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Chemicals and Development

Health and Economic Benefits of Sound Chemicals Management

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Table of Contents

Executive Summary

This report explores the social, economic, environmental and health benefits that can be achieved through sound management of chemicals. Part I introduces key concepts in sound chemicals management, and Part II looks in detail at efforts to improve chemicals management in selected countries. Part III suggests directions for future research. We pay particular attention to the relationship between legislative and enforcement initiatives, on the one hand, and programs to help industry identify cost-saving opportunities for pollution prevention, on the other.

Part I: Conceptual Framework

Benefits of Sound Chemicals Management

Projects to improve chemicals management yield health, environmental and economic benefits. In addition, these projects can produce indirect social benefits.

Health and environmental benefits

Toxic chemicals are a significant and growing threat to health in developing countries. Resulting in part from toxic exposures, chronic diseases are emerging as an increasingly important source of illness. Important sources of toxic chemical exposures include toxic metals, pesticides used in agriculture, obsolete pesticide stocks, hazardous waste including electronic waste, and industrial chemicals. Projects to address these sources of exposure can translate directly into preserving the health of workers and communities.

Economic benefits

Improvements in health and environmental conditions also yield economic benefits. Improving chemicals management reduces health care costs, allows workers to be more productive, and allows children to learn and develop to their fullest capacity.

In addition, projects to improve chemicals management can produce direct financial benefits for firms. Numerous case studies have documented the experience of facilities that reduced their use of water, energy, or toxic chemicals, while achieving substantial financial savings.

At the country level, poor management of chemicals is an impediment to growth and development. Sound management of chemicals is necessary to gain public trust and support for industrial development in developing

countries. Poor chemicals management may also hinder access to international markets for the export of food and other goods.

Projects designed to reduce use of harmful chemicals can also spark the development of new markets in safer alternative products or inputs. In one example, an initiative to eliminate use of chlorofluorocarbons (CFCs) at a Brazilian firm led to the development of a new, locally based market in renewable alternative inputs.

Indirect benefits

Finally, projects to improve chemicals management can yield indirect social benefits. For example, a project in Vietnam reduced the use of toxic chemicals in agriculture, while simultaneously addressing gender issues. Similarly, a cleaner production project in China was designed explicitly to include a component focusing on the gender dimensions of occupational health and safety management.

Components of Sound Chemicals Management

Legislation and Administrative Capacity

The legislative and administrative environment is a key factor helping to determine the success of efforts to promote sound chemicals management in individual industry sectors. Principles for effective chemicals management include establishing broad principles in framework legislation, which are then elaborated in detailed secondary legislation; making use of existing data on chemical hazards; and applying rules horizontally across sectors of the economy.

Integrated Pollution Prevention and Control

A key concept in environmental policy making is Integrated Pollution Prevention and Control (IPPC). Key components of IPPC include requiring industries to use Best Available Techniques (BAT) as determined by permit-licensing authorities; and use of Environmental Management Systems (EMS) to structure an organization's environmental affairs.

Financing Pollution Prevention and Control

Lack of access to adequate financing can hinder widespread adoption of cleaner production and pollution control measures. Problems include lack of experience among firms in preparing creditworthy applications, and poorly developed local financial and capital markets. Promising areas for future work include creating incentives for cleaner production by requiring a cleaner production audit as a prerequisite for investment in development projects. Governments can also tailor fiscal policies to support cleaner production initiatives.

Mobilizing the Supply Chain

Private companies operating internationally can invest in "greening the supply chain," by introducing environmental performance requirements for their suppliers. We look at the example of Hennes and Mauritz (H&M), a Swedish clothing company that has explicitly included sound chemicals management in its broader corporate social responsibility agenda. Among other activities, H&M has developed a pilot program to encourage safer production processes in its supplier companies in developing countries. Programs of this kind are most likely to succeed when regulatory structures are in place to support their goals.

Part II: Cleaner Production in Practice

Country Case Studies

Our case studies of country-specific projects examine the interactions between legislative initiatives to improve chemicals management and on-the-ground projects to educate firms about cleaner production options.

South Africa has undertaken a range of projects to promote cleaner production. This case study shows how small, early demonstration projects in key industries can raise awareness of the possibilities for cleaner production, and can lay the groundwork for more ambitious national strategies and legislation.

In *Tanzania*, work toward sound chemicals management has occurred in two areas: adoption of new legislation on chemicals, and industry-specific cleaner production projects. Barriers to the widespread adoption of cleaner production practices in Tanzania include a lack of investment capital for cleaner production projects. There may be untapped opportunities for cleaner production in agriculture, agro-processing, and other sectors.

We look at *China's* initiative to establish cleaner production as a central component of the country's environmental policies. Interesting cases include an instance of an enterprise that was able to expand production thanks to the financial savings from its cleaner production project; and successful combination of a cleaner production program with an effort to improve the situation of women in industry. We look in detail at the role of bilateral assistance from two countries, Norway and Canada, in the development of China's cleaner production program.

