programme started in 1987, following political concern over agricultural intensification leading to environmental damage. It focuses on preserving vulnerable wildlife habitats and environmentally sensitive areas and moorlands. The programme includes restrictions on pesticides, but has no specific goals for reduced use.

  The UK is also researching the effects of pesticides on non-target species, and is modelling the risks associated with pesticide application to agricultural land, including effects on microbial biomass and leaching to surface waters.

- The United States is gradually implementing a programme to protect endangered and threatened species from pesticides. Developed in 1989, the programme is run at a county level, and is based on maps and bulletins that outline the species' habitats and specify limits on pesticide use. Compliance with the bulletins is legally enforceable.

  The US is also conducting research aimed at recommending ways to change land use and farming practices so as to reduce environmental impacts. One project is looking at how improved farm management (in terms of pesticide and nutrient applications and animal husbandry) reduces non-point source pollution. A second project is studying rates and pathways of chemical movement, exposure of biological systems to agrochemicals, and effects of exposure.

1.3 Activities to Reduce Pesticide Use

Increasing Pest Control Efficiency and Effectiveness

Pest Forecasting and Treatment Thresholds

Virtually all of the survey respondents noted the importance of agricultural authorities' advice to help farmers reduce pesticide use while keeping crop pests under control. Nearly all said their agriculture ministry regularly issues bulletins with pest and disease forecasts and advice on crop protection. These bulletins help farmers optimise pesticide use and consequently reduce it. In addition, several survey respondents said that, in recent years, the bulletins have given increased attention to reducing and better targeting pesticide use. Research in two areas has helped make this possible:

- Pest forecasting, based on meteorological data and pest monitoring devices such as pheromone traps, has improved.

- Treatment thresholds that indicate when pest or pathogen levels in crops are sufficiently high to warrant pesticide treatment, offering farmers an alternative to routine application, have been developed for many crops.

Countries have also applied new technology, such as user-friendly PC-based systems, to get information quickly to extension agents and farmers.

Several countries noted that the use of forecasts and thresholds is now widespread, with significant reductions in pesticide use. For example, Germany reported that herbicide use can be reduced by 25 to 30 per cent with equally effective control. Greece noted that farmers growing sultana grapes on the island of Crete have reduced the amount of insecticides used to control *Lobesia botrana* by 35 per cent during the last ten years through pest forecasting and use of treatment thresholds. Austria reports that forecasting and thresholds have helped accomplish an overall drop in pesticide use by as much as 50 per cent, depending on the crop.

Testing and Certification of Application Equipment

Several survey respondents described the success of programmes to test and certify pesticide application equipment. The purpose is to eliminate waste and spillage from faulty equipment. Some countries have made these programmes mandatory, other countries have made them voluntary. Finland and Switzerland have made equipment certification a requirement for farmers who apply for environmental subsidies. Several countries reported that their programmes had shown that existing equipment is even more defective than expected.

Several countries noted their progress to date with testing and certification programmes (figures for the end of 1994):

- Sweden has inspected 11,000 sprayers and aims to test at least 1,500 a year.
- Finland has inspected 7,000 sprayers. It requires sprayers to be retested every five years.
- Norway has certified about 5,000 sprayers.

Improving Application Technology

Many OECD countries are engaged in research to improve pesticide application techniques, making application more efficient, better targeted and better timed, and thereby reducing overall emissions to the environment. Considerable progress has been made. The following examples give an idea of the scope of this work and the possibilities for use reduction:

- Australia has developed or refined:
  - rope-wick and carpet-wick applicators which allow more specific targeting of erect weeds in crops and pastures;
  - a "Detectspray" unit which uses electronic sensors to detect the presence of weeds in a fallow paddock and activate the spray unit only when required;
  - band spraying techniques used in direct-seeding of crops and pastures;
  - techniques which direct the pesticide spray unit only at those parts of the plant where the target pests or diseases are normally found;
  - "spray topping" techniques by means of which herbicide is directed, at a low rate, specifically at the seed head of annual grass weeds in pastures to kill the seed head.
- In Canada, a spray efficacy research group made up of federal, provincial and industry representatives is working to improve techniques used to apply pesticides in forests. The group has initially focused on understanding spray drift and deposit, and developing models to facilitate drift prediction.
- Germany has developed equipment for "tunnel spraying" (also called the "collector system") used on wine grapes and fruit. This equipment has an apparatus on the plant side, opposite the spraying, that catches leftover spray before it escapes to the environment, saving an average of 35 per cent of the amount sprayed (when leaves are small in spring, the savings can be up to 75 per cent).
- The Netherlands has improved equipment for mechanical, physical and chemical weed control. This includes development of spraying gear and techniques that use low doses and achieve optimum application within the rows.
- The United Kingdom has carried out research to better understand the physics of spray transport and spray nozzle and equipment performance, with the goal of improving control of droplet size distributions, reducing drift, and advancing techniques consistent with biological efficacy. The UK has also developed:
  - low-volume application techniques which permit standard spray recommendations lower than label rates and than the European average;
  - "patch spraying" systems which detect weeds and target herbicides, and therefore can reduce substantially the amount of herbicide applied;
  - methods to combine weeding machines with low-dose herbicide applications.

Research on Reduced Application Rates

A number of OECD countries are carrying out, or requiring from registrants, studies of how reducing pesticide doses affects crop production and pest control. Countries have initiated this research for different reasons — but they seem to arrive at the same results, as seen in the following examples:

- In Australia, use rates were studied intensively in the early 1970s because of the need to minimise farm costs. Based on this research, all pesticide labels now indicate the most cost-effective application rate.

- Canada is currently requiring new efficacy studies on certain pesticides and revising these pesticides' labels to show the lowest effective application rate.

- Research has been carried out in Denmark, the Netherlands, Sweden and the United Kingdom recently on reduced herbicide use and farm productivity. All four countries have found that the best economic results, and often the highest yields, can be obtained when low rates of herbicides (lower than label rates) are applied annually, despite less effective weed control. One reason is that the crop being protected is less stressed with lower herbicide exposure.

- Finland and Germany require a determination of the lowest effective dose and rate as part of the registration procedure. Special attention has been paid to this requirement in recent years.

- The Netherlands has reduced the quantity of pesticides applied to sugar beets and maize by increasing the number of applications, but using far lower doses.

- In Norway, research has been carried out in recent years on reduced herbicide and insecticide application as part of integrated pest management in orchards.

- Switzerland has historically set use rates at the lowest effective rate.

- In Turkey, pesticide efficacy at reduced application rates has been studied beginning in the 1970s. Basic studies have been completed on apple, grain, potato, lentil, chickpea and greenhouse plants, and work is still ongoing.

Implementing Integrated Pest Management (IPM)

Research into the various components of integrated pest management has been going on for many years in virtually all OECD countries. Many reported, however, that interest in IPM really took hold in the mid to late 1980s, among farmers and government policy makers alike. IPM was by this time no longer considered an old-fashioned notion or a non-mainstream approach appropriate only for farmers with an ecological bent. It became the intelligent and modern approach, requiring more skills and knowledge and aimed at achieving better and longer-lasting pest control with less impact on natural resources. All countries responding to the survey had begun programmes to promote the use of IPM during the last ten years. And every respondent described a significant increase in the use of these methods on farms and in forests.

Resistant Varieties, Healthy Plants

In virtually all OECD countries, crop varieties have been bred that are resistant to local pests and diseases — and are therefore less dependent upon pesticidal protection — in their agricultural research programmes. Many of the survey respondents told of success in this area. Some countries noted that resistant varieties are increasingly used by farmers; Germany reported that resistance level is considered in the registration of new varieties. Among many other examples, Australia reported that disease-resistant strains of cotton are now used in more than 90 per cent of the country's cotton planting, and Japan also reported that it has reduced rice blast through plant breeding.

Many survey respondents also mentioned the importance of their programmes in providing healthy plant materials to farmers. Some said they had recently improved quarantine measures for this purpose.

Biological Controls

Nearly all the survey respondents emphasised the importance of their research on, and development and use of, biological pest controls (including micro-organisms and viruses, predatory insects, and insect pheromones used for either monitoring or mating disruption). Countries have pursued development of biological controls for decades, so as to provide tools to combat pests that cannot be controlled by chemicals. Today, countries are expanding their programmes because of their contribution to risk reduction: biological pest controls are often less toxic to man and the environment than chemical pesticides. Several survey respondents pointed out that biological controls have a mixed record. Some are very effective, many provide only partial control, and others do not work well. Nevertheless, it is clear that biological controls are increasingly accepted and used in all OECD countries on a wide variety of crops and sites. The following are just a few of the examples given:

- Australia describes its experience with biological pest and disease control as a mix of spectacular successes, moderate successes, and at least one dismal failure.

  The spectacular successes include:
  - control of the cactus Prickly Pear with the caterpillar *Cactoblastis cactorum*, and control of rabbits with the virus *Myxomatosis*.

  The moderate successes include use of:
  - insects to control weeds such as ragwort, Paterson's curse and boneseed,
  - fungal rusts to control blackberry,
  - a bacterial inoculant to control crown gall in fruit trees, and
  - a bacterial inoculant to control bacterial blotch in mushrooms.

  The dismal failure, in which the "beneficial" predator became itself a pest, was the introduction of the cane toad to control cane beetles.

- In Austria, biological pest control is used in horticulture and on corn, fruit and wine grapes. In 1994, biological controls were used on 12,000 hectares, including 200 hectares of greenhouses. *Bacillus thuringiensis* was used on 11,460 hectares of vegetables, corn, fruit and wine grapes; *Typhlodromus pyri* was used on 200 hectares of fruit and wine grapes; and *Trichogramma evanescens* was used on 156 hectares of corn. Austria established a breeding station for beneficial organisms in 1993.

- The forest industry in Canada has greatly increased its use of *Bacillus thuringiensis* for forest pest control, and the province of British Columbia has a sterile insect release project to control coddling moth.

- Finland mainly uses biological controls in greenhouses, but some products are also approved for outdoor use. Approved products include the fungicide Rotstop, containing *Phlebia gigantea*, for use in forests, and the fungicide Mycostop, containing spores of *Streptomyces griseoviridis*, in horticulture and greenhouses.

- In France, a joint effort involving farmers, plant protection services, research institutes and professional organisations is developing biological pest controls mainly for greenhouses but also for use in fields. Based on its annual surveys of the extent of use of biological controls, France reports that such controls are applied on 80 per cent of greenhouse tomatoes.

