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UNEP's Role in Environmental Exposure and Risk Assessment of Pesticides

An Evaluation of International Organizations Work and the Needs of Developing Countries, Including the Feasibility of Environmental Hazard Classification and Labelling

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Preface

The United Nations Environment Programme (UNEP) has requested the European Environmental Research Group (MFG) to investigate UNEP's role in environmental exposure assessment.

Background

Following the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in June 1992, efforts have been made to improve the coordination and harmonization of work at national and international levels regarding chemical hazard evaluation and risk assessment of chemicals in general and also specifically of pesticides.

International organizations, which are presently heavily involved in work on hazard evaluation and risk assessment in relation to pesticides, are the International Programme on Chemical Safety (IPCS), the United Nations Food and Agriculture Organization (FAO), and the Organization for Economic Cooperation and Development (OECD).

IPCS which is jointly sponsored by the World Health Organization (WHO), the International Labour Organization (ILO), and the United Nations Environment Programme (UNEP) works in close co-operation with both FAO and OECD in respect to hazard evaluation/risk assessments for specific pesticides and methodologies for interpreting data and assessing exposures an risks.

One of the major products of IPCS regarding pesticides are the Maximum Residue Levels (MRLs) in Food recommended by the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) to the Codex Alimentarius Committee. However, there is little univer sal acceptance of the Codex' MRLs. In consultation with FAO and national authorities IPCS has, therefore, initiated a fundamental restructuring of the JMPR process and proposes a new approach called the Joint Meeting on Pesticides (JMP). This new process should provide evaluations of pesticides which will include environmental fate and ecological assessment, guidance

and protection of worker's health and safety and would include pesticides which would normally not be included in the present JMPR process (i.e., pesticides which do not cause residues in food). The JMP process is described in the paper by Burin and J. Herrman [1993]. A flow chart providing an overview of the process is annexed to the paper which is part of the terms of reference.

Terms of reference

1. To study in detail the above described activity of IPCS and FAO as well as other related activities carried out by other organizations, such as the pesticide project of the OECD.
2. To identify which are the specific needs of countries, especially developing countries, to more effectively assess environmental risks and exposures of pesticides.
3. To recommend to UNEP if and in which ways the programme can best contribute to the overall efforts to satisfy these needs and formulate the objectives of the recommended activities.
4. To further identify the specific tasks which need to be carried out by UNEP to meet these objectives and to estimate the resources needed to do so at a short, medium and long-term bases.
5. To make a preliminary study of the feasibility of environmental hazard classification and labelling and its applicability and practical value for countries, in particular developing countries.
6. To prepare a report of the findings and recommendations to UNEP.

This document has been aimed at fulfilling these terms of reference.

1. Introduction

1.1. Historical Background

IRPTC

For many years, UNEP has been involved in activities related to toxic chemicals and chemical safety, mainly through its *International Register of Potentially Toxic Chemicals (IRPTC)*. By fostering the establishment of international conventions and soft law concerning chemically oriented environmental problems, UNEP has contributed considerably to the promotion of chemical safety. IRPTC was established in 1976, following up the recommendations of the UN Conference on the Human Environment, Stockholm 1972. One of its main objectives is to identify, or help identify, potential hazards from chemicals, and to improve the awareness of such hazards. IRPTC is, hence, the programme activity centre of UNEP concerned with chamicals and their safe handling and use. The activities of IRPTC are oriented not only towards pesticides but also to other types of chemical substances, notably industrial and consumer chemicals. It is, however, not within the current mandates of IRPTC to make hazard or risk assessments of chemicals, but to provide information needed for making such assessments [Sundén-Byléhn, 1992].

PIC

Another UNEP activity in the field of chemical safety is the *London Guidelines for the Exchange of Information on Chemicals in International Trade*, which were adopted in 1987 by the UNEP Governing Council. They aim at enhancing the management of chemicals in all countries through the exchange of scientific, technical, economic and legal information on chemicals. In 1989, the London Guidelines were amended with the *Prior Informed Consent (PIC)* procedure. PIC refers to the principle that an export of a chemical that is banned or severely restricted because of human health or environmental concern should not be transported to another country without formal agreement of the importing country. The PIC procedure is now also applied to acutely hazardous pesticides which, although not banned or severely restricted, are known to cause health or environment

problems, particularly in developing countries. UNEP has also produced a series of legislative guidance documents to assist countries in implementing the London Guidelines. UNEP and FAO have established a joint programme to assist governments, particularly of developing countries, in the implementation of the PIC procedure by providing operational assistance, training and technical advice. The UNEP/UNITAR Training Programme has a similar aim[UNEP, 1993].

APELL

A third development in this field is the UNEP Programme on *Awareness and Preparedness for Emergencies at Local Level (APELL)*. This programme aims to prevent technological accidents and their impact through assistance to decision-makers and technical personnel in improving community awareness of hazardous installations and in preparing accident response plans. An APELL Handbook, published in 1988, is available in 14 languages. This Handbook has been supplemented by a manual on *Hazard Identification and Evaluation in a Local Community*, jointly published by UNEP and OECD.

IPCS

A forth activity of great importance in the field of chemical safety, in which UNEP takes part since 1980, is the joint venture of UNEP, ILO and WHO that initiated the creation of the *International Programme on Chemical Safety (IPCS)*. The main objective of IPCS is to assess the risks to human health and the environment posed by chemicals, thus providing internationally evaluated scientific information on which countries can base their chemical safety measures. Thus, IPCS has been the coordinator and focal point for evaluation of chemicals at the global level since its founding in 1980. Because of their wide use and significant health impact, particularly in developing countries, special attention has been paid by IPCS to pesticides. For example, out of the 150 *Environmental Health Criteria (EHC)* monographs published by IPCS so far, some forty are dealing with pesticides.

Reorganization of the Joint Meeting on Pesticides (JMP)

However, during the last few years, it has been felt that, al though a great deal of progress has been made by IPCS, the evaluation of pesticides at the global level is not achieving the success that is possible [Burin & Herrman, 1993]. For example, several international meetings over the last years, including two meetings in Sweden (in October 1991 and May 1992), an OECD Special Session on Pesticides in Paris (May 1992) as well as the UNCED in Rio de Janeiro in June 1992, have all identified the need to increase efforts in the environmentally sound management of chemicals in general and of pesticides in particular.

These needs have been thought to be met by:

- Reorganization of the Joint Meeting on Pesticides (JMP).
- Development of Prior Informed Consent Provisions.

Universally accepted evaluation criteria for sound management of toxic chemicals

A discussion document for the OECD Special Session on Pesticides (SSP/92.84) concludes "that the focus of work in this area is to make more transparent and consistent the criteria and procedures used by member countries in the evaluation of data and in data interpretation with respect to test results submitted in support of pesticide registration". It was furthermore agreed at the OECD/US-EPA Re-registration Workshop in Washington (October 1992) that a worthwhile goal is to work for the day when a single evaluation of a pesticide would be universally accepted by nations. A universally accepted evaluation would facilitate trade and reduce resource requirements at the national level.

In spite of the manifold activities of UNEP in the field of environmentally sound management of chemicals and chemical safety, the Programme as such has, so far, not been directly involved in the assessment of environmental hazard and environmental risk of chemicals. Therefore, the developments following the many decisions and recommendations by UNCED, including its Preparatory Committee (PrepCom), may result in a new or extended role (in this context) to be assigned to UNEP in the future.

The various international meetings and other follow-up activities, up till the end of 1993, with the aim of preparing for the implementation of Chapter 19 of Agenda 21 [UNCED, 1992] on Environmentally Sound Management of Toxic Chemicals have in principle followed two tracks: one is dealing with the management of chemicals in general, and the second one is more specifically focusing on pesticides. Although the main purpose of the present report is to discuss the future role of UNEP in Environmental Exposure and Risk Assessment of Pesticides it was considered pertinent to also briefly review the latest developments along the first one of the above mentioned two tracks, dealing with chemicals in general. This is because there are several important overlaps between the two tracks, and particularly because many of the activities, programmes and coordination efforts related to chemicals in general obviously will be necessary to draw upon by those who will specifically deal with the safe use and management of pesticides.

1.2. A Possible New Role for UNEP in the Field of Environmentally Sound Management of Toxic Chemicals in General

At its second session in March/April 1991, the PrepCom for UNCED invited WHO, UNEP and ILO, within the framework of IPCS, in cooperation with FAO and other relevant organizations, to report on ongoing work carried out through appropriate governmental expert meetings concerning possible proposals for an intergovernmental mechanism for risk assessment and management of chemicals (PrepCom Decision 2/17).

This invitation prompted the UNEP Governing Council to take an initiative at its sixteenth session, requesting the Executive Director to prepare, in cooperation with the above mentioned UN organizations as well as with OECD, EU and other relevant organizations, draft proposals for such a mechanism and to convene a meeting of government-designated experts to consider the draft proposals [IPCS Secretariat, 1991].

The London Meeting

The Meeting of Experts to discuss draft proposals for an Intergovernmental Mechanism for Chemical Risk Assessment and Management was held in London on 16-19 December 1991. It was attended by government-designated experts from 71 countries and representatives of ten UN organizations and other bodies, two intergovernmental organizations and ten non-governmental organizations. The starting point of the discussions at the London Meeting was the following statement of the PrepCom for UNCED at its third session:

- The collaboration on chemical safety between the IRPTC of UNEP, ILO, and WHO, in the IPCS should be the nucleus for international cooperation in environmentally sound management of toxic chemicals;
- all efforts should be made to strengthen this programme; and
- cooperation with other programmes, and particularly the Chemicals Programme of OECD, should be promoted.

The interventions of many delegates at both the second and third UNCED PrepCom sessions indicated wide support for the view that:

- Increased collaboration and cooperation among the programmes should be encouraged with gaps closed and duplication avoided;
- best use of existing institutions should be encouraged and the creation of new agencies avoided.

The London Meeting was thus requested to review the case for, and the requirements of, an intergovernmental mechanism for chemical risk assessment and management.

The report of the London Meeting [UNEP, 1991] was submitted to the Secretary-General of UNCED. The Meeting clearly agreed with the views expressed at sessions of the UNCED PrepCom (see above) and stated *inter alia*:

> "To implement the concept of an intergovernmental mechanism, the Meeting strongly endorsed the need for an enhanced role of the IPCS, increased coordination among UN organizations and an intergovernmental forum on chemical risk assessment and management to promote environmentally sound mangement of chemicals. The purpose of the forum is to provide guidance, develop strategies in a coordinated and integrated manner, provide the required political support and foster understanding of the issues by governments. The Meeting took the view that the work of the forum would be facilitated, if national governments were to examine their own systems and nominate focal points."

Furthermore, the Meeting stressed the following points:

> "In particular, the Meeting believes that the mandate of the IPCS should be extended to include explicitly the coordination of risk assessment and risk management activities of international organizations in the United Nations system and the role of IPCS in supportof the intergovernmental forum. Recognizing the importance of the OECD Chemicals Programme, the IPCS should be empowered to strengthen agreements with that programme so as to allow full use of the work of OECD by the wider international community. The Meeting noted the range of organizations in the UN system with roles relevant to chemical risk assessment and management which also may need to be strengthened. It strongly recommends that the UNCED Preparatory Committee should invite FAO and other relevant UN bodies including those engaged in the transport sector,as well as OECD, to cooperate in the IPCS."

UNCED Agenda 21

UNCED [1992] largely approved the proposals and recommendations made by the London Meeting and stated (Agenda 21, § 19.6) that collaboration on chemical safety between UNEP, ILO and WHO in the IPCS should be the nucleus for international cooperation on environmentally sound management of

toxic chemicals. All efforts should be made to strengthen this programme. Cooperation with other programmes, such as those of OECD and EU and other regional and governmental chemical programmes, should be promoted.

In the final paragraphs of Chapter 19 (19.76 and 19.77), Agenda 21 again refers to the London Meeting, noting that this Meeting called for the taking of appropriate measures to enhance the role of IPCS and establish an intergovernmental forum on chemical risk assessment and management. To further consider the recommendations of the London Meeting and initiate action on them, as appropriate, the Executive Heads of WHO, ILO and UNEP are invited to convene an intergovernmental meeting within one year, which could constitute the first meeting of the intergovernmental forum.

In response to the invitation of Agenda 21, the Executive Heads of UNEP, ILO and WHO decided to convene the *International Conference on Chemical Safety (ICCS)* to be held, upon the invitation of the Government of Sweden, in Stockholm on 25-29 April, 1994 [IPCS Secretariat, 1993b]. The Conference will examine a set of detailed proposals for establishing an *Intergovernmental Forum on Chemical Safety (IFCS)*, including its purpose and scope as recommended by the London Meeting. If there is agreement to do so, the ICCS will also consist of the formal convening of the first meeting of the Forum. An informal consultation to prepare for the ICCS in Stockholm was held at ILO, Geneva, on 6-8 December 1993.

As proposed by UNCED, special mechanisms have been established within the UN system to ensure the implementation of Agenda 21. This includes the establishment of the Department for Policy Coordination and Sustainable Development (DPCSD) as part of the UN Secretariat, and the *Commission on Sustainable Development (CDS)*, in which 53 Member States are members on a rotating basis, and the *Inter-Agency Committee on Sustainable Development (IACSD)* with the following nine core members: UNEP, UNDP, ILO, FAO, UNESCO, WHO, WMO, IAEA, and the World Bank.

The second session of CDS will take place on 16 May - 3 June 1994. At that meeting, the Commission, in accordance with its Multi-Year Thematic Programme of Work, will examine reports on 'Health, Human Settlements and Freshwater' and on 'Toxic Chemicals and Hazardous Wastes'. Governments, UN and non-UN intergovernmental organizations and non-governmental organizations are involved in the preparations for the meeting. Moreover, *'Task Managers'* have been designated for various

chapters, issues and programme areas of Agenda 21 to assist the IACSD in ensuring coordinated contributions of the UN system for the implementation of Agenda 21 in specific areas. The Task Managers will prepare coordinated inputs for consolidated analytical reports of the Secretary-General, which will focus on common UN system strategies for the implementation of Agenda 21 and identify areas for further action for consideration by the CSD. UNEP has been designated the Task Manager for 'Toxic Chemicals and Hazardous Wastes'.

UNEP's involvement

The future deep involvement of UNEP in issues related to the assessment of chemical risks, environmentally sound management of chemicals and toxic chemicals and hazardous wastes might indicate a partly new—or at least expanded—role of UNEP in the broad field of chemical risk assessment and management. It is, however, quite clear that UNEP is already participating, to a smaller or greater extent, but mainly indirectly, as a partner of joint programmes, in most of the activities included in the six programme areas of Chapter 19 of Agenda 21:

(a) Expanding and accelerating international assessment of chemical risks;
(b) Harmonization of classification and labelling of chemicals;
(c) Information exchange on toxic chemicals and chemical risks
(d) Establishment of risk reduction programmes;
(e) Strengthening of national capabilities and capacities for management of chemicals;
(f) Prevention of illegal international traffic in toxic and dangerous products.

The various past and present UNEP activities in these areas have been reviewed recently in a document prepared [by Lönngren & Shillaker, 1993] for the Informal Consultation on 6-8 December 1993 for the ICCS.

As another preparatory action for the implementation of Agenda 21, Chapter 19, an inventory was prepared of international activities relevant to the six programme areas defined (see above) Up till 1 November 1992, contributions to this inventory had been received from 9 UN bodies, OECD and the CEC [IPCS/ICC 1992]. It turned out that some 214 different international activities were reported as currently being carried out, which support implementation of one or more of the six UNCED Programme Areas. Of those being undertaken on a global level, about 60% were activities of the three organizations collaborating in the current IPCS, i.e. ILO, UNEP and WHO, either by the IPCS Secretariat on behalf of ILO, UNEP and WHO, or carried out by ILO, UNEP and WHO individually, but as contributions to the

IPCS and coordinated through the IPCS Intersecretariat Coordinating Committee (ICC). Activities of the three current IPCS cooperating organizations, plus OECD and CEC accounted for about 75% of all activities. The addition of activities of FAO, IMO and UNIDO brought the coverage to about 90% of all activities.

A summary of the current activities of international organizations and programmes split up on the six UNCED Programme Areas, as well as an overview of the Joint Programmes, involving two or more organizations, is provided in Appendix I [from IPCS/ICC, 1992] . It can be seen from Appendix I that, except from its contributions to the IPCS cooperation, UNEP has hitherto been a relatively weak actor in the field of chemical risk assessment.

Therefore, and particularly considering its new function as Task Manager for 'Toxic Chemicals and Hazardous Waste' in relation to the IACSD activities, it seems reasonable to assume that UNEP will have to play a much more active role and become more directly involved in the practical assessment of environmental hazards and environmental risks posed by chemicals, including the assessment of environmental exposure by chemicals.

In this section we have briefly discussed the historical background of UNEP's activities related to chemicals in general, and we have noted that UNEP has played an important role in this field. We have also noted that UNEP, through a series of recent initiatives and through decisive responses to the challenges expressed in Agenda 21, most probably will come into the position to play an even more central role in the future, particularly with respect to assessments of environmental risks and environmental exposure of chemicals. We shall now look into and discuss the background of UNEP's role and operational position in a specialized field of environmentally sound management of toxic chemicals, namely the risk assessment and management of pesticides, which is the main subject of this report.