Integrated pest management (IPM) programs in *Thailand* and *Vietnam* have helped to improve the health of farmers, while also helping to create new markets in safer produce.

Incineration of medical waste can release significant quantities of pollutants such as mercury and dioxins. Efforts to address this problem in *India* have created opportunities to bring regulators, industry, and environment and health advocates into collaborative relationships. New legislation has been developed in tandem with the introduction of cleaner technologies.

In *Ukraine, Belarus***,** and *Russia*, a tri-country program has worked to reduce pollution of the Dnipro river. In this project, the Canadian International Development Agency (CIDA) provided aid to three countries to work simultaneously on a transnational environmental problem. The program led to significant improvements in these countries' administrative capacity for environmental management.

Role of Bilateral Aid

Several bilateral and multilateral aid agencies have been working for a number of years to support efforts at sound chemicals management in recipient countries.

- Bilateral aid programs create opportunities for donor countries to support the development of new *legislation* on chemicals. Cooperation of this kind can help recipient countries to avoid repeating mistakes that have been made in the past in donor countries.
- Many bilateral aid programs have helped to fund the development of *cleaner production programs*. Aid in this area can take several possible forms: helping to support broad programs such as UN-sponsored Cleaner Production Centres; supporting national initiatives for cleaner production; and helping to finance cleaner production initiatives at individual facilities.
- Finally, some aid agencies provide funding for *research* programs that further the goals of sound chemicals management. Areas for research can include support for tracking of health-environment interactions, as well as research on industry-specific techniques for reducing or eliminating use of toxic chemicals.

Some opportunities may be missed due to lack of awareness among recipient countries that aid is available for improved chemicals management. It is important that bilateral aid agencies communicate effectively with recipient countries about the possibilities for addressing chemical exposures.

Directions for Future Research

Suggested areas for future research include examining the effects of international trade and investment agreements on the development of chemicals management systems within individual countries, and improving systems for tracking environmental health indicators in developing countries.

List of Abbreviations

AusAID	Australian Government Overseas Aid Agency
BAT	Best Available Technique
CEPITA	Cleaner Environmental Production in Industry in Tanzania
CIDA	Canadian International Development Agency
CFCs	Chlorofluorocarbons
CNCPC	China National Cleaner Production Centre
CP	Cleaner Production
DANIDA	Danish International Development Agency
DCE	Development Cooperation in the Environment Programme
DEAT	South African Department of Environment and Tourism
DNV	Det Norske Veritas
DTI	Department of Trade and Industry
EAC	East African Cooperation
ECZ	Environmental Council of Zambia
EMDU	Environmental Management Development in Ukraine
EMS	Environmental Management Systems
EPB	Environmental Protection Bureau
EPER	European Pollutant Emission Register
EP3	Environmental Pollution Prevention Project
EU	European Union
FAO	Food and Agriculture Organization
FFS	Farmer Field Schools
GEF	Global Environment Facility
GHS	Globally Harmonized System of Classification and Labeling of Chemicals
GIS	Geographic Information Systems
HACCP	Hazard Analysis and Critical Control Point
HELI	Health and Environment Linkages Initiative
H&M	Hennes and Mauritz
IDRC	International Development Research Council
ICPIC	International Cleaner Production Information Clearinghouse
ILO	International Labour Organization
INEM	International Network for Environmental Management
IPM	Integrated Pest Management
IPPC	Integrated Pollution Prevention and Control
KemI	Swedish Chemicals Inspectorate
LVFA	Lake Victoria Fish Processors' Association
MOAC	Thai Ministry of Agriculture and Cooperatives
NAFTA	North American Free Trade Agreement
NCPC	National Cleaner Production Centre

NGO	Non-governmental organization
NILU	Norwegian Institute for Air Research
NORAD	Norwegian Agency for Development Cooperation
OECD	Organization for Economic Co-operation and Development
POPs	Persistent Organic Pollutants
PRG	Pollution Research Group
PVC	Polyvinyl chloride
REACH	Registration, Evaluation and Authorisation of Chemicals
SAICM	Strategic Approach to International Chemicals Management
SEMS	Supplier Environmental Motivation Strategy
SEPA	State Environmental Protection Agency (China)
Sida	Swedish International Development Agency
SFT	Norwegian Pollution Control Authority
SME	Small or Medium Sized Enterprise
SPS	Sanitary and Phytosanitary
TI	Norwegian Institute of Technology
TOT	Training of Trainers
TVEs	Township and Village Enterprises
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
US-AEP	United States – Asia Environmental Partnership
VWU	Vietnam Women's Union
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization

Introduction

The production and sale of chemicals accounts for a large and growing proportion of trade world wide. Developing countries play an increasingly important role, both as producers and as users of chemicals. Chemicals cross national boundaries both through trade relationships and by moving through the environment; thus, global coordination is necessary to solve problems of chemical exposure. Binding agreements that have grown out of international collaboration and negotiation on chemicals include the Montreal Protocol on Substances that Deplete the Ozone Layer, the Stockholm Convention on Persistent Organic Pollutants, the Basel Convention on Hazardous Wastes, and the Rotterdam Convention on Prior Informed Consent.