- In Germany, beneficial insects are now used on 320 hectares in greenhouses and on more than 5,000 hectares of maize. Pheromones (for mating disruption) were used on 13,200 hectares of wine grapes, and *Bacillus thuringiensis* on 9,000 hectares, in 1993. Parasitic wasps were used on 5,800 hectares of corn in 1993 to fight a harmful butterfly.

- Greece and Japan have also used *Bacillus thuringiensis* successfully against lepidopteran pests of fruits and vegetables.

- Japan successfully used the release of sterile insects to eradicate the melon fly on different islands between 1978 and 1993. Japan has also had success in controlling pests by introducing natural enemies, including the pink wax parasite (*Amicetus beneficius Ishii* and *Yasumatsu*) used to control pink wax scale (*Ceroplastes rubens Maskell*), and the vedalia ladybird (*Rodolia cardinalis* (*Mulsant*)) used to control cottony cushion scale (*Icerva puchasi Maskell*).

- In the Netherlands, biological pest control in greenhouses, particularly for vegetables, has become common practice.

- In Norway, research has been carried out during the last 25 years on biological control of pests in greenhouses. Today, most Norwegian farmers apply biological controls for cucumbers and tomatoes with little use of chemical pesticides. In 1994, for example, 87 per cent of greenhouse tomatoes were not sprayed with chemical pesticides.

- The U.S. Environmental Protection Agency established a new division, the Biopesticides and Pollution Prevention Division (BPPD), in 1994, on a pilot basis, to accelerate the registration of biological pesticides and advocate the use of safer pest control technology. More than 20 new biopesticides were to be registered before the one-year pilot period ended in November 1995. Because of its success BPPD may become a permanent part of EPA's Pesticide Program.

Other Non-chemical Methods

Countries reported research on, and increasing use of a variety of horticultural pest control methods including crop rotation, early harvesting, top clipping, mechanical weed control, and irrigation management. Japan also noted the widespread use of solar heat to control soil diseases.

Several countries emphasized the importance of border controls to prevent the introduction of new pest species.

Guidelines, Information and Advice

Developing IPM methods that work has not been the only challenge. The information must also be conveyed to farmers, and farmers must be convinced that the methods work. Countries have used a variety of approaches to do this, including the following:

- All survey respondents reported research on IPM and alternative pest control strategies, and the provision of information to farmers about these strategies through the agricultural extension service. Guidelines had been developed in nearly all countries for integrated methods for specific crops, most often fruits and vegetables. In Canada, forest managers are developing programmes for the use of IPM in forests. The United Kingdom has written guidelines for the use of alternative methods of weed control around watercourses and lakes.

- In Australia, New Zealand, Norway and the United States, computer-based networks have been developed to facilitate the exchange of information among agricultural researchers, extension services, private organisations and farmers regarding integrated pest management methods.

- Canada's federal government offers a course on integrated forest pest management and publishes newsletters describing current developments in IPM. The Canadian provinces provide farmers with information on IPM, pest resistance, and alternatives.

- Denmark is experimenting with farmer-based crop protection consultative groups in which eight to ten farmers, together with a consultant, discuss problems and possibilities related to limiting pesticide use. In August 1994, Denmark also began requiring farmers to keep a journal of pesticide use on all fields.

- In Finland, research institutes, extension organisations and farmers are working co-operatively on several integrated production projects, including one on production of quality vegetables and another on organic strawberries.

- German farmers are required by law to consider the principles of integrated plant protection when using pesticides. Germany reports that a very large number of farmers operate according to these principles. Roughly 80 per cent of seed fruits and 50 per cent of vegetables are produced according to supervised integrated plant protection procedures.

- During the last ten years, Greece has launched a programme of IPM in greenhouses in which pesticide use is limited to insecticides containing *Bt* as an active substance and certain fungicides which can be used in winter only.

Participants are visited on a regular basis by extension service specialists who give them information and advice. Products are awarded a green label. Participation in the programme has risen from three to seven per cent of all greenhouses in Greece over ten years.

- In New Zealand, annual field days are held to show farmers and the public what techniques and new farming practices are available.

- The Netherlands has launched a programme called "Towards a Viable Crop Protection" to increase awareness of pesticide risks and provide a basis for various IPM extension programmes.

- In Norway during the last ten years, a five-day course on IPM in orchards has been offered. About 500 farmers — out of 1,000 who derive their main income from orchards — have attended this course.

- Portugal is carrying out a programme, which will run through 1998, to provide training, information, and economic incentives to farmers to improve their use of pesticides and increase use of IPM and organic methods. The programme will focus on pome and stone fruits, citrus trees, vineyards, vegetables and olive trees.

- Sweden has established five regional plant protection centres to promote integrated crop protection. They work on pest forecasting and warning services, develop strategies to combat pests, and carry out some field trials. Sweden also has county Boards which administer demonstration trials, field courses, etc., providing an important source of information on new technology and the possibility of reducing dose rates.

- In Turkey, a project supported by the World Bank will be carried out during 1995-1998, aiming to educate first government officials and then farmers about IPM.

- The United States initiated a Pesticide Environmental Stewardship Program in 1994 to instil a "pollution prevention" approach in agriculture and other areas. Among other things, the programme aims to meet the government's goal of having 75 per cent of U.S. agricultural land under IPM by the year 2000. The "PESP" programme has become one of the major activities of EPA's new Biopesticides and Pollution Prevention Division, and is one of the most innovative and successful. The programme is based on voluntary partnerships between pesticide user groups, government and industry experts, and scientists. The goal is to find and use pest control methods that require less pesticide overall and to shift to less toxic products. With the help of their "partners", the pesticide users develop and implement environmental stewardship plans and goals specific to their individual situation. Eleven grower groups (grain, fruit and vegetables) and 18 other professional organisations (including golf course, lawn care and power companies) were participating at the time of the survey. The US is devoting significant staff and money to this programme, providing support for projects such as the SARE almond project described below.

Model Farms

Five survey respondents described an approach that engages farmers directly in the development and use of IPM methods, on a "model farm" close to home. These farms also provide information on the economic viability and environmental benefits of such methods:

- Germany was the first European country to organise model farms to demonstrate integrated production methods, under a programme that began in 1978. This programme is run by local plant protection services and state governments. Farmers may visit the farms, and results of their experiments are published.

  In 1991, Germany began a second model farm programme which involves ten farms in different regions of the country and participation of staff from the agriculture ministry and from universities. The goals are to put into practice current knowledge about integrated production, and to demonstrate the results to farmers.

- France's Forum for an Integrated and Environmentally-Friendly Agriculture (FARRE) directs 34 model farms with the purpose of promoting integrated production. FARRE's mandate is to maintain the economic viability of farming and to keep a balance between environmental, economic and market objectives. FARRE's overall integrated approach allows for the use of production methods and cultural practices that are tailored to local conditions, thus taking advantage of opportunities for high-quality production, and taking account of the fragility of the environment when deciding which farming methods to use. FARRE is a member of the European Initiative for Integrated Farming (EIF), which includes six national associations engaged in the promotion of IPM in their respective countries.

- A Netherlands project called "Arable Farming 2000", begun in 1990, had created 38 model farms serving 500 farmers at the time of the survey. The project aims at further dissemination of knowledge and experience with IPM.

- The United Kingdom has established more than 20 demonstration farms, under four different programmes, to illustrate integrated crop management. These include:

  — Linking the Environment and Farming (LEAF), begun in 1989, which involves industry;
  — Less Intensive Farming and the Environment (LIFE), which was begun in 1991 as part of a European network of integrated farming systems research;
  — LINK:IFS (Integrated Farming Systems), begun in 1992, which investigates the integration of conventional and organic farming methods; and
  — Focus on Farming Practice (FOFP), begun in 1994, which also looks at the integration of conventional and organic farming.

  Participants in the projects include people from government, research institutes, and the crop protection industry, as well as individual farmers.

  Among the results and activities of these farm projects are the following:

  — LEAF has developed guidelines for integrated crop management which have been agreed by a forum of farmers, scientists, environmentalists and government representatives. LEAF is now preparing and will publish a practical guide to integrated crop management.

— LEAF has also produced an environmental audit for non-participating farmers, so that they can assess for themselves the sustainability of their farming methods.

— Farms participating in LEAF, FOFP and LIFE arrange training visits for farmers throughout the year.

— Under LIFE, two demonstration farms have been set up with funding from the European Union to assess the commercial viability of integrated methods.

- The United States funds projects on "whole-farm" systems and farm economics under a programme called Sustainable Agriculture Research and Education. SARE projects involve farmers and ranchers, and often include joint funding by states or private organisations. From 1988 to 1991, SARE funded 164 regional and 31 national projects at a total of $17.7 million. The impressive results obtained in some of these projects are illustrated by an example from California:

- A project focusing on almond production in the Central Valley (California's $600 million almond industry produces 60 per cent of the world's almonds) has substantially reduced pesticide and fertilizer applications, and the Almond Commodity Board has proposed expanding the model to other regions in the state. This project involved federal environmental and agricultural departments, agribusiness, non-profit organisations, pest control advisors, and local farmers. Among its accomplishments:

  - Twenty-eight participating growers completely eliminated their dormant season (winter) applications of organophosphate pesticides and significantly reduced nitrate applications. One corporate farm alone eliminated dormant organophosphate applications on 1,800 acres.

  - The project received strong grower and industry support, as well as the attention of major farm media, agribusiness, and major farm associations.

  - The project resulted in unprecedented sign-ups under previously ignored federal cost-share programmes for pesticide and nitrate use reduction.

  - California is now using this model as the basis for a new project to reduce reliance on chemical pesticides for five other major crops.

Grower Initiatives

Still another approach to implementing IPM not only involves, but is led by, grower groups. In several OECD countries, farmers who grow the same crop have come together to develop their own guidelines and protocols for using IPM. In some cases they have also set goals to reduce pesticide use by a specific amount. Often the groups have their protocols approved by the supermarket chains who will be selling the food, or by a government regulatory agency, who might award the food a "green label".

- The earliest such arrangement was reported by Spain, where voluntary ATRIAS (Farmers Associations for Integrated Treatments in Agriculture) began work in 1979 to promote IPM in cotton. The groups began by converting a subsidy that encouraged pesticide use into technical help to farmers to rationalise their use of pesticides. After two years, the use of pesticides among participating farmers was reduced by 50 per cent. ATRIAS subsequently expanded to other crops. At the

end of 1993 there were 343 ATRIAS, responsible for 543,000 hectares throughout Spain, covering the most important crops grown and the crops for which the highest pesticide use takes place (this represents 4 per cent of total Spanish agricultural land, but a larger percentage of production). The projects maintain a very local focus, each dealing with local crops and conditions, insect pests and pathogens. Some of the ATRIAS have reported pesticide use reductions of up to 40 per cent, as well as increased use of "soft" methods such as biological controls. Technical support and training are provided by regional governments.

