
CHEMIC

# Overview

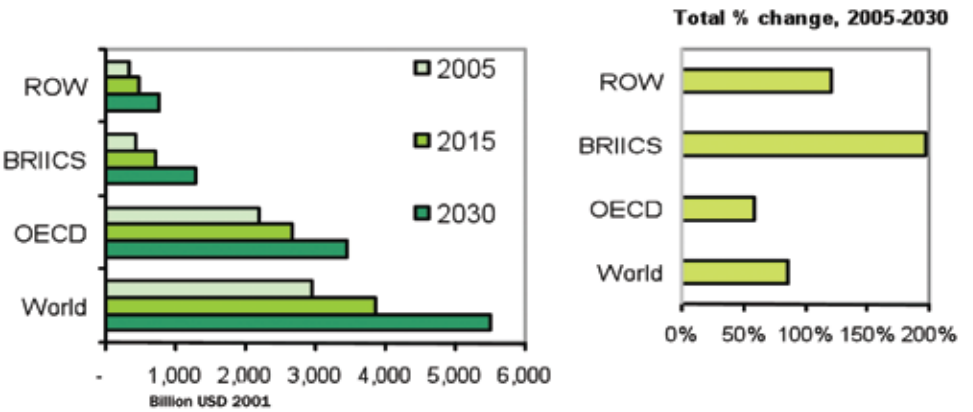
## Chemicals in society

The chemical industry is one of the largest sectors of the world economy; nearly every manufactured product contains one or more of the thousands of chemicals produced by it. The production of chemicals is increasing at a rate of 3-4 per cent per year, with more and more of this production happening in developing countries (*see figures I.1 and I.2 below*). The share of chemical production in industrialized countries is decreasing—from 84 per cent in 1970 to 75 per cent at present and is expected to decrease further to about 63 per cent by 2030.[1] (*See chapter on Trends*).

Chemicals are very diverse in their properties, the quantities manufactured and their use (*see figure I.3*). Some chemicals are produced in very large quantities and have widespread use in the production of other chemicals and consumer products. Others, including pesticides and pharmaceuticals, are manufactured in much smaller amounts and for very specialised uses,.

The physical, chemical, and toxic properties of chemicals also vary greatly—while many are not hazardous, others are very persistent in the environment, travel large distances from where they are released, and are harmful to human health and the environment even in small amounts. Chemicals of international concern include persistent organic pollutants, ozone depleting substances, and heavy metals such as mercury, lead and cadmium. (*For more information, see annexes 1 and 2*).

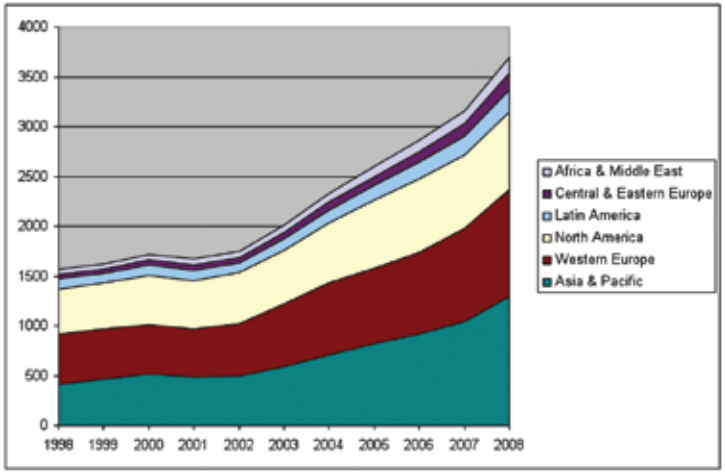
**Figure I.1. Chemical production 2005-2030**




Note: BRIICS include Brazil, Russia, India, Indonesia, China and South Africa.
Source: OECD Environmental Outlo ok to 2030, 2008

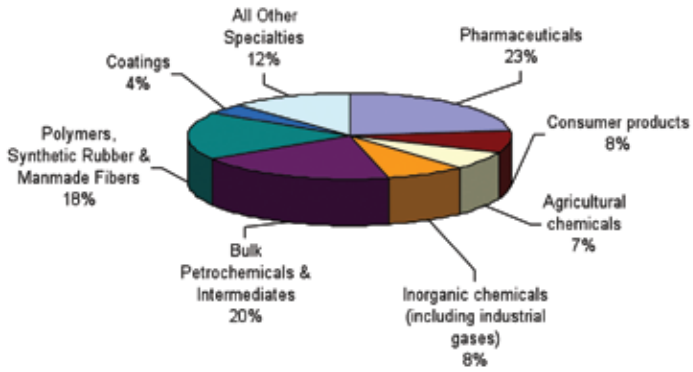
1 OECD: OECD Environmental Outlook to 2030, 2008 and OECD Environmental Outlook, 2001.

**Figure I.2. Global chemical production by region in billion USD**




Source: American Chemistry Council: Guide to the business of chemistry, 2009

**Figure I.3. World chemical production by category in 2008**




*Source*: American Chemistry Council: Guide to the business of chemistry, 2009

## Emerging issues

Recently there has been a growing interest and concern over the spread of, and potential exposure to, chemicals contained in products, such as personal computers, textiles and costume jewellery. During the second session of the International Conference on Chemicals Management (ICCM) in May 2009, the need for chemicals information in consumer articles was identified as an emerging policy issue for consideration. (*see table I.2*). Information exchange and effective communication throughout the product chain are key to enable users to avoid hazardous chemicals; these factors are also key to manage risks to users and the environment.

Another emerging challenge is nanotechnology. Nanotechnology is a field of applied science concerned with the control of matter at dimensions of roughly 1 to 100 nanometres—one nanometre being one-billionth of a meter. Nanotechnology has enormous potential for social, economic and environmental benefits—from innovative medical techniques to savings on materials and energy, as well as advances in pollution detection and remediation. However, with their impacts on human health and the environment as yet largely unknown and public controls largely absent, more systematic research and sector-specific policies are necessary. While in 2005 more than USD 10 billion was spent on nanotechnology research, only about USD 39 million per year are spent by the United States and the European Union on research on the effects of nanoparticles on human health and the environment.[2]

## Millennium Development Goals

Chemicals touch on many aspects of development and affect drinking water, air, and food quality. The health of people, environments and ecosystems in general depends upon their sound management. As such, the sound management of chemicals is central to sustainable development and, as described in table I.1, is closely linked to the achievement of the United Nations Millennium Development Goals (MDGs).

**Table I.1. Link between sound management of chemicals and the Millennium Development Goals**

| Millennium Development Goal | Sound chemicals management's contribution towards achieve the Millennium Development Goals |
|---|---|
|  ***N°1: Eradicate extreme poverty and hunger*** | *The poor are at higher risk of exposure to toxic and hazardous chemicals because of their occupations, living conditions and lack of knowledge about handling chemicals. Sound management of chemicals can improve the living environment and work conditions of the poor and thus their health, while at the same time proper use of chemicals such as pesticides and chemical fertilizers can boost crop yields, protect the productivity of freshwater and marine fisheries and ecosystems on which poor communities depend.* |
|  ***N°2: Achieve universal primary education*** | *Raising awareness about chemical safety issues at the primary education level can contribute to reducing the occurrence of chemical-related accidents at home, in the community, or at work. Sound management of chemicals also helps to protect children's mental and physical development, enabling them to attend school and pursue education.* |