At the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, the global community renewed its commitment to sound management of chemicals, and adopted a goal of minimizing adverse effects of chemicals on human health and the environment by 2020. This agenda includes a commitment by industrialized countries to provide technical and financial assistance to support developing countries' efforts to achieve sound management of chemicals.[1] A number of specific agenda points were agreed upon in the services of these goals. These include promoting the ratification and implementation of international agreements on chemicals and hazardous waste; prompt implementation of a globally harmonized system for classification and labeling of chemicals; and working to reduce risks from heavy metals, among other goals.

The Strategic Approach to International Chemicals Management (SAICM) is an on-going process in which countries are working to achieve the goals defined at WSSD. Among other functions, the SAICM process provides a way for countries to work together to improve implementation of existing treaties and protocols.

The goals of international cooperation on chemicals include transferring proven structures and capacities for effective chemicals management to developing countries. The aim is to implement the best possible technologies and management systems, and to allow developing countries to avoid mistakes other countries have made during industrialization. Areas for information transfer include systems for classifying chemicals; information on the hazards of specific chemicals; and knowledge about safer alternatives to toxic chemicals, where these alternatives have been identified.

[1] Johannesburg Plan of Implementation, http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POIChapter3.htm .

In this report, we consider the ways in which sound chemicals management can form part of a broader economic development agenda. Ee look at the ways in which sound chemicals management produces tangible health and economic benefits. We also discuss the role of legislative initiatives in creating the conditions for successful pursuit of sound chemicals management.

We include several detailed case studies that examine the interplay between initiatives to develop or improve legislation on chemicals, on the one hand, and on-the-ground efforts to promote cleaner production, on the other. Our case studies include programs to address hazards from pesticide exposure in Thailand and Vietnam; the experience of South Africa in a range of programs to promote cleaner production; the effort to achieve safer management of medical waste in India; cleaner production legislation and demonstration projects in China; chemicals legislation and cleaner production efforts in Tanzania; and a program to build capacity for pollution control and cleaner production in transition economies of Eastern Europe.

PART I – Conceptual Framework

1. Benefits of Sound Chemicals Management

Sound chemicals management can contribute directly to improved health and environmental quality. These health and environmental benefits translate into economic benefits, for example by decreasing health care costs and making it possible for children to learn effectively and adults to work productively.

In addition, projects to improve chemicals management can yield other economic benefits. Cleaner production, for example, often produces financial benefits at the facility level. Innovative financing programs for cleaner production can also help to jump-start industrial development projects more generally. Furthermore, reducing use of toxic chemicals can spark the development of new markets in safer alternatives, and can open up new opportunities for trade in international markets. Projects to improve chemicals management can also generate indirect social benefits, such as improved gender relations.

1.1 Health and Environmental Benefits

1.1.1 Chemical exposures and human health

Threats to human health posed by environmental conditions can be categorized as "traditional" or "modern" hazards.[2] Traditional hazards are those associated with lack of economic development, such as exposure to pathogens in drinking water, lack of basic sanitation, and indoor air pollution from fuels used for cooking and heating. Modern hazards include industrial pollution, exposure to chemicals used in agriculture, climate change, and stratospheric ozone depletion. In some countries, traditional hazards have largely given way to modern hazards. In others, the traditional hazards have persisted even while the modern hazards associated with industrial development have taken hold.

According to World Health Organization estimates, environmental hazards broadly defined are responsible for about a quarter of the total burden of disease worldwide.[3] We do not know what percentage of these problems can be attributed to chemical exposures. However, estimates are available

[2] Carlos F. Corvalán et al., "Health, Environment and Sustainable Development: Identifying Links and Indicators to Promote Action," *Epidemiology* 10:5 (September 1999), 656–660.

[3] World Health Organization, "Health and Environment in Sustainable Development: Five Years after the Earth Summit" (Geneva: World Health Organization, June 1997).

in some subcategories, such as occupational exposures. According to International Labour Organization (ILO) estimates, exposure to hazardous substances is responsible for nearly a quarter of all work-related illnesses and fatalities in the world (some 160 million cases of work-related diseases, and more than 400,000 workplace fatalities per year).[4] To achieve a complete tally of illnesses and disabilities resulting from chemical exposures it would be necessary to go beyond occupational exposures and to consider illnesses in the non-working population, including infants and children.