- In Australia, rice, banana, apple and pear growers have signed agreements with the Australian Consumers Association to reduce their use of pesticides, in some cases by as much as 50 per cent, over the next ten years. The pome fruit agreement, for example, includes plans to:

  — identify pesticides that are no longer necessary (twelve have already been identified);
  — identify (through research and development) alternative methods of pest control;
  — develop codes of practice covering various aspects of chemical use;
  — monitor pesticide use over the period (at least 30 orchards are keeping records of pesticide use as well as use of predators, bactericides, oils, and other "alternative" products);
  — initiate an education and training programme for growers about the benefits of IPM (a teaching module suitable for apple and pear cultivation has been developed).

- Denmark reported that producers of fruits and vegetables began forming user groups, starting in 1993, to promote integrated production. Their purpose is to promote good cultivation practices and reduce the use of pesticides and fertilizers. At the time of the survey the groups had developed integrated production guidelines for 14 fruits and 52 vegetables. It is estimated that around 70 per cent of Denmark's total fruit and vegetable production is now grown under integrated schemes. The work of these groups is voluntary, but is checked by the Danish Plant Directorate.

- In New Zealand, growers and marketing companies have signed contracts to ensure that only certain pesticides are used and that post-harvest treatment intervals are respected.

- In the United Kingdom, a consortium of major retailers and the National Farmers Union began an initiative in the 1990s to develop crop protocols using integrated crop and pest management for all major crops in the country. About 20 protocols have been published.

Economic Instruments

Both OECD countries and the European Commission have experimented with economic instruments to encourage the use of IPM and organic methods.

Agri-environmental Subsidies

Many of the survey respondents described programmes that provide grants or subsidies to farmers who use approved methods. In some cases the compensation is available

on a long-term basis; in others, it is provided only during the transition period from conventional to integrated farming.

One of the most comprehensive programmes mentioned is an "agri-environmental" subsidy programme initiated under the European Union's Common Agricultural Policy. Regulation 2078/92 provides money to all EU Member States for grants to farmers who use environmentally friendly farming methods. Established in 1992, the programme has had active participation, according to the European Commission. All EU countries have developed an "action plan", with criteria for environmentally friendly farming, which farmers must comply with in order to receive a grant. The following survey respondents mentioned their participation in the programme:

- France is implementing 2078/92 by doubling its budget for environmental farming. France's programme focuses in particular on reconciling the need to protect crops with the protection of water quality. A key part of the programme is a reduction in agricultural inputs in 33 water catchment areas. Farmers in these areas are required to follow specific methods and itineraries, which include principles of integrated pest management as well as lists of products that cannot be used. The programme also includes support for conversion to organic and to "extensive" (less intensive) farming, and restrictions on the use of pesticides in vulnerable areas.

- By the end of 1995, Germany had 5,650 participants in 2078/92, covering 83,400 hectares. This included 4,600 hectares under organic production and 22,330 under integrated production (both including arable crops, fruit and grapes), as well as 45,600 in pasture and 60 hectares of untreated field margin strips which are also valued as conservation areas for rare species. Germany notes that these numbers will rise in 1996.

- Portugal is providing aid to place 40,000 hectares under chemical control based on advice, 6,600 ha under IPM, and 2,000 hectares under organic farming practices. Farmers receive subsidies running from Esc 6,800/hectare (for chemical control) to 105,000/ha (for organic farming).

- The United Kingdom has developed schemes for moorland, environmentally sensitive areas, habitat, nitrate sensitive areas, organic farming, and countryside access. The organic aid scheme, for example, aims to increase organic production in England three-fold by offering financial assistance to farmers who convert. Among other things, it encourages soil improvement and the use of alternative methods to control pests and diseases. The UK says it is too early to assess progress, but 46 applications had been received by the end of November 1994, representing some 2,500 hectares.

Other countries also described programmes initiated and funded nationally, including the following:

- Austria has various national programmes supporting ecological farming (in addition to its participation in 2978/92). For example, in 1995, 23,000 farms participated in a special programme for organic farmers. Austria notes that this shows almost 10 per cent of all farms in Austria are managed without chemical inputs, a European record.

- Finland, the Netherlands, Norway and Sweden all have programmes to help farmers financially during the transition period to integrated or organic production:

- Finland pays farmers a subsidy of about FIM 2,000/hectare for three years during the shifting phase to organic farming. Farmers who produce organic products must use methods determined by the Ministry of Agriculture and Forestry, and fields must have been under cultivation by these approved methods for at least two years. Finland currently has some 26,000 hectares in organic farming, out of 2.5 million hectares of agricultural land.

- The Netherlands offers subsidies to support the change-over to "ecological-biological" farming.

- Norway began a programme in 1990 that offers financial support for farmers making the transition to alternative methods and organic farming. About 500 farmers, representing 6,500 hectares or 0.5 percent of cultivated land in Norway, participate in the programme.

- Sweden offers a subsidy of Skr 700 to 2,000 (depending on the cultivation region) per hectare per year, for a period of three years, to farmers who change from conventional to ecological farming. By 1993, approximately 1800 farmers had participated and 46,000 hectares were enrolled in the programme.

- Switzerland began a unique and comprehensive programme in 1993, offering compensation and an ecological label for using IPM on pome fruit, pip fruit, berries, potatoes and vegetables. Switzerland's system is based on the idea that the state should encourage and support environmental farming. In a two-year study, the Swiss government determined what the income loss and extra labour were for different crops grown using environmentally friendly methods. The results of this study were used to set compensation levels for farmers. Switzerland also provides compensation for integrated cereal production, under a programme that began in 1991. Farmers benefiting from this programme can use only post-emergence herbicides — no insecticides or fungicides — and therefore must plant resistant varieties. About 20 per cent of Swiss farmers participate in the cereal programme.

- The United States provides financial assistance to farmers who develop a comprehensive management programme incorporating sustainable practices. These may include soil and tilth testing, field scouting, cover crops, green manure, improved rotations, composting and manure management, and other techniques for reducing the use of agrochemicals. Farmers must maintain basic pesticide and nutrient records. Individual farmers may receive up to $3,500 a year for three years.

  The US also has a programme to reduce commodity programme barriers to implementation of sustainable farming practices. This programme protects farm payments to farmers who incorporate resource-conserving crops as part of a rotation on payment acreage. Participating farmers must develop a plan to reduce soil erosion, improve soil tilth and fertility, protect surface and ground water, interrupt pest cycles, and conserve water. Farmers are required to plant at least 20 per cent of their base acreage in resource-conserving crops such as forage legumes, legume/small grain mixtures, or legume/grass mixtures.

Green Labelling

Several survey respondents also described special "green" labels for products grown by approved methods. The labels are intended to give these products a market advantage and thereby encourage use of the approved methods.

- The European Commission (EC) label for products of organic farming (provided for by Council Regulation (EEC) No. 2092/91) requires farmers to follow specific rules and procedures, use only a limited list of pesticides and fertilizers, and have their farms inspected by designated authorities. The label is available only for products grown within the European Union. The EC notes that this label, together with the 2078/92 programme, has led to a firm development of organic farming in several countries. In France, for example, the label has been awarded to some 3,250 producers covering 20,000 hectares.

- Australia introduced a national standard for organic and "biodynamic" products in 1992, to ensure that food labelled "organic" was produced under an approved production system using only fertilisers and pesticides designated "natural" by agriculture authorities. Both consumer demand for certified produce, and the number of certified growers, are growing.

- Denmark has had a state-controlled label for ecologically produced products since 1989. This currently represents less than 10 per cent of the market, but the demand is increasing and has surpassed the supply of labelled products.

- France, in addition to offering the EC label for organic farming (see above), has a national label for foodstuffs produced with integrated methods. The label guarantees that they were produced according to rules defined by the International Organization for Biological and Integrated Control of Noxious Animals and Plants (Organisation internationale de lutte biologique et intégrée contre les animaux et les plantes nuisibles). France's plant protection service, research institutes, and other professional organisations have also been involved in development of the label and requirements for obtaining it. In order to be "accredited" and receive this label, producers must use integrated methods (using chemicals only as a last resort) and keep records of how they produced their crops. France notes that the label programme is technically very successful, but is insufficiently known by consumers.

- German growers (e.g. of fruit, vegetables, wine grapes, hops) who use supervised IPM methods are permitted to sell their products with a green label.

- The Netherlands describes its green labelling of food and flower products as one of its most successful activities.

- Switzerland has had an ecological label since 1993 for food produced using approved methods. This label, along with other economic factors, has convinced a growing number of farmers to use IPM. These other factors include consumer and retailer preference for Swiss produce grown by approved ecological methods (as compared with imported food), and farmers' belief that agricultural subsidies will continue to favour environmentally friendly farming in the future. Switzerland notes that the use of IPM has increased most among fruit, vegetable and wine grape growers.

- In the United States, organic labelling is being developed at both federal and state levels. The federal programme is being developed in response to a 1990 law, with standards for certifying farms, producers and processors as organic. Several state labelling programmes are already in place.

Taxes on pesticides

Although a number of OECD countries have used taxes or fees to support pesticide registration and re-registration, only a few have used, or plan to use, taxes on pesticides to try to discourage unnecessary use. These countries include the following:

- Denmark will introduce a tax of 37 per cent in 1996 on the retail price of insecticides and soil disinfection agents, and a tax of 15 per cent on herbicides, fungicides, repellents and growth regulators. The tax rates reflect the differences in the average costs of these two groups of pesticides, so that farmers' tax burden for spraying one hectare will be the same regardless of the pesticide used. About 80 per cent of the revenue obtained will be returned to the farmers through reduced land taxes. The rest will be used for research and registration costs.

- Norway instituted an "environmental tax" of 13 per cent, accompanied by a "control tax" of six per cent, in 1992. These taxes are paid by pesticide manufacturers and importers and are calculated from yearly sales. The purpose of the environmental tax is to increase the cost of using pesticides, thus leading to more careful and considered use. The control tax is intended to cover the expenses associated with the authorisation and regulation of pesticide dealers. The two taxes together produce a revenue of about Nkr 20 million a year, the cost of running Norway's pesticide use reduction programme.

- Sweden believes that its environmental levy of SKr 20 per kilogram of active ingredient, along with an earlier price regulation levy of SKr 46 per hectare and dose, explains about ten per cent of its reduction of pesticide use to date.