2 UNEP: GEO Yearbook 2007

| Millennium Development Goal | Sound chemicals management's contribution towards achieve the Millennium Development Goals |
|---|---|
|  ***N°3: Promote gender equality and empower women*** | *Women and girls are disproportionately affected by indoor air pollution, water and food pollution and the negative effects of household chemicals, as they tend to assume the bulk of household and food preparation responsibilities. Occupational factors, such as the gender division of labour, further expose women to certain chemicals used in, for example, agriculture, the solvents industry, and health care. Biases in educational systems may result in the fact that women are less well-equipped to understand, cope with, and anticipate the implications of chemicals exposure, and environmental degradation. Sound manage-ment of chemicals can improve women's working and living conditions, increase their knowledge on the handling and health implications of chemicals and help protect them and their families.* |
|  ***N°4: Reduce child mortality*** | *Improper labelling, storage and use of chemicals are significant causes of poisoning in developing countries. Yearly, many children die as a result of chemical at home or at work through involvement in activities such as agriculture and mining. In addition to acute poisonings, chemical pollution of air, soils, water, and food increase the incidence, prevalence, rate of mortality, and costs of certain paediatric diseases. Sound management of chemicals, combined with better nutrition can improve children's living conditions, decrease their sensitivity to chemicals and reduce child mortality.* |
|  ***N°5: Improve maternal health*** | *Certain types of chemicals (such as POPs) can build up to dangerous levels in humans causing adverse reproductive, developmental, immunological, hormonal, and carcinogenic effects. Women who have accumulated these kinds of chemicals in their lipids or body fat can pass as much as one third of their toxic burden to their infant children, both prenatally and after birth (through breastfeeding). Sound management of chemicals can lower a women's risk of contamination, improve maternal health, and therefore, the health of future generations.* |
|  ***N°6: Combat HIV/AIDS, Malaria and other diseases*** | *Proper use of medications and other chemical medical products (such as treated mosquito bed nets) play a major role in disease prevention and treatment. Chemicals are also used for effective control of vector-borne diseases, such as malaria, kala-azar, dengue fever and chagas disease and help prevent millions of deaths worldwide. Sound management of chemicals promotes safe handling and disposal of expired medications and health care waste and encourages the use of environmentally friendly vector disease control practices.* |

| Millennium Development Goal | Sound chemicals management's contribution towards achieve the Millennium Development Goals |
|---|---|
|  ***N°7: Ensure environmental sustainability*** | *Chemicals can contribute to global warming, ozone depletion and climate change, can cause severe environmental degradation and disrupt ecosystems through the contamination of water, soil, air and flora and fauna. Sound management of chemicals can help prevent and/or minimize harmful chemicals from entering the environment and reduce the need for difficult and costly environmental remediation.* |
|  ***N°8: Global partnership for development*** | *International co-ordination and co-operation efforts towards improved chemicals management, such as through the Strategic Approach to International Chemicals Management (SAICM) adopted in 2006, and chemicals-related Multilateral Environmental Agreements (MEAs), create global partnerships and initiatives. Global partnerships and initiatives help countries integrate objectives for the sound management of chemicals into national and local development policies and plans, while simultaneously identifying options to catalyze the necessary supporting financing.* |

Source: UNDP/GEF: Managing Chemicals for Sustainable Development, 2007

## Sound management and sustainable production and use of chemicals

The sound management of chemicals, including hazardous wastes, aims to prevent and, where this is not feasible, to reduce or minimize the potential for exposure of people and the environment to toxic and hazardous chemicals as well as chemicals suspected of having such properties. It includes prevention, reduction, remediation, minimization and elimination of risks during the life cycle of the chemicals: production, storage, transport, use and disposal, including the risks from chemicals found in products and articles. It involves the application of the best managerial practices to chemicals, which requires strengthened governance and improved techniques and technologies at each stage of the life cycle.[3] Additional research and development that focuses on clean production and green/sustainable chemistry is crucial to achieve sustainable consumption and production.

### The sound management of chemicals and their wastes is strengthened by:

- *Adequate legislation and risk management policy framework*
- *Information gathering and dissemination*
- *Effective education programmes*
- *Awareness of alternatives, best available techniques and best environmental practices (BAT/BEP)*
- *Capacity for biological and environmental monitoring, data interpretation and risk assessment*
- *Capacity for implementation and enforcement of risk management*
- *Capacity for rehabilitation of contaminated sites*
- *Capacity to respond to emergencies and poisoning*
- *Recognition of the gender dimension of exposures*
- *Adequate resources*

### The application of sound management of chemicals is based on the following principles:

**POLLUTION PREVENTION:** Rather than rely on treatment and control technology to prevent the release or exposure to chemicals, it looks at ways to prevent the use of hazardous chemicals and the production of pollutants, including wastes[4].

**THE PRECAUTIONARY APPROACH:** It encourages the use of cost-effective measures to prevent potential negative health and environmental impacts even if there is lack of full scientific certainty.

**INTERNALIZATION OF ENVIRONMENTAL AND HUMAN HEALTH COSTS:** This can be achieved through the use of economic instruments such as the "polluter pays" or the facilitated "extended producer responsibility".

**RIGHT-TO-KNOW:** This encourages access to information on chemicals, their safe use and releases to the environment in a timely fashion to workers and the public, including vulnerable groups.

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3 UNDP 2009 Managing Chemicals for Sustainable Development, UNDP 2009 Technical Guide

4 Integrated Pest Management to reduce reliance on pesticides is an example of this; refer also to Sixth Session of the Intergovernmental Forum on Chemical Safety Dakar, Senegal 15 – 19 September 2008: 13-14. http://www.who.int/ifcs/documents/forums/forum6/report/en/index.html

**USE OF BEST AVAILABLE SCIENTIFIC INFORMATION AND ASSESSMENTS:** This principle ensures that decisions are based on the most up-to-date understanding of the chemicals, their impacts on health and the environment, the best available techniques and environmental practices and the benefits achieved from the use of alternative approaches or substitutes.[5] Finding cost-effective and locally-appropriate alternatives for industrial and household chemicals can be a technological and financial challenge for developing countries. For agricultural chemicals, however, several developing countries have made integrated pest management a key element of their crop protection strategies.

**Box I.1. Key components of a sound management of chemicals governance framework**

- *Constitutional provision (health; quality of life; environment; sustainable development, etc.)*
- *Enabling policy and legislative framework*
- *Mechanism for national coordination*
- *National plans and priorities*
- *Stakeholder participation, including women, indigenous communities, workers, and other vulnerable groups*
- *National infrastructure and government institutional capacity for risk assessment and management including:*
- *National waste management strategy for toxic and hazardous wastes*
- *Site remediation*
- *Emergency prevention, preparedness and response*
- *Diagnosis and treatment of intoxication*
- *Basic information for risk management, to inform decision-making and for tracking progress such as:*
- *Information on chemicals imported, manufactured, formulated, in transit, and traded*
- *Clinical, epidemiological, and environmental data*
- *Toxicity, fate, distribution, and pathways of exposure*
- *National monitoring strategy to support assessment and basic information for decision-making and monitoring of human populations, food (including animal feeds) and the environment (including air, water, soil, sediment, flora, and fauna)*
- *Risk communication strategies for awareness raising and outreach and education to support risk prevention and reduction (accessible, timely, and appropriate information, including as applicable to vulnerable groups)*
- *Support for research*
- *Financial resources*

Source: UNDP Technical Guide for Integrating the Sound Management of Chemicals in MDG-Based Policies & Plans, 2009

## International initiatives on the sound management of chemicals

Many of the international efforts to address chemicals since 1992 have occurred as a result of the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro where a first global consensus emerged on the concept of sound chemicals management. Chapter 19 of Agenda 21 entitled "Environmentally Sound Management of Toxic Chemicals, Including Prevention of Illegal International Traffic in Toxic and Dangerous Products" recognized the crucial importance of sound chemicals management throughout their life cycle to achieve social and economic development. Chapter 19 addresses chemicals issues in six programme areas:[6]

- *Expanding and accelerating international assessment of chemical risks*
- *Harmonization of classification and labelling of chemicals*
- *Information exchange on toxic chemicals and chemical risks*

5 Sound and Sustainable Management of Chemicals: A Training Manual for Workers and Trade Unions, UNEP, 2008.
6 UNDP: UNDP Technical Guide for Integrating the Sound Management of Chemicals in MDG-Based Policies & Plans, 2006 and Chapter 19 of Agenda 21.