In 2002, a World Bank report reviewed the existing scientific literature on the relationship between poverty and exposure to toxics in developing countries. The report concludes that toxics are a significant and growing threat to health among the poor in developing countries. In rural areas, toxic exposures in agriculture are a major concern. The growth of urban poor populations and of informal economies presents additional hazards. Resulting in part from toxic exposures, chronic diseases are emerging as an increasingly important source of illness in developing countries. According to World Health Organization estimates, the burden of chronic disease in developing countries is expected to exceed the burden from infectious disease by 2020.[5]

Children are particularly vulnerable to toxic exposures, both because they drink more water, eat more food, and breathe more air than adults per unit of body weight, and because their organ systems are developing rapidly. A toxic exposure experienced by a fetus, infant or child during a developmental "window of vulnerability" can produce permanent damage and lifelong disability.[6] Children's participation in the work force increases their risk of exposure to toxic chemicals. Participating in the informal labor sector, or engaging in scavenging activities, also exposes children to risks from toxic chemical exposures. The ILO estimates that of about 250 million working children between the ages of five and fourteen in poor countries, nearly two thirds have been exposed to hazardous work conditions of some kind.[7]

Toxic metals, especially lead and mercury, have particularly devastating effects in infants and children. In China and Mexico, where lead exposure has been studied in some depth, very high levels of lead exposure have been recorded among children. The conditions that produce these exposures are found throughout the developing world. Lead exposure can result from past or present use of leaded gasoline, battery manufacturing

[4] United Nations Development Programme, "Managing Chemicals, Sustaining Livelihoods: UNDP and Management of Persistent Organic Pollutants, Ozone-Depleting Substances and Other Chemicals," 2005.

[5] Lynn Goldman and Nga Tran, Toxics and Poverty: The Impact of Toxic Substances on the Poor in Developing Countries (World Bank, August 2002).

[6] Ted Schettler et al., *In Harm's Way: Toxic Threats to Child Development* (Boston, MA: Greater Boston Physicians for Social Responsibility, 2000); Ted Schettler et al., *Generations at Risk: Reproductive Health and the Environment* (Cambridge, MA: MIT Press, 1999).

[7] Goldman and Tran 2002.

and recycling, operation of lead smelters, and other activities. Mercury exposure results from a range of activities including operation of mercury processing plants, small-scale (artisanal) gold mining, and other activities. Small-scale mining creates particular health risks for 13 million miners worldwide, including many women and children. [8]

Pesticides represent a significant part of the chemical load in the environment of developing countries. Pesticide poisonings of workers are common, and virtually all deaths from pesticide poisonings occur in the developing world.[9]

Other important sources of toxic exposures include obsolete pesticide stocks; exposure to persistent organic pollutants (including both pesticides and other industrial chemicals); and increasing production and use of chemicals in industry. Chemical production in developing countries has increased steadily over the past several decades, and has often involved the most hazardous chemicals. To name one example, the production of benzidine and benzidine dye has been phased out gradually in developed countries after studies in the 1970s confirmed that benzidine caused occupational cancers; yet over the same period, production increased in developing countries.[10]

Annual worldwide production of hazardous waste, from sources including chemical manufacturing, energy production, pulp and paper factories, mining, and leather and tanning processes, passed 400 million tons a decade ago. Although developing countries produce less than a quarter of the total, waste management is a significant problem in poorer countries. A study in Mexico found that almost 90% of hazardous waste is managed with inadequate control. Developing countries also receive hazardous wastes from wealthier countries, through both legal and illegal routes.[11]

Electronic waste is a rapidly growing problem. Recycling of e-waste creates health risks due to the many hazardous materials involved—lead and cadmium, mercury, polychlorinated biphenyls, brominated flame retardants, PVC, chromium, barium, beryllium, and carbon—and the lack of protection for workers.[12]

As we have seen in this discussion, environmental exposures and damage to environmental resources are a significant drain on developing country economies. Sound chemicals management can contribute directly to improved health and environmental quality, both at the community level and from an occupational health perspective.

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[8] Leticia Yáñez et al., "Overview of Human Health and Chemical Mixtures: Problems Facing Developing Countries," *Environmental Health Perspectives* Vol. 110, Suppl. 6 (December 2002), 901–909; also see Goldman and Tran 2002.

[9] Yáñez et al. 2002.

[10] Goldman and Tran 2002.

[11] Yáñez et al. 2002.

[12] Yáñez et al. 2002.

1.1.2 Documenting health and environmental benefits

Although health and environmental benefits are the central motivator of most or all programs to improve chemicals management, many projects do not include tracking of health and environmental indicators. Many cleaner production projects track financial indicators only, because health and environmental benefits are assumed to be present. For example, a consultant responsible for USAID-sponsored cleaner production projects in South America noted that none of the USAID projects included tracking of health or environmental indicators.[13] In contrast, the projects did include detailed tracking of financial and safety at demonstration facilities. Thus, it can be difficult to obtain information about specific health or environmental outcomes of an individual project.

Some projects do include a component of tracking health indicators. One example is the case of an IPM project in Thailand in which farmers learned to carry out health surveys themselves, as we discuss below.