Collecting Data on Pesticide Use

Many of the survey respondents said that insufficient data are available on pesticide use, and that this makes it difficult to measure progress in risk reduction. Most countries do not actually collect data on pesticide use, but rather on pesticide sales and/or imports and exports. Some countries collect separate figures for different pesticide types (e.g. herbicides, fungicides, insecticides, growth regulators, etc.). However, only a few respondents mentioned collection of data on pesticide use for specific crops. For example: the Australian chemical manufacturers' association keeps records of the value of farm chemical sales, which can be broken up into commodity groups; Norway's Plant Protection Centre is developing a project to obtain information on pesticide use in vegetables, fruits and berries, based on interviews with farmers in different districts; and the European Commission is collecting information on pesticide use for specific crops and in specific regions (see below).

National Programmes with Use Reduction Targets

Several OECD countries have initiated large-scale national programmes that aim directly at reducing pesticide use. Sweden, Denmark and the Netherlands were the first to do so. Sweden began its programme in 1986, Denmark in 1987, and the Netherlands in 1991. All

three programmes set dates for reducing the use of pesticides and levels by which they had to be reduced, compared to use levels during the early 1980s. These programmes' goals were ambitious, demanding significant reductions within relatively short time periods.

Denmark and the Netherlands have tried to address the problem that quantity alone (tonnes of pesticide applied) is not an accurate indicator of risk by developing a system for measuring use reduction that includes other factors. In addition to total tonnes of pesticide applied, the Netherlands measures emissions to air, soil, ground water and surface water and Denmark records the frequency of application. Denmark is now trying to develop indexes for different aspects of environmental loading, focusing on such factors as mobility and persistence.

All three countries initiated a variety of projects to achieve their use reduction goals. Many of these projects were similar to projects initiated in other OECD countries and described elsewhere in this report. Among the most important were:

- information campaigns promoting pesticide use reduction and alternative methods;
- new, often mandatory, training and education requirements for farmers;
- establishment of regional centres and advisory services to provide pest forecasting systems and advice on integrated pest control strategies;
- field trials, courses and demonstrations;
- spray equipment inspection and certification programmes;
- research on resistant varieties, biological controls, integrated methods, and other ways to reduce pesticide use;
- taxes on pesticides;
- financial support for farmers making the transition to integrated or organic production; and
- restrictions on aerial spraying and on the use of certain pesticides.

By the early 1990s, the three countries all reported progress in meeting their goals. Sweden had reduced the total quantity of pesticides applied by 65 per cent, and the dose by 45 per cent, compared with 1985 levels. Denmark had achieved a 40 per cent reduction in total volume, but only a very small reduction (5 per cent) in the number of doses used per hectare. (Ironically, this was due partly to other environmental protection measures that brought more land under herbicide treatment, including the introduction of wintergreen crops to reduce nitrate leaching, and a ban on stubble burning to prevent air pollution.) The Netherlands reduced the total quantity of pesticides applied by 40 per cent by 1994, and estimated a similar reduction in emissions, but indicated that emissions were hard to measure. In Sweden and Denmark the greatest reduction was in herbicide use; herbicides were also reduced in the Netherlands, but the greatest reduction in that country was in soil disinfectants

The three countries also noted that their programmes had other positive results besides the use reductions achieved. Most important were the development of a good working relationship with the farming community; increased farmer awareness of pesticide risks and the importance of using safe practices; improved performance of application equipment; and progress in research on alternative approaches. Denmark and the Netherlands both noted that the biggest barrier to reducing pesticide use was the economic risk that must be borne by farmers, in the absence of reliable pest control alternatives or policies to protect those who reduce pesticide use.

During the early 1990s several other countries also initiated use reduction programmes, including the same types of activities as those implemented in Sweden, Denmark and the Netherlands. The survey respondents gave the following examples:

- In 1992, Finland began a Rural Environment Programme that aims to halve pesticide use by the year 2000 by removing farmland from production, giving financial support to farmers who make the transition to integrated or organic production, and applying other measures used in national use reduction programmes. Run jointly by the Ministry of Agriculture and Forestry and the Ministry of Environment, the programme intends for pesticide use to continue diminishing even after the initial year 2000 goal is reached. To date, Finland has primarily reduced herbicide use, like Sweden and Denmark.

- Norway initiated a programme to reduce use as much as possible.

- The Canadian provinces of Quebec and Ontario began programmes with targets for reduction.

EC Fifth Environmental Action Plan

The European Commission has also initiated an ambitious new programme to change pesticide use and incorporate environmental goals into Europe's agricultural policy. With the adoption of the Fifth Environmental Action Plan in 1992, the EC committed itself to reducing the impacts of pesticide use to the point where natural resources (water, soil and genetic resources) are maintained and agriculture is sustainable. This goal is supposed to be reached by the year 2000, through replacement of chemical crop protection by non-chemical methods and a shift towards less harmful pesticides. Along with the 2078/92 programme of "agri-environmental" grants to farmers described earlier, the EC initiated a major research project to work towards this goal. The project is being carried out as a collaborative effort between the Netherlands and the EC, and includes regular consultation with other European countries. To date, the project has collected and published information in two reports:

- *Pesticides in the EC* by the Dutch Agricultural Economics Research Institute (LEI-DLO) describes pesticide use in different European countries, including quantities used on different crops, costs of pesticides for major farming types, disposal of leftover stocks, etc.

- *Towards a Future EC Pesticide Policy* by the Dutch Centre for Agriculture and Environment (CLM) describes the environmental problems caused by pesticide use in Europe, summarises existing policies, and proposes new agricultural and policy approaches to reduce the environmental problems.

The EC is now working on the second phase of the project, which is expected to be complete by early 1997, and which includes:

- further analysis of pesticide use patterns in selected regions (to be done through farmer interviews);

- an analysis of the link between residues in the environment (water and soil) and adverse impacts;

- an analysis of the impact on pesticide use of current instruments and legislation at both the EU and country level (the EU review will cover the 1992 Common Agricultural Policy reform, the 2078/92 programme, registration and re-registration);

- further elaboration of the CLM proposals for new policies to reduce environmental problems, beginning with a review of existing activities in certain Member States; and

- a detailed investigation of other possible instruments for reducing the adverse environmental impacts of pesticide use in agriculture.

IPM Success Stories

Many of the survey respondents said they had not yet developed tools to measure the success of their IPM and risk reduction projects, or that the projects were too new to have measurable results. Nevertheless, in the absence of a more comprehensive progress report, five countries gave examples of how farmers have used IPM methods to improve pest control, reduce reliance on chemical pesticides, or reduce costs. These success stories give an idea of what can be accomplished:

In Australia:

- More than 80 per cent of citrus growers in Queensland have adopted IPM practices, including pest monitoring and use of beneficial organisms. In most cases, the stimulus was concern about the development of resistance in the major pest, red scale. Other factors included a well targeted and applied research strategy, support by pest monitoring services, establishment of a commercial rearing facility for beneficials, and, importantly, the reduced costs over a chemical spray regime of more than $A 1000 per hectare for mature orchards.

In France:

- Fruit growers using IPM in the Midi-Pyrénées, Limousin, Centre, Rhône-Alpes and other regions have, since the late 1980s, reduced substantially their use of insecticides and fungicides. Apple growers in the Midi-Pyrénées region have, for example, reduced the number of treatments for grey aphids from three to one and the number of acaricide treatments from 2.6 to 1.4. They have also increased the colonisation of orchards with predators and reduced fungicide treatments for spot. Plum and peach growers have reduced insecticide and acaricide application from seven to five and from six to four treatments respectively, per season. Meanwhile, fungicide applications have dropped from 11.6 to 9.6 treatments per season for these crops.

- In France's wine-growing regions (including Aquitane, Bourgogne, Champagne, the Centre, Midi-Pyrénées, and Poitou-Charentes), a comparison of pesticide treatments for vines managed with integrated control vs. those under conventional protection showed important reductions with integrated control. For example:

  in Aquitane in 1993:
  - six anti-mildew treatments under IPM vs. 14 under classical protection;
  - two treatments against the grape budworm vs. 2.5;
  - 0.5 acaricide treatments vs. 1.5.

  and in Bourgogne in 1992:
  - five anti-mildew treatments under IPM vs. eight under classical protection;
  - 6.5 treatments for powdery mildew vs. eight;
  - 1.5 treatments for budworm vs. 2.7;
  - 1.5 acaricide treatments instead of 2.2.

In New Zealand:

- The development of organophosphate-resistant predator mites, in research sponsored by the Apple and Pear Board beginning in 1980, has reduced pesticide treatment of pip fruit crops from seven applications per year to two per year. Field trials are ongoing to develop a synthetic pyrethroid-resistant predator mite.

In the United Kingdom:

- Tomato and cucumber growers reduced fungicide use by 55 per cent and insecticide use by 24 per cent between 1981 and 1991 (based on weight of active ingredient applied per hectare of crop grown). The fungicide reduction was achieved largely through the use of more sophisticated environmental control. The insecticide reduction was due largely to the introduction of biological control agents.

- Between 1983 and 1992, pesticide use in the top fruit industry was reduced by about 16 per cent per hectare, partially through the use of IPM.

In the United States:

- 2,300 cotton growers in Alabama, farming on 420,000 acres, are using crop rotation, pest scouting, biological controls, and resistant varieties to control insect pests. These farmers have reduced their use of pyrethroid and carbamate insecticides by 40 per cent, compared with non-IPM pest control practices. Insecticide costs have been reduced by $6,000,000 and the value of yield increases as a result of reduced insect damages is estimated at $12,000,000.

- Oriental fruit moth is being controlled on about 8,000 acres of California peaches using pheromone-based mating disruption. This has resulted in a reduction in the number of organophosphate insecticide applications for this pest from five to none each year, with comparable quality and yield.

- Growers on more than 1,000,000 acres of cotton in California's San Joaquin Valley use some form of monitoring for lygus bugs to make pest control decisions. As a direct result, average pesticide use decreased by 85 per cent (from 10.5 applications to 1.5 applications per year) between 1970 and 1993, with estimated savings of $60 per acre. Yield increased during the same period.

- Soybean cyst nematode (SCN) was rated as the second most important disease of soybeans during the 1992 growing season. Education programmes on SCN management, stressing the integration of non-host crops and planting of resistant varieties in recommended rotations, were directly responsible for the elimination of nematicides for the control of SCN in Illinois. The savings to Illinois producers were estimated at $23,400,000 in 1992.

- 200 apple growers in Michigan, farming on 25,000 acres, use tree row volume calculations to reduce pesticide spray rates. The adoption of this practice has resulted in a 25 per cent reduction in pesticide use, and net farm income has increased by $50 per acre.