- *Establishment of risk reduction programmes*
- *Strengthening of national capabilities and capacities for the management of chemicals*
- *Prevention of illegal international traffic in toxic and dangerous products*

In 2002, during the WSSD in Johannesburg, governments renewed their commitment to sound management of chemicals throughout their life cycle for the protection of human health and the environment by setting the goal that, by 2020, chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment.

Significant progress has been made on the implementation of Chapter 19 of Agenda 21 and toward the achievement of the WSSD 2020 goal. Over the years, a series of measures have been adopted to deal with the risks chemicals pose for both people and the environment. Responses to the problem of contaminants now include 17 multilateral agreements and numerous intergovernmental organizations and coordination mechanisms. Among them is the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal, the 1998 Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals, the 2001 Stockholm Convention on Persistent Organic Pollutants, and the 2006 Strategic Approach to International Chemicals Management (SAICM). More recently, at the 25th meeting of UNEP Governing Council in 2009, Governments agreed to produce a legally binding instrument on mercury and requested the establishment of an intergovernmental negotiating committee to carry out this endeavour in 2013.

**Table I.2. Some major international instruments on chemicals**

| Entry into force | MEA | Objective |
|---|---|---|
| 1986 | International Code of Conduct on the Distribution and Use of Pesticides | *Voluntary instrument unanimously adopted by FAO Member States with an aim to set forth responsibilities and establish voluntary standards of conduct for all entities involved in the distribution and use of pesticides* |
| 1989 | Montreal Protocol on Substances that Deplete the Ozone Layer | *Protect the ozone layer by phasing out the production of substances that deplete it* |
| 1990 | International Labour Organization (ILO) Convention No.170 | *Protect workers but also the general public and the environment from the harmful effects of chemicals* |
| 1992 | Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal | *To establish strict controls on the transboundary movements of hazardous and other wastes and require that they are managed in an environmentally sound manner to ensure that human health and the environment are protected* |
| 2004 | Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade | *Promote international efforts to protect human health and the environment from hazardous chemicals by enabling countries to take informed decisions on the import of hazardous chemicals and pesticides listed in the Convention* |

| Entry into force | MEA | Objective |
|---|---|---|
| 2004 | **Stockholm Convention on Persistent Organic Pollutants (POPs)** | *Protect human health and the environment from POPs by restricting and ultimately eliminating their production, use, trade, release and storage* |
| 2006 | **Strategic Approach to International Chemicals Management (SAICM)** | *Strengthen sound chemicals management across all relevant sectors in order to achieve the WSSD 2020 goal. SAICM addresses all the phases and elements of chemicals safety, taking into account a range of environmental and public health concerns throughout the life-cycle of chemicals. SAICM was adopted by the International Conference on Chemicals Management (ICCM) in 2006.* |

*Note: For more information, see annex 3.*

In order to promote a coordinated framework of action at the international level, the Inter-Organization Programme for the Sound Management of Chemicals (IOMC) was established in 1995. The seven participating organizations are the UNEP, the International Labour Organisation (ILO), the United Nations Food and Agriculture Organisation (FAO), the World Health Organisation (WHO), the United Nations Industrial Development Organisation (UNIDO), the United Nations Institute for Training and Research (UNITAR) and the Organisation of Economic Cooperation and Development (OECD). In addition, United Nations Development Programme (UNDP) and the World Bank are participating as observer organizations. Members consult on the planning, programming, implementation and monitoring of activities undertaken jointly, or individually, and help ensure that programmes are mutually supportive, complementary, and avoid duplication of efforts.

The Environmental Management Group (EMG) is another mechanism at the international level to promote sound management of chemicals through inter-agency cooperation. Its membership consists of the specialized agencies, programmes and organs of the United Nations including the secretariats of the Multilateral Environmental Agreements. It is chaired by the Executive Director of UNEP and supported by a secretariat provided by the same organization.

The coordination of sound management of chemicals can also take place at the regional level, where governments, especially those whose economies are—or strive to be—closely integrated, to co-operate, and can share the often resource-intensive burden of a variety of chemicals issues, including data collection and sharing; basic research; evaluation; and even approvals and other regulatory actions. Such groupings span a wide spectrum from organizations that are relatively well integrated, such as the European Union, to less closely integrated fora for cooperation, such as SADC (Southern Africa Development Community), CILSS (Permanent Interstate Committee for Drought Control in the Sahel), Mercosur (Mercado Común del Sur (Southern Common Market)), ASEAN (Association of Southeast Asian Nations), SPREP (South Pacific Regional Environment Programme), APEC (Asia-Pacific Economic Cooperation), SAARC (South Asian Association for Regional Cooperation) and NAFTA (North American Free Trade Agreement) and its associated body, the North American Commission

for Environmental Cooperation (NACEC).[7] Regional agreements on chemicals and wastes management include inter alia the Bamako Convention, the Waigani Convention and the European Union's REACH.

Under pressure from international and regional agreements, there has been a significant reduction in the use of some toxic chemicals, and safer alternatives are being identified. Voluntary initiatives, such as the chemical industry's Responsible Care programme encourage companies to work towards continuous improvement of their health, safety and environmental performance.

However, harmful and persistent pollutants, such as heavy metals and organic chemicals, are still being released to the land, air, water from various sources including manufacturing, use of agrochemicals and from leaking stockpiles. The shift of industry to newly-industrialized countries and the limited management capacities in developing countries over chemicals use and disposal still represent important challenges to be addressed in order to achieve acceptable levels of protection of human health and the environment towards the risks posed by chemicals.

## Special challenges of developing countries in the sound management of chemicals

It is often the world's poorest people, including women and children, who have the highest risk of exposure to toxic and hazardous chemicals. Their occupations, living conditions, lack of knowledge about safe handling practices, and limited access to sources of uncontaminated food and drinking water are among the factors that increase this risk. Living in countries where regulatory, health and education systems are weak exacerbates this problem.

### Some of the main challenges in developing countries include:

**INSTITUTIONAL AND TECHNICAL CAPACITY:** Developing countries often do not have the institutional, technical and financial capacities to implement adequate control and protection mechanisms or to enforce legislation on sound chemicals management.

**WORKER KNOWLEDGE:** In many developing countries poor people work in close proximity to toxic chemicals. These workers are often unaware of the high risk that poor working conditions and lack of safety requirements exposes them to.

**PUBLIC AWARENESS:** Most of the population is usually unaware of the hazards associated with exposure to toxic chemicals and the risks of chemical-related incidents. In agriculture, for example, poor knowledge of safe pesticide use, excessive use of pesticides, lack of facilities for personal hygiene, and inappropriate storing and disposal conditions lead to human toxic exposure.

**INFORMAL SECTOR:** The informal and the agricultural sectors are the main sources of human exposure to toxic pollutants in developing countries. Activities such as small-scale smelting, mining and waste disposal pose particularly high risks to exposure to toxic chemicals for workers and the community.

7 From Developing and Sustaining an Integrated National Programme for Sound Chemicals Management; UNITAR, 2004.

**AVAILABILITY OF BEST AVAILABLE TECHNIQUES (BAT) AND BEST ENVIRONMENTAL PRACTICES (BEP):** The production of the most toxic chemicals is often readily transferred to developing countries, where cleaner technologies and BAT/BEP are not available or affordable. Even when the risks posed to human health caused by certain chemicals are known, it is sometimes difficult for developing countries to replace them as they are highly effective and accessible at a low cost. Finding cost-effective and locally-appropriate alternatives is a technological and financial challenge for developing countries.