For some chemicals, the health and environmental benefits of improved chemicals management are relatively well documented. For example, scientists have established clear relationships between use of leaded gasoline, blood lead levels in children, and effects on intelligence and other measures of normal neurological development. It may be more difficult to document relationships between exposure and health outcomes with newer chemicals, whose health effects may be less completely characterized. In these instances, it is particularly important to apply the precautionary principle to avoid the possibility of irreversible harm.

1.2 Economic benefits

In this section, we look at the economic benefits that can be achieved through sound chemicals management. First, we review the economic justifications for application of the precautionary principle. Second, we take a brief look at the financial benefits that can be gained through cleaner production projects. Third, we note that despite these financial benefits, financing mechanisms and a strong regulatory framework are often necessary to motivate firms to undertake cleaner production.

1.2.1 The economic basis for precaution

The costs of inaction on health and environmental threats are well documented. A 2001 study by the European Environment Agency, *Late Lessons from Early Warnings: the Precautionary Principle 1896–2000,* looked at the health and economic costs of repeated failures to act in a timely fashion on early warnings of environmental hazards. The report focuses primarily on the experience of industrialized countries, and makes the case that ear-

[13] Miguel Franco, PA Consulting, personal communication.

lier action on a range of environmental hazards could have saved tens of thousands of lives as well as significant sums of money. The chapter on asbestos, for example, cites an estimate of the costs of late action on asbestos in just one country. Had asbestos been banned in 1965, rather than in 1993, an estimated 34,000 deaths from asbestos exposure would have been prevented in Holland alone, and billions of dollars would have been saved in building and compensation costs.[14] As this example makes clear, prompt action to address environmental threats to human health can yield large benefits.

1.2.2 Applying precaution is an opportunity for developing countries

A 2004 report by the World Health Organization (WHO) proposes a framework for a global approach to public health based on the precautionary principle. The WHO document notes that the precautionary principle is a particularly important guideline for economies in transition, where decision makers may face difficult combinations of environmental, health, and economic challenges. Those countries may be contending with pollution from past industrial activities, economic difficulties, "poor or even deteriorating public health and the demands of rapid political, social, and economic change." Under these conditions, the precautionary principle can help to "ensure that mistakes made in the past in industrialized countries are not repeated." Shifting the burden of studying chemical hazards to industry may be particularly important when government capacities are overstretched.[15]

1.2.3 Financial benefits of cleaner production

The case for pollution prevention as a source of financial benefits for individual firms has been documented in detail over the past two decades. A seminal work on the topic was the 1979 publication *Pollution Prevention Pays.* This study documented the advantages that companies can gain by preventing pollution. These range from cost-cutting options to reduction of conflict with surrounding communities.[16] In another early study of the topic, the environmental organization INFORM published a detailed account of how twenty-nine organic chemical companies in the US were reducing hazardous wastes. [17] The report identified five types of opportunities for waste reduction: process changes, operational changes, equipment changes, chemical substitutions and product reformulations. The authors

[14] European Environment Agency, *Late Lessons from Early Warnings: the Precautionary Principle 1896–2000* (Luxembourg: Office for Official Publications of the European Communities, 2001), p. 58.

[15] Marco Martuzzi and Joel A. Tickner, The Precautionary Principle: Protecting Public Health, the Environment, and the Future of our Children (Copenhagen: WHO, 2004).

[16] Michael G. Royston, *Pollution Prevention Pays* (Oxford : Pergamon Press, 1979).

[17] David J. Sarokin et al., Cutting Chemical Wastes: What 29 Organic Chemical Plants are Doing to Reduce Hazardous Wastes (New York: INFORM, Inc., 1985).

found that "simple changes in the ways materials are handled can achieve large reductions in waste generation."

In developing countries, there are many documented cases of facilities that made a small investment in production changes to reduce use of water, energy, or toxic chemicals, and achieved savings many times larger than the original investment. This phenomenon is examined in depth in a recent report produced by the Swedish Chemicals Inspectorate (KemI), "Building a Healthy Economy: Chemicals Risk Management as a Driver of Development." The report examined a series of case studies documenting the financial advantages achieved by small and medium-sized enterprises through adoption of cleaner production (or pollution prevention) techniques. Financial benefits result in large part from reduced use of raw materials. In some countries, there are also financial benefits associated with reduced costs for hazardous waste treatment, reduced fees for water consumption, elimination of punitive fines for illegal discharges, and other costs that are mediated through government regulation.[18]

The country case studies in chapter three of this report provide further examples. The Cleaner Production in China project produced a wide range of case studies showing financial benefits at the facility level; the DANIDA projects in South Africa also demonstrate these benefits in detail.

These and other examples show that financial benefits are an incentive for companies to carry out cleaner production. Frequently financial benefits may be reinvested in additional cleaner production efforts, creating a positive feedback loop. Cleaner production methods can also free up working capital to support plant expansions and new employment opportunities.