- At least 35 per cent of Nebraska's corn acreage (approximately 2,500,000 acres) is rotated to soybeans, which reduces the need for insecticides to control corn rootworms. Use of crop rotation for corn rootworm control has resulted in a reduction in soil insecticide use of over 1,000,000 pounds of active ingredient per year, saving farmers at least $10,000,000 annually in production costs with no loss in yield.

- 500 peanut growers, farming on 30,000 acres in Oklahoma, have adopted a disease forecasting system which has reduced pesticide applications by 60 per cent. These efforts have increased profits by an average of $50 per acre and resulted in an additional $1,500,000 in income for a five-county region.

- In excess of 19 million pounds of insecticide was applied to Texas cotton in the late 1960s prior to intensive IPM education programmes conducted by the Texas Agricultural Extension Service. In less than ten years, insecticide use dropped to about 2.3 million pounds (about an 88 per cent reduction) and remains there today as a direct result of multiple-tactic cotton IPM programmes.

1.4 Conclusions

The survey showed that OECD countries have gained a wealth of experience in pesticide risk reduction over a relatively short time. Based on this experience, the survey respondents identified the activities that had been most successful and the factors that seemed to be most important to their success. They also described the difficulties they had encountered, and identified future work at the international level that would be helpful to their national risk reduction programmes. The countries' comments in these areas are summarised below.

The Most Successful Pesticide Risk Reduction Activities

Listed by many countries:

- registration
- farmer education and training
- research/development and adoption of integrated pest management

Listed by several countries:

- herbicide use reduction

Listed by one country:

- human health and worker protection (Germany)
- regulation of soil fumigants (the Netherlands)
- labelling for worker protection (the Netherlands)
- green labelling (the Netherlands)

Keys to Success

Listed by many countries:

- Obtain the farming community's commitment to and participation in risk reduction activities. Farmers must be involved because risk reduction can only occur as a result of their decisions and actions. Farmers must be convinced that adopting risk reduction strategies is in their best interest.
- Provide farmers with the knowledge and technologies needed. Develop an extensive agricultural research and extension networks reaching to the regional and local levels.
- Give risk reduction as a shared task to the agriculture and environment ministries. They can accomplish more by working together than by working separately.
- Encourage co-operation between government, agriculture and industry.
- Take economic impacts into account.

Listed by several countries:

- Increase environmental awareness generally; develop a public consensus on the goals and process for risk reduction.
- Make activities mandatory to the extent possible.

Listed by one country:

- Avoid prolonged discussions about the size of various risks and try to get a general agreement that pesticide use is associated with potential risks for farmer, sprayer, consumer and the environment, and that these risks should all be reduced as much as possible (Sweden).
- Use risk assessment and a case-by-case approach, and develop competent regulatory authorities (Switzerland).

Problem Areas

Listed by many countries:

- Measuring progress is difficult. It is difficult to quantify risks and to measure risk reduction, and it is often hard to determine the effects of a specific activity because other factors could have contributed. It can also be difficult to measure progress without a national risk reduction policy with well defined objectives and parameters on which to base an assessment.
- Insufficient baseline data are available on pesticide use.

Listed by several countries:

- It is difficult to balance the conflicting interests of agricultural production vs. environmental protection.
- Risk reduction activities can be very resource-intensive, at a time when many governments are undergoing funding cutbacks.
- It is difficult to eliminate high-risk pesticides.
- National requirements or programmes sometimes run counter to pesticide risk reduction. Some examples include: (1) agricultural programmes that encourage intensive farming or discourage crop rotation, (2) publication of spray calendars that encourage regular spraying routines whether they are needed or not, and (3) legislation that makes it illegal to use pesticides at use rates or doses lower than indicated on the label.
- National requirements aimed at protecting the environment can sometimes cause an increase in herbicide use, e.g. minimum-till strategies to minimise soil structure decline and reduce erosion.

Listed by one country:

- Consumers prefer unblemished produce, and grading programmes reject even slightly blemished or dimpled fruit (Australia).
- Reducing emissions to the environment and reducing fungicide use are difficult (the Netherlands).
- For most countries, it will be difficult to reduce the dependence on chemical pesticides (i.e. instituting a fundamental change in the use of pesticides), which is the major contribution to risk reduction (the Netherlands).

Work Needed

Listed by many countries:

- information sharing about countries' experiences in pesticide risk reduction
- data on pesticide use in OECD countries.

Listed by several countries:

- an agreed definition of IPM
- efforts to increase general awareness about relevant environmental issues (e.g. through international green labelling of agricultural products)
- increased integration of environmental measures and goals in both national and international agricultural policies
- harmonization of risk evaluation
- development of core sets of data requirements for alternative pest control agents (e.g. biological controls), and development of a supportive regulatory climate internationally for such products
- an OECD risk reduction project.

Listed by one country:

- a co-ordinated international effort to promote IPM (Canada)
- a co-ordinated international effort to promote risk reduction activities (the Netherlands)
- taxes on pesticides to reduce use, with co-ordinated introduction of taxes in several countries or agreements on minimum rates, so as to reduce the consequences for international competition (Denmark)
- opportunity for regular consultation between OECD countries and countries of Eastern Europe (Hungary)
- models to predict the risks to workers who apply pesticides in Mediterranean conditions, as well as models for environmental risks in this region (Portugal)
- joint international action against selected old pesticides which present unacceptable risks to human health and the environment (Sweden).

Part 2

Activities in Selected FAO Countries

Respondents:	
Ecuador	South Africa
Jamaica	Sri Lanka
Korea	Thailand
Malaysia	Zambia

2.1 Framework for Risk Reduction

Reasons for Initiating Activities to Reduce Pesticide Risks

Direct experience with the overuse of pesticides, and the need for more sustainable agricultural development, have been two of the most important motivating factors for the initiation of activities to reduce risks associated with pesticide use in FAO countries.

The specific reasons for initiating activities cited by the FAO countries which took part in the survey were for the most part parallel to those identified by the OECD countries. However, greater emphasis seemed to be placed on issues related to human health concerns, reflecting the greater risks to farm workers, farmers, and farm families associated with pesticide handling and use in developing countries. In addition, increasing awareness of the availability of newer, "safer" active ingredients and formulations, and of activities at the international level such as the FAO/UNEP Joint Programme on Prior Informed Consent and the Pesticide Action Network (PAN) Campaign on the "Dirty Dozen", have also stimulated interest in pesticide risk reduction, the identification of alternative agricultural practices, and less hazardous products.

Risk Reduction Approaches

The FAO countries responding to the survey appeared to have a great deal in common with each other in their approaches to pesticide risk reduction. Each country had initiated a range of activities in response to concerns related to the risks to human health and the environment posed by pesticides. No country reported a specific programme on risk reduction as such, but in all cases legislative mandates in place (most often those related to pesticide registration) covered the development of risk reduction type activities. Where pesticide legislation had only recently been promulgated, there was a greater recognition of the importance of the precautionary principle in the registration and use of pesticides.

The activities reported by these countries had for the most part been developed with the overall aim of increasing safety in the handling and use of pesticides. In some instances projects had been initiated in response to concerns related to specific agricultural practices or crops.

In most of these countries, a legislative or legal framework for the development of policies related to pesticide risk reduction existed. The challenge therefore lay in the effective implementation of such policies. One of the principal problems encountered in developing countries is that much of the target population consists of small farmers working in subsistence agriculture. They are often illiterate and unaware of many of the potential health and environmental risks associated with the misuse of pesticides. In many countries there is a range of dialects or languages, which complicates the development of consistent training or information materials.

This situation is frequently exacerbated by a lack of extension personnel, inadequate resources, and poor infrastructure. The result is that often the only effective way to reduce risks to health and the environment in the short term is to control or restrict the availability of the more toxic pesticides through government regulatory action. This too can be difficult, because pressure from farmers to compete both locally and internationally makes it hard for regulatory agencies to justify restricting pesticides that are being used in other countries. Illegal import and use of pesticides which have been restricted due to the hazards resulting from their use may follow.

In almost all cases the reported national pesticide risk reduction activities were marked by a high degree of co-operation not only among government departments or ministries, but also with universities, hospitals, non-governmental organisations, international and bilateral aid agencies, and the private sector. There was a definite trend for programmes on pesticide use to consider all members of a family, not just the applicator or end user, and to encourage co-operative action at the community level. The importance of co-operation and shared responsibility was a consistent theme in many of the activities reported to be in place in these FAO countries.

2.2 Activities to Reduce Risks

Product Registration

In all responding countries the first line of action for controlling the use of pesticides was through registration. The degree of evaluation undertaken as part of the registration process varied widely among countries. In all cases attention was given to international reviews and the regulatory actions taken in developed countries. In many countries pesticide registration schemes had only been in place for the last 15 years or so. Earlier, most pesticides had been manufactured, imported and used with little or no regulatory control. The result was that the present regulatory systems had been initiated in situations where many pesticides had already been used for years. This presented a unique set of problems, including the need to develop an inventory of products in use in the country and then convince farmers that products they had been using for a number of years might no longer be considered acceptable.

Many older, acutely toxic pesticides considered of concern today result in a quick kill, have a broad spectrum of activity, and are generally lower priced than their alternatives (where these alternatives are available). Cost is frequently one of the principal driving forces in the decision-making process for both governments and farmers in developing countries. Experience has shown that difficulties can result from an immediate ban, or prohibition on the use, of a product. Such unilateral actions may promote the development of a black market or illegal trade in the prohibited pesticide, a problem exacerbated by the limited control exercised at border points in many countries.

Eliminating Hazardous Pesticides

It is increasingly recognised that regulatory actions to ban or phase out the use of a chemical must be tied to programmes aimed at changing farmers' attitudes and cultural practices. There is also a need to ensure that recommended alternative products or practices are available, affordable, and practical at the local level.

- In Malaysia, activities to identify and ban or restrict pesticides whose use may pose unacceptably high risks, and to identify and register less hazardous alternatives, are routinely carried out as part of the registration process.

- In South Africa, a proposal that registration applications for less hazardous formulations receive priority attention is under consideration. Similarly, Zambia reviews applications for less toxic products more quickly than it does applications for more toxic ones, which are scrutinised more thoroughly.

Korea had identified the elimination of pesticide formulations classified (according to the WHO Hazard Classification) as extremely hazardous (Class 1a) and highly hazardous (Class 1b) as a long-term goal of its registration scheme, as amended in 1994. At the time of the survey, 22 of the 568 formulations in use were classified as highly hazardous.