1.3. UNEP's Role in Pesticide Assessments

A series of international meetings held in 1991 and 1992 came out with various recommendations, which will help in setting the scene for future, consolidated activities within this specialized sector of chemical evaluation. The most relevant meetings, leading up to the preparation of what could be considered as the central policy document for future initiatives in this field (at the

Carshalton Meeting in UK, on 15-17 July 1992 [IPCS, 1992a]), were the following:

- The Joint FAO/WHO Conference on Food Standards, Chemicals in Food, and Food Trade, held in March 1991. This conference, while generally supporting the Joint FAO/WHO Meeting on Pesticide Residues (JMPR), requested that risk assessment procedures and principles be more transparent.
- The Meeting in Saltsjöbaden, Sweden, in October 1991, organized by the Swedish National Chemicals Inspectorate, and attended by representatives of 12 countries and 9 international bodies, was convened to discuss possible improvement of the cooperation on pesticides control and opportunities for risk reduction in the pesticides field [KemI, 1992]. The meeting noted that in the field of assessment of pesticides, several improvements seemed desirable, and recommended that IPCS should develop a long- range strategy for review of risk assessment issues. It was also noted that a prerequisite for substantial progress in this work is an increased transparency on how countries and international organizations arrive at their decisions and conclusions, and the meeting made specific recommendations to IPCS and OECD for improved harmonization of registration and control procedures for pesticides. UNEP was represented at this meeting.
- The OECD Special Session on Pesticides, held in Paris in May, 1992. The objective of the Special Session was to identify the most appropriate role for OECD in this process, and it was decided that OECD should initiate a one-year project, concentrating its efforts in the following areas:
  - Data requirements;
  - test guidelines;
  - reregistration (together with the US-EPA).

New EU pesticide Directive

An additional part in the same series of events were the activities taking place in the EU, where the implementation of the Directive on registration of agricultural pesticides, adopted in 1991, implied not only a major reregistration activity, but also the development of uniform principles for the assessment and evaluation of new and old compounds.

IPCS

The recommendations formulated at the above mentioned meetings and activities, as well as the views expressed by the UNCED PrepCom, prompted the Director of IPCS to make an invitation for an informal consultation at Carshalton, UK, on 15-

17 July 1992 [IPCS, 1992a]. The meeting was attended by governmental experts from seven countries and representatives of FAO, WHO, IPCS, OECD and GIFAP. However, UNEP and ILO were not represented at the meeting.

The Carshalton Meeting was convened to:

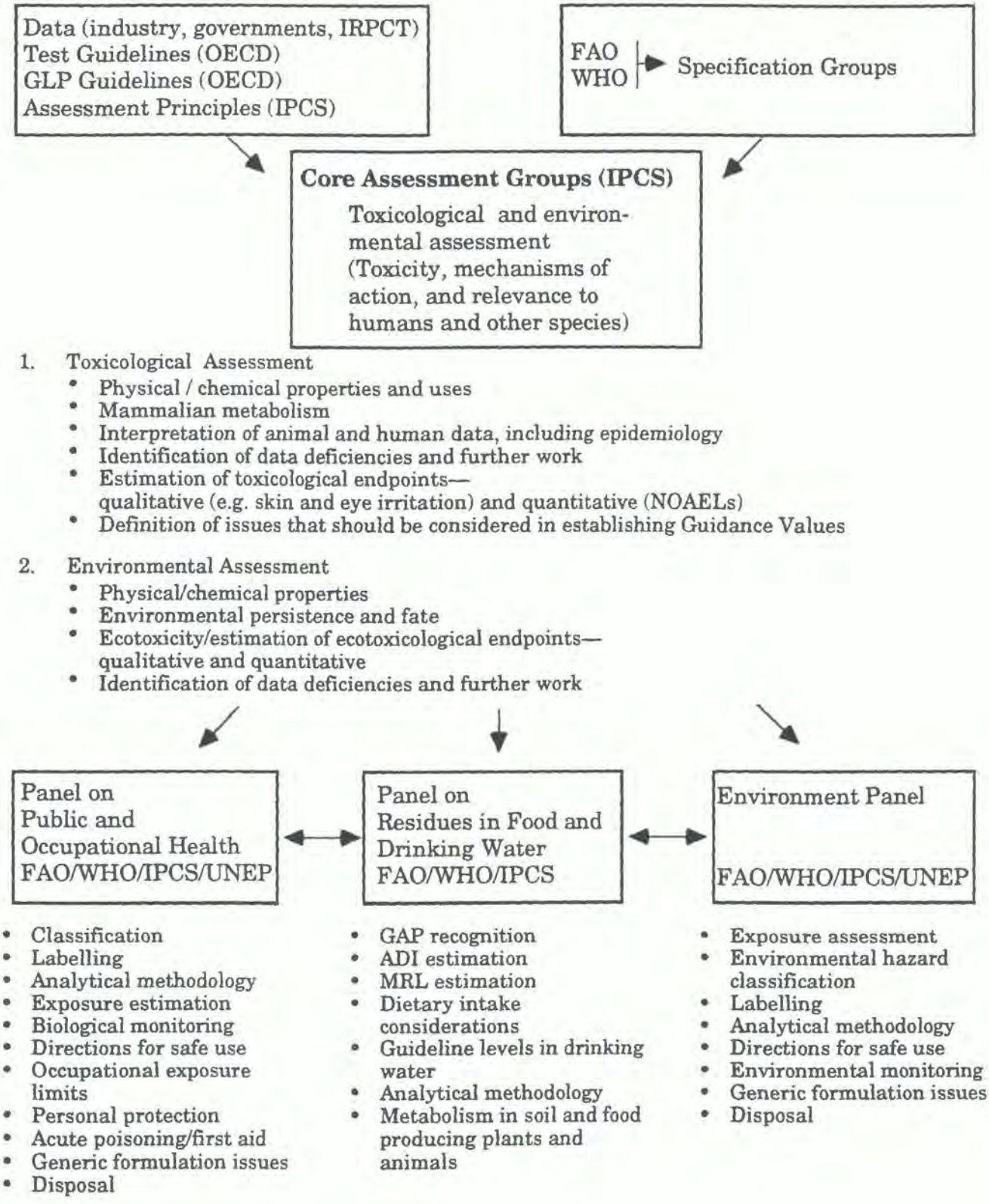
(a) Critically examine pesticide activities within IPCS and joint activities between IPCS and other organizations, particularly FAO;
(b) consider activities that are not presently being addressed, but should be; and
(c) advice IPCS on ways to consolidate the many present IPCS pesticide activities to make them more efficient and to ensure that important areas of concern are covered.

The objective of the Consultation was to advise IPCS on procedures for timely assessment of pesticide safety and use that can reasonably be dealt with at the international level, so that advice responsive to the needs of countries and other users of pesticide information, as well as the Codex Alimentarius Commission, can be provided. This assessment should include occupational safety and environmental effects, but avoid duplication of work with other international bodies. Emphasis should be placed on a more efficient use of available funds and resources, trying to be more proactive than is currently the case.

The goal is for broad acceptance of harmonized assessments of pesticides at the international level, which would substitute for work usually done at the country level. With this in mind, countries should be encouraged to designate a portion of their resources that would normally go into pesticide assessment activities into this international effort.

Joint Meeting on Pesticides

The Consultation discussed various options for an integrated and consolidated approach to IPCS pesticide activities, taking into account the gaps that have been identified. It recommended a *Joint FAO / WHO / UNEP / IPCS Meeting on Pesticides (JMP)*, in which a toxicological and environmental core assessment would form the starting point of the various other activities. At a later point in time, a panel on public and occupational health, a panel on residues in food and drinking-water, and an environmental panel would address the various issues of relevance so that practical advice and guidelines could be provided. The Consultation advised that the process should be used in a flexible way, e g all three panels would not necessarily meet at a given time if the compounds and other subjects on the agenda showed no need to do so.



Source: [Burin & Herrman, 1993]

Figure 1. Proposal for the organization of the Joint Meeting on Pesticides.

The assessment process proposed by the Consultation is shown in *Figure 1*.

Outline of this report

The modalities of this process and the possible contributions of UNEP and other agencies will constitute the core of the present report. These issues will therefore be discussed in more detail in Chapters 5-7. Before coming to this concluding discussion, however, we will make an overview of current approaches to environmental exposure and environmental risk assessment of chemicals, as well as of environmental classification and labelling of chemicals and preparations. Then, a brief presentation will be given of current activities of various international organizations in relation to pesticides. Furthermore, a brief discussion will be provided about the possible needs of developing countries regarding information related to environmental exposure and environmental risks posed by pesticides.

2. Environmental Assessment of Chemicals and Preparations

2.1. General Overview

Almost all man-made chemical substances will sooner or later enter the environment as a result of their production, distribution, use, and disposal. This means that man-made chemicals are almost always present in the environment on a localized basis, while in some cases, their occurrence is more widespread. The way in which substances enter the environment depends on their inherent, physical and chemical properties, the production processes, as well as on the pattern of use and the disposal practices.

The assimilative capacity of the environment

The *assimilative capacity* of the environment means that the environment has a certain capacity to render an introduced substance harmless by breakdown, inactivation or dilution. However, if this capacity is exceeded, damage may be inflicted on organisms, communities, ecosystems or the physical environmental integrity (climate, etc.). In order to evaluate the possible impact on the environment of substances which may be introduced into it, various assessment schemes have been developed.

Environmental assessment of substances

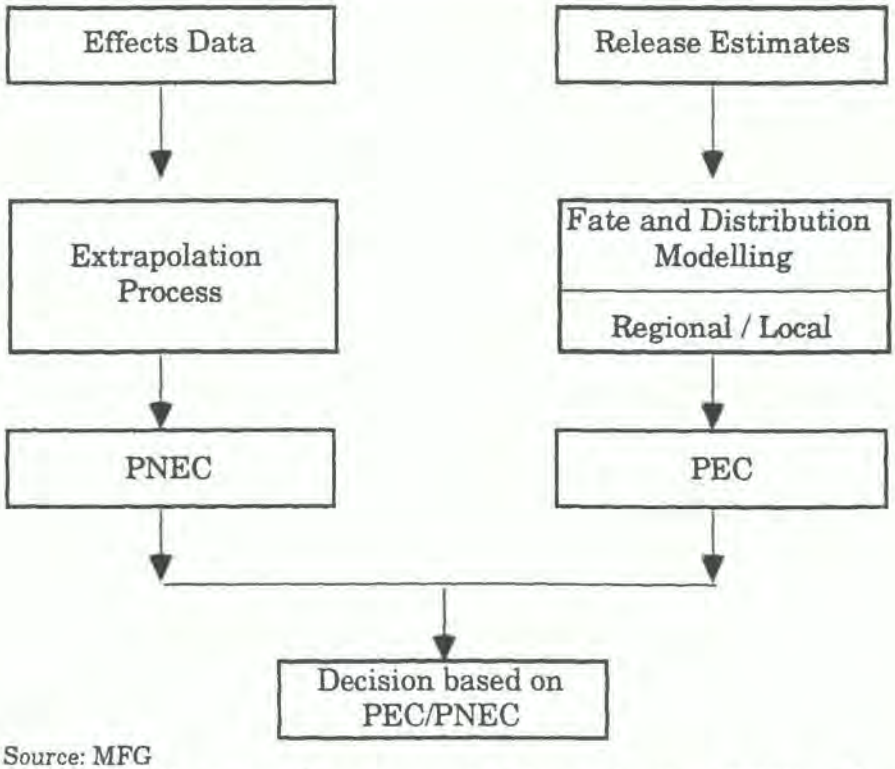
Unfortunately, the terminology in this field is somewhat vari able, among international organizations as well as among countries. In this chapter, we are going to use the terminology currently in use in most industrialized countries, notably by OECD and ECETOC. According to this, the environmental assessment of substances is normally carried out in a step-wise manner, where the following steps can be distinguished:

(1). **Environmental Hazard Identification (EHI)** or Assessment of the Potential Environmental Hazard of a substance,

which is usually made as a basis for Environmental Classification (see Section 2.4) of the substance. The EHI is entirely based on the inherent properties of the substance under assessment, both the exposure-related properties (such as solubility in water, *n*-octanol/water partition coefficient, and ready biodegradability), and the effect-related properties (acute and chronic aquatic toxicity, etc.). The OECD Minimum Pre-marketing set of Data (MPD), which should be available on all new chemicals before they are marketed, can serve as a basis for a meaningful first assessment of the potential hazard of a substance to the environment.

(2). **Environmental Hazard Assessment (EHA)** of a substance requires both an *Exposure Assessment* and an *Effects Assessment* of that substance. The environmental hazard posed by a substance is a function of its inherent toxicity to organisms in the environment and the environmental concentration attained. Therefore, in the Exposure Assessment, the concentration a substance will reach in the environment is calculated (or measured). The Predicted Environmental Concentration (PEC) can be estimated based on information on how and in what quantity the substance enters the environment and on how it is subsequently distributed and transformed. In the Effects Assessment, the maximum concentration of the substance not causing adverse effects is established, i.e. the Predicted No Effect Concentration (PNEC). The PNEC is derived from available ecotoxicological data, together with an application factor (or uncertainty factor) where appropriate to compensate for any restrictions in the data. The EHA in itself consists in a comparison of the PEC and the PNEC, for example by forming the ratio PEC/PNEC. When this ratio is < 1, it can be concluded that the substance under assessment does not constitute an environmental hazard (see *Figure 2*).

(3). **Environmental Risk Assessment (ERA)** includes a calculation of the probability that a hazard will occur. This level of refinement in the environmental assessment of substances is only exceptionally possible to attain, due to the lack of necessary data. (It should be observed, however, that in some environmental assessment schemes for substances, the PEC/PNEC comparisons, and consequently the prediction of local environmental concentrations, based on use patterns etc., are considered as being part of the ERA.)



Source: MFG

Figure 2. Predicted Environmental Concentration (PEC) and Predicted No Effect Concentration (PNEC) in decision making.

2.2. Environmental Hazard Assessment of Chemical Substances

2.2.1. Differences between environmental and human health hazard assessments

As can be inferred from Section 2.1, there are quite considerable differences between an assessment of a substance's hazard to the environment and its hazard to human health. In contrast to the assessment of hazard to human health, the EHA must include a much more comprehensive exposure assessment and identify the environmental compartments at risk, i.e. the compartments to which the substance will preferentially be distributed. This will also allow an identification of the crucial targets of exposure, including the most sensitive populations and communities, in which the exposure to the substance may, at an early stage, cause adverse effects.

Another fundamental difference between the human health hazard assessment and the EHA is that, while the former considers adverse effects only in one species, the latter has to take account of possible effects to a plethora of species, belonging to many different taxa, inhabiting both terrestrial and aquatic ecosys-

tems. Furthermore, the effects assessment must cover several levels of organization, from the survival of individuals, over the recruitment of populations and the integrity of communities to the structure and function of whole ecosystems.

Limintations of most EHA schemes

In most EHA schemes, only the hazards related to organisms in the environment are addressed. Effects on the physical environment, such as those causing climate changes or ozone depletion are not considered, or are addressed in separate schemes. In principle, a comprehensive EHA scheme should be applicable to all environmental compartments. Because the aquatic environment is generally regarded as the main compartment at risk, emphasis has been placed on this in the development of most EHA schemes. This situation is also due to the fact that data is rarely available regarding toxicity to terrestrial organisms, except when it comes to pesticides.

2.2.2. Existing environmental hazard assessment schemes

OECD (HAAB)

Several national authorities and international organizations are developing EHA concepts and procedures for new and/or existing substances. OECD has a long tradition of work in this field, notably in trying to promote awareness and improvement of procedures for hazard assessment used by Member Countries, and to harmonize those procedures in order to assist Member Countries in protecting human health and the environment from the potentially harmful effects of chemicals. Already in the 1980s, OECD was actively involved in setting up harmonized hazard assessment schemes within the framework of its 'Existing Chemicals Programme'. As a basis for this, OECD commissioned a review of the various procedures, developed and used in Member Countries, for EHA of chemicals [Landner, 1984].

Since that time, considerable improvements have been made in hazard assessment concepts for new and/or existing substances and the assessment procedures have been greatly refined. Several national authorities have made considerable progress in the field of EHA during the last decade (e.g. authorities in Germany, The Netherlands, Switzerland, UK and USA), and at least in Switzerland the EHA procedure has legal status. The obvious problem of this development is that assessment schemes tend to differ between different countries. Therefore, OECD still has an important role to play in the harmonization of the various approaches. This harmonization effort is currently conducted by the OECD Hazard Assessment Advisory Body (HAAB), which has accomplished eight meetings by the autumn of 1993 (see Section 3.8 for further details). OECD has issued some important documents mainly describing existing mathe-

matical models useful for estimating environmental exposure [OECD, 1989; 1991].

The Ispra Workshop

Some interesting, recent developments of EHA schemes have also been made by the EU and ECETOC. The CEC, DG XI, organized in 1990 a workshop on 'Environmental Hazard and Risk Assessment in the context of Directive 79/831/EEC' ('the Ispra Workshop' [CEC, 1990]) to discuss and identify common principles for the EHA of substances to achieve a harmonized and transparent procedure for the evaluation of new substances within the European Union [CEC, 1990]. The main points of agreement at this workshop were that the hazard assessment process should be iterative, that exposure scenarios should be developed according to the use of the substances (e.g. surfactants and solvents), and that there was a need for differentiation in the assessment process of the exposure from limited point sources (e.g. manufacturing sites), and exposure from diffuse release (e.g. through widespread use of substances).

ECETOC

Inspired by the outcome of the Ispra Workshop, ECETOC has worked out a comprehensive proposal for an EHA procedure, which is considered to be applicable, in principle, to all substances irrespective of whether they are 'existing' or 'new', including for example active substances in pesticides. The proposal is described in ECETOC's Technical Report No. 51 [ECETOC, 1993]. Since the ECETOC description of a modern EHA scheme is a good example of a comprehensive, clear and detailed guideline for practical use, the following presentation of the various phases of the assessment will be based on this document.