Projects designed to reduce use of harmful chemicals can also spark the development of new markets in safer alternative products or inputs. In one example, an initiative to eliminate use of chlorofluorocarbons (CFCs) led to the development of a new, locally based market in renewable alternative inputs. With support from the Montreal Protocol Unit of UNDP, a Brazilian company developed a system for replacing CFCs with castor oil in production of polyurethane chemicals. This initiative not only reduced CFC use, but also established local ongoing demand for mamona seeds, the source of castor oil. The resulting scale-up of local mamona production helped to generate jobs for 4500 farm families in the region. Similarly, other cases have been documented in which locally produced materials were adopted in place of polluting industrial inputs, thus contributing to the development of regional economies and stimulating market potential for small businesses.[19]

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[18] Rachel Massey, Building a Healthy Economy: Chemicals Risk Management as a Driver of Development (Stockholm: Swedish Chemicals Inspectorate, 2005).

[19] United Nations Development Programme, "Managing Chemicals, Sustaining Livelihoods: UNDP and Management of Persistent Organic Pollutants, Ozone-Depleting Substances and Other Chemicals," 2005.

Improvements in chemicals management can also improve a country's situation with regard to international trade. Illustrations of this phenomenon include the creation of new domestic and international marketing opportunities, discussed in our case studies of IPM programs in Thailand and Vietnam. In our discussion of a project to improve environmental standards in South African textiles production, we also see that firms worked to qualify for international eco-labels such as the EU flower, and that this option for certification helped to increase the incentives to adopt cleaner production measures.

Financial Benefits from Cleaner Production: Fuyang Chemical General Works

The Fuyang Chemical General Works plant produces ammonium bicarbonate and urea fertilizers, employing 1300 people and producing 200,000 tons of product with a gross value of US$ 30 million. The plant also generates large amounts of air and water pollution, discharging ammonia and sulfur with its wastewater. As part of a cooperation project funded by the Canadian International Development Agency (CIDA), employees and management at this fertilizer plant implemented a host of good housekeeping measures such as pipe and valve maintenance, recycling of materials, efficient use of raw materials and energy, and careful handling of intermediate and final products; as well as medium-cost solutions for reducing emissions of ammonia and sulfur. CIDA financed an investment of US$ 193,000 for new equipment; this investment increased productivity while cutting costs, and paid for itself in a single year.[20] Using the profits generated from these productivity gains, the Fuyang Fertilizer Company was able to finance the purchase of a second plant in a nearby county. The engineer responsible for the cleaner production implementation at the first plant is now technical director at the new plant. In this way the knowledge and experience gained from the original demonstration project will help guide operations at the new plant.[21]

1.2.4 The need for regulation and financing

In spite of the documented benefits, there can be significant obstacles to adoption of pollution prevention techniques, even when there are significant financial advantages to be gained. Obstacles identified in the KemI report include financing problems, lack of education and information, and lack of regulatory incentives. Although pollution prevention options can often be self-financing, there is a nevertheless a need to identify and put into place practical mechanisms for financing pollution prevention.[22]

Some economists have pointed out that regulation can help businesses to develop more cost-efficient practices. Michael Porter of the Harvard Business School points out that firms do not always make the most effi-

[20] "Fuyang Chemical General Works: a Cleaner Production Success Story," June 1999. Case study available at http://www.chinacp.com/eng/cpcasestudies/casestudy3.html.

[21] Personal communication, Bob Lao, December 29 2005. Cost figures are converted from 1999 RMB to 2005 USD.

[22] Massey 2005.

cient choices in the absence of regulation, and that well-designed environmental and health regulations can turn companies' attention to best practices that would not otherwise be developed.[23] Other literature shows that the costs of environmental regulation usually turn out to be much lower than projected before legislation is passed. Reasons include economies of scale, positive learning curves in compliance, technological innovations, and falling costs of existing technology.[24]

1.2.5 Other relevant literature

WHO and the United Nations Environment Programme (UNEP) have joined forces to develop the Health and Environment Linkages Initiative (HELI).[25] The initiative supports policy makers in actions that address environmental threats to health. Focusing on the health and environmental linkages to economic development, the program has developed and refined assessment tools to support cross-sectoral and collaborative decision-making. HELI has carried out pilot projects using these assessment tools in several countries.

HELI also recently produced an analysis of the factors that shape environment and health policy in developing countries. The analysis concludes that "the primary barriers to more effective policy are neither a lack of evidence nor a lack of knowledge. They are economic, institutional, political and social. Macroeconomic factors such as trade globalization, market liberalization, debt burdens and structural adjustment policies are among the most powerful drivers of national political agendas and, indirectly, environment and health policies."[26]

The United Nations Development Programme (UNDP) is among the agencies that have taken the lead in linking development goals with chemicals management. UNDP fosters international cooperation in this area and provides financing through the Global Environment Facility (GEF), the Multilateral Fund of the Montreal Protocol on Substances that Deplete the Ozone Layer, and other mechanisms. A 2005 report by UNDP uses case studies from Brazil, China, Malawi and Latvia to illustrate the wide-ranging economic and health benefits that can arise from the transfer of newer green technologies to standard chemicals production. Sectors as diverse as foam production, solvents, refrigeration and agriculture were able to document a range of employment and economic benefits in addition to a reduction in the use of dangerous or polluting substances.[27]

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[23] Michael E. Porter and Claas van der Linde, "Toward a New Conception of the Environment-Competitiveness Relationship," *Journal of Economic Perspectives* 9:4 (Fall 1995), 101–04.