1
6
100mM Tris pH
750mM KCl
15mM MgCl2

## Trends in the production and consumption of chemicals

Trends in the global chemical industry have been described in various industry sources. These reports focus on the producers and formulators of chemicals and chemical products, and do not include the mining, petroleum and manufacturing sectors. The OECD Environmental Outlook for the Chemicals Industry, published in 2001, considered trends in the chemical industry with a focus on its member countries. In 2008, the OECD also published the OECD Environmental Outlook to 2030, which included a chapter on chemicals with updated data. The International Council of Chemical Associations (ICCA) publishes reports on the industry such as the ICCA Review 2007-2008.[8] The data presented here has been extracted from these reports, thus most of it relates to OECD countries. There is little reliable data from developing countries, and even less regarding issues such as illegal trade of chemicals or hazardous wastes.

Most data on the size of the chemical industry is based on sales. The size, however, is not a direct measure of quantities, since high-value chemicals which account for a large proportion of the value of sales are usually produced in small amounts. The 2001 OECD Outlook indicates that since 1970, global sales in chemicals have grown almost nine-fold. In 1998 the chemicals industry accounted for 7 per cent of global income and 9 per cent of international trade, with an estimated USD 1,500 billion in sales.

Total sales have increased significantly within a decade—ICCA estimates that in 2007, the turnover for the global chemical industry was USD 3,180 billion. Pharmaceuticals accounted for about one third of this total. The globalization of the chemical industry is also evident in the increase in trade. ICCA estimates that between 1998 and 2007, world trade in chemicals almost tripled to USD 1,380 billion. This is about 45 per cent of the value of the global chemical industry; over 35 per cent of this world trade is intra-company in nature.

Other trends of the industry include the following:

- *The chemicals industry is expected to continue to grow over the next 20 years, at a rate of 3-4 per cent per year.*
- *Most production and trade in chemicals occurs in and among OECD countries and will continue to do so for the foreseeable future.*
- *Growth in production and consumption will grow much faster in non-OECD countries than OECD ones, reducing the overall share of the OECD countries in this sector.*
- *The main growth centres of chemical sales and production are in Asian emerging economies.*
- *Trade in chemicals is expected to continue to increase.*
- *Almost 80 per cent of the global chemicals production is located in 15 countries: United States, Japan, Germany, China (including Taiwan Province), France, United Kingdom, Italy, Republic of Korea, Brazil, Belgium/Luxembourg, Spain, the Netherlands, Switzerland and Russian Federation.*
- *Non-OECD countries with important chemical manufacturing include the BRIICS countries—Brazil, Russia, India, Indonesia, China and South Africa; other countries with a rapidly growing chemical sector include Argentina, Malaysia, Saudi Arabia, Singapore and the Philippines (see table II.1).*

8 International Council of Chemical Associations (ICCA), ICCA Review 2007-2008. Available at http://www.icca-chem.org/ICCADocs/01_icca_review2007_2008.pdf.

- *Chemical companies in OECD countries will concentrate more and more on life-science and speciality chemicals.*
- *Chemical producers are likely to merge, which qwqwill result in larger and fewer multinational companies.*

The shift in production from OECD countries to developing countries is related to many factors including the increase in manufacturing and other industrial production that is occurring in developing countries, the need to be closer to major users, and the lower costs of operations.

**Table II.1. Growth of the chemicals industry in BRIICS Countries (Sales in millions of Euros)**

| BRIICS COUNTRIES | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|
| Brazil | 38,096 | 35,606 | 30,297 | 31,602 | 37,009 | 48,773 | 56,721 | 62,865 |
| Russia | 9,458 | 10,909 | 8,021 | 15,731 | 16,630 | 17,926 | 20,595 | 22,939 |
| India | 30,547 | 28,602 | 27,757 | 26,314 | 29,230 | 35,275 | 39,329 | 46,553 |
| Indonesia | 6,700 | 7,489 | 6,627 | 5,789 | 5,793 | 5,911 | 8,224 | 10,866 |
| China | 91,450 | 98,823 | 102,198 | 114,244 | 134,761 | 185,926 | 236,352 | 274,591 |
| South Africa | 7,012 | 6,675 | 6,372 | 7,293 | 8,215 | 9,062 | 9,448 | 9,797 |
| Total | 183,263 | 188,104 | 181,272 | 200,973 | 231,638 | 302,873 | 370,669 | 427,611 |

*Source: International Council of Chemical Associations (ICCA)*

## Health and environmental effects of chemicals

### Impact of chemicals on health

The overall burden of death and disease from chemicals is not well known. However, the WHO is currently preparing a publication on this topic. This section reflects previously published information. The 2002 WHO World Health Report and the various Global Burden of Disease reports have examined environmental contributions to mortality and disease in the world population. These reports highlight large and preventable exposures such as contaminated drinking water and poor sanitation, urban air pollution and indoor pollution from cooking stoves.

While some chemicals have been linked to adverse health effects, data limitations have prevented the quantification of the total burden of disease due to exposure for all but a few agents such as asbestos and lead. Data are more readily available and reliable for acute illnesses and deaths due to massive or extremely toxic exposures, such as chemical plant explosions or pesticide ingestion leading to death. It is estimated that one to five million deaths occur each year due to pesticide poisoning.[9] This range reflects the well-known problem of underreporting for both acute non-fatal pesticide poisoning and deaths due to pesticide ingestion. Moreover, children face higher risks from pesticides than adults and need greater protection against these chemicals, particularly in developing countries.[10]

9 Jeyaratnam, J. 1990. Acute pesticide poisoning: a major global health problem.

10 The revised questionnaire on "Transmission of Information", the annual report submitted by Parties to the Basel Convention, includes a request for information on studies health and environmental effects of the generation, transportation and disposal of hazardous and other wastes (http://www.basel.int/natreporting/index.html), which is a potential source of documentation.

The WHO 2002 report provides an indication of the contribution of chemical exposure to the incidence of certain diseases (*see table II.2*). Where better data are available (*poisonings and suicide*) the contribution of chemical exposure is significant. It is likely that current data underestimates the overall contribution of chemicals to adverse health impacts. While not all occupational diseases result from exposure to chemicals, the highest exposures to chemicals occur in the workplace and thus chemicals are contributors to the health outcomes in this sector. The burden of illness from outdoor air pollution is estimated from exposure to particles and some major pollutants such as ground-level ozone. It is also likely that some of the impacts seen are related to exposures to toxic chemicals.

**Table II.2. Indicative fraction of certain diseases related to selected environmental factors**

| | Outdoor airpollution | Chemical | Occupational |
|---|---|---|---|
| *Perinatal conditions* | ● | ● | ● |
| *Congenital anomalies* | ● | ● | ● |
| *Cancer* | ● | ● | ▲ |
| *Neurospychiatric disorders* | | ● | ▲ |
| *Cardiovascular diseases* | ● | ● | ▲ |
| *COPD* | ● | | ▲ |
| *Asthma* | ● | | ▲ |
| *Poisonings* | | ■ | ● |
| *Suicide* | | ▲ | ● |

● less than 5% ▲ 5-25% ■ more than 25%

*Source: WHO, 2006*[11]

The WHO 2006 report estimates that:

- *42 per cent of chronic obstructive pulmonary disease (COPD), a gradual loss of lung function, is attributable to environmental risk factors such as occupational exposures to dust and chemicals, as well as indoor air pollution from household solid fuel use.*
- *5 per cent (2-10 per cent) of all congenital anomalies are attributable to environmental causes.*
- *About 9 per cent of the disease burden of lung cancer is ascribed to occupational exposure.*
- *2 per cent of the leukaemia disease burden is related to occupational exposures to chemicals.*
- *19 per cent (12-29 per cent) of all cancers are attributable to the environment.*
- *2 per cent of the ischaemic heart disease burden and 3 per cent of the cerebrovascular disease burden could be related to lead exposure.*

11 Prüss-Üstün A, and Corvalán C. 2006. Preventing disease through healthy environments. Towards an estimate of the environmental burden of disease. World Health Organisation, Geneva. http://www.who.int/quantifying_ehimpacts/publications/preventingdisease.pdf

- *68 per cent (46-84 per cent) of poisonings in adults are attributable to occupational or environmental exposure.*
- *85 per cent (60-98 per cent) of poisonings in children are related to exposure to chemicals, including pharmaceuticals, often because they are not stored properly.*

Infant health problems, such as increased mortality from low-birth-weight and preterm infants, and congenital anomalies could be related to environmental exposure to toxic chemicals as well. While the links between many health conditions to the environment or occupation is usually considered small-to-moderate, there is uncertainty surrounding these estimates since evidence linking specific environmental and occupational exposures to various cancers is incomplete. In addition, available data only allow for a limited number of cancers to be addressed.