2.2.3. Exposure assessment

The objective of exposure assessment is to identify the relevant environmental compartments in which a substance will reside, and to provide information on the resulting steady-state concentrations. These concentrations can be measured directly or (which is generally the case) predicted by using appropriate mathematical models. As mentioned before, most EHA schemes use a stepwise or iterative approach, in which the principal decision points involve a comparison of the PEC with the PNEC. In the ECETOC scheme, three phases are used, the 'screening', 'confirmatory' and 'investigative' phase, and they are related to the level of detail of the data used.

Phases of exposure assessment

A substance can be released into the environment from a single or multiple point sources or from diffuse sources. The type of source will strongly influence the release estimation and will de

termine the type of mathematical model to be used for predicting the fate and distribution of the substance. Thus, the assessment process involves the use of *regional* and/or *local* mathematical models, which describe so-called 'generic' or 'evaluative' environments having standardized, but realistic properties such as composition, temperature, volume, and so on. Non-dispersively used substances and substances used in a closed system or enclosed in a matrix, may not need an evaluation in a regional model, if emissions arise only from a limited number of single point sources. However, substances being constituents of pesticides would normally need to be assessed by means of a regional model.

Generic environmental scenarios will need to be standardized and agreed upon, for example for different environmental conditions in the subtropical and tropical zone such as humid, semi-arid and arid conditions, different main types of soils, aquatic systems, etc. Various environmental parameters such as dilution in rivers, air or soil should also be agreed upon on a scientific basis. The regional model calculates essentially steady-state concentrations in the various environmental compartments (air, water, soil, sediment and biota), using a specific volume for each compartment in a generic region. Homogeneous partitioning of the substance among completely mixed compartment volumes is not attained in reality, and hence the values obtained for the PECs represent average values, which are often exceeded locally as a function of release pattern and use. The local air, water or soil models are therefore designed to complement the regional model and to refine the prediction of actual substance concentrations for the compartment of concern near or at the source of emission.

Mackay Level 3 Fugacity Model

It is usually considered that the 'Mackay Level 3 Fugacity Model' [Mackay, 1991] is the most appropriate regional model for screening purposes [see e.g. ECETOC, 1993], because it takes into account almost all processes involved in the distribution and fate of a substance:

- Partitioning between the air, water and solid phases within compartments,
- degradation and advection in compartments,
- non-equilibrium between compartments, and
- mass transfer between compartments driven by non-equilibrium between compartments.

The regional model provides essential information which is required before progressing to the local models.

Thus, the regional model approach can be used to:

- Identify environmental compartments of concern,
- provide information on average concentrations in compartments,
- identify sensitive parameters and data gaps,
- allow substances to be ranked on the basis of PEC/PNEC ratios, and
- set priorities.

In the regional model, the following groups of data are required:

- Production (imports), use and disposal pattern of the substance.
- Physical and chemical properties of the substance.
- Data on reactivity or stability of the substance.
- Characteristics of the regional environment.
- Mass transfer factors (kinetic parameters) describing the exchange processes between the environmental compartments.

2.2.4. Effects assessment

As indicated before, only hazards related to organisms in the environment are considered in this overview. Data on a given substance are rarely sufficient to indicate the PNEC without the application of a factor to compensate for uncertainties in the predictive power of the data or to provide an extra measure of safety. These factors are often termed Application Factors (AF). The size of an AF depends on two aspects of the data:

Application Factors

- Ecological relevance:
  Data from short-term studies in the laboratory generally need large AFs; data from long-term laboratory studies or ecosystem field studies need smaller AFs.
- Number of studies:
  The miminum data set at the acute or chronic level should be three studies on at least two taxonomic groups; at the ecosystem level, one carefully conducted study on appropriate species or communities should be sufficient.

Thus, the PNEC is estimated from acute or chronic ecotoxicity data originating in laboratory, model ecosystem or field studies. The three AFs necessary for this estimation are:

- AF1: derives the PNEC from acute laboratory studies.
- AF2: derives the PNEC from chronic laboratory studies.
- AF3: derives the PNEC from ecosystem studies.

Different values of the AFs have been proposed in different national and international EHA schemes. For example, the US-EPA has proposed a range of AFs going from 1 to 1,000 depending on the available ecotoxicity data. The AFs used in the German UBA assessment scheme are: 1,000 when only few acute data are available, 100 when several acute data can be used, and 10 when chronic data for 3 species are available.

In order to provide a scientific basis for the choice of AFs, ECETOC has set up an ecotoxicological database, extracted from the published literature according to strict selection criteria. The database, containing information on 360 substances tested against 120 marine and freshwater species, was then used to derive appropriate AFs. Because the original database contained only few data on ecosystem studies, it was supplemented with information on such studies for ten active ingredients of agrochemicals.

In the analysis carried out by ECETOC [1993], where all inorganic substances and metal-organics were excluded, the ratio between the geometric mean of the acute toxicity values (LC_{50} or EC_{50}) and the chronic no-observed-effect-concentration (NOEC) was calculated for each of 58 substances. The 90 percentile of these ratios was then chosen as the appropriate acute/chronic ratio for this group of substances. The value obtained fell in the rangeof 27 to 40, the variation depending on the types of test organisms included in the analysis. A similar calculation of the ratio between chronic NOECs and ecosystem study NOECs, mainly based on active ingredients of agrochemicals, came to a value of 5.

Thus the AF1 was set at 200 ($40 \times 5 \times 1$), the AF2 at 5 (5×1) and AF3 at 1, considering that a NOEC from a well-conducted ecosystem study would not require an application factor, i.e. AF3 = 1. This means that a PNEC from a satisfactory set of acute ecotoxicity data would be 0.005 of the lowest EC_{50}; the PNEC from a set of chronic ecotoxicity data would be 0.2 of the lowest NOEC and from a well-conducted ecosystem study, the PNEC would be equal to the NOEC of that study.

Important issues

The ECETOC [1993] report also lists a certain number of issues for further consideration or future research. Several of these issues are highly relevant when it comes to an application of the proposed EHA scheme to subtropical and tropical regions and to assessments of pesticides. These issues for further consideration and study will therefore be discussed in some detail in Chapter 6 of the present report, where suggestions are given for future initiatives by UNEP. In this context, it should only be recalled that

the EHA scheme presented above, although intended to cover all environmental compartments, is based almost entirely on data obtained on aquatic organisms. There is a clear shortage of data on soil- or sediment-dwelling organisms, especially of data obtained under relevant and realistic exposure scenarios. However, it may well be that this kind of ecotoxicological data are more easily available for pesticides than for most other chemicals. Compilation of appropriate databases for pesticides, covering high quality ecotoxicity data on organisms other than those living in the water column, is therefore urgently needed.

2.3. Environmental Risk Assessment of Substances

According to the terminology used in this report, Environmental Risk Assessment (ERA) would imply that the *probability* that a hazard will occur can be calculated. Even if the level of refinement of the exposure assessment and the level of sophistication of the mathematical models used today may be such that the probability of attaining a certain concentration of a substance in a well delimited sector of the environment can be calculated with sufficient accuracy, our ecological knowledge is generally insufficient to calculate the probability of the occurrence of an adverse effect.

It must be held in mind that ecotoxicology is still a young science, and only for a few substances, released to the environment by man, do we have a sufficient database to be able to make a proper, scientifically based calculation of the probability that a given environmental concentration will actually cause a defined degree of harm to the ecosystem in question. Interesting developments in the field of ERA have been made by ecotoxicologists working with environmental contamination by radionuclides. Another area where the advancements in risk assessment are quite obvious is in relation to human health, in particular in the assessment of cancer risks caused by either direct or indirect (environmental) exposure of humans to carcinogenic substances.

However, assessment of the risks to the environment (properly speaking), caused by releases of man-made substances such as pesticides, may be an activity that has to wait some time until the scientific basis has developed sufficiently to allow its successful accomplishment. In order to promote this development to take place in the near future, it is essential to identify the data gaps and to define ways to achieve the relevant information needed

2.4. Hazard Classification and Labelling of Chemicals

2.4.1. General classification and labelling systems

It is clearly pointed out in Agenda 21 (§ 19.26) that :

> "Globally harmonized hazard classification and labelling systems are not yet available to promote the safe use of chemicals, *inter alia*, at the workplace or in the home. Classification of chemicals can be made for different purposes and is a particularly important tool in establishing labelling systems. There is a need to develop harmonized hazard classification and labelling systems, building on work in progress."

Agenda 21 furthermore sets the following objective (§ 19.27):

> "A globally harmonized hazard classification and compatible labelling system, including material safety data sheets and easily understandable symbols, should be available, if feasible, by the year 2000."

To this can be added that relatively little progress has been made, on a global basis, with regard to environmental hazard classification and labelling (EHCL) of chemicals. Agenda 21 seems to emphasize the hazard classification and labelling of chemicals on the basis of their health effects and on the basis of their physical hazards (explosive, flammable or oxidizing substances). Reference is made to safety data sheets such as the International Chemical Safety Cards (ICSC), which contain very little information related to environmental hazards. However, there is no doubt that there is also a need to develop scientifically based and harmonized guidelines for EHCL on a global basis, in order to assist (developing) countries to issue rules for national EHCL systems, which will result in enhanced protection of the environment.

The general hazard classification systems (for chemicals) currently in use within the UN system are briefly reviewed in the following, and after that, some comments are given to the current EU system for classification and labelling of chemicals.

The UN hazard classification system

For the safe transport of dangerous goods, including chemicals, a scheme elaborated within the UN system isss in current use. The basis of this is given in the UN Recommendations on the

Transport of Dangerous Goods, with the latest issue in 1991, 'The Orange Book'. These recommendations cover principles of classification and the definition of classes, a list of principal dangerous goods, general packaging requirements, testing procedures, marking, labelling or placarding, and shipping documents. There are nine classes of dangerous goods, such as explosives, oxidizing substances, poisonous (toxic) and infectious agents. Goods, both substances and preparations, are classified according to the main type of immediate danger they would present in an accident. Human health effects are limited to acute toxicity, including corrosion. Ecotoxicological effects are not considered. The labelling system includes colours and symbols to signal specific hazards. 'The Orange Book' lists some 2,500 items of dangerous goods most commonly carried [Lönngren & Shillaker, 1993].

The main importance of the UN Recommendations on the Transport of Dangerous Goods is that they form the technical basis for several binding international agreements, conventions and other instruments, related to the International Carriage of Dangerous Goods by Road (ADR) or by Inland Navigation (ADN). The UN Recommendations are also a basis for e.g. the International Convention for the Prevention of Pollution from Ships (MARPOL, 1973/78) and for several other international conventions.

GESAMP

An activity which might influence the above discussed UN Recommen-dations and form the basis for a future incorporation (perhaps through IMO) of environmental considerations into the classification of dangerous goods is the hazard classification of chemical substances carried out by the Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). GESAMP is sponsored by UN, UNEP, FAO, UNESCO, WHO, WMO and IMO, and in its evaluation of the hazards that substances carried by ship pose for the marine environment, it takes into account the threat to aquatic and human life, the reduction of amenities and interference with other uses of the sea. The GESAMP evaluation programme, currently in progress, could best be characterized as a hazard classification, and it clearly includes some aspects of environmental hazard classification. So far, GESAMP has evaluated some 2,500 chemicals with respect to their potential hazard to the marine environment.

In addition to the above mentioned systems, other ways of cate gorizing hazardous chemicals exist. Examples are ways of ind cating carcinogenic risks, proposed by IARC, the WHO recommendations for classifying pesticides, and FAO's recommenda tions concerning labelling of pesticides [Lönngren & Shillaker 1993].

In 1975, the World Health Assembly adopted a proposal for a classification of pesticides by hazard, and recommended the use of the classification to Member States, international agencies and regional bodies. The classification is based primarily on the acute oral and dermal toxicity to the rat, and comprises four classes: 'extremely hazardous', 'highly hazardous', 'moderately hazardous' and 'slightly hazardous'. The most recent version of the classification system was issued in 1990.

FAO International Code of Conduct

In the FAO International Code of Conduct on the Distribution and Use of Pesticides, one of the articles deals with labelling, packaging, storage and disposal of pesticides. The main recommendation is that all pesticide containers should be clearly labelled in accordance with applicable international guidelines, such as the FAO guidelines on good labelling practice. Proposals on pictograms for pesticides have also been issued by FAO. Among the specific recommendations, reference is made to the WHO hazard classification.

International Labour Conference

In 1989, the International Labour Conference adopted a resolu tion concerning the harmonization of systems of classification and labelling for the use of hazardous chemicals at work. In response to the resolution, ILO evaluated the size of the task of harmonizing existing systems of classification and labelling of hazardous chemicals.

IPCS (CG/HCCS)

Among the more recent developments in this field is the establishment, in January 1992, of an IPCS Coordinating Group for the Harmonization of Chemical Classification Systems (CG-HCCS). The IPCS CG-HCCS should include representatives of the following: IPCS (ILO, WHO, UNEP); FAO; UN Committee of Experts on Transport of Dangerous Goods (UN CETDG); other relevant UN organizations and agencies; OECD; regional and national existing classification systems; international organizations of suppliers, employers, workers, consumers, environmental groups, and any other relevant concerned associations [IPCS, 1993b]. The ILO provides the secretariat of the Coordinating Group. The main task of the CG/HCCS is to catalyse the development of a globally harmonized classification and hazard communication system for chemicals, according to an established workplan.

The Coordinating Group will function within a restructured and strengthened IPCS, as recommended by UNCED. It is supposed to represent a model for setting up eventual coordinating structures to address the other five UNCED Programme Areas.

The following objectives are guiding the work of the CG/HCCS:

- to coordinate international efforts in the harmonization of systems of classification and hazard communication for chemicals;
- to ensure that the harmonization process delivers benefits for human health and environmental protection;
- to promote the benefits of a harmonized system;
- to ensure that harmonization proposals are cost-effective; and
- to ensure that all interested parties are consulted.

A list of bodies participating in the IPCS CG/HCCS is provided as Appendix II.

OECD Clearing House

Within the framework of this cooperation, OECD has set up a Clearing House, led by the CEC, Sweden and the USA, to undertake the harmonization of classification criteria for acute oral toxicity and hazard to the environment. The CG/HCCS has agreed that OECD should continue to be the focal point for harmonization of all health effects and that the UN Committee of Experts on Transport of Dangerous Goods should join the Clearing House [Lönngren & Shillaker, 1993].

The IPCS CG/HCCS has accomplished four consultations, the latest one on 2-3 November 1993, at ILO, Geneva. In the Progress Report to the November meeting [IPCS, 1993a],the status of the ongoing work is summarized. With regard to health hazards, the OECD Clearing House on Harmonization of Classification Systems has elaborated proposals for harmonized criteria of *acute toxicity hazard categories (oral, dermal and inhalation)*. Furthermore, OECD is preparing work plans to consider harmonization of criteria for the hazard categories: *toxic (long-term), irritant, sensitizer, carcinogen, mutagen and reproductive / developmental effects*. Australia and the UK have started work on *reproductive and developmental effects*.

Physical hazards

With regard to physical hazards, a report on Classification Systems for Physical Hazards and Possibilities for Greater Harmonization, commissioned by ILO will serve as a starting point for discussion and initiation of harmonization activities.

Environmental hazards

As far as environmental hazards are concerned, the OECD Clearing House has elaborated proposals for harmonized criteria for *aquatic toxicity* based on those developed in the EU and the Nordic countries. The Clearing House also held a meeting in February 1993 in Uppsala, Sweden, to explore the state of the art in order to identify and prepare the next steps towards the development of *criteria for the soil / terrestrial environment* .

The general feeling is that quite considerable progress has been made by the CG/HCCS with regard to harmonization of classification systems for health hazards and physical hazards. However, in the field of harmonization of systems for environmental hazard classification and labelling, a great deal of work still seems to remain, particularly with regard to soil and terrestrial environment.

Perhaps the most advanced harmonization of systems for classification and labelling of chemicals has, so far, been accomplished by the ECE, albeit only on a regional level. However, this work may serve as a model for the future efforts within the CG/HCCS, and the OECD Clearing House is also relying upon the EU achievements, e.g. in its work on classification for environmental hazards.

EU

Detailed criteria for the classification of substances and preparations as dangerous for human health and clear rules for their subsequent labelling have been laid down by the EU. The EU Council Directive 67/548/EEC (27 June 1967) on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances, amended for the seventh time in 1992 by Directive 92/32/EEC, codified the current rules. This directive, together with technical adaptations, addresses the general requirements for dangerous substances and preparations (with some exceptions). Another Directive (88/379/EEC) gives more detailed guidance for dangerous preparations (with the exception of e.g. pesticides), particularly regarding the use of concentrations limits for classification and labelling.

Thus, within the EU, as well as in several other European countries, legal provisions are in force for classification and labelling of both substances and preparations with regard to their hazards to human health. The objective of the classification is to identify all the toxicological and (intrinsic) physical/ chemical properties of substances and preparations, which may constitute a hazard during normal handling and use. Having identified any hazardous properties, the substance or preparation must then be labelled to indicate the hazard(s) in order to protect the user and the general public.