[24] Nicholas Ashford, "Compliance Costs: The Neglected Issue of Technological Innovation," in *European Agency for Safety and Health at Work Magazine*, (Fall 1999), 30–33.

[25] Health and Environment Linkages Initiative: http://www.who.int/heli/risks/toxics/chemicals/en/

[26] Health and Environment Linkages Initiative, "Challenges in Decision-Making": http://www.who.int/heli/decisions/en/

[27] United Nations Development Programme, "Managing Chemicals, Sustaining Livelihoods: UNDP and Management of Persistent Organic Pollutants, Ozone-Depleting Substances and Other Chemicals," 2005.

1.3 Indirect benefits

In addition to the health, environmental and economic benefits already discussed, other social benefits can result from projects to improve chemicals management. In one example, in Vietnam, a project developed with support from Australia reduced use of toxic chemicals in agriculture, while simultaneously addressing gender issues. Similarly, a cleaner production project in China was designed explicitly to include a component focusing on the gender dimensions of occupational health and safety management.

Projects to improve chemicals management can also have significant implications for administrative capacity for environmental protection. For example, we discuss a program that addressed pollution of the Dnipro River, leading to significant capacity building, both in development of new environmental legislation, and in improving administrative capacity for environmental regulation. The role of NGOs can also be strengthened through efforts to improve chemicals management.

2. Components of Sound Chemicals Management

In this section, we consider the components of sound chemicals management. We begin by looking at the elements of effective legislation on chemicals. We then present the concept of Integrated Pollution Prevention and Control, a framework of principles to guide chemicals legislation, enforcement, and information management, as well as cleaner production. We present some of the challenges and opportunities associated with financing cleaner production and pollution control initiatives. Finally, we look at the prospects for creating demand for cleaner production through international markets.

Multiple actors are involved in all the activities we discuss. For example, NGOs may engage in program development, public education, and lobbying for improved chemicals management; aid agencies may provide technical assistance to industry; financial institutions may provide loans for cleaner production or pollution control; and government agencies may develop new legislation, and implement and enforce existing laws. Each actor may operate at several levels; for example, NGOs can act both as awareness changing agents and as executing agents.

2.1 Legislation and administrative capacity

Some countries have little or no legislative framework for chemicals regulation; others have extensive legislation, which may or may not be fully implemented and enforced. The absence of a sufficient legal framework or, in some cases, failure to implement existing laws, increases the likelihood of human exposure to toxic chemicals and can even make it difficult to determine what chemicals are in use in a given country.[28]

For those countries that have not yet adopted legislation on chemicals, or that are in the process of updating and revising their chemicals legislation, it is worthwhile to identify the characteristics that the most successful chemicals policies have in common. Initiatives to improve chemicals management need to consider not only legal framework and administrative capacity, but also the obligations that are placed on industry, and the available instruments for enforcement. In this section, we look at important issues that arise in designing chemicals legislation. Key elements include defining obligations of manufacturers, importers, and users of chemicals;

[28] Goldman and Tran 2002.

and defining instruments for communication of safety information (such as labeling and creation of safety data sheets).

Depending on its design, chemicals legislation may either promote or impede adoption of cleaner production methods. For this reason, bilateral and multilateral aid programs working on chemicals have increasingly chosen to integrate their facility- or industry-specific projects with projects to help strengthen chemicals legislation. We discuss this pattern further in country-specific case studies in Chapter 3, and in our discussion of bilateral aid programs, in Chapter 4.

2.1.1 Choosing a better path

Just as cleaner production methodologies can provide an opportunity for developing countries to leapfrog past polluting technologies that have been used in industrialized countries, developing countries also have the opportunity to avoid some of the mistakes of the past as they design their own legislative frameworks on chemicals.

Historically, one of the major problems in both Europe and the US has been the lack of information about chemicals, and the absence of structures for precautionary decision making under conditions of uncertainty. Under the current system, many chemicals are "innocent until proven guilty." Specifically, all chemicals that were on the market in 1981 are exempt from most safety testing requirements. The European Union is engaged in a long-term effort to improve chemicals management by closing a major regulatory loophole that has had a significant influence on regulation of chemicals over a period of decades. Under the new European chemicals regulation, REACH, manufacturers and importers of chemicals will have an eleven-year time frame in which to provide information on the health and environmental effects of the chemicals that they sell. Specific testing requirements will be tiered by volume, with higher-volume chemicals subject to more tests.