### Data on environmental effects

The adverse effect of chemicals on the environment has been widely documented.12 The present report discusses the effects of chemicals on some components of the environment, namely the atmosphere, water, soil and biodiversity which have a negative impact on ecosystem services that are valuable to people and society.

**ATMOSPHERE:** Chemicals affect the atmosphere in significant ways: they can act as air pollutants; contribute to acid rain formation; and function as greenhouse gases and ozone depleters. Additional chemicals continue to be identified as ozone depleters. The significant ozone depleting potential of nitrous oxide, for example, was not understood until recently. Hazardous air pollutants enter the atmosphere from industrial emissions, the use and disposal of products that contain them, and at other points in the chemical life cycle.

Information on the atmospheric impacts of chemicals is available from a variety of sources. Air pollution data are available for many regions. Sales volume data for chemicals categorized as hazardous air pollutants could also serve as proxy for estimating of the magnitude of certain types of air pollution from chemicals.

**WATER RESOURCES:** Chemical contamination of water resources is a world-wide problem that has been documented extensively. Environmental impacts include cancers and endocrine disruption in aquatic animals and loss of invertebrate biodiversity amongst others. Small amounts of some individual chemicals (for example, lindane, now listed in the Stockholm Convention) have the potential to contaminate vast amounts of water. Plastic waste has become a major contaminant in oceans.[13]

**SOIL RESOURCES:** Industrial chemicals contaminate soil in urban as well as industrial settings. For example, metals, solvents, and other toxic substances contaminate many operating and abandoned industrial sites. Case in point: "Soils contaminated with cadmium are a serious problem in many Asian countries, where cadmium enters the food supply, especially rice; more than 10 per

12 The Millennium Ecosystem Assessment is one important source for broadly synthesized information on environmental factors. This study considers the relationship between ecosystem services and human well-being. It does not, however, focus specifically on the role of chemicals in affecting ecosystems. The most recent edition of the Global Environmental Outlook (GEO 4) may also provide additional guidance regarding possible structure for an examination of chemical impacts on the environment.

13 For one recent discussion in the popular press, see: "Scientists uncover new ocean threat from plastics," London Independent, http://www.independent.co.uk/news/science/scientists-uncover-new-ocean-threat-from-plastics-1774337.html

cent of China's arable land is contaminated with cadmium." [14] Agricultural chemicals, on the other hand, deplete soil resources. For example, insecticides and fungicides kill beneficial microorganisms, decreasing ecosystem resilience and reducing soil fertility.

**BIODIVERSITY:** Persistent and bioaccumulative chemicals are found as widespread contaminants in wildlife organisms, especially those individuals high on the food chain. These chemicals cause cancers, immune dysfunction and reproductive disorders which can contribute to species extinction.[15]

**AGRICULTURE:** Chemical fertilizers and pesticides used to boost agricultural productivity are also associated with agricultural losses. For example, pesticide use can lead to severe pest outbreaks by damaging natural predator populations. Studies have documented a pattern in which pesticide use initially leads to an increase in productivity, followed by a pest outbreak that lowers productivity below the initial level that preceded the use of the chemical. Over time, productivity rises again but does not usually reach the original level. Intensive pesticide use can also lead to the emergence of resistance among the pest population. Farmers frequently become trapped in a "vicious cycle" in which they must use increasing amounts of agricultural chemicals to counteract ecosystem imbalances created by using them. The use of agricultural chemicals can also deplete soil fertility by reducing populations of beneficial soil micro-organisms.

In addition to these ecosystem effects, studies have found that farming populations in developing countries sometimes experience diminished productivity due to illnesses resulting from pesticide exposures. Other impacts of pesticides include "erosion of biodiversity, reduction of populations of pollinators and other beneficial insects, and contaminated fish, birds and wildlife. Many environmental goods, such as bees, bush-meat, or fish, are of critical economic or food security value to poor communities."[16]

**FISHERIES:** Fisheries, an important source of protein and of income for populations around the world, can be severely affected by chemicals. Persistent organic pollutants can accumulate in fish, especially those high in the food chain. As a result, the value of this otherwise excellent protein source is diminished or lost completely.

Chemical contamination is associated with disease in fish populations, including cancers and increased vulnerability to infectious agents. Chemicals can also destroy fish populations.

Industrial and agricultural run-off can lead to large-scale fish kills, and lower-level chemical contamination of water bodies can decimate fish populations over time. Pesticides, for example, are cited as a major threat to the continued survival of some salmon populations. Given the economic value of fisheries worldwide, significant economic losses may result from chemical-related reductions in the size or quality of fishery resources.

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14 "International Transport of Lead and Cadmium via Trade: an International Concern?" Thought starter prepared by the Center for International Environmental Law (CIEL) in consultation with the FSC Working Group and on behalf of the Government of Germany. Presented at the Sixth Session of the Intergovernmental Forum on Chemical Safety, Dakar, Senegal, September 2008. (http://www.ciel.org/Publications/PbCd_ThoughtStarter_Mar08.pdf).

15 A compilation of recent articles of endocrine disrupting effects in wildlife can be found at: http://www.ourstolenfuture.org/NewScience/wildlife/wildlife.htm.

16 http://www.africastockpiles.net/about/poverty


KEEP OUT
NO SWIMMING
NO BOATING
NO FISHING
CONTAMINATED WATER
BY ORDER OF DEPT. OF HEALTH

## Poverty and chemicals management

### Trends and global policies

Chemicals are an integral part of the daily life with over 100,000 different substances in use. The continued growth pattern of global production, trade and use of chemicals is exerting an increasing chemicals management burden on developing countries and countries with economies in transition and these countries have the least capacity to deal with such complex challenge. By 2020, developing countries are expected to lead the world in growth rate for high volume industrial chemicals, increasing their share of world chemicals production to 31 per cent. Chemical consumption in developing countries is likewise growing much faster than in developed countries and could account for a third of global consumption by 2020.

The contributions that the sound management of chemicals makes to the achievement of the Millennium Development Goals (MDGs) adopted at the 2005 World Summit are explicitly recognized within the Dubai Declaration on the Strategic Approach to International Chemicals Management (SAICM) adopted in 2006 at the first International Conference on Chemicals Management. SAICM observed that, "the sound management of chemicals is essential if we are to achieve sustainable development, including the eradication of poverty and disease, the improvement of human health and the environment and the elevation and maintenance of the standard of living in countries at all levels of development."

Improper production, transport, use and disposal together with inadequate storage and control, can lead to environmental damage, serious illness, sick and absent labour forces and death while obsolete stockpile clean-up operations can be very expensive. This is particularly relevant to developing countries where are higher levels of poverty as there is an established link between poverty and increased risks of exposure to toxic and hazardous chemicals.