Both acute and long-term toxic effects, whether resulting from a single instance of exposure or repeated or prolonged exposure, are taken into account for potential human health effects. The major categories of danger for classification on the basis of toxicological properties are 'very toxic', 'toxic', 'harmful', 'corrosive', 'irritant' and 'sensitizing', as well as the special effects of car-

cinogenicity, mutagenicity and toxicity to reproduction. Standard symbols (pictograms), risk phrases and safety phrases have been developed and are obligatory for the marketing of a substance or a preparation in the EU.

2.4.2. Environmental classification and labelling of substances

As mentioned before, the classification and labelling of substances (and preparations) with regard to their environmental hazards is an issue lagging behind the classification and labelling based on toxicological and physical/chemical properties. However, also in this field, the EU together with the Nordic countries, has taken a leading role. Recently, criteria and rules have been established for classification and labelling of substances as 'dangerous for the environment' within the EU as well as in several other European countries. Also for environmental hazard labelling, standard symbols, risk phrases and safety phrases have been developed and are, today, obligatory for the marketing of substances in the EU and in the EFTA countries. Even if the legal provisions are set down also for classification and labelling of preparations as 'dangerous for the environment', the detailed classification criteria have not yet been established for this purpose (see Section 2.4.3).

Objective

The primary objective of classifying substances as dangerous for the environment, and labelling them on the basis of their classification, is to alert the user to dangers posed to ecosystems when using the substance. At present the classification system is focused on hazards to the aquatic ecosystem and to the destruction of the ozone layer. The major categories of danger for classification of substances on the basis of ecotoxicological properties and other intrinsic properties relevant for environmental exposure are 'very toxic to aquatic organisms', 'toxic to aquatic organisms', 'harmful to aquatic organisms' and 'may cause long-term effects in the environment'.

The type of data needed as a basis for the classification are those specified in the Base Set of the EU or by the OECD MPD. This includes solubility in water, *n*-octanol/water partition coefficient, P_{ow} (as an indicator of bioaccumulation potential), ready biodegradability and acute aquatic toxicity (preferentially determined in tests with fish, *Daphnia* and unicellular algae). At present, no detailed criteria have yet been established for the classification of substances based on their intrinsic ecotoxicological effects on terrestrial organisms or on long-term effects in terrestrial ecosystems.

Nevertheless, the EU system for environmenetal hazard classification and labelling of substances appears to be the only existing system in wide practical use for this purpose. The experiences gained, over the last few years, from the practical and general application of this system would be of great value to study in detail by the relevant UN organizations, notably by UNEP, in order to evaluate to what extent this system—or a modified version of it—would be applicable in subtropical and tropical developing countries.

2.4.3. Environmental hazard classification and labelling of preparations

Although rules for the classification and labelling of preparations as dangerous for human health are already in force within the EU (and several other European countries), see Directive 88/379/EEC, such rules are not yet established for the classification and labelling of preparations as dangerous for the environment. However, work is in progress to develop appropriate criteria, based on concentration limits of dangerous substances in the preparations, both within the CEU and in a Working Group established by the Nordic Council of Ministers (with Sweden as Lead Country).

One of the main objectives of the last mentioned Working Group is to investigate the practical consequences (such as frequency of classified and labelled preparations belonging to different use categories, level of regulation of dangerous substances, etc.) of the application of different types of criteria models, including different levels of concentration limits. The final report of the Nordic Working Group will be finalized in the first quarter of 1994. The work is carried out in concertation with the relevant EU Groups of Experts.

3. The Activity of International Organizations in Relation to Pesticides

WHO and FAO have traditionally been the UN organizations that dealt with pesticide hazards for the past 20-30 years. The focus has been on pesticide residues in food. However, a number of factors has increased the interest in OECD countries as well as in developing countries of a broader forum of pesticide risk assessment [IPCS Secretariat, 1993a]:

- Increased pesticide use in developing countries requiring a more thorough scientific evaluation.
- A growing environmental concern has created a demand for broader assessment than the traditional pesticide residue assessment.
- The GATT is discussing the use of Codex MRLs as international norms for dispute resolution of claims of non-tariff trade barriers.
- More countries are committing to the FAO International Code of Conduct on the Distribution and Use of Pesticides [FAO, 1990].
- Differing standards create problems for developing countries when exporting food products.
- The formation of the European Union has increased the need for common denominators as a basis for regulations.

The following provides a brief review of the activity of international organizations in relation to pesticides testing, assessment, guideline setting (including classification and labelling) and monitoring.

3.1. UNEP

United Nations Environment Programme (UNEP) was formed in 1973 as a direct result of the 1972 Stockholm Conference on the Human Environment [UNEP, 1992] to catalyze, coordinate and stimulate action within the UN system with regard to the Action Plan for the Human Environment:

- To provide improved knowledge of the resources of the biosphere. The emphasis was to be on interdisciplinary studies of natural and man-made ecosystems, so that future management of these resources could rationally integrate previously disparate disciplines.
- To encourage and support the integrated planning and management of development. This approach would mean accepting for environmental consequences in the management of natural resources. UNEP's approach was to encourage management systems that maximize social, economic and environmental benefits.
- To assist all countries, especially developing countries, to deal with their environmental problems. This meant helping mobilize additional finance for technical assistance, education and training, and a free flow of information and experiences. UNEP also had to promote the full participation of developing countries in national and international efforts to preserve and enhance the environment.

UNEP has a number of specialist units on:

- Industry and Environment
- Energy
- Environmental monitoring
  - Global Environment Monitoring System (GEMS)
  - Global Resource Information Database (GRID)
  - IRPTC
  - INFOTERRA.

UNEP is not a funding agency [United Nations Environment Programme, 1990]. It uses its resources to start up programmes that draw on funding from other agencies, governments and organizations. UNEP's funds come from four sources: The regular budget from the United Nations; voluntary contributions to the Environment Fund; trust funds; and counterpart contributions. Roughly three fifths of the Environment Fund is spent on global programmes such as GEMS, climate, IRPTC, and INFOTERRA —the rest is spent in inter-regional and regional activities mainly in developing countries. The hazard of chemicals, including pesticides is addressed through IRPTC discussed in the following.

3.1.1. International Registry of Potential Toxic Compounds (IRPTC)

Through the International Register of Potential Toxic Chemicals (IRPTC) UNEP conducts work on chemicals including pesticides. Since the IPCS programme was initiated in 1980 as a coordinated effort with WHO and ILO, IRPTC has provided the raw material for chemical safety decisions. IPCS (housed at the WHO headquarters in Geneva) processes it, publishing evaluations on health and environmental risks, advice on control and exposure levels and on further research. This high-quality information flows back to the IRPTC data profiles [IRPTC, 1990].

The IRPTC was established in 1976 by UNEP and the same year, the UNEP Governing Council agreed that the Register would have four main objectives. In 1989, the Governing Council revised these objectives and added a fifth [Sundén-Byléhn, 1992]:

1. Facilitate access to existing data on chemicals and thereby contribute to a more efficient use of national and international resources available for the evaluation of the effects of the chemicals and their control;
2. On the basis of the information in the Register, identify impor tant gaps in existing knowledge on the effects of chemicals, and call attention to the need for research to fill those gaps;
3. Identify, or help identify, potential hazards from chemicals and wastes, and to improve the awareness of such hazards;
4. Provide information about national, regional and global policies, regulatory measures and standards and recommendations for the control of potentially toxic chemicals;
5. Facilitate the implementation of policies necessary for the exchange of information on chemicals in international trade.

It is obvious from the above listed objectives that IRPTC's activities are oriented not only towards pesticides but also to other types of chemical substances. The activities of IRPTC related to chemical safety are the following:

- *chemical data profile development*, where information on chemical substances is gathered and stored in a computerized system for subsequent data retrieval and dissemination;
- *legal data gathering*, which has become an independent activity within the data profile development;
- assists developing countries in setting up their own *National Registers on Potentially Toxic Chemicals (NRPTC)*;

- implementation of the *London Guidelines* for the Exchange of Information on Chemicals in International Trade including, since 1989, the *Prior Informed Consent Procedure (PIC)*, in a joint programme with the FAO;
- operates a *Global Network* for the exchange of information on chemicals;
- offers *training* including a joint IRPTC/UNITAR (UN Institute for Training and Research) training programme aimed at assisting countries in the implementation of the London Guidelines;
- *publishes scientific and technical documents* on chemicals and the *IRPTC Bulletin* devoted to information on hazardous chemicals;
- provides a Query Response Serevice.

Pesticides

In relation to pesticides, a few things among IRPTC's activities may be noted [cf. Lönngren, 1992]. A considerable portion of the about 600 chemicals for which IRPTC has elaborated Data Profiles are pesticides. IRPTC has also cooperated actively in the elaboration of the 'UN Consolidated List of Products Whose Consumption and/or Sale Have Been Banned, Withdrawn, Severely Restricted or Not Approved by Government'. More than 100 pages (out of 246) of this List deal with agricultural chemicals, of which most are pesticides.

IRPTC is the UNEP body that participates in the International Programme on Chemical Safety (IPCS) discussed below. Although IRPTC staff has participated in Environmental Health Criteria (EHC) task group meetings, IRPTC has so far never been directly responsible for actually assessing hazards. The JMP/Environment (JMPE) panel would hence bring a new type of responsibility to IRPTC (see Chapter 5).

3.2. FAO

The Food and Agriculture Organization (FAO) is a specialized agency within the UN system that bears the responsibility of executing projects within this area.

FAO has had a major interest in the whole concept of pesticides inasmuch as pest control is considered a prerequisite for a stable and increasing food production. However, FAO has also shown awareness regarding the safe use and handling of pesticides. Already in 1970, FAO issued guidelines and a Model Scheme for the establishment of national ortanizations for the registration and control of pesticides. As a result of two government consultations held in 1977 and 1982, the *FAO Code of Conduct on the*

Distribution and Use of Pesticides was worked out, and it was approved by the FAO Conference in November 1985. The Code was amended in 1989, when the PIC Procedures were incorporated [Lönngren, 1992]. The objectives of the Code are to set forth responsibilities and establish voluntary standards of conduct for all public and private entities engaged in the distribution and use of pesticides, particularly where there is no, or an inadequate, national legislation to regulate pesticides.

A great number of guidelines for the implementation of the Code have been issued by FAO. Of particular interest in this context are the 1985 'Guidelines for the Registration and Control of Pesticides', which contains a section on 'Prediction of Environmental Effects', and 'Revised Guidelines on Environmental Criteria for the Registration of Pesticides' [FAO, 1990]. The latter comprises two parts, one dealing with principles and includes sections on exposure, effects, hazard, ecological significance and risk, while the second part deals with test procedures, including physical-chemical properties, fate and mobility in the environment, and effects on the environment.

JMPR

Since 1963, FAO has worked closely with WHO on the question of pesticide residues in food in the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) [Logothetis & Westlake, 1964].

3.3. ILO

With regard to chemicals, the International Labour Organization is responsible for occupational health and safety of chemical products and contributes to the international collaboration through:

- Codes of practice
- Guides and manuals
- Provision of technical advisory services
- Technical cooperation projects.

In response to the 1989 International Labour Conference Resolution concerning the harmonization of the criteria for classification, identification and labelling of chemicals used at places of work, ILO contributes to the IPCS with scientific support and use of outputs from the IPCS. Since 1992, ILO has provided the secretariat of the CG/HCCS

The interest of ILO in the field of pesticides is limited to safe handling, transport and administration with regard to occupational health and safety. ILO's interest is thus complimentary to UNEP's interest, which is focused on the external environment after the pesticide has been applied.

3.4. WHO

The 1972 United Nations Conference on the Human Environment held in Stockholm, Sweden, recommended that programmes guided by the World Health Organization should be conducted for the early warning and prevention of harmful effects of the various environmental contaminants, acting singly or in combination, to which humans were being increasingly exposed directly or indirectly [IPCS, 1989].

WHO is responsible for the WHO Guidelines for Drinking Water Quality that was first published in 1984. In 1992, these guidelines were updated with evaluation documents for some 128 chemical contaminants in drinking water (among which are 30 pesticides) drafted by various institutes and reviewed by IPCS. The final set of guidelines containing guideline values whenever possible was submitted to the WHO Office of Publications in October 1992, and the evaluation documents were submitted for publication in 1993. (WHO is also responsible for Air Quality Guidelines. However, pesticides are not included in this programme.)

Pesticides

The WHO Recommended Classification of Pesticides by Hazard was approved by the World Health Assembly in 1975. In 1976 the first set of guidelines of hazard classification of individual pesticides was published and has since been revised at 2-year intervals. The individual products are classified according to their oral and dermal toxicity, e.g.:

- Class 1a: Extremely Hazardous
- Class 1b: Highly Hazardous.

In 1977, WHO's governing body, the World Health Assembly, decided that the problem of long-term strategies to control and limit the impact of chemicals should be addressed at the interagency level. Together with the International Labour Organization (ILO) and UNEP the International Programme on Chemical Safety (IPCS) was formerly launched in April 1980. Therefore, the IPCS was launched in April 1980 together with ILO and UNEP. Since 1990, the responsibility for activities related to pesticides have been transferred to IPCS.

3.5. FAO/WHO Joint Activities

FAO/WHO have joint activities on chemicals in food:

- Joint FAO/WHO Expert Committee on Food Additives (JECFA).
- Joint FAO/WHO Meeting on Pesticide Residues (JMPR).

The evaluation of food additives, food contaminants, pesticide residues and veterinary drug residues provide Member States with estimates of the levels at which chemicals can be safely tolerated by the human body. The recommended levels are then used by national regulatory agencies and by the Codex Alimentarius to establish safe levels of these substances in foodstuffs. These activities also involve IPCS.

JMPR

The Joint FAO/WHO Meetings on Pesticide Residues have been held since 1963 during which time approximately 210 pesticides have been evaluated. The objectives of the JMPR are to review toxicological and related data and estimate, where possible, acceptable daily intakes (ADIs) for pesticides (WHO Expert Group on Pesticide Residues), and to review pesticide use patterns, data on chemistry, composition, and methods of analysis and estimated maximum residue levels (MRLs) for pesticides (FAO Panel of Experts on Pesticide Residues in Food and the Environment) [IPCS, 1993c].

During the joint meetings, the two groups coordinate their activities and issue a joint report. In addition residues monographs are published by FAO in the FAO Plant Production and Protection Paper series, and toxicological monographs that are published by WHO.

A database has been developed in cooperation with the National Institute of Hygienic Sciences, Tokyo. A first summary based on this database published in 1991 contained information on ADI values and full references. A revised version has been made available in 1993 [IPCS, 1993c].

3.5.1. Codex Alimentarius Commission

The Codex Alimentarius Commission was founded by governments and is administrated by the joint FAO/WHO Food Standards Programme. The Commission has 10-15 different 'food-products' committees in addition to the interdisciplinary ones such as the Codex Committee on Food Additives, which is 'served' by the JMPR and the Codex Committee on Pesticide Residues.

Setting Maximum Residue Limits to pesticides in food products has been the traditional means of guiding the risk management of pesticides. The secretariat of the WHO panel of the JMPR issued those guidelines. A comprehensive summary has been provided in the Environmental Health Document No. 104 [IPCS, 1990b] —for a summary of toxicological evaluations performed under JMPR, please refer to [IPCS, 1992b]. However, the lack of

a universal acceptance of the Codex MRLs and the need for a broader evaluation including environmental fate and ecological assessment of pesticides have created a need for a restructuring of this whole process [Burin & Herrman, 1993].

3.6. UNEP/FAO Joint Activities

Prior Informed Consent Procedures

The PIC scheme was adopted by UNEP in 1989 under the London Guidelines on the Exchange of Information on Chemicals in International Trade and is operated jointly by FAO and UNEP (through its IRPTC) [UNEP & FAO, 1990; UNEP & FAO, 1991c; UNEP & FAO, 1991b; UNEP & FAO, 1991a; UNEP & FAO, 1992a; UNEP & FAO, 1992b; UNEP & FAO, 1993]. PIC is a programme in progress.

Pesticides will be placed in the PIC process, if they meet one of three criteria:

- A chemical that is banned for health or environmental reasons in five countries or more.
- A chemical which is newly banned or severely restricted for health or environmental reasons in a single country after 1 January 1992.
- Chemicals causing health or environmental problems under the conditions of use in developing countries.

The FAO International Code of Conduct on the Distribution and Use of Pesticides states that "no pesticide in these categories should be exported to an importing country participating in the PIC procedure contrary to that country's decision" [FAO, 1990].

While compliance is voluntary, a scheme of operation is now in place facilitating the PIC work. Governments have been asked through the FAO/UNEP Joint Programme to nominate designated national authorities for the implementation of the information exchange and PIC Procedures of the London Guidelines and the International Code of Conduct [UNEP & FAO, 1993]. PIC is an ongoing programme and an evaluation of this programme is not part of the discussion of this document. Still, the success of the PIC programme is one of the most important conditions for the JMPE process as well.

The early findings in the 1950ies and 1960ies of persistent pesticides in birds and fish population were the start of a new discipline, the environmental hazard assessment of chemicals. Focus was on the *dirty dozen*, which already in the 1960ies were counted in more than one dozen, Table 1. The implementation and

enforcement of the PIC procedure should assist their control and ultimate elimination. All but five of those are or will be included in the PIC procedure [Dinham, 1993].

Table 1. Rachel Carson's *dirty dozen*.

Compound	Included in PIC Procedure	To be included in PIC
Aldrin	Yes	
Aminotriazole		
Camphechlor		
Chlordane	Yes	
CIPC / IPC-Carbamates		
DDT / DDE / DDD	Yes	
Dieldrin	Yes	
Dinitro-herbicides	Yes	
Endrin		Yes
HCB	Yes	
HCH		
Heptachlor / -epoxide	Yes	
Lindane (or γ-HCH)		
Mirex		Yes
Telodrin		Yes
Toxaphene	Yes	

Source: [Carson, 1962].