- Initial plans had been to phase out the production of such chemicals by 10 per cent a year over ten years, with the goal of a complete phase-out by 2004. The plan has since been modified to limit production of pesticides which had already been re-evaluated to the amount produced in 1991. Those in the process of re-evaluation would have their production limited to 1994 levels.

Thailand implemented a new phased registration system in 1992 with the specific goal of controlling or restricting pesticides which might be of high risk. This new classification system is not in line with the WHO Hazard Classification. Under this new system, all pesticides except those in Category 1 had to be registered before they could be imported or marketed in Thailand. The existing substances on the market were being reviewed and classified into four levels of control or categories. Category 1 pesticides meeting specified criteria could be freely produced, used, imported or exported; Category 2 had to be notified to the authority; Category 3 required a permit; and Category 4 were prohibited for import, manufacture or use.

- At the time of the survey, 44 pesticides whose use might pose unacceptable risks had been classified. A total of 19 were classified as Category 4 (prohibited), and 23 as Category 3 (requiring a permit for import, manufacture or use), while two were classified as industrial chemicals.

In recognition of continuing pesticide poisoning incidents, and in view of the limited financial and manpower resources available, Sri Lanka had instituted a series of regulatory controls to phase out the use of problematic pesticides. A phased withdrawal was adopted, rather than an immediate prohibition, in recognition of the fact that time was needed to identify safer alternatives and to make farmers aware of these alternatives.

- Parathion was de-registered in 1985, followed by dimethoate in 1989. Monocrotophos and methamidophos, which were widely used on rice and vegetables, were targeted for phase-out in 1988. By 1993, the quantities of methamidophos and monocrotophos imported were, respectively, approximately 35 and 50 per cent of the levels imported in 1988. The final withdrawal was completed in 1994, when the Department of Agriculture no longer recommended these two compounds for pest control. This final withdrawal had to await the screening of safer alternatives for various crops.

Reducing Worker Risks

Training and Education

All countries reported programmes in place to train farmers in the safe handling and proper and effective use of pesticides. In most instances, these training activities were undertaken in co-operation with the pesticide industry, international organisations, and/or non-governmental organisations. For example, Sri Lanka reported that CARE International, working in co-operation with government officials, had a plan to train 25,000 farmers over a five-year period. The Pesticide Association of Sri Lanka had also provided assistance to the Government in the training of users and dealers, as well as children in rural schools.

The fact that many of the farmers in developing countries are illiterate and work on small-scale plots requires innovative thinking in the development of training programmes. Audio-visual tools and hands-on demonstrations are an important part of many programmes. In addition, there is a trend in some countries towards a more "holistic" approach to training in which the entire community is involved, usually as part of a larger programme to increase public awareness. Programmes are increasingly targeted at children and incorporated into the school curriculum at several levels. For example, Thailand has been a pilot country in a co-operative programme developed by GIFAP on the safe use of pesticides. This has included educational programmes to increase awareness in high school students through the development of curriculum materials and informal methods to support the work of NGOs at the field level. About 750 trainers, 700 retailers and 330,000 farmers have been trained in this programme.

Other community-centred programmes of interest include the following:

- In Jamaica, training in safe use has been presented as part of a larger public awareness campaign. The centrepiece of the campaign is a full-length play targeted to rural users who are reported to have an illiteracy rate of 30 per cent. The play is divided into a series of nine short skits, each of which highlights a different aspect of the safe use of pesticides. Brief radio messages, based on characters in the play, emphasize the same nine points regarding safe pesticide use. Posters and pamphlets using the characters in "comic book" style, illustrating scenes from the play with the appropriate message highlighted, have also been developed for general distribution. T-shirts are distributed to the farmers attending training sessions, with the message "if you spray don't delay wear protective gear".

- In Ecuador, a programme on safe use of pesticides has been initiated with the objective of providing education and information to farmers and farm workers. The programme is aimed at minimising human health risks and adverse effects on the environment through intensive train-the-trainers sub-programmes on the safe and efficient use of pesticides. The programme is targeted at aerial and terrestrial applicators, distributors, medical personnel, and farmers. Farmers are urged to learn procedures for appropriate management of pesticides to avoid contamination, as well as first aid measures in case of poisoning. The goal is to train at least 2,000 trainers who in turn will educate others. Manuals for technicians, physicians, applicators and distributors have been developed for the programme.

- In South Africa, a programme entitled *STOP — Safety Towards Our People* has been developed with the objective of informing young people of the potential hazards of chemicals. It is seen as a means to foster a positive attitude in the adults of the future, as well as to educate the whole family, since the children often pass the information along to both their parents and their younger brothers and sisters. A syllabus, "The safe handling and storage of pesticides," prepared for teachers; a reader, "Don't fool be cool with pesticides," aimed at children, and a pamphlet, "What you should know about the safe handling and storage of pesticides," have all been prepared. The project has been implemented in five regions. Since its initiation, approximately 225 teachers from 154 schools were trained. A total of 9,400 students have participated in the programme to date. The importance of community involvement in the successful implementation of this project has been emphasized. Its successful implementation has in part been due to close co-operation between the public and private sectors.

- In Zambia, a training programme targeted at retailers, agricultural extension workers and public health workers has been developed. The initial stage of the programme was very successful: in the first year, some 30 institutions had their key persons trained in pesticide application, safety, and pesticide poisoning symptoms. A radio programme that was initiated was widely accepted: both the media and the public have asked for the programme to be done in all seven of Zambia's local languages. Zambia is now seeking assistance to continue the training programme.

Codes of Practice

In South Africa, Codes of Practice have been developed by the South African Bureau of Standards in co-operation with the private sector. These Codes do not have a legal basis, but serve to establish acceptable standards of conduct for the users as well as the public and private sectors. Codes have been adopted for a range of topics including the Safe Handling of

Pesticides, Safe Disposal of Surplus Pesticides, Application of Fumigants, etc. These Codes have been implemented with varying degrees of success. Most recently, at the time of the survey, the Code of Practice of the Aerial Application of Agricultural Remedies had been incorporated into the regulations under the Hazardous Substances Act administered by the Department of Health. The aim of this Code is to assure that workers involved in mixing and loading agricultural remedies, and those responsible for cleaning the equipment, are adequately protected against the hazards involved. In order to obtain a license to conduct aerial spraying, a training course must be successfully completed. The incorporation of the provisions of this Code in the regulations of the Hazardous Substances Act will strengthen its legal basis and facilitate enforcement.

Training and Licensing of Retailers/Applicators

In Korea, Malaysia and Sri Lanka, comprehensive training and licensing/certification schemes for retailers or distributors of pesticides have been developed. Korea and Sri Lanka require certificate holders to participate in training courses in the safe handling, use and storage of pesticides. The training courses cover:

- ensuring that certain minimum conditions are met relative to the storage and handling of pesticides;
- recognition of the fact that these outlets are frequently the main source of information on pesticides for small farmers;
- the possibility of limiting the number of outlets permitted to sell certain hazardous pesticides and thus limiting their availability.

In South Africa, all Pest Control Officers (PCOs) must successfully complete the prescribed training and be registered with the ministry of Agriculture. PCOs include salaried applicators (ground and aerial) who apply pesticides in agriculture as well as for structural pest control.

In Zambia, a programme has been initiated with the objective of training and licensing all pesticide retailers and distributors. However, this has proved to be extremely difficult due to the large number of retailers and distributors throughout the country.

Training of Medical Professionals

An important aspect of the safe use of pesticides in developing countries is ensuring that medical personnel have appropriate training in recognising the effects of pesticide poisoning, and in appropriate treatment regimes.

- In Thailand, a co-operative training programme for medical professionals has been established among the Ministry of Public Health, Food and Drug Administration and the Toxicological Society of Thailand. Approximately 1,300 doctors, paramedics and nurses are being trained in pesticide poisoning first aid, diagnosis and treatment. The programme has also provided doctors nation-wide with reference texts, a medical newsletter, a trade/common name reference index, and databases.

Distributing Information to Users

All countries noted that an important component of training programmes in safe handling and use of pesticides is the preparation of additional reference materials for wider distribution. These documents are generally in the form of guidelines, brochures, leaflets and posters which are freely distributed. They cover such topics as appropriate storage and handling practices, the importance of protective clothing, tips to improve worker safety, minimising impacts on the environment, maintaining equipment, etc. The documents are often developed by government agencies. However, non-governmental organisations and the private sector are also frequently involved and play a role in the distribution and promotion of such materials. In many countries where illiteracy is high, these materials have to be developed in a simplified form, making maximum use of pictures and symbols.

Further Measures to Increase Worker Safety

In Korea in 1993, 110,000 sets of protective clothing and 2.8 million masks were distributed in an effort funded by the Ministry of Fisheries and Food (MAFF) and provincial governments. In addition, 1.5 million detoxifying tablets for organophosphate poisoning were distributed by the Agriculture Association Federation (AAF).

In Thailand, an important component of the safe use programme has been the promotion of suitable protective clothing as part of an overall strategy to make farmers aware of the associated benefits.

The Environmental Council of Zambia and the pesticide industry have been discussing possibilities for the development of protective wear suitable for tropical countries, to replace that suitable for temperate climates, which is more often available.

Programmes to Ensure that Only Pesticides of Acceptable Quality Are Available

The quality of the pesticides available in developing countries may in some instances be inferior to those marketed in developed countries. In some cases, the product contains a lower level of active ingredient than is listed on the label, encouraging the farmer to apply the product more frequently than recommended on the label. In other cases, the inferior quality products may contain toxic contaminants or degradation products which represent a greater hazard to human health and the environment than the pesticide itself. In response, some countries such as Malaysia have developed stringent regulations such that only factories meeting certain minimum standards are allowed to operate. Some countries have also established laboratories to monitor the quality of imported pesticides, and a few are covering operating costs for such laboratories by imposing taxes on pesticides.

Better management of pesticide stocks is a recurrent theme in training given to pesticide dealers and retailers. This training emphasizes the importance of storing pesticides under appropriate conditions (adequate ventilation, etc.) and ensuring appropriate rotation of stocks so that product viability is maintained.

Container Recycling/Disposal Programmes

A continuing problem in many developing countries is the reuse of pesticide containers for household purposes (e.g. food and water storage). There are also recurring problems related to the inadequate storage of pesticides by individual farmers.

The successful operation of a programme to recycle pesticide containers is dependent on the level of infrastructure development in the country, and on co-operation between government ministries and between the government and private sector.