A key challenge for countries is to balance risks and benefits when making national decisions on chemicals. Many developing countries are confronted with the challenge of becoming recipients of an increasing amount of outdated technologies and chemicals. One of the key barriers to progress on this fundamental problem is the lack of global consensus on the costs of inaction on the sound management of chemicals. Reporting on the costs of poor chemicals management occurs virtually every day somewhere in the world, but these events (chemical accidents or when especially vulnerable populations have received acute or chronic exposures, etc.) typically receive inadequate attention. This is due in great part to the fact that the story line has not been explained in the economic language of key financial decision makers, has not been aggregated into a meaningful national, regional and global picture, and has not been adequately linked to sustainable development in a form that is manageable to grasp at the political level.

### Multiple elements

Due to the widespread use of chemicals in society and industry, there are no simple solutions to achieve sound management of chemicals. Evidently, a solution would require multiple elements, including:

- *Methodologies to collect relevant information.*
- *Risk assessment based on the scientific information.*
- *Governance structures to manage chemicals, including products containing hazardous chemicals, through legal actions, economic instruments, voluntary agreements and substitution with less hazardous chemicals amongst others together with the necessary institutional infrastructures and coordination mechanisms.*
- *Capacity building activities in developing countries and countries with economies in transition*
- *Awareness raising on the potential negative effects of hazardous chemicals at the political decision-making level and among producers of, traders in, and users of chemicals.*

## Major challenges to the sound management of chemicals

As indicated in the overview chapter, there are a number of major challenges in achieving sound management of chemicals. These challenges are related to a number of interrelated issues, including:

- *Lack of financial resources for chemicals management.*
- *Lack of coherent legislation and lack of coordination between ministries.*
- *Lack of institutional, technical and legal capacities for development, implementation and enforcement of legislation.*
- *Lack of information and awareness of the impacts of chemicals on the environment and health.*

### Lack of financial resources for chemicals management

Financial resources are the foundation for all activities geared toward the achievement of sound management of chemicals. However, it is widely recognized that the resources available to address chemical safety issues at national, regional and global levels are inadequate.

Most of the chemicals management related Multilateral Environmental Agreements (MEAs) are scientifically justified, but are generally confronted with insufficient financial and/or market based mechanisms for their implementation.

In a number of developing countries and countries with economies in transition chemicals management relies on resources from bilateral donors and multilateral funds such as the Global Environment Facility (GEF) for Persistent Organic Pollutant (POPs) and the SAICM Quick Start Programme for enabling activities. However, the existing windows in GEF are limited to specific issues and themes such as land degradation, climate change, international waters and POPs and even though the POPs window covers an important aspect of sound management of chemicals, it does not cover most of the issues outlined in SAICM.

The largest available funds for the sound management of chemicals that developing countries might tap into lie within the development aid from donor countries, regional development banks and national budgets. However, this source is only being used by developing countries and countries with econo-

mies in transition to a limited degree. This is partly explained by the fact that most Poverty Reduction Strategies in developing countries and countries with economies in transition do not acknowledge the connection between sound management of chemicals and sustainable development as stated in the Dubai Declaration of SAICM. In any case, these bilateral and multilateral funding mechanisms would not ensure the long-term sustainable funding of the necessary activities for sound management of chemicals.

Finally, competition between the ministries for the scarce funds available for sound management of chemicals constitutes an institutional barrier for the cooperation between the ministries.

### Lack of coherent legislation and inter-ministerial coordination

Due to its cross-sectoral nature, the responsibility for management of chemicals in most countries is spread over a number of ministries such as those for agriculture, industry, labour, environment and health. Even within one ministry, activities related to chemicals are often the responsibility of different agencies. For developing countries and countries with economies in transition, this has in many cases led to a fragmented approach that leaves some chemicals insufficiently covered by legislation. Furthermore, an uncoordinated approach to chemicals management causes an inefficient use of the limited resources available.

It has been observed within international coordinating mechanisms such as the IOMC and the United Nations EMG that the growing number of international agreements and related capacity building programmes creates a challenge for countries to link and integrate them to national frameworks or programmes for the sound management of chemicals. There is no process in place to manage the multiple conventions' obligations or facilitate inter-ministerial cooperation.

A consolidated and coordinated international approach to assist developing countries in building the necessary infrastructures (legislation, coordination mechanisms, etc.) to deal with increasing number of industrial chemicals in their countries is needed. UNEP has a role in coordinating this new area, in cooperation with different MEAs and other stakeholders.

Many of the agreements contain similar provisions related to core capacity elements such as adequate legislation, information gathering and dissemination. There may, therefore, be opportunities for countries, ministries and other stakeholders to collaborate and ensure coordinated and coherent approaches. Other potential areas for coordinated or synergetic approaches to capacity building include public participation and stakeholder involvement, integrated import control, or technology transfer, to name just a few. A particular challenge for coordination is that several international organizations have regional offices which are actively, and sometimes independently, involved in chemicals management capacity building.

### Lack of institutional, technical and legal capacities for development, implementation and enforcement of legislation

To achieve the WSSD 2020 goal on sound management of chemicals, it is essential to bridge the widening gap in capacities between developed countries and developing countries and countries with economies in transition. This entails the strengthening of institutional, technical and legal capacities for development, implementation and enforcement of measures for sound management of chemicals in these countries through legal actions, economic instruments, voluntary agreements, substitution with less hazardous chemicals, etc., together with the necessary institutional infrastructures and coordinating mechanisms.

The implementation of legislation on chemicals management needs to be supported by institutional capacity in a coherent way. In general, two different types of institutions are needed for successful implementation of the legislation. Firstly, there is a need for the central ministerial institutions responsible for the technical and legal work on government policies on chemicals. This includes the assessment of chemicals, issuing authorizations, running registers on chemicals, participating in international negotiations, and implementing MEAs relevant for chemicals, amongst others. Secondly, there is a need for enforcement institutions dealing with the protection of human health and safety, and the protection of the environment.

Apart from lacking the legal and technical personnel capacities to perform the necessary tasks to achieve the sound management of chemicals, developing countries lack adequate laboratory capacities to carry out the analysis of chemicals in different media, such as soil, water, air, etc. This further limits their capacity to monitor chemicals in the environment and particularly to fulfil their obligations under the Stockholm Convention. At the subregional level, developing countries might consider sharing these burdens in a similar way to how it is done in the SAHEL region in Africa.

Many developing countries and countries with economies in transition have yet to recognize that the main responsibility for providing information for risk assessment and risk management lies with the industries producing and marketing chemicals. The legislative and regulatory system needs strengthen the responsibility of industry for providing this information.

Finally, the lack of institutional capacity and structures for enforcement of the legislation of chemicals, including MEAs, is one of the causes for the illegal trafficking in chemicals, albeit not the only one. The root of this problem is mainly related to the lack of financial resources to develop the institutional capacities for inspection services and customs control.

### Lack of information and awareness of the impacts of chemicals on the environment and health

The negative impacts of chemicals on health and the environment are often insufficiently known—this includes both their extent and their mode. At the same time, these impacts are not emphasized enough in the government priorities of developing countries and countries with economies in transition. Sound management of chemicals competes for scarce resources with other environmental and health issues, such as climate change, sanitation and ecosystem degradation, whose effects are widely recognized. The negative impacts of chemicals are not as visible as other environmental and health effects. Moreo-

ver, the lack of financial resources makes it almost impossible to monitor these negative effects of chemicals, making more difficult the enforcement of existing legislation.

Many people still do not recognize that chemicals management intersects with other important national and international objectives related to sustainable development, including protection of vulnerable groups, protection of water supplies and drinking water and poverty eradication. Decisions and activities taken regarding the sound management of chemicals and hazardous waste should be viewed within these broader issues.