Further to this, at least 24 other pesticides are in WHO Class 1, ten of which are important in more than one country, confer to Table 2.

Article 3.5 of the FAO Code states:

> "Pesticides whose handling and application require the use of uncomfortable and expensive protective clothing and equipment should be avoided, especially in the case of small-scale users in tropical climates."

It is important that WHO Class 1 pesticides are evaluated in this regard. Several of the pesticides in Table 2 require special handling if used for example in the United States or the United Kingdom [The Pesticide Trust, 1989].

3.7. IPCS

IPCS was set up in 1980 as is a joint programme between ILO, WHO and UNEP to provide cooperation in the field of chemical

Table 2. Important pesticides in WHO Class 1 that may not necessarily be included in the PIC procedure.

Compound	WHO Class①	UN List②	Countries③
Azinphos-methyl	1b	1	3
Azinphos-ethyl	1b		1
Brodifacoum	1a		1
Captafol	1a	3	1
Carbofuran	1b	2	8
Chlorfenvinphos	1a		1
Coumatetralyl	1b		1
Demeton-S-methyl	1b	2	1
Dichlorvos	1b		2
Dicrotophos	1b	2	1
DNOC	1b	2	1
Ethoprop	1a		1
Fenamiphos	1a		2
Fenthion	1b		3
Methamidophos	1b	1	5
Methomyl	1b	1	2
Methyl parathion	1a	4	5
Monocrotophos	1b	1	5
Omethoate	1b	3	1
Phorate	1a	4	1
Phosphamidon	1a	3	5
Prothoate	1a	4	1
Terbufos	1a		1
Triazophos	1b		1

Source: [The Pesticide Trust, 1989].
①WHO Class 1a: Extremely hazardous; Class 1b: Highly hazardous.
②Total number of countries that have banned or severely restricted the pesticide according to the UN list.
③Number of countries that use this pesticide from a survey of Egypt, Senegal, Sudan, Bangladesh, India, Indonesia, Malaysia, Korea, the Philippines, Costa Rica, Columbia, Equador, and Paraguay.

safety and, in particular, to provide assessments of the risks to human health and the environment posed by chemicals [IPCS, 1989; IPCS, 1990a]. The programme would not deal with monitoring of chemicals and those aspects already addressed elsewhere in the three organizations. Among the important objectives of the original IPCS were to catalyze and coordinate activities in relation to chemical safety, and in particular to:

- Evaluate risks to human health and the environment from exposure to chemicals.

- Promote the development and use methods for the evaluation of health and environmental risks and hazards of chemicals.
- Promote technical cooperation between member states.
- Promote cooperation with respect to emergencies and chemical dependent accidents.
- Support national programmes for the prevention and treatment of poisonings involving chemicals.
- Promote training of the required manpower.

One of the most important tasks of IPCS has been the preparation of Environmental Health Criteria Documents [IPCS, 1991]. IPCS has also been the coordinator for pesticide evaluations since 1980 [Burin & Herrman, 1993].

In response to the recommendations of the PrepCom of UNCED, as well as of the London Meeting in December 1991, the Intersecretariat Coordinating Committee (ICC) started preparatory work and examined the implications of a strengthened IPCS (cf. Section 1.2). Draft proposals for a strengthened IPCS were elaborated during the second half of 1992, and a final proposal was issued on 18 October 1993 [IPCS/ICC, 1993]. The strengthened IPCS would be based on the original concept of a joint programme in the true sense of the word—with the Cooperating Organizations having equal rights and responsibilities in its decision-making, contributing resources and assuming their appropriate share of the workload and coordination costs.

'New' IPCS

The overall objective of the 'new' IPCS would be to promote the environmentally sound management of chemicals within the principles of sustainable development and improved quality of life for humankind. To this end, the Programme would catalyze and coordinate activities in relation to chemical safety, including capacity building and promotion of research, and in particular:

(a) Carrying out and disseminating evaluations of the risks to human health and the environment from exposure to chemicals, including those of natural origin, combinations of chemicals and chemical processes.
(b) Producing health or environment based guideline values foracceptable exposure to the agents evaluated.
(c) Promoting the development, improvement, validation, harmonization and use of internationally acceptable methods fo laboratory testing and exposure assessment, for clinical, toxicological, ecological and epidemiological studies, etc.
(d) Promoting the development and global application of a harmonized system for classification of chemicals and a compatible labelling system.

(e) Promoting and facilitating information exchange on chemicals, chemical accidents, chemical risks, cleaner technologies and hazard communication systems, and the full implementation of international guidelines, in particular the PIC Procedure.
(f) Promoting effective international cooperation with respect to prevention of, preparedness for and response to emergencies and accidents involving chemicals.
(g) Promoting development and use of safer alternative chemicals and technological approaches to risk reduction.
(h) Promoting activities to reduce the risks of chemicals, taking into consideration their entire life cycle.
(i) Promoting technical cooperation with Member States, in particular developing countries, to facilitate the use of available evaluations, and improve the capabilities of national authorities to conduct their own evaluations of health and environmental hazards and risks from chemicals.
(j) Promoting the establishment and strengthening of national capabilities and capacities for safety aspects relating to management of chemicals, throughout their entire life cycle.
(k) Promoting the strengthening of national capabilities and capacities to detect and halt illegal international traffic in toxic and dangerous products in contravention of national legislation and relevant international legal instruments.

The proposed objectives and activities of the 'new' IPCS constitute, if adopted, a considerable expansion of the current work programme. Some of the most important changes, in the perspective of UNEP's new role, are the emphasis given to environmental aspects and to the assessment of exposure to chemicals, as well as the explicit promotion of scientific and technical research. Furthermore, the statement that each Cooperation Organization would be a full decision-making partner in the IPCS seems to imply that, for example, UNEP will have to take a more active role than hitherto in the actual work on assessment of environmental exposure and environmental hazard and risk of chemicals.

It is quite clear that the above referred objectives and activities of the 'new' IPCS relate to all kinds of chemicals, combination of chemicals and chemical processes. However, the future work of IPCS in this general field of chemical safety most certainly will also set the scene for and have important implications for the more specific work on pesticide management and pesticides safety. In fact, the above principles will provide the general framework for all specialized work on environmentally sound management of chemicals, including that of pesticides.

As mentioned in Section 1.3, a Consultation held in Carshalton, UK [IPCS, 1992a] suggested that a new initiative be taken in the field of international pesticide assessments by transforming the current JMPR into a new body, the *Joint Meeting on Pesticides (JMP)*. The IPCS Secretariat has further developed this proposal [Burin & Herrman, 1993; IPCS Secretariat, 1993b], and it is presumed that the new mechanism will come into force in the beginning of 1994. A general observation is tha the discussion in the above mentioned documents tends to focus mainly on the toxicological assessment of pesticides, although it is clearly pointed out that an environmental assessment should also be included. This is reflected *inter alia* by the proposal to establish an Environmental Panel (JMPE) as well as a separate Core Assessment Group (CAG) for Environmental Assessment (see *Figure 1*).

The possible role of UNEP in these two bodies will be further discussed in Chapter 5 of the present report.

3.8. OECD

OECD has long been involved with hazard and risk assessment of chemicals and chemical products. During discussions at the spring 1989 Joint Meeting on further OECD work on hazard assessment, the development of a single, definitive hazard assessment procedure for all types of chemicals (industrial, pesticide, etc.) was considered not to be possible in the foreseeable future [OECD, 1992]. It was agreed that the most useful work for OECD would be to encourage and facilitate the exchange of information between Member Countries on hazard assessment procedures in current use, to assist in the selection of the most effective assessment methods for each type of chemical, and to pursue a long-term goal of greater harmonization of the method: used. The consequence of this conclusion is that for the time being, pesticides will have to be assessed as an independent group of chemicals.

3.8.1. The Hazard Assessment Advisory Body (HAAB)

HAAB is working towards mutual acceptance of integrated assessment schemes by developing:

- A compendium of the assessment methods used in Member countries (or harmonized methods for a number of endpoints
- A detailed listing of the information to be included in the assessment report (how the quality of the data is reviewed, anc which other aspects should be considered in the evaluations)

The HAAB has already prepared a guidance document for aquatic effects assessment [OECD, 1993b]. This document was prepared by the Netherlands and will be released as an OECD monograph [OECD, 1993a]. Another document on terrestrial effects assessment has been prepared by Denmark with support from the EU Commission.

According to its work programme for 1993-94, the HAAB is currently conducting the following activities:

- Aquatic effects assessment guidance document
- Data estimation
- Product registers
- Exposure models
- Exposure assessment
- Existing chemicals provisional guidance
- Polymers
- Terrestrial effects assessment
- Testing strategies
- Integrated assessment schemes.

Mid to late 1994, an OECD workshop will be held on Environmental Hazard/Risk Assessment. The HAAB has doubts whether pesticides and general chemicals can be addressed in the same workshop. First of all, the exposure scenarios of the two differ, and the hazard assessment of pesticides is much more advanced—more information is generally available.

3.8.2. OECD Working Group on Pesticides

As a follow-up to these initial one-year projects, the 20th Joint Meeting agreed to launch a three-year Activity on Pesticides (1994-96). This activity is aimed at achieving harmonization of national pesticide assessments and control procedures, at achieving more efficient re-registration of pesticides through Member Country cooperation and at promoting the reduction of risks from the use of pesticides.

A draft proposal for a workplan for the Pesticide Activity, developed on the basis of recommendation of a Pesticide Working Group Meeting in March 1993, was endorsed by a meeting of national pesticide administrators (i.e. a provisional Pesticide Forum). It was then submitted to the 20th Joint Meeting, where there was a wide agreement to carry out, on a priority basis, the following five projects:

- Test Guidelines
- Data Requirements
- Hazard/Risk Assessment
- Re-registration
- Risk Reduction.

Following the recommendations made by the May 1992 Joint Meeting of the Chemicals Group and Management Committee [OECD, 1993a] a number of pesticide projects was initiated. UNEP is a member of this working group.

Member countries differ greatly in how they define and regulate 'non-agricultural products' that might or might not be termed 'pesticides'.

Development of OECD Test Guidelines suitable for evaluation of pesticides should be given highest priority in any future pesticide programme to the following:

- Environmental fate
- Ecotoxicology
- Human health

The work should be incorporated into the existing Test Guidelines Programme.

A pilot project to compare data reviews is under way. A glossary of key terms used in pesticide reviews, a comparison of peer review processes, and member countries' reviews of rat teratology studies should be included.

OECD will take the lead on environmental hazard and risk methodologies. The Fraunhofer Institute (Schmallenberg, FRG) works independently on environmental fate and transport, but communicates with the OECD secretariat.

In November 1991, the Joint Meeting of the OECD Chemicals Group and Management Committee gave mandate to the CEU, the USA and Sweden to initiate a Clearing House to examine existing systems for the classification of chemicals based on:

- acute oral toxicity,
- environmental hazard,

and to report to the Joint Meeting on the feasibility of elaborating harmonized approaches to the classification of chemical dealing with these endpoints.

At several Clearing House Meetings, classification criteria for the above endpoints were developed and discussions were initiated on:

- classification criteria for the terrestrial environment;
- classification of ozone depleting substances;
- classification of preparations.

It was also recommended that a periodic review and updating of Classifications systems should be planned by OECD.

According to information obtained directly from OECD, as part of the OECD Test Guidelines Programme a guidance document is under development on applicator/bystander exposure to pesticides, a document of particular relevance for the future work of the JMPO programme.

3.9. Commission of the European Union

In 1991 the Commission of the European Community (CEC), (now called the Commission of the European Union (CEU)) started a re-registration activity for pesticides on the basis of a uniform scheme. A new detailed technical guidance document accompanying the New Substances Risk Assessment Directive is available (October 1993). A similar document accompanying the 'existing substances risk assessment Directive' will be available in June 1994 [OECD, 1993a].

DG VI has prepared a Directive on plant protection products that was adopted in July this year and a Directive for non-agricultural pesticides is being prepared by DG XI.

Another document on terrestrial effects assessment has been prepared by Denmark with support from the EU Commission. A joint activity between the US and the EU on QSAR/MPD comparisons is hardly relevant for the work with pesticides, but may be so for the work with chemicals in general.

3.10. EPPO/Council of Europe

Since 1962, the Council of Europe has published booklets on pesticides, the 6th edition appeared in 1984 and the 7th edition in 1991.

The European and Mediterranean Plant Protection Organization (EPPO) together with the Council of Europe (CoE) are developing pesticide risk assessment schemes and a validation exercise has been initiated for 5 chemicals. The results should be available in February 1994 [OECD, 1993a]. JMP should follow these activities closely.

3.11. ECETOC

The European Centre for Ecotoxicology and Toxicology of Chemicals is part of the CEFIC, and is situated in Brussels, Belgium. Most of ECETOC's activities are directed towards the activities of the EU Commission concerning risk assessment of new and existing substances [ECETOC, 1993] (cf. Section 2.2). Work on exposure is continuing and new task forces have been established to develop validity criteria for model ecosystem studies, environmental exposure assessment with three subgroups on release estimation, degradation and mathematical modelling; and human exposure assessment of chemicals released to the environment. Reports of these task forces are expected by March 1994.

As an industry group, ECETOC is of course very interested in a world-wide harmonization of risk assessment procedures, and contacts with the JMP programme should be established to drag on data from ECETOC.

3.12. NGO's

Thirty years ago, Rachel Carson alerted the world to the environmental hazards of pesticides [Carson, 1962]. Since then new pesticides that are less persistent in the environment have been developed, and the environmental sciences have gone through a tremendous development. In OECD countries a re-registration procedure of pesticides are taking place, and the PIC procedure may be of great benefit to developing countries in their safe handling of pesticides. Still, there is abundant evidence that even today health and environmental problems of pesticide use exist, and the NGOs play a significant role in this documentation [The Pesticide Trust, 1989; Dinham, 1993]. In the long run, the pesticide hazards can only be reduced by directing resources to non-chemical sustainable methods of pest control, and the NGOs have an important role to play in this regard.

The Pesticide Action Network (PAN) is a world-wide coalition of citizen groups and individuals who are opposed to the overuse and misuse of pesticides. Launched in 1982, PAN unites over 300 organizations in some 50 countries. PAN aims at raising public awareness about pesticide abuse by campaigning against particularly toxic pesticides as well as unethical corporate marketing practices. PAN seeks to promote alternatives to pesticides and to encourage effective policies on the manufacture, distribution and use of pesticides.

The Pesticide Trust is an environmental charity and includes in its membership a wide range of interests—environment, food and consumer, farming and growing, conservation, wildlife, medical, health and safety and development organizations, all of which have long-standing concerns about pesticide issues. The Trust aims at:

- creating awareness of the use and regulations of pesticides and the problems associated with pesticides among decision makers, workers and consumers;
- providing a forum for discussion of the issues and to help co-ordinate action to tackle problems;
- stimulating and promoting the implementation of ecologically sound, less pesticide dependent methods and products in agriculture, insect vector control and other areas of pest control.

Therefore, it is important to include NGOs such as the Pesticide Trust and the Pesticide Action Network (PAN) in the JMP, and it may become easier to get trust funds from aid agencies, if NGOs are part of the scheme.

4. Needs of Developing Countries to Assess Environmental Exposure and Risks of Pesticides

The crucial question whether or not developing countries in sub-tropical and tropical regions will have to undertake their own environmental hazard and risk assessments of chemicals, including pesticides has been much debated. On one hand, it is argued that developing tropical countries can rely upon assessments, exposure limits and environmental quality criteria established by industrial countries in the temperate zone. On the other hand, it is often claimed that the environmental conditions in the tropical region are so different from those in the temperate or sub-arctic regions that it is impossible to transfer the results of environmental hazard assessments of chemicals from one region to another.

Ecology

In order to put this question into perspective, a short review will be provided of some of the main ecological differences between temperate and tropical regions [after Landner, 1985]. Also some basic issues related to the current use habits of pesticides in tropical developing countries will be commented on as a background for a discussion of their future needs and of their possibility to undertake risk reduction programmes, including implementation of Integrated Pest Management (IPM).

One of the most fundamental characteristics of many natural tropical ecosystems is their high age, which is in contrast to most ecosystems at higher latitudes. In sub-arctic and temperate regions, most continental ecosystems (forests, prairies, lakes, rivers) have been modified, or in many cases created, during the glacial period, at a relatively late geological age. The last great glaciation, some ten thousand years ago, with its profound re-

moulding of the landscape, is in fact the main cause of the majority of those lakes and rivers that exist today in the northern parts of Europe and North America. The same is the case for some sub-arctic inland seas such as the Baltic Sea. In contrast to this, some of the larger tropical lakes are very old: Lake Malawi is about 2 million years, and Lake Tanganyika is estimated to be 10-15 million years old.

Old, tropical ecosystems are quite often characterized by a very great richness in plant and animal species. Most of these species are strongly specialized, some of them being unique for the ecosystem in question (endemic species). The evolution process, which has proceeded for a very long period of time without being disrupted by any geological or other irregular events, has thus resulted in high species diversity and a strong specialization of the different species, each of them having a specific function in the ecosystem or occupying a specific and narrow ecological niche. All this results in a high efficiency of the systems with respect to the utilization and conversion of the solar energy for production of biomass and cycling of this energy to higher trophic levels. Such ecosystems, showing a complex network of 'food webs' rather than a few simple 'food chains', can be considered as having reached a high degree of 'maturity'. Because of their great complexity, they are difficult to investigate and understand in detail.