- In Sri Lanka, a programme was initiated in 1989 in which triple-washed 200 litre drums were either recycled or used by local smiths for the manufacture of hardware items. The reuse of glass bottles was addressed through a programme in which *Poison* (in the three languages in use) and *Do Not Reuse* were printed on the bottles. The programme has had limited success, as bottle merchants recycle the bottles and simply paste labels over the warning. A programme for the collection and recycling of pesticide bottles, in collaboration with the Ministry of Environment and the Pesticide Association of Sri Lanka, is under consideration.

- In Thailand, the industry has established a project to construct a disposal facility for pesticide waste and bulk packaging, to be completed by the end of 1995.

- In Zambia, regulatory authorities discourage large-volume packaging and encourage small, ready-to-use volumes so as to reduce the exposure and risks which accompany decantation. With the assistance of FAO and bilateral assistance provided by Germany through GTZ (German Technical Co-operation, Gesellschaft für Technische Zusammenarbeit), Zambia has also embarked on a large-scale pesticide waste disposal programme, scheduled for completion in early 1996.

It is important that greater attention be paid to the needs of small farmers, and to the supplying of smaller containers that may be disposed of easily. The use of smaller containers reduces hazards associated with handling, e.g. decanting of concentrated materials into smaller bottles and the storage of surplus product. The move to more readily disposable packaging such as water soluble films, or pesticides double-packed in an inner dissolvable packet or bag, has generally entailed increased costs in developed countries, which precludes the use of such packaging in many developing countries.

Protecting the Environment

All of the responding countries referred to reducing the levels of pesticides in the environment as one of their goals. However, there was little information available on projects specifically targeted at improving environmental quality, protecting sensitive species or areas, etc. One respondent noted that "even if the farmers take precautions to protect themselves from pesticide exposure and poisoning, contamination of the environment due to these same pesticides is more often than not disregarded."

In Malaysia and South Africa, special licensing and training requirements for the aerial application of pesticides had been implemented. In Malaysia, conditions attached to approvals for aerial spraying included a requirement that monitoring be done during and after the spraying operation.

2.3 Activities to Reduce Pesticide Use

Restricted Distribution or Availability

The quantities of specific pesticides imported may be limited and/or their distribution restricted on the basis of agricultural need and the availability of viable alternatives. Restricting the distribution of a product in a country through limiting those outlets/suppliers where it can be obtained could be part of the pesticide registration process. Sri Lanka reported success with this approach.

Promoting Sustainable Farming Methods

Need-based Use of Pesticides

In many developing countries, small farmers' only source of income is their crop. They are understandably wary of taking risks regarding production, and frequently consider the prophylactic use of pesticides almost as a kind of crop insurance.

- In Sri Lanka there have been some attempts at training programmes for farmers which emphasize the need-based use of pesticides as opposed to prophylactic applications. In spite of much effort, the results have not always been satisfactory due to the difficulty in changing farmers' attitudes.

- Thailand has instituted a model farm to demonstrate to farmers how to minimise pesticide use through improved application technology and the development of "good agricultural practices".

Development of Thresholds

Malaysia, South Africa and Sri Lanka noted that the definition of threshold values for pest or pathogen damage was a means of reducing the frequency of pesticide application. This was identified as an important component of a need-based approach to the application of pesticides and IPM. It was also noted, however, that the amount of resources necessary to develop specific data for each pest/commodity combination, and to transfer this knowledge to farmers, was frequently a stumbling block to the wider application of this strategy.

- South Africa noted that it had been possible to reduce the number of insecticide sprays on cotton per season from 14 to five with the definition of appropriate threshold values.

Improving Application Technology

Innovative approaches to the application of pesticides had been developed with the aim of reducing the number of applications and the amount of pesticide applied. In most instances these activities appear to have been undertaken in countries on an *ad hoc* basis. Their purpose has been to reduce the pesticide load in the environment, hazards to workers, and the costs associated with crop production.

- South Africa reported that improved application techniques for cotton had improved efficiency. When coupled with the use of threshold values, they had the effect of reducing the level of insecticide used on cotton by 30 per cent.

- Sri Lanka reported that mixing liquid formulations with sand for broadcast applications to standing crops avoided problems of seedling phytotoxicity and reduced the need for multiple herbicide applications. Similarly, the use of a locally developed wiper applicator for post-emergent control of weeds in row-planted crops reduced the amount of product applied as well as reducing spray drift.

Alternative Pest Control Practices

All countries were involved in research on the availability of alternatives to the use of chemical pesticides. They referred to ongoing work to investigate the introduction and increase of natural enemies such as parasites and predators, as well as pest-resistant crop varieties. The reasons for undertaking this work generally related to repeated problems with adverse health and environmental effects, the realisation that misuse of pesticides creates problems of pest resistance and resurgence, and the recognition that beyond a certain point increased inputs do not necessarily lead to a corresponding increase in profit for farmers.

Biological Control

All responding countries were involved in ongoing research to identify and further develop the use of biological control methods. In most instances this research had been directed at a specific pest/commodity combination and results had demonstrated mixed success. Biological control agents offer several advantages for developing countries, including lower costs for labour, lower cost than many commercially available pesticides, lower acute toxicity, and in some cases the possibility of being prepared at the village level. The disadvantages are that they are frequently slower-acting than commercial pesticides, the level of control is not always reliable, and they frequently require application at a specific point in the pest's life cycle in order to be effective. Overall, they require a greater level of knowledge and of proactive behaviour on the part of the farmer. This has been one of the obstacles to their wider acceptance.

Some examples of the biological control applications referred to by countries include:

- Sri Lanka had investigated the use of predatory weevils for the control of the aquatic weed *Salvinia*, and of *Metarhizium anisopliae* for the control of rhinoceros beetle in coconut, while neem seed water extract is recommended for attacking cabbage and mustard caterpillar pests.

- Thailand launched a five-year project in 1992 to reduce dependence on chemical pesticides. An important component of this project has been the establishment of three pilot plants:

  — use of botanicals: to produce and formulate botanicals/pesticides from natural plants (e.g. for neem seed extract the target is 10,000 litres/year for use on vegetables and several kinds of plants);

  — to produce Nuclear Polyhedrosis Virus (NPV) for use on grapes and cotton;

  — to produce *Bacillus thuringiensis* (*Bt*) for use on cabbages in several provinces in northern Thailand.

- Ecuador has a number of programmes in place to encourage the use of biological control and reduce pesticide use. The following are examples of the successful introduction of biological controls:

  — control of *Icerya purchasi* Maskell on trees in the city centre (where pesticide use was deemed unacceptable) with the introduction of the predator *Rhodolia cardinalis*.

  — control of *Hypothenemus hampei* Ferrari in coffee with the introduction of the Uganda wasp *Prorops nasuta* Waterston.

Identification of Pest-resistant Crop Varieties

All countries reported they had programmes in place directed at the identification and testing of crop varieties resistant to insect pests and diseases. In most cases these were part of ongoing agricultural research programmes. For some crops, such as rice and cotton, there appeared to be renewed interest as part of the development of integrated pest management programmes.

Integrated Pest Management

The activities initiated under this general heading covered a wide range and included investigating the effects of changing existing agricultural practices, reducing the use of broad spectrum pesticides in favour of those that are more specifically targeted, identifying resistant plant varieties, biological control, etc. In large part, the development of an effective IPM strategy is dependent on the farmer's understanding of the operation of the agroecosystems of different crop types.

Malaysia, Sri Lanka and Thailand are participants in the FAO Intercountry Programme for IPM in Rice. The programme has a total of eleven participating countries and was initiated in 1982. It was developed using a unique farmer-centred approach, which focuses attention at the village level with the farmer as a trainer and decision-maker. Experience in this programme has shown that, to improve pest management practices, farmers need to learn skills to:

- identify important pests and diseases;
- assess their respective damages and decide on control actions;
- identify natural enemies;
- analyse the situation, weigh control options, and choose an option that best suits the situation.

The programme has demonstrated its sustainability. Insecticide use on rice has been significantly reduced, with a positive effect on overall yield. Farmers have reduced their cost of production and the general environment has benefitted with this reduction in pesticides use, resulting in increased production of fish and other aquatic foods and fewer pests in other crops because more natural predators have survived.

Projects have been initiated which will extend the training techniques and farmer-centred approach developed in this programme to other crops, including cotton, soybean and vegetables, and to other countries and continents.

Individual countries also indicated that they had IPM programmes in place for other crops:

- Malaysia was practising IPM on crops such as rice, cocoa and vegetables.
- South Africa had had successful programmes using IPM and biological control methods for citrus, deciduous fruit and cotton pests, as well as for noxious weeds.
- Sri Lanka anticipated extending IPM practices to high-value crops such as beans, chilies and other vegetables.
- Thailand was practising IPM on fruit trees such as durian, pomelo and vegetables.

Green Labelling

Korea provided an overview of its programme for green labelling of products grown by approved methods, to give them a market advantage.

In Korea two programmes are administered by the National Agricultural Products Inspection Office (NAPIO) of the Ministry of Agriculture, Forestry and Fisheries. One is for "organically produced agricultural products", the second is for "pesticide free agricultural products".

Organically produced agricultural products:

- Farmers should not have used any chemical fertilisers or pesticides for at least three years. The soil should not be contaminated with heavy metals and must have an organic matter content of more than 3 per cent. The water quality should be second level or greater, according to the Korean water quality classification system.

Pesticide free agricultural products:

- Conditions are similar to organically produced agricultural products, except that chemical fertilizers can be used.

2.4 Conclusions

The perception of what is considered acceptable risk varies widely between developed and developing countries, as well as among developing countries. Moreover, the development, promotion and effective implementation of pesticide risk reduction and safer handling practices in developing countries is often hampered by a varying combination of climatic, economic and social conditions.

The reasons pesticide risk reduction activities have been initiated in countries are very similar, i.e. demonstrated adverse effects on human health and the environment and the realisation that there are alternative agricultural practices and products that can minimise or eliminate risks. In the countries surveyed there was, for the most part, an adequate legislative basis for the development of risk reduction policies. In fact, most countries already had a range of activities in place, though they were not necessarily co-ordinated under the heading of a risk reduction programme.

With these observations in mind, it is possible to identify types of risk reduction activities that have been successful and factors that have inhibited the successful development and implementation of others.

Pesticide Registration

A system for pesticide registration which provides for an assessment of a product before it is permitted for sale or use was in place in all countries surveyed. The systems had the common objective of ensuring that only those pesticides that could be handled safely under the conditions of use in the country in question could be registered. The reality in most developing countries is that registration systems have been implemented, but their efficiency needs to be improved. There are thus a wide range of products already available on the market, some of which would not be considered acceptable by modern standards. The process of identifying these compounds, as well as appropriate, less hazardous alternatives and agricultural practices, is an important risk reduction activity in countries. It is also one that appeared to be working well, based on the information collected in the survey.