The need to reconcile chemicals and waste management strategies and plans with macro-economic policies and other sectoral policies that drive chemicals production and use has never been so great. However, in many countries chemicals management is unfortunately considered a "luxury" issue which will have to wait until the country has developed further. This is predominantly caused by lack of information and awareness by the political decision-makers on the importance of the sound management of chemicals for sustainable development. A related limitation is the lack of knowledge about cost effective alternatives, best available techniques and best available practices (BAT/BEP), including integrated pest management and integrated vector management approaches to reduce reliance on pesticides. This can be rectified.

The lack of information on the impacts of chemicals is not limited to developing countries. For this reason, a number of OECD countries are working on initiatives to increase the available information on this area. This information will be of relevance for developing countries and countries with economies in transition too. In addition, in response to the request by the WSSD to improve the availability of hazard data on chemicals, the OECD initiated the development of a global portal of information on chemical substances (eChemPortal) in 2004 which provides free access to information on the properties and hazards of chemicals. There is, however, a need to raise awareness about and improve access to this information for developing countries and countries with economies in transition.

## What can we learn from the case studies?

The case studies provide some insights into factors that support the sound management of chemicals and their wastes. While the cases illustrate only a subset of the experience gained through the years, and address only some of the different challenges faced, they convey useful lessons that can be used to improve the sound management of chemicals in general. The lessons derived from the 18 case studies contained in this volume have been grouped as follows:

- *Priority setting at the national level*
- *Stakeholder involvement*
- *Multi-sectoral and integrated programmes*
- *Legislation*
- *International harmonization and cooperation*
- *Information and knowledge*
- *Life cycle analysis*
- *Alternatives*

### Priority setting at the national level

The integration (mainstreaming) of the sound management of chemicals into national development planning processes has been recognized by SAICM as an important element for national resource mobilization for the sound management of chemicals and to address the adverse impacts of chemicals on health and the environment.

The experience illustrated by the case studies stresses that to effectively participate in the development planning processes, the environment and health sectors need to improve their economic analysis. It also shows that officials from environment and health ministries in developing countries need to increase their capacity so as to understand the development planning processes, which can in part be addressed through training in the process and language of development planners and finance ministries.

The lessons learned from the Africa Stockpile Programme stresses that mainstreaming the pest and pesticide management in a country's broader development agenda and ensuring that adequate funding is available helps guarantee the continuity of work started and also helps prevent the recurrence of build-up of unwanted stocks of pesticides.

### Stakeholder involvement

Many international chemicals agreements, such as the Stockholm Convention and SAICM, recognize that the involvement of all stakeholders at the local, national, regional and global levels is key to achieving the objectives of the sound management of chemicals. A transparent and open implementation process as well as public participation in decision-making featuring in particular a strengthened role for women is also crucial.

The Dubai declaration of SAICM recognizes that the private sector has made considerable efforts to promote the sound management of chemicals through voluntary programmes and initiatives such as product stewardship and the chemicals industry's responsible care programme. The declaration further recognizes that non-governmental public health and environmental organizations, trade unions and other civil society organizations have made important contributions to the promotion of chemical safety. Many of the case studies support these assertions and show the advantages of stakeholder involvement.

The experience from Japan shows that participation of stakeholders, especially industry, is critical to national policy development and the adoption of successful programmes for the management of chemicals. This is echoed in the 2010/15 PFOA Stewardship Program in the United States. In Moldova, the involvement of local stakeholders was an important factor in improving the management of POPs. A wide group of local stakeholders, including governments, NGOs and local communities affected by POPs pollution was involved and the consensus reached through the consultation process resulted in a National Action Plan supported by all.

The project to eliminate POPs from Pacific Island countries confirm that attaining political endorsement at the Ministerial level for work at the ground level is crucial. In addition it shows the significance of engaging key contacts and involving local populations in all phases of the project. Furthermore, communication between the project team and the local citizens has to be regular and in a language

and form easily understood by all. Finally, the experience shows the importance of training before implementing key activities to make sure all stakeholders are effectively engaged.

The case study on illegal traffic of DDT in Tajikistan exemplified the creation of successful partnerships of government authorities, representatives from ministries, businesses, the scientific community, NGOs, the general public and others. In the same way, the success of the Africa Stockpile Programme is the result of cooperation among from government, NGO and industry stakeholders.

The case study in Ghana shows that NGOs and community-based organizations can make significant contributions to programme implementation and reporting because they have the trust of the community. Similarly, in Cameroon, the use of NGOs in service delivery has enabled municipal authorities to engage communities that are out of reach through the formal sector, achieving environmental objectives and contributing to employment. The impact of NGOs can be increased through greater government recognition of their potential contribution, improved access to technical, financial, training and policy support and strengthened coordination, collaboration and communication between researchers, academia and policy makers.

The Responsible Care Global Charter and the Global Product Strategy developed by the International Council of Chemicals Associations (ICCA) are examples of private sector driven contributions to fulfil the goal of WSSD and SAICM. Lessons learned from the implementation of these programmes are that there developing countries lack the capacity to effectively manage chemicals and that there is a need to promote transparent, science-based and cost effective regulatory regimes around the world. This has led ICCA to develop a set of principles for chemicals management systems based on a combination of regulation and industry-led initiatives.

### Multi-sectoral and integrated programmes

SAICM stresses the need for a multi-sectoral approach to ensure sound management of chemicals. The Global Plan of Action in SAICM recommends the implementation of integrated national programmes in a flexible manner. The case studies illustrate such flexibility.

The experience from Mexico shows that effective and coordinated efforts that include active participation from all sectors are needed when deciding to phase out a chemical. Not only did this initiative propose a coordinated programme to reduce the adverse effects of chemicals and their wastes, this successful partnership improved the collaboration between government and industry on other chemicals management issues.

The PCB management and disposal demonstration project in China shows a successful integrated programme that includes the development of regulation, strengthening of technical capacity, increased awareness and clean-up activities that can be used as a model for other provinces in the country.

### Legislation

The experience from Japan indicates that hazard-based regulation can be a starting point for more comprehensive chemicals management. As well, the case study from the United States shows how regulations can complement voluntary measures. The experience from Peru highlights that it is not

enough to have legal controls in place, but that an enforcement programme to ensure standards are being met is also needed.

### International harmonization and cooperation

SAICMs objective on Knowledge and Information underlines the need to make the existing risk reduction and other tools for the sound management of chemicals from various participating organizations of the IOMC more widely available so that they can be considered and used in all countries. Several of the case studies highlight the benefits of such exchange.

The experience of Japan indicates that international harmonization is an important element of policy development. It also highlights that participation in international hazard and risk assessment programmes and recommendations from the international community can contribute to effective and efficient chemicals management at the national and international levels.

The case study of lindane in Mexico shows the benefits that can be gained from collaboration with other countries to improve national level programmes. It also shows that national initiatives can contribute to regional and global efforts to improve the management of chemicals.

### Information and knowledge

Access to sufficient knowledge and information to adequately evaluate and manage chemicals throughout their life cycle has long been recognized by international chemicals agreements as the cornerstone of sound chemicals management. However, technical information, the results of hazard and risk assessments, socio-economic methodologies and the tools to develop and apply science-based standards are not available to all stakeholders. Several of the case studies highlight the importance of access to information to help guide decision-making and the implementation of programmes.

The Dubai Declaration of SAICM states that it is the responsibility of industry to make data and information on the health and environmental effects of chemicals needed to use chemicals and the products made from them safely available to stakeholders.

The case of lindane in Mexico is an example of a successful initiative which demonstrates that synergies can result from the close cooperation among government agencies such as information exchange, communication and public participation. The Africa Stockpiles Programme shows that good information is crucial when planning programmes. In this case, the lapse in time between initial inventory taking and disposal operations as well as incomplete identification of stocks resulted in a significantly larger implementation cost than initially estimated.