This lack of understanding can also be explained by the fact that the predominant part of ecological research has, so far, been directed to the younger ecosystems, i.e. those having a lower degree of maturity and hence a lower complexity. These are the ecosystems generally found in the sub-arctic and temperate regions of the world. Consequently, it is not surprising that the understanding of how the impact of human activities, such as discharges of chemicals including spreading of pesticides, affects, changes and perhaps threatens the continued existence of tropical ecosystems is still very scarce.

Consequences

The above mentioned lack of sufficient understanding of how chemical contaminants may affect the structure and function of complex tropical ecosystems creates a considerable problem in the interpretation of results from environmental effects assessment of chemicals. Even if some of the standard laboratory test species for testing of chemicals are of tropical origin, there are few -- if any -- systematic investigations of the relative sensitivity of these species compared to other tropical species, particularly compared to the sensitivity of rare or highly specialized species which may have a crucial function in the ecosystem. Therefore, for the time being, it is extremely difficult to derive so

called 'PNEC' values (see Section 2.2.4) for tropical ecosystems from acute toxicity data obtained in the laboratory. Thus, ther is an urgent need to conduct systematic research in this field t generate relevant knowledge for tropical conditions.

Also with regard to the assessment of environmental exposure from chemical contaminants, it is necessary to consider severa important dissimilarities between the tropical and the temperate conditions, for example, when using mathematical models calculate the environmental fate of a chemical and to estimate 'PECs' (see Section 2.2.3). Most probably, the same principle models as those used in temperate regions can be applied to tropical environments, but the parameters have to be adjusted in order to account for the special tropical conditions.

Just to give a few examples of fundamental dissimilarities in basic characteristics between temperate and tropical ecosyste that may influence the chemical exposure assessment, the following could be mentioned (where the difference as compared temperate systems is pointed out):

- The higher mean temperature (by definition) and smaller yearly variation (lack of seasonality) results in a different heat balance and mixing pattern of the water mass in lake and reservoirs. A higher water temperature results in low solubility of gases such as oxygen and carbon dioxide, whi means that smaller quantities per unit volume are availat to aquatic organisms. At higher water temperature, the metabolism of organisms is enhanced: Growth rate and ra of decomposition increases, and thereby the rate of oxygen consumption (oxygen reserves are depleted faster). Due t higher rate of decomposition, accumulation of detrital org matter in soils and sediments is less pronounced. Many t and bioaccumulating substances can be expected to give n pronounced effects in warm than in cold climates, becaus the rate of uptake into organisms increases with tempera ture. The solubility in water and thereby the bioavailabil will increase with increasing temperature for an array of toxic substances.
- Light energy: The higher total incipient radiation togethe with lower yearly variation and lower variation in day le provides a different energy budget in lakes, reservoirs an coastal waters. Light transparency in marine waters is u ally higher, which results in higher primary production i marine benthic communities and relatively less phytopla ton production. Light penetration into river water is usu

lower, due to siltation. Photodegradation of chemical contaminants in soils and clear waters may be enhanced due to the higher total radiation, but the frequently high turbidity of fresh waters acts in the opposite direction. Desiccation of topsoil in semi-arid and arid regions may counteract the biodegradation of chemical contaminants.

- Salinity of marine waters is higher and biological precipitation of calcium carbonate from the water (e.g. corals) is much higher. Calcareous sediments, characteristic of tropical seas, have lower sorption capacity for chemical contaminants than clay sediments. Salinity of inland waters is higher, particularly in semi-arid and arid regions, where strong erosion and high evaporation results in increased salinity, which changes the solubility properties of the water.

Chemical pesticides are the only toxic chemicals that are deliberately introduced into the environment, and it is well-known that they cause widespread environmental problems. They are responsible for water pollution, including contamination of drinking water reservoirs, soil degradation, insect resistance and resurgence, and destruction of natural flora and fauna. The current scientific literature abunds with papers reporting on declining fish production and fish kills in, for example, Brazil, Egypt, Malaysia, the Philippines, Sudan, Tunisia and Venezuela in areas subjected to pesticide spraying schemes [see Dinham, 1993].

Restricted pesticides

The current trend of moving the production facilities for pesticides, including those having been banned or severely restricted in OECD countries, to Third World countries may increase the problem of uncontrolled use and dispersal of pesticides. According to UNIDO figures from 1985, 33 tropical and sub-tropical countries have facilities for formulating pesticides, and at least 11 produce technical grade active ingredients. Third World factories not owned by the major transnational companies may manufacture pesticides with expired patents, early inventions which tend to be highly toxic and persistent. They include, for example, DDT, toxaphene and parathion [Dinham, 1993]..

The PIC Procedure is an important advance as a mechanism for reducing trade in hazardous chemicals. However, the success of PIC will depend on decisions taken by importers and on the availability of non-hazardous alternatives. Policies to reduce pesticide hazards in the Third World based on trade controls and legislation to prevent export of pesticides banned in OECD countries may not address some of the fundamental problems. Many of these are caused by the scale of pesticide use, the difficulty of

using pesticides safely under certain conditions of use, particularly in hot tropical climates, inadequate occupational health and safety standards, lack of education, and poverty.

Risk Reduction

At the Saltsjöbaden Meeting (October 1991) on the Control of Pesticides [KemI, 1992], one important issue for discussion was Opportunities for Risk Reduction in the Pesticides Field. The meeting called upon countries and international bodies to support national pesticide risk reduction programmes, and to develop appropriate criteria and policies to encourage introduction of such programmes both in developed and developing countries. Such initiatives should cover not only agricultural pesticides, but also wood preservatives, slimecides and anti-fouling paints.

Several OECD countries have ongoing pesticide risk reduction programmes with quantitative goals of 25-50% reduction of pesticide use over a period of 5-10 years, combined with other measures to reduce the risks. In Asia, pest outbreaks induced by widespread agricultural insecticide use was reported to threaten rice production. Therefore, to ensure the continued growth of rice production, several Asian governments have implemented *Integrated Pest Management (IPM)* programmes which will reduce agricultural insecticide use dramatically.

As an example, the success story from Indonesia may be cited [Kenmore, 1992]. In this country, over 85% of the insecticides registered on rice in 1986 were banned on rice. The national pesticide subsidy of over USD 120 million per year, in 1985, was eliminated by January 1989. Over one million person-days of direct training in field skills to apply IPM were given in 20 months, making the Indonesian National IPM Programme the largest environmental field training effort in the world. Between 1986 and 1990, Indonesia's rice production rose by 10.4%, and rice yields per hectare rose by 10.1%. On a national basis, the annual production of formulated pesticides dropped by 61% between 1987 and 1990.

In order to prepare for similar success stories in other developing countries, it is strongly recommended to promote the sharing of information on activities in progress and on experiences and results from risk reduction programmes conducted in various countries. Many developing countries may need guidance on what kinds of pesticides to focus on in their risk reduction or IPM Programmes. This guidance must be based on sufficient knowledge about the types and quantities of pesticides used in the country (e.g. through improved National Registers of Pesticides) and on assessments of the environmental exposure and risks of the pesticides used in the national environmental

context. The key issue for success of any IPM Programme is promotion of education and training for all those involved in the handling of pesticides, including improved application techniques. Such training programmes have to be tailored for the local needs and include production of relevant information material (posters, broschures, radio and TV programmes) in easily understandable form and in local languages.

Environmental quality criteria

It is sometimes argued that developing countries would need assistance from international organizations and OECD countries in order to establish limit concentrations (guideline levels) for pesticides in various environmental media (soil, water, biota). It is also argued that developing countries need guidelines for monitoring of pesticides (and other chemical contaminants) in the environment. However, all chemicals control systems relying upon the requirement of monitoring concentrations of chemicals in the environment have some important drawbacks in common: They are very resource-demanding, there is seldom any direct link between monitoring results and regulation, and therefore, such regulatory systems tend to be very inefficient. This is particularly true for developing countries, where the necessary resources in high-tech analytical equipment and in sufficient and highly competent (scientifically trained) staff is seldom adequate. All this means that the actual ability of most developing countries to implement advanced environmental monitoring programmes with the aim of describing the fate and ecological effects of chemicals, including pesticides, this ability simply does not exist, and will not exist for several years to come.

Therefore, we would strongly recommend **not** to base the regulatory system for control of pesticides in developing countries on the principle of environmental monitoring. As a consequence, we do not think that the inclusion of pesticide concentration limit values into the set of national environmental quality criteria is an efficient means to achieve the goal of pesticide risk reduction and environmentally safe management of pesticides.

Alternative approaches

Alternative approaches to environmentally safer pesticide management, which do not include a monitoring scheme as a prerequisite, and which we consider as more efficient than the one discussed above are:

- Strict implementation of the PIC Procedure, possibly assisted by an internationally legally binding instrument, in order to control imports of hazardous chemicals, including pesticides.
- Setting up or improving the efficacy of NRPTCs, particularly of mechanisms for national registration and control of pesti-

cides, in order to get comprehensive information about the types and quantities of pesticides used in the country.

- Establishment of a system of licencing and control for all facilities of pesticide manufacturing and formulating, in order to regulate the production and make sure that banned pesticides are not produced.
- Launching of pesticide risk reduction and IPM Programmes, *inter alia* targeted to the reduction or elimination of the use of pesticides that have been identified as hazardous to human health and the environment under the actual conditions in the country (see below). Such IPM Programmes would include large-scale training and information efforts targeted to farmers, agricultural workers, pesticide dealers, etc.
- Identification of the environmental hazard of chemicals, including pesticides, should be made based on the actual environmental conditions existing in the country (or region) in question, and the results of these assessment will guide the IPM activities. The environmental exposure assessment should make use of existing mathematical models, adjusted by the introduction of appropriate parameters.
- Support and facilitate national and international research programmes with the aim of increasing the knowledge about the environmental fate and ecological effects of chemicals, including pesticides in tropical and sub-tropical ecosystems.

5. UNEP's Role in Assisting to Meet the Needs of Developing Countries

5.1. In Relation to Environmentally Safe Management of Chemicals in General

Before addressing the possible future role of UNEP in the field of environmentally safe management of **pesticides**, which is the main subject of the present report, and which will be discussed in Section 5.2, it would be pertinent to give a brief overview of UNEP's role within the wider field of management of chemicals in general. This is because a great number of international activities dealing with chemicals in general are already in progress or are in the planning stage, activities in which UNEP will play an important role. The more restricted field of safe pesticide management will also, by necessity build upon the structures created and the results achieved within the mainstream programmes on safe management of chemicals.

The previous chapters of this report have clearly demonstrated that a great number of international organizations, both within and outside the UN system and both governmental and non-governmental, are today engaged in chemicals control and management programmes. Many have ambitions to contribute to some or all of the six UNCED Programme Areas of Chapter 19 o Agenda 21. Therefore, in order to optimize the use of financial and human resources, and to avoid duplication of effort, it is necessary to try to identify the area of competence and responsibility where UNEP, in a global context, is unique and thus, concentrate its future efforts.

Sustainable development

To our understanding, first of all, UNEP has an overall responsibility for environmental protection and management and for the promotion of sustainable development and use of natural resources. However, there are several other international organi-

zations, both within and outside the UN system, which have the same or similar objectives on their agenda. Secondly, since its start, UNEP has devoted a particular interest to the developing countries of the world, and has concentrated a great deal of its efforts to assist developing countries in dealing with their environmental problems. Again, there are many UN Agencies and other international organizations which are targeting their efforts on the developing countries.

UNEP's contributions

However, if we focus on the combination of the above mentioned two fields of interest: *environmental protection and management* and *developing countries*, it appears that no other international body, except for UNEP, is trying to cover the two fields in an integrated way and on a global level. Therefore, it seems reasonable that UNEP should continue to focus on this integrated goal and to further develop it within the framework of international cooperation on the safe management of chemicals. Thus, it is recommended that one of UNEP's main contributions to the coordinated international work within the 'new' IPCS should be exactly to promote the establishment of new knowledge and the improvement of capacities and capabilities in the fields of environmental exposure and risk assessment as well as environmentally safe management of chemicals under the types of environmental conditions that are typical for most developing countries. By 'typical' environmental conditions, in this context, is meant those conditions prevailing in sub-tropical and tropical regions of the world, including both arid, semi-arid and humid climates. These are the regions on which the scientific ecological knowledge is least developed, and where the methods for assessment of environmental exposure and risks of chemicals are most uncertain, and are most urgently needed.

The assumption that UNEP could play a unique role in this particular context is furthermore corroborated by the analysis made in the previous chapters. For example, within the IPCS Coordinating Group for the Harmonization of Chemical Classification Systems (CG/HCCS), where considerable accomplishments have already been made, it turns out that the efforts, so far, have been concentrated on physical hazards and hazards to human health. Consequently, the harmonization of systems for environmental classification of chemicals is lagging behind, and moreover, the specific aspects relating to tropical/sub-tropical environments are not yet really being addressed by CG/HCCS. Also another successful international coordinating body, the OECD Hazard Assessment Advisory Board (HAAB), would need to expand its field of interest to cover also the specific problems related to EHA of chemicals in tropical environments, if the approaches to EHA should become useful and valid on a global scale.

In fact, the leading international organizations in the field of development and harmonization of schemes and procedures for EHA of chemicals (OECD, CEU and ECETOC) all represent countries which have no (or a very limited) part of their territories within the tropical zone, and therefore, these countries have limited direct interest to include the specific aspects of tropical environments into the models and procedures they use. Here, UNEP would have a unique task to support the interests of tropical countries and to see to it that due consideration is given to the requirements that may be formulated on the basis of the developing knowledge of the fate and effects of chemicals under warm climate conditions. The principles, models and practical procedures for chemical EHA, which have been developed in the industrialized countries will most probably be applicable also to EHA in tropical countries, but there is a need to adapt the models by incorporating appropriate parameter values, relevant for tropical ecosystems.

There is a third example that can be used to justify that UNEP will have to prepare itself for a more active role to play as a chief promoter of environmental protection in tropical countries within the international cooperation on management of chemicals. UNEP has not participated directly in the previous work of JMPR, but as a result of the now proposed reorganization of this activity, with the establishment of JMP, to be coordinated by IPCS, UNEP has been proposed an important role in the environmental assessment of pesticides (see Section 5.2).

It would be pertinent to list, in some detail, the various future activities that UNEP may want to undertake in order to fulfil its task to meet the needs of developing countries in the field of environmentally safe management of chemicals. These possible activities will be presented in a logical sequence, following the different sequence of steps normally taken in relation to environmental problems caused by chemicals:

- *Environmental Classification of Chemicals.* The final objective would be to develop and apply a globally harmonized system for classification of chemicals and a compatible labelling system. This means that the system for environmental classification of substances as well as prepara- tions should, ideally, be harmonized, or even one and the same, for all countries in all climatic regions of the world. A legally binding classifi- cation and labelling system for environmental hazards of chemical substances has already been adopted by the CEU. However, this system only covers environmental hazards in the aquatic environment and hazards to the ozone layer. It does not yet cover classification and labelling of preparations as dangerous for the environment.

Now, in the work towards a global harmonization of environmental classification of chemicals, it would be useful to review the criteria established for the aquatic environment in OECD countries in the light of possible specific requirements in tropical environments. Furthermore, in the forthcoming development of criteria for classification of chemicals with regard to hazards in the terrestrial environment, it would be useful to incorporate the views of experts on tropical environments in the work coordinated by the CG/HCCS. UNEP should take the initiative to ensure that the needs of tropical developing countries are adequately addressed in this global harmonization.

Harmonization of the classification and labelling systems is important, because it will establish a common and coherent basis for chemical hazard communication, from which the appropriate elements relevant to means of transport, consumer, worker and environmental protection can be selected. It must, however, be kept in mind that the hazard classification process refers only to the hazards arising from the intrinsic properties of chemical substances; it is based on a 'hazard identification' (cf. Section 2.1). This first step in the assessment sequence is usually intended to provide quite stringent results: a large array of chemicals are netted, based on their properties which *may*, but not necessarily *does*, mean that all of them constitute a real danger under normal handling. Therefore, the results of the hazard classifica- tion process will not necessarily provide a useful tool for guidance of risk management or risk reduction programmes. For this purpose, the next step in the sequence, the EHA, has to be carried out.

- *Environmental Hazard Assessment of Chemicals*. As pointed out in Section 2.2 of this report, an EHA includes both Exposure Assessment andEffects Assessment, and basically consists in deriving as good and as relevant estimates as possible of PEC and PNEC, which are then compared with each other. It has also been pointed out before that the EHA must be adapted to the regional and/or local environmental conditions if the results of the EHA for an individual chemical substance should be useful as a tool for various management decisions.

  Building on the principle EHA approach developed and recommended by ECETOC [1993] (see Sections 2.2.3 and 2.2.4),

the following development needs can be identified in order to provide the necessary input for adaptation of the EHA procedures for use by developing countries in the tropical zone. UNEP would be the appropriate organization to take the responsibility for promoting the generation and communication of this know-how among developing tropical countries:

In relation to regional exposure models, such as the 'Mackay Level 3 (or Level 2) Fugacity Model' [Mackay, 1991], there is a need to:

- define the boundary conditions for the different environmental compartments in generic environmental scenarios, typical for arid, semi-arid, humid, etc. tropical ecosystems;
- derive adequate parameter values for application of the models, and communicate recommended values for a limited number of typical conditions in tropical environments;
- validate the adapted exposure models through joint research and monitoring programmes in selected tropical areas.