Another area where work is needed is on harmonization of procedures and requirements for registration of pesticides (as well as other pesticide regulations), which differ widely between countries. Efforts are urgently needed to harmonize such regulations, at least on a subregional level, so as to reduce the negative impacts that result from lack of harmonization.

Training and Education

Training is an important component of risk reduction activities. However, it is difficult to measure the success of training and education in relation to risk reduction in most countries. Although statistics are available on the number of people trained, there is at present no way to actually measure the impact of training or the distribution of information documents, brochures, etc. (e.g. whether there has been a drop in the number of poisoning cases reported over a number of years, fewer cases of misuse or incorrect applications, etc.).

It is evident, however, that training programmes in pesticide safety should be designed to reach as broad an audience as possible, because the hazards associated with pesticides in

many developing countries are not limited to the applicator or end user. For example, while the importance of proper storage of pesticides is a component of training programmes in safe use, there are continuing problems owing to the fact that many farmers store pesticides in their living quarters, often in close proximity to food preparation areas and within the reach of children. If training programmes attempt to address such problems, they must be directed not just at the end user but at all members of the community including children and women. It is only through such an approach that lasting changes in the attitude of farmers towards a more judicious handling and use of pesticides will be achieved. "Holistic" approaches to training and education are relatively new, and it may be several years before their full impact can be assessed. Initial indications are that attitudes at the farm level are changing and that, where viable and affordable alternative chemicals or agricultural practices have been identified and/or protective equipment is available, farmers will make use of them.

The farmer-centred approach to Integrated Pest Management pioneered in the FAO Intercountry Programme on Rice has demonstrated some significant gains in reducing insecticide use in the growing of rice. This approach emphasizes the importance of providing farmers and other end users with the skills and knowledge to enable them to make informed and effective pest management decisions.

Availability of Alternative Products and Practices

Training in the safe use of pesticides in developing countries has its limitations and is not sufficient on its own. Improved, low-risk formulations and easily disposable packaging are also necessary. It is generally the case, however, that the higher costs of these alternatives precludes their use by small farmers. There is a need to identify ways in which such innovations can be made available to farmers in developing countries at an affordable cost.

In general, it was agreed that the knowledge and awareness of pesticide users had improved in certain developing countries as a result of training activities. But the fact remains that even where there is some concern for human exposure, environmental impacts are more often than not disregarded. The need to increase farmers' awareness of the importance of environmental protection remains.

Promoting Sustainable Farming Methods

The promotion of a need-based approach to the application of pesticides has been problematic, largely due to difficulties in changing farmers' attitudes. It must be recognised that the margin for error is small and that, if a crop fails, a farmer could lose a year's income. The reluctance of farmers to adopt new and improved techniques without reasonable assurance of their success is therefore understandable.

- Countries have had considerable success in identifying novel approaches to the application of pesticides which serve to increase the efficiency of the product, as well as reducing the frequency of application and the total amount applied.

- Where thresholds of acceptable pest damage have been developed, they appear to be accepted, since direct cost savings to the farmer result from reduced pesticide use. One of the principle obstacles to the wider application of this approach is the lack of sufficient funds for the development and validation of these thresholds and their demonstration to farmers.

- There are also numerous success stories concerning the development of biological control agents and their application to specific pest/commodity combinations. The development of crop varieties resistant to insect pests and disease has been an important part of agricultural research in countries for many years. These activities have demonstrated the possibility of developing alternative approaches which might result in reduced levels of pesticide use.

What is not clear is how well innovations are or would be accepted and implemented at the farm level, and what the result would be in terms of measurable levels of risk reduction. Furthermore, it is not clear if these experiences are similar to those of other countries in the region with similar agricultural practices.

Integrated Pest Management

The increased interest in Integrated Pest Management in recent years has provided a framework for a more structured approach to the development of activities aimed at promoting the need-based use of pesticides and reducing the potential hazards to health and the environment associated with their use. The success with IPM for rice in Asia is well-documented. There has been interest in expanding this programme on rice to other countries, and in initiating such programmes for other crops. In those countries where this approach has been successfully applied to rice, it is being applied to other crops. As noted previously, the farmer-centred approach and the role of the farmer as decision-maker are considered primary reasons for the success of this programme.

Directions for the Future

The assistance and support of developing countries needs to continue, in order to address the most obvious problems. Guidelines on technical issues needs to be provided, and regulations need to be harmonized at least on a regional level. Labelling of pesticide containers, hazard classification systems using colour bands, and clearly understandable pictogramms and explanations in official languages should be introduced and made obligatory. The kind of pesticide formulation used under the climatic conditions of many developing countries needs to be regulated, and stench, colour or other markers should be introduced in formulations. The exposure of spray applicators to pesticides needs to be reduced through wearing of appropriate clothing and use of safer, non-leaching application equipment, as well as through training in application techniques which reduce worker contamination. Disposal of pesticides, and of empty containers, needs to be addressed with the support of industry. Product control needs to be strengthened in order to introduce Maximum Residue Limits, and thus reduce the quantity of pesticides used. Promotion and sales strategies should be further restricted by government authorities.

A wealth of experience and information related to pesticide risk reduction activities is available in individual countries. What seems lacking is a more co-ordinated framework which would allow countries to share their experiences and information and thereby make more efficient use of the limited resources available. Development of such a framework might be possible through the regional working groups established as part of the Intersessional Group (ISG) of the Intergovernmental Forum on Chemical Safety (IFCS). FAO and OECD might also consider initiating a process for country-to-country exchange, for example by grouping countries based on geography, culture, language, crops grown and other pertinent factors, and encouraging these groups to share their experiences and to collaborate on risk reduction projects.

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Contents

***Please note*:**

[F] indicates that the entire publication is available from the OECD in a separate French translation. The other publications listed are available in English only, but they often include a French summary.

[GLP] indicates that the publication is part of the OECD Series on Principles of Good Laboratory Practice and Compliance Monitoring. Translations of this series into German, Russian, Polish, Czech, Slovak, Hebrew, Spanish and Italian exist or are planned. For more information, please contact the Environmental Health and Safety Division.

[BIO] indicates that the publication is part of the OECD Series on the Harmonization of Regulatory Oversight in Biotechnology.

The Environment Monograph Series:

Since 1988, the Environment Monograph Series has made technical documents prepared by the OECD Environment Directorate available to the public. The Environment Monographs on this list were prepared by the Environmental Health and Safety Division. Copies are available upon request at no charge, in limited quantities.

No. 14, *Final Report of the Expert Group on Model Forms of Agreement for the Exchange of Confidential Data on Chemicals* (1988)[F]

No. 15, *Final Report of the Working Group on Mutual Recognition of Compliance with Good Laboratory Practice* (1988)[F]

No. 17, *The Use of Industry Category Documents in Source Assessment of Chemicals* (1989)[F]

No. 24, *Accidents Involving Hazardous Substances* (1989)[F]

No. 25, *A Survey of Information Systems in OECD Member Countries Covering Accidents Involving Hazardous Substances* (1989)[F]

[superseded by the *Users Guide to Information Systems Useful to Emergency Planners and Responders Available in OECD Member Countries* (1991)]

No. 26, *Report of the OECD Workshop on Ecological Effects Assessment* (1989)[F]

No. 27, *Compendium of Environmental Exposure Assessment Methods for Chemicals* (1989)[F]

No. 28, *Workshop on Prevention of Accidents Involving Hazardous Substances: Good Management Practice* (1990)[F]

No. 29, *Workshop on the Provision of Information to the Public and on the Role of Workers in Accident Prevention and Response* (1990)[F]

No. 30, *Workshop on the Role of Public Authorities in Preventing Major Accidents and in Major Accident Land-Use Planning* (1990)[F]

No. 31, *Workshop on Emergency Preparedness and Response and on Research in Accident Prevention, Preparedness and Response* (1990)[F]

No. 35, *A Survey of New Chemicals Notification Procedures in OECD Member Countries* (1990)[F]

No. 36, *Scientific Criteria for Validation of In Vitro Toxicity Tests* (1990)[F]

No. 39, *International Survey on Biotechnology Use and Regulations* (1990)[F]

[no number] *Users Guide to Hazardous Substance Data Banks Available in OECD Member Countries*, OCDE/GD(91)102 (1991)[F]

[Also translated into Spanish by the United Nations Environment Programme's Industry and Environment Office (UNEP IE).]

[no number] *Users Guide to Information Systems Useful to Emergency Planners and Responders Available in OECD Member Countries*, OCDE/GD(91)103 (1991)[F]

[Also translated into Spanish by UNEP IE.]

No. 43, *International Directory of Emergency Response Centres* (1992)[F]

[The International Directory is a co-operative project of OECD and UNEP IE. The emergency response centres listed in this Directory are located in both OECD and non-OECD countries.]

No. 44, *Workshop on Prevention of Accidents Involving Hazardous Substances: The Role of the Human Factor in Plant Operations* (1992)

No. 45, *The OECD Principles of Good Laboratory Practice* (1992)[F, GLP]

No. 46, *Guides for Compliance Monitoring Procedures for Good Laboratory Practice* (1992)[F, GLP]

[superseded by No. 110, *Revised Guides for Compliance Monitoring Procedures for Good Laboratory Practice* (1995)]

No. 47, *Guidance for the Conduct of Laboratory Inspections and Study Audits* (1992)[F, GLP]

[superseded by No. 111, *Revised Guidance for the Conduct of Laboratory Inspections and Study Audits* (1995)]

No. 48, *Quality Assurance and GLP* (1992)[F, GLP]

No. 49, *Compliance of Laboratory Suppliers with GLP Principles* (1992)[F, GLP]

No. 50, *The Application of the GLP Principles to Field Studies* (1992)[F, GLP]

No. 51, *Guiding Principles for Chemical Accident Prevention, Preparedness and Response: Guidance for Public Authorities, Industry, Labour and Others for the Establishment of Programmes and Policies related to Prevention of, Preparedness for, and Response to Accidents Involving Hazardous Substances* (1992)[F]

[The Guiding Principles are also available in Russian. They are being translated into Spanish, and may also be translated into other languages. For more information, please contact the Environmental Health and Safety Division.]

No. 52, *Report of the OECD Workshop on Monitoring of Organisms Introduced into the Environment* (1992)

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[The OECD's Chemical Accidents Programme and Road Transport Research Programme co-operated in organising this workshop.]

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