The Chemicals Information Exchange Network (CIEN) illustrates the profound 'digital divide' that exists between developed countries and countries on the path to development. However it shows that, given the opportunity, those who would use, gather and share this information are eager, dedicated and enthusiastic to do so. CIEN training sessions are universally judged to be an eye-opening experience to participants and to be inspiring in revealing the wealth of accessible information which countries need and simply have not yet discovered.

CIEN training also shows that on-going support is needed to fully make use of the available information so that it can be used effectively for decision-making and to institutionalize exchange of information at the national level. As the experience of developed countries has shown, sound management of chemicals is a long-term goal and requires sustained efforts. CIEN-ESTIS as a dedicated communications tool is a solid first step which contributes to achieving this chemicals management capacity.

### Life cycle approach

The life cycle approach is an important element in achieving the objective of SAICM. The case study on Crop Protection Stewardship is an example of a life cycle approach that follows a chemical from the research stage, transport and distribution, use and finally to the disposal of obsolete stocks. The case study underlines that the role of industry, government and other stakeholders is of a dynamic nature and changes throughout the life cycle of a chemical.

In the example on polybrominated flame retardants in Switzerland, information on the contribution of various stages of the life cycle to environmental releases helped the development of the most effective measures to reduce them. However, the analysis stressed that globalization of markets made it extremely difficult to trace the flow of substances in products from production, to consumption and disposal. This case study also points to the need for an international effort to improve the availability of data through better recording, reporting and monitoring of substance flows.

### Alternatives

The Global Plan of Action of SAICM identifies the need for alternatives to toxic chemicals and underlines that better agricultural methods should be promoted.

This compilation includes two agricultural examples that deal specifically with alternatives. The case studies from India and Ghana show that small holders can increase their income when they adopt agricultural practices such as integrated pest management (IPM) or "non-pesticidal management" that reduce the need for pesticides. However, to move these initiatives beyond demonstration projects, agricultural extension efforts that provide farmers with the skills to effectively deal with pests using alternative methods have to be deployed more widely and consistently.[17] If access to markets for organic and pesticide free produce and products were better developed, and production standards and certification strengthened, farmers could benefit from the price advantage for these commodities. This would then facilitate wider adoption of such practices.

## Summary of main challenges and strategies to achieve sound management of chemicals throughout life cycle

This section offers an overview of the main challenges that are experienced by countries and the management tools available to promote sound management of chemicals throughout their life cycle. Table III.1 illustrates, either directly or indirectly, the different case studies presented in the document and as

17 Examples of efforts to extend IPM more widely can be found at http://www.fao.org/agriculture/crops/core-themes/theme/pests/ipm/en/ and http://communityipm.org/.

such could be useful to countries in their efforts to achieve sound chemicals management by 2020. In an attempt to facilitate the readers' understanding, the life cycle approach presented here is simplified and does not exhaustively identify all challenges and strategies nor reflect possible interrelations and overlaps between different steps of life cycle.

**Table III.1: Main issues and possible management strategies to achieve sound management of chemicals throughout the life cycle**

| Lifecycle steps | Main challenges | Management strategies | Case studies |
|---|---|---|---|
| **Production (including formulation)** | *- Evaluate hazardous properties of chemicals and risks associated including conditions for safe use* | *- International harmonization on classification and labelling of hazards and testing methods (OECD test guidelines and good laboratories practices; GHS)*<br>*- Pre-evaluation and registration system to assess risks of chemicals before allowing them on market (e.g. REACH in EU, OECD High Production Volume Programme)* | *1, 3, 17 and 18* |
| | *- Control quality of production and formulations, in particular enforce ban in production of certain prohibited substances* | *- Product stewardship, especially from mother companies to formulators; and strong involvement of industry (voluntary approach)*<br>*- Phase in safer alternatives* | |
| | *- Control generation of polluting waste and releases into the environment* | *- Establish license system for polluting industries, establish monitoring of releases and request phasing in cleaner production standards, such as use of best available techniques and best environmental practices*<br>*- Chemicals Leasing*[1] | |
| | *- Control exposure of workers in chemical production industry* | *- Establish national inspection systems and implementation of adequate occupational health and safety standards, such as risk communication programmes within companies on safety use/handling* | |

| Lifecycle steps | | Main challenges | Management strategies | Case studies |
|---|---|---|---|---|
| Use | **Distribution** | *- Monitor chemicals available in market*<br>*- Ensure safe transportation of chemicals*<br>*- Improve knowledge transfer to distribution chain (retailers)*<br>*- Disseminate relevant information to end-users* | *- Develop authorization mechanisms and registers of chemicals to be sold in markets*<br>*- Strengthen customs control to identify prohibited substances and products that contain them*<br>*- Enhance emergency prevention, preparedness and response*<br>*- Increase awareness on potential hazards and exposure of chemicals and implementing sound labelling of chemicals such as GHS* | *1, 3, 6, 7, 12, 14, 17 and 18* |
| | **Manufacture of consumer products** | *- Control toxicity of consumer products/articles containing chemicals* | *- Establish inspection systems (and/or voluntary programmes) and implement adequate standards of chemicals content in products/articles* | *3, 17 and 18* |
| | | *- Control polluting releases during manufacturing process* | *- Establish licensing system for polluting industries, establish monitoring of releases into the environment and phase in cleaner production standards, such as use of best available techniques and best environmental practices* | |
| | | *- Control exposure of workers to chemicals* | *- Establish national inspection systems and implementation of adequate occupational health and safety standards in companies, such as risk communication programmes on safety use/handling* | |
| | **Consumers use** | *- Control appropriate use of chemicals* | *- Increase awareness on potential hazards and exposure to chemicals and appropriate use through promotion of safe practices and sound labelling of products in local languages*<br>*- Enhance emergency prevention, preparedness and response that includes diagnosis and treatment of intoxication*<br>*- Manage left-over and packaging* | *13, 17 and 18* |

| Lifecycle steps | | Main challenges | Management strategies | Case studies |
|---|---|---|---|---|
| End-of-life | **Recycle** | - *Low awareness of possible negative effects of recycling practices of products containing hazardous substances*<br>- *Control informal recycling practices* | - *Inventory of recycling practices*<br>- *Legal and regulatory measures to prohibit and strictly control recycling operations (e.g. licensing system)*<br>- *Establish recycling facilities and promote a market for recycled items*<br>- *Raise awareness among the public of the benefits of minimizing and recycling wastes* | *15* |
| | **Disposal** | - *Incomplete data on toxicity and quantity of hazardous wastes*<br>- *Insufficient waste management infrastructures and facilities, in particular for hazardous wastes*<br>- *Lack of awareness of possible negative effects of improper disposal practices* | - *Establish national systems to make an inventory of hazardous wastes and their toxicity*<br>- *Establish licensing systems with standards on collection, packaging, labelling, transportation and storage of hazardous wastes at the national level*<br>- *Set up environmentally sound and sustainable hazardous waste disposal facilities*<br>- *Establish national monitoring systems of contaminated sites*<br>- *Raise awareness among the public of positive effects of sound disposal of hazardous wastes*<br>- *Set up arrangements for hazardous wastes transfer to countries with adequate disposal technologies*<br>- *Promote product stewardship through lifecycle (cradle to grave) approaches.* | *5, 8, 9, 10, 11 and 18* |

In addition to the corrective strategies described in the matrix, there are a number of key strategies and/or activities that encompass all steps of the life cycle of chemicals. These include:

- *Sound planning and coordination, when decision-making at the national level is based on inter-ministerial and inter-sectoral processes and takes into account economic benefits of implementing sound management of chemicals (e.g. mainstreaming).*
- *Information collection through continuous monitoring of chemicals contamination in human beings and the environment.*
- *Mechanisms for effective enforcement.*