In relation to local exposure models for the air, water and soil compartments, there is a need to:

- produce a user's manual, *inter alia* containing recommendations on factors to be used for estimating the fate (biodegradation, photodegradation, sorption, bioaccumulation, mobility, dilution, etc.) of chemicals under various conditions in tropical environments;
- validate the adapted local exposure models through a limited number of case studies reflecting typical situations in tropical countries.

In relation to effects assessment for both the aquatic and the soil and terrestrial environment, there is a need to:

- review the relevance and practicality of standard test organisms for tropical environments and, if needed, recommend a limited number of additional standard test species of particular relevance for tropical conditions;
- actively participate in the development of harmonized test guidelines for effects testing in the soil/terrestrial environment, where due consideration should be given to particular needs of tropical regions;
- derive appropriate application factors for estimation of PNEC from laboratory tests, factors that are relevant for

tropical ecosystems and provide a reasonable level of protection of the most sensitive components of the ecosystems.

In relation to the complete EHA process, there is a need to:

- prepare and distribute recommendations, guidelines and manuals, which are adapted to and ready-for-use by scientists and chemicals control officers in developing countries;
- include information about the various phases of the EHA process and about results obtained into existing information systems and networks for exchange of information, such as the various IRPTC systems;
- organize and conduct education and training in EHA through existing UN structures, such as the UNEP/UNITAR Training Programme.

It is obvious that the above recommended activities must be backed up by advanced scientific research. According to the proposed objectives for the 'new' and expanded IPCS, the co-operating international bodies will have an enlarged task to catalyze and promote scientific research and capacity building in Member Countries. UNEP's role in this context would be to serve as the main promoter and catalyst for high-quality research in the fields of tropical ecology and tropical environmental chemistry, perhaps through the creation of 'Centers of Excellence' and support of scientific networks in tropical developing countries.

- *Improved Information about Chemicals and Environmental Risks Caused by Chemicals.* In order to be successful in any kind of risk management activities in relation to chemicals in any country, it is absolutely necessary to ensure that high-quality information about the nature and the scope of the problem be readily available for the relevant governmental agencies. The ongoing UNEP/IRPTC activity to assist developing countries in setting up their own NRPTC should therefore be given high priority, in order to improve the quality and efficacy of such Registers and make sure that they are regularly updated and as complete as possible.
- *Environmental Risk Management in relation to Chemicals.* Risk management may include a great variety of actions, from communicating information about chemical risks to users of chemicals, over issuing of recommendations for substitution of hazardous chemicals and of rules and regulations

on safe handling of chemicals, to import restrictions and complete banning of certain dangerous chemicals. To become efficient, all risk reduction programmes must be based on reliable information about imports/exports/production, use patterns including quantities, degree of exposure and hazard from chemicals, and feasible alternatives (production processes, pest management, consumer habits).

Existing efforts for chemical risk reduction in developing countries should be further supported to enhance their rate of implementation. Among these, the PIC Procedures are of utmost importance and should be further promoted by the introduction of an internationally legally binding instrument.

Establishment of national programmes for reduction of chemical risks for the environment in developing countries can only partly be based on information generated on the international level. Therefore, information on the national situation must, in many cases, be generated through activities undertaken by the country in question. This kind of information, data on types and quantities of chemicals used (from the NRPTC) and information on environmental hazards for specific ecosystems or local environmental compartments (generated by national EHA), will serve as an important steering mechanism for how to design and implement a specific risk reduction effort. Such an effort could consist in specific regulation of a chemical factory, by setting strict limits for emissions or requirements for a specific wastewater treatment, by enforcing discharge fees to reduce the most hazardous components in emissions or by banning a certain type of production. When it comes to reduction of risks in pesticide use, the implementation of IPM programmes is of particularly great interest, but again, such efforts should be based on a clear estimate of the actual level of hazard under the situation prevailing in the country.

In order to ensure a successful implementation of these risk reduction activities in developing countries, there is a general need to get guidance and assistance from an authoritative international body, such as UNEP. Thus, promotion of international exchange of information on obtained results and experiences in various countries as well as distribution of know-how, guidelines and manuals, including training activities, would be a key task for UNEP to fulfil.

5.2. In Relation to Environmentally Safe Management of Pesticides

The use of pesticides in agriculture has important consequences for at least three more or less complex systems: (1) the target system, including the farmland (soil) and the crop; (2) the non-target ecosystems, including adjacent aquatic and terrestrial ecosystems as well as remote ecosystems situated downstream or downwind at various distances from the fields where pesticides are applied; and (3) man, including pesticide manufacturers, importers, dealers, agricultural workers, populations living in adjacent areas and consumers of crops. Different practices and management tools have been developed in relation to each of these systems, in order to obtain optimal efficiency and safety. The relationsships between the different systems, management tools and goals may be illustrated as indicated in *Figure 3* (modified after Bro-Rasmussen[1985]).

Good Agricultural Practice

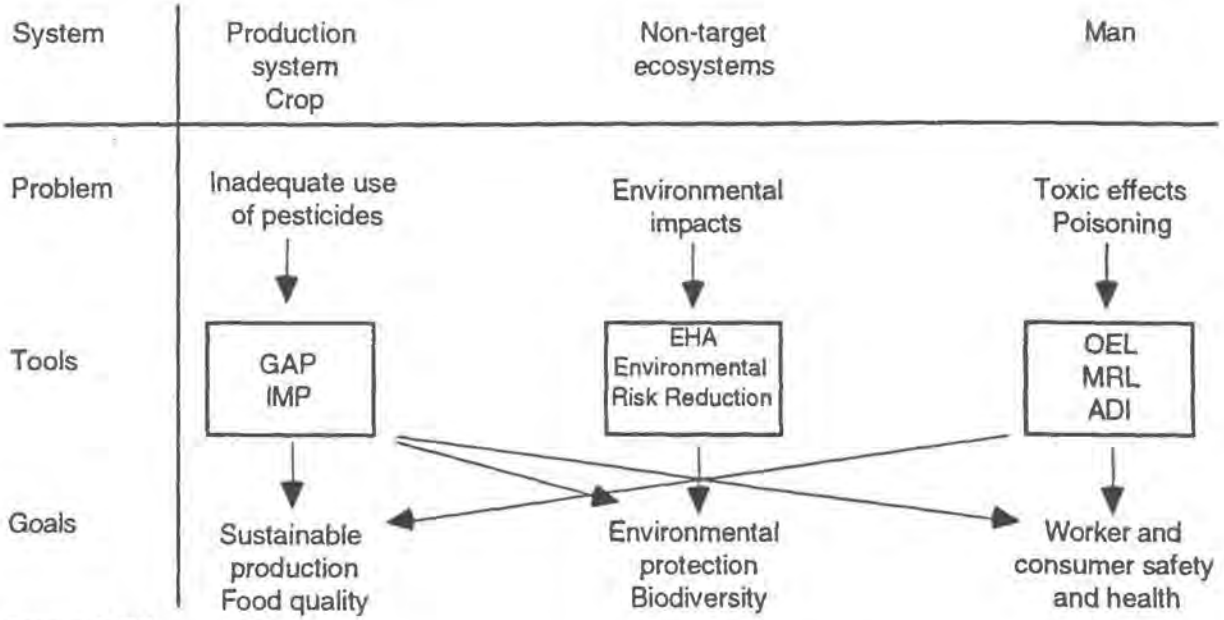
Among the important management tools that can be used to promote sustainable production of agricultural crops and improve food quality is the application of the principle of Good Agricultural Practice (GAP). GAP includes the identification of minimum pesticide use on specific crops, as a function of crop rotation schemes and use of alternative pest control techniques, including Integrated Pest Management (IPM), selection of appropriate, low-risk pesticides and establishment of safe application methods including worker protection. An important aspect is to protect soils and other components of the production system from inadequate or excessive use of pesticides, in order to ensure its long-term, sustainable production capacity.

The development and implementation of GAP and IPM as well as monitoring that these principles are respected are undertakings that would normally be promoted and assisted by FAO, with some cooperation from ILO. However, since the relationship between GAP/IPM and protection of non-target ecosystems is becoming more and more obvious, it may be useful to involve UNEP in this process, in particular to include advices from UNEP-sponsored experts on the design and implementation of IPM programmes.

It is quite obvious that UNEP is the international body which has the main, overall responsibility for promoting the protection of natural ecosystems and the preservation of biodiversity. Therefore, it seems reasonable to conclude that UNEP will take up this task also in the field of safe management of pesticides.

Safety and human health

Aspects such as promotion of worker and consumer safety and protection of human health and well-being have since long been



Source: MFG.

Figure 3. Problems, management tools and goals in the safe use of pesticides in agricultur

the tasks of WHO and ILO. Elaboration of management tools such as Occupational Exposure Limits (OEL) has been on the agenda of ILO for a long time. Evaluations of pesticides with the aim of establishing values for Maximum Residue Levels (MRL) of pesticides in crops and for Acceptable Daily Intake (ADI) of food additives and other chemicals have been carried out for more than 30 years within the FAO/WHO Joint Committees JMPR and JEFCA. More than 200 pesticides hav been evaluated by JMPR.

It might be assumed that UNEP does not have any direct inte est in or competence for this particular aspect of pesticide mai agement, except when it comes to exposure of human beings t pesticides through a general contamination of the natural env ronment, including drinking water sources and bioaccumulati in fish and game. Evaluations of these particular risks for hu man exposure caused by pesticide use or abuse may be assiste by the application of the environmental exposure models that UNEP may want to have primary access to, as a part of its EI Programme (see Section 5.1).

Scientific research

In order to establish an efficient programme for pesticide eva ation and management, a comprehensive plan for scientific re search and development would be needed as a back-up. Amo the various fields of interest, related to the environmentally s management of pesticides, where there is an urgent need to c velop further knowledge, preferentially under the auspieces c UNEP, the following can be listed:

(1) Establishment of a clear definition of the boundaries between target areas and non-target areas; particularly the intermediate 'conflict zone' must be clearly delineated.
(2) Review of the concept Good Agricultural Practice, *inter alia*, to express in more specified, quantitative terms the 'undue hazards' and 'undue contamination' of the environment.
(3) Since multiple and/or prolonged application of pesticides in the same field may disrupt the ecological balance and result in environmental deterioration in terms of reduced productivity and vanishing of natural pest controllers, e g insectivorous birds, there is a need to evaluate in more detail the effects of such applications of several pesticides, and of prolonged use of pesticides in the same fields.
(4) Definition of 'generic environments' (volume, relative size of compartments, environmental properties, etc.) for various sub-tropical and tropical regions to be used as a basis for mathematical model calculations of PEC (e.g. according to the Mackay Regional Exposure Model, Level 2 or 3 [Mackay, 1991]).
(5) Evaluation of test species, test protocols and procedures for derivation of PNEC that are relevant for sub-tropical and tropical zones. This (as well as point 4) is necessary for conducting appropriate EHAs of pesticides based on the environmental reality in most developing countries.
(6) When assessment tools have been refined and adapted to the environmental reality in developing countries, start a programme for comprehensive EHAs of active compounds in pesticides used in developing countries.

The new international body proposed by the Carshalton Meeting in July 1992 [IPCS, 1992a], to take over the international coordination of pesticide assessments, the Joint Meeting on Pesticides (JMP) (see Section 1.3 and *Figure 1*), will incorporate environmental assessments, and would also assign an important role to UNEP. This proposal was further elaborated in two papers, one by Burin and Herrman (1993) and the second one by the IPCS Secretariat [1993b]. A few comments will be given to this proposal in the following.

Agenda 21

Chapter 19.6 of Agenda 21 specifically stresses that the UNEP, ILO and WHO cooperation through IPCS should form the nucleus for future international cooperation on environmentally sound management of toxic chemicals. Furthermore, it mentions that cooperation with OECD and other regional and governmental chemical programmes should be promoted. It is recognized that ILO, WHO and UNEP are international bodies,

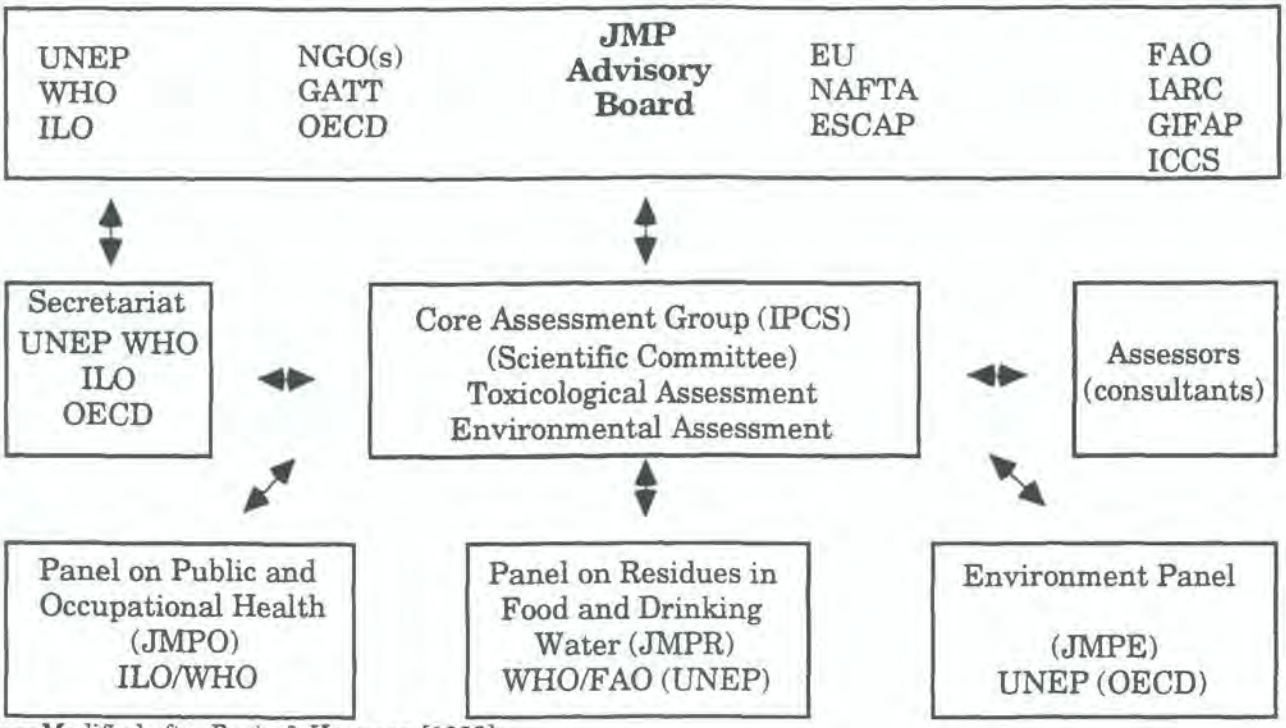
which in this context are mainly dealing with the adverse consequences of pesticide use, while FAO has a primary interest in the beneficial effects of pesticides used in agriculture. However, FAO has an important expertise particularly regarding GAP and experience from the former JMPR Panel. This expertise should be taken care of by ensuring that FAO is represented in an Advisory Board (see below) and that FAO nominated experts and/or members of the former JMPR Panel are appointed members of the CAG and of the 'new' JMPR, in order to secure continuity.

We largely agree with the proposal by the IPCS Secretariat [1991] that the JMP Secretariat should consist of employees of the international organizations that will be responsible for planning and implementing the activity. This would include UNEP, WHO and ILO. However, we would like to add that also OECD should be represented in the Secretariat, if possible. IPCS should have the coordinating role, in consultation with these organizations. In order to get the broadest possible input to setting priorities for the assessment of pesticides by the JMP, we would suggest that the establishment of an Advisory Board be considered. Members of this Board would be representatives of all relevant UN Organizations, and in addition representatives of regional governmental organizations, such as OECD, NAFTA, CEU and ESCAP, as well as of industrial organizations such as GIFAP and of other non-governmental organizations (NGOs), see *Figure 4*. This Advisory Board may need to convene only every second year.

The role of the Advisory Board would be to:

- Propose pesticide candidates for assessment by the Core Assessment Group (CAG)
- draw pertinent issues to the attention of the CAG
- provide data, including data from non-public sources and the 'grey literature', to the CAG
- give advice on priorities of pesticide re-evaluations
- provide information on possible ways of phasing out controversial pesticides
- give opinions on the assessment documents prepared by the CAG.

The two CAG, one dealing with toxicological assessments and the second one with environmental assessments, would be coordinated by IPCS. However, the formation and the responsible bodies of the three proposed Panels, the Panel on Public and Occupational Health (JMPO), the Panel on Residues in Food and Drinking-Water (JMPR) and the Panel on Environment (JMPE),



Source: Modified after Burin & Herrman [1993]

Figure 4. Revised proposal for organizing the Joint Meeting on Pesticides.

may need some further discussion. If we should follow the principle that 'specific organizations should be responsible for discrete activities', it appears more appropriate to concentrate the membership of JMPO to those organizations that are directly responsible for the issues to address, i e WHO and ILO. Thus, a reasonable structure for JMPO would be to assign the responsibility for the Panel to ILO, and the work should be carried out jointly with WHO.

Since the 'old' JMPR contained two groups of experts, the FAO Panel of Experts on Pesticide Residues in Food and the Environment, and the WHO Expert Group on Pesticide Residues, the smoothest solution for the future would be to continue with this structure and create one FAO subpanel and one WHO subpanel of the 'new' JMPR. However, we feel that UNEP should be represented in the both of these JMPR subpanels, particularly to give advice on how to estimate environmental exposure to pesticides that may result in hazardous concentrations of residues in drinking-water, fish and game.

Finally, UNEP may wish to take responsibility for the JMPE, and include OECD as a partner for joint accomplishment of the work, particularly in the field of environmental exposure assessment and EHA. Our suggested modifications of the original proposal for structuring of JMP are presented in *Figure 4.*

Core Assessment Group

As proposed by the IPCS Secretariat [1991], there is a need to develop working procedures for the CAG and the Panels, at an early stage of the process. Direction should be provided by asking consultants to prepare working papers for the first meetings. It is understood that the CAG should be composed of scientific experts from national governmental institutions and universities. They should represent a broad range of expertise so that, together, they would cover all aspects of pesticide evaluation and, thus, act as a scientific committee. To the greatest extent possible, experts from developing countries should be included in the CAG, in order to get an adequate input of this kind of expertise to the deliberations of the groups.

The only existing 'official' document laying down principles and providing guidelines for pesticide assessments is the EHC 104 ('Principles for the toxicological assessment of pesticide residues in food', 1990). This document only covers one aspect of pesticide assessments and, moreover, may need some updating. Therefore, the first task of the joint CAG would be to develop a series of documents describing standardized procedures for the various aspects to be covered in evaluation of pesticides. Separate volumes might be issued for each of the three aspects covered by JMPO, JMPR and JMPE, respectively, in addition to a summary volume. This can be a time-consuming task, but once this has been developed, the speed of comprehensive pesticide assessments can be increased considerably, because individual institutions, on a consultancy basis, can produce draft assessment documents using these guidelines. The documents on specific pesticides should then be reviewed by the CAG, and on the basis of their scientific evaluation, they should come to recommendations on guideline values, before transmitting the documents to the relevant Panels.

Panels

Members of the Panels should be invited primarily from regulatory agencies, but some of the experts from the CAG should also be included in the Panels. Again, it is important that regulatory agencies from developing countries are well represented in the three Panels. The main task of the Panels would be to establish guidance values, such as OEL, ADI, MRL and guidance levels in drinking -water, in accordance with the proposal from the IPCS Secretariat [IPCS Secretariat, 1991]. The main task for the JMPE would be to establish an Environmental Hazard Classification of the pesticide active ingredients as a basis for Environmental Hazard Labelling and for development of directions for environmentally safe use and disposal. Furthermore, the JMPE would consider the possibility to carry out (or to review the results of) an environmental exposure assessment for limited number of standard cases and provide guidance to

Member Countries on how to apply the results of such assessments. This might include recommendations on the inclusion of a certain pesticide into IPM Programmes being implemented by Member Countries.

We would also like to suggest that the Panels should expand their fields of activity to include also aspects of pesticide re-registration and provisions for inclusion of pesticides into national risk reduction programmes, e g IPM schemes. Therefore, among the members of the panels, there should be a few representatives of NRPTCs and of national authorities responsible for chemicals risk management.

The concept of 'pesticide'

Finally, the concept of 'pesticide' should also be reviewed so that not only agricultural pesticides will be included in the JMP process, but also the various groups of products with similar function in other target systems. Many of these products, e g pesticides used in disease vector control programmes, slimecides, disinfectants, anti-fouling chemicals and other biocides, contain the same or very similar active ingredients as agricultural pesticides. It would therefore be logical to include most of these chemicals in the assessment and risk-reduction schemes carried out by JMP, in order to ensure that a global approach is taken to this whole group of toxic chemicals.

6. Tasks that UNEP is Recommended to Fulfil in the Near Future

Based on the considerations made in previous chapters, we conclude that there is a certain number of urgent new tasks, related to environmental problems caused by chemicals in developing countries, that should be addressed on a global level, with the aim of accomplishing the objectives set by Chapter 19 of Agenda 21. We consider that UNEP is the most appropriate international organization to take the main responsibility for implementing (or at least initiating) the following activities related to the environmentally sound management of chemicals in general. These activities would also create the basis for specific activities related to the environmentally safe management of pesticides:

- In the work towards a global harmonization of environmental hazard classification of chemicals, UNEP should take the initiative to ensure that the specific needs of tropical developing countries are adequately addressed. This work is coordinated by the CG/HCCS.

- In the international harmonization of environmental hazard assessment procedures for chemicals, UNEP should take the initiative to promote the necessary scientific research providing information for adequate modifications of existing exposure models to account for realistic conditions in tropical and sub-tropical regions. Moreover, similar information should be generated for obtaining correct estimates of PEC and PNEC in tropical and sub-tropical regions. Finally, UNEP should promote the preparation and distribution of guidelines and manuals as well as organize and conduct educatior and training in the various phases of EHA, particularly adapted for developing countries.

- In relation to the different aspects of chemical risk reduction programmes to be launched in various developing countries, UNEP should promote improved information about chemicals and regular updating of national registers of chemicals, improved information about possible substitution of hazardous chemicals, and development of guidelines on regulation of toxic emissions from the chemical industry. Furthermore, UNEP should assist developing countries to make efficient use of results from EHA of chemicals as a steering mechanism for decisions and implementation of risk reduction programmes.

Management of pesticides

Within the more limited field of activity related to the environmentally safe management of pesticides, the new IPCS initiative to create a Joint Meeting on Pesticides (JMP) should be fully supported by UNEP. This implies that UNEP will have a great number of new obligations, mainly related to its role to defend the environmental interests of developing countries, particularly countries in the tropical and sub-tropical zone. We would like to recommend the following:

- First of all, UNEP should make sure that sufficient funding is available for UNEP's full participation in the JMP process. Assuming that the Governing Board of UNEP will appoint IRPTC to be the responsible body to participate in JMP, this unit must get access to funding that should cover the necessary human resources, travelling, office costs as well as limited funds for catalyzing the initiation of research projects.

- UNEP/IRPTC should commit itself to take full responsibility and a firm lead of the Panel on Environment (JMPE), in which it should work together with OECD. Furthermore, UNEP/IRPTC should assist the Panel on Residues in Food and Drinking-Water (JMPR) as well as the JMP Secretariat and the Core Assessment Group (CAG) for Environmental Assessments.

- UNEP/IRPTC should also assist the JMP Secretariat in organizing the proposed Advisory Board and prepare for its first meeting, which should provide advice on pesticide candidates to be included in the JMP process. In this context, UNEP should promote the inclusion of biocides other than agricultural pesticides, i e toxic chemicals used as slimecides, disinfectants, anti-fouling agents, etc.

- UNEP/IRPTC should promote the initiation of development of guideline documents for JMP, and particularly take a lead role in the development of guidelines for JMPE.

- Within the framework of JMP, UNEP/IRPTC should initiate a pilot project on re-evaluation and re-registration of pesticides, where particularly the environmental aspects should be given full consideration. In this pilot project, which should draw upon experiences from the EU and the USA, a full life-cycle evaluation of pesticides, including manufacturing, transport, storage, use and disposal, might also be tried.

- As a complement to the activities in the JMP, UNEP/IRPTC should work with FAO, NGOs and industry in order to further develop the environmental aspects of GAP and IPM, and try to define practical schemes for 'low external inputs for sustainable agriculture'.

- As a long-term activity, UNEP/IRPTC should assist in designing and implementing training programmes and workshops for pesticide control authorities in Third World countries, particularly addressing assessment of environmental exposure and effects of pesticides as well as means for reduction of environmental risk caused by pesticides.

In addition to the obligations directly related to the JMP process, UNEP will continue to fulfil its tasks within ongoing programmes, which have a strong bearing on the environmentally safe management of pesticides. A few examples of particular relevance may be given:

- UNEP/IRPTC should continue and increase its efforts to assist in developing NRPTC, particularly guidelines for improved registration of pesticides. In this context, existing registration systems should, as far as possible, be expanded to include the registration of all biocides.

- UNEP, in cooperation with FAO, should increase its efforts to assist in the implementation of the PIC Procedures in all Third World countries. This may include assistance to developing countries to raise funds from industrialized countries and international aid organizations to finance this work.

- UNEP should coordinate, through IRPTC, the communication of information acquired through the PIC Procedure to all governments and the general public, including NGOs.

- UNEP should also promote the strengthening of the PIC Procedure to include all pesticides causing health or environmental concern, particularly under use and environmental conditions existing in tropical countries. This may be achieved through relevant EHA exercises, followed by information and training campaigns.

- Finally, UNEP should try to develop mechanisms to make sure that the new GATT treaty will not block initiatives to limit international trade in banned or otherwise hazardous pesticides and schemes to promote sustainable agriculture.

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List of Abbreviations

ADI
Acceptable Daily Intake.

AF
Application Factor.

CAG
Core Assessment Group.

CCPR
Codex Committee on Pesticide Residues.

CDS
Commission on Sustainable Development, in which 53 Member States are members on a rotating basis.

CEC
see CEU

CEU
Commission of the European Union (see EU).

CAG
Core Assessment Groups on Toxicological and Environmental Assessment.

CDS
Commission on Sustainable Development

CG-HCCS
IPCS Coordinating Group for the Harmonization of Chemical Classification Systems.

DG
Directorate General (Commission of the European Union).

EC
see EU

ECETOC
European Centre for Ecotoxicology and Toxicology of Chemicals.

EEC
see EU

EHC
Environmental Health Criteria.

ERA
Environmental Risk Assessment

EU
European Union, formerly EEC (European Economic Community).

FAO
Food and Agriculture Organization of the United Nations.

GAP
Good Agriculture Practice.

GATT
General Agreement on Tariffs and Trade.

GEMS
Global Environment Monitoring System.

GESAMP
Group of Experts for the Scientific Assessment of Marine Pollution.

GRID
Global Resource Information Database

HAAB
The OECD Hazard Assessment Advisory Body

HEM
Harmonization of Environmental Monitoring. A UNEP organization situated in Munich.

IACSD
Inter-Agency Committee on Sustainable Development with the following nine core members: UNEP, UNDP, ILO, FAO, UNESCO, WHO, WMO, IAEA, and the World Bank.

IARC
The International Agency for Research on Cancer.

ICCS
International Conference on Chemical Safety

IEO
UNEP's Industry and Environment Office

IFCS
Intergovernmental Forum on Chemical Safety

ILO
The International Labour Organization.

IPCS
The International Programme on Chemical Safety. The former IPCS will from 1994 become PCS, and a new IPCS will be formed exclusively for the JMP programme.

IRPTC
The International Register of Potential Toxic Chemicals

JMP
The Joint Meeting on Pesticides.

JMPO
The Joint FAO/WHO/ILO/UNEP Meeting on Pesticides—the Panel on Occupational Health.

JMPE
The Joint FAO/WHO/UNEP Meeting on Pesticides—the Panel on Environment.

JMPR
The Joint FAO/WHO Meeting on Pesticides—the Panel on Residues in Food and Drinking Water.

MFG
European Environmental Research Group.

MRL
Maximum Residue Limits in Food and Agricultural Products.

NGO
Non-Governmental Organization

NOAEL
No Observed Adverse Effect Level.

NOEL
No Observed Effect Level.

PAN
The Pesticides Action Network.

PCS
Programme on Chemical Safety, e.g. responsible for EHC documents. Formerly IPCS.

PEC
The Predicted Environmental Concentration.

PIC
Prior Informed Consent.

PNEC
Predicted No Effect Concentration.

OECD
Economic Cooperation and Development.

UN
United Nations

UNCED
United Nations Conference on Environment and Development.

UNEP
Unite Nations Environment Programme.

UNITAR
United Nations Institute for Training and Research.

WHO
World Health Organization.

Appendix I

Programme areas of Chapter 19 of UNCED Agenda 21 is provided as Appendix I.

Table 1. **Summary of current activities of international organisations and programmes according to UNCED Chapter 19 of Agenda 21 on environmentally sound management of toxic chemicals**

PROGRAMME AREAS OF CHAPTER 19 OF UNCED AGENDA 21	IPCS			FAO	IMO	UNIDO	UNRESC					UNDP*	UNITAR	OECD	UNCTAD*	UNDP*	WB*	GATT*	EC
	ILO	WHO	UNEP				ECA*	ECE	ECLAC*	ESCAP	ECWA*								
A. EXPANDING AND ACCELERATING INTERNATIONAL ASSESSMENT OF CHEMICAL RISKS																			
1. Chemical risk assessment	–	–	–	–	–			–						–					–
2. Tools for chemical risk assessment	–	–	–	–	–			–						–					–
B. HARMONISATION OF CLASSIFICATION AND LABELLING OF CHEMICALS	–	–	–	–	–			–						–					–
C. INFORMATION EXCHANGE ON TOXIC CHEMICALS AND CHEMICAL RISKS	–	–	–	–	–	–		–					–	–					–
D. ESTABLISHMENT OF RISK REDUCTION PROGRAMMES	–	–	–	–	–	–		–					–	–					–
E. STRENGTHENING OF NATIONAL CAPABILITIES AND CAPACITIES FOR MANAGEMENT OF CHEMICALS	–	–	–	–	–	–		–						–					–
F. PREVENTION OF ILLEGAL INTERNATIONAL TRAFFIC IN TOXIC AND DANGEROUS PRODUCTS			–							–				–					–

Legend: Organisations which have not provided as yet data on their activities are marked with an *.

Table 2. **Joint Programmes undertaken by international and regional organisations according to UNCED Programme areas**

JOINT PROGRAMMES	UNCED Action Programmes						
	A		B	C	D	E	F
	A1	A2					
EC/IPCS (IPCS Chemical Safety Cards)		▬		▬			
EC/ECETOC				▬			
EC/CEN/ISO					▬		
EC/CEN Development of European Standards						▬	
EC/Dublin Foundation for th Improvement of Living and Working Conditions				▬			
ESCAP/UNEP							▬
FAO/WHO Joint Meeting on Pesticide Residues (JMPR)	▬						
FAO/WHO Codex Alimentarius Commission			▬		▬		
FAO/IAEA Joint Division, Agrochemicals and Residues Section		▬			▬	▬	
FAO/WHO Joint Expert Committee on Food Additives, (JECFA)	▬						
GEMS Fresh Water and Urban Air Quality and Human Exposure Assessment Location (HEAL) (UNEP/WHO (PEP))		▬		▬			
GESAMP (Group of Experts for the Scientific Aspects of Marine Pollution: UN, UNEP, FAO, UNESCO, WHO, WMO, IMO, IAEA)	▬	▬		▬			
IAEA/WHO/UNEP/UNIDO Interagency Project on Risk Management for Large Industrial Complexes	▬						
IMO/WHO/ILO: IMO Sub-Committee on the Carriage of Dangerous Goods					▬		

Appendix II

A list of bodies participating in the IPCS CG/HCCS is provided as Appendix II.

LIST OF BODIES PARTICIPATING IN THE IPCS CG/HCCS
(as of September 1993)

This list includes bodies that have participated since the beginning of the activity and potential participants that have been invited to attend the 4th meeting of the Group (2-3 November 1993).

NATIONAL INSTITUTIONS:

AUSTRALIA	Worksafe Australia
CANADA	Labour Canada
JAPAN	Ministries of Health, Environment, Labour and Industry
USA	Occupational Safety and Health Administration
UK	Health and Safety Executive
SWEDEN	National Chemicals Inspectorate (KEMI)

INTERNATIONAL ORGANIZATIONS/PROGRAMMES

- World Health Organization (WHO)
- International Labour Office (ILO)
- Food and Agriculture Organization of the UN (FAO)
- United Nations Environment Programme (UNEP)
- International Maritime Organization (IMO)
- International Civil Aviation Organization (ICAO)
- UN Committee of Experts on Transport of Dangerous Goods (CETDG)
- Organization for Economic Co-operation and Development (OECD)

REGIONAL BODIES

- Commission of the European Communities (CEC) (Directorates General XI and V)

NON GOVERNMENTAL ORGANIZATIONS

- International Council of Chemical Associations (JAPAN, CANADA, USA, AUSTRALIA, EUROPE/CEFIC)
- International Council on Metals and the Environment (ICME)
- US Council for International Business (International Organization of Employers)
- Hazardous Materials Advisory Council (HMAC, USA)
- International Federation of Chemical, Energy and General Workers' Union (ICEF)
- International Confederation of Free Trade Unions (ICFTU)
- World Wide Fund for Nature (WWF)
- International Organization of Consumers Unions (IOCU)
- International Social Security Association, (ISSA)

JOINT PROGRAMMES	UNCED Action Programmes						
	A		B	C	D	E	F
	A1	A2					
)/ILO: IMO Sub-Committee on Containers and Cargoes					▬		
S (UNEP/ILO/WHO) International Programme on Chemical Safety)	▬	▬	▬	▬	▬	▬	
:D/UNEP International Directory of Emergency Response Centres				▬			
EP/WHO/FAO Global Environment Monitoring System (GEMS), Food Contamination Programme	▬			▬			
EP/UNITAR (PIC training activities)				▬		▬	
EP/ILO/WHO/UN Centre on Transnational Corporations				▬			
EP/OECD IEPAC					▬	▬	
EP/FAO Promotion of Integrated Pest Management Programmes					▬		
EP/FAO/WHO/UNCHS Panel of Experts on Environmental Management for Vector Control					▬		
IDO/FAO/WHO/ESCAP/CIRAD							▬
IDO/IUPAC Golobal Network on Safety in Chemical Production							▬
IDO/WHO/UNEP/FAO Code of conduct for the relaese of genetically engineered microorganisms					▬		
IO (EURO)/IPCS: TFS and ECB (TOB)	▬	▬		▬			
IO (EURO)/IPCS/OECD/UNEP (IEPAC) Guidelines for health aspects of chemical accidents						▬	
IO/ICOH				▬			