REACH will generate substantial new information on the properties and effects of chemicals, thus facilitating risk management in developing countries as well as in Europe. This new information can guide the creation of legislation on occupational exposures, waste management, consumer protection, emergency services, and other areas of government responsibility that require specific information about chemical hazards. The information generated under REACH will be particularly useful in controlling hazards from carcinogenic, mutagenic, and reproductive toxic substances (CMRs), persistent and bioaccumulative (PB) chemicals, and high/medium volume substances. REACH will also work in synergy with the Rotterdam Convention on Prior Informed Consent by increasing the amount of information that exporters will make available to buyers of chemicals.

2.1.2 Guidelines for chemicals legislation

A number of bilateral aid programs are working to help both with legislation and with development of administrative capacity. Some aid programs actually write the legislation for the aid recipient country; others only provide comments. The Swedish Chemicals Inspectorate has developed a set of guidelines on chemicals legislation for the countries with which it engages in institutional cooperation. Key approaches for effective chemicals management include establishing broad principles in framework legislation, which are then spelled out for practical application in detailed secondary legislation; making use of using existing data on chemical hazards; communicating hazard information according to internationally accepted standards; and applying rules horizontally across sectors of the economy. [29]

- *Framework legislation.* Countries should ideally adopt an overarching framework on chemicals, embodying key principles such as the precautionary principle and the substitution principle. Framework legislation should also define clearly the responsibilities of industry and of government authorities. Detailed secondary legislation should introduce internationally accepted systems for information management and communication, promote early action on risk reduction measures, create incentives for cleaner production practices, and support the introduction of safer products, among other measures.
- *Using existing information.* Developing countries can and should make use of existing information on the health and environmental effects of chemicals and take advantage of existing systems for categorizing and tracking chemicals. Industrialized and developing countries alike face the problem that testing and assessing the safety of industrial chemicals is too large a task to be carried out effectively by most government agencies. For this reason, it is important to place responsibility on chemical manufacturers and importers to provide information on the safety profiles of their products. In addition, developing countries should not devote scarce resources to carrying out safety tests on chemicals that have already been studied, and to the greatest extent possible should "piggyback" on existing registration and classification systems. Capacity building in areas such as risk assessment may be desirable for any number of reasons, but need not be a prerequisite for adopting strong regulations on chemicals. The development of a globally harmonized system for the classification of chemicals, currently in progress, should facilitate this process.
- *Horizontal application of rules.* Rule making on chemicals should be applied "horizontally" across sectors of the economy. For example, if a chemical is restricted due to its potential to cause occupational illness, that restriction should apply equally in all sectors, rather than being adjudicated individually by multiple ministries.

[29] Torbjörn Lindh, Swedish Chemicals Inspectorate, personal communication.

The case studies in Part II of this report illustrate a number of points regarding the role of, and challenges for, chemicals legislation in developing countries and economies in transition. We see that legislation can actively impede the goals of cleaner production, as in the India case in which municipal legislation actually required the use of hospital incinerators, a highly polluting technology. In contrast, China has adopted legislation that explicitly promotes cleaner production. The South Africa case illustrates an effort to achieve coherence among different levels of legislation, with an active interchange between programs working to achieve cleaner production "on the ground" on the one hand, and projects to improve the legislative environment to promote cleaner production, on the other.

2.2 Integrated Pollution Prevention and Control

A central concept in environmental policy making is Integrated Pollution Prevention and Control (IPPC). The purpose of IPPC is to achieve a high level of environmental protection through a combination of pollution prevention and pollution control. In Europe, the 1996 IPPC Directive links legislation with cleaner production and other important concepts for management of chemicals.[30] More generally, IPPC provides a set of principles that are relevant for development of chemicals management programs throughout the world. The principles of IPPC are designed to be implemented and enforced by law, especially through industrial permitting systems and compliance monitoring.

Key components of IPPC in Europe include the following:

- Industries are required to use Best Available Techniques (BATs) as determined by permit-licensing authorities within each member state. The European Commission's IPPC Bureau facilitates the exchange of information on BATs among industry experts, member state authorities, research institutes and NGOs.[31] Once defined through this process, BATs are disseminated among member states and serve as guidelines for permit-licensing processes.
- An Environmental Management System (EMS) enables an organization to reduce its environmental impacts and boost efficiency. The EMS methodology focuses on continual improvement over time. In Europe, firms can register through the Eco-Management and Audit Scheme (EMAS) for certification of the validity of their EMS program. Internationally, firms can be certified as complying with the ISO 14001 standards. Both EMAS and ISO 14001 include extensive re-

[30] "The IPPC Directive," http://europa.eu.int/comm/environment/ippc/index.htm.

[31] European Commission Press Release, "Questions and Answers on Implementation of the Integrated Pollution Prevention and Control Directive" (March 11, 2005).

quirements on policy, procedures, auditing, and reporting.[32] In many cases the use of EMS is a legal requirement under the IPPC Directive.

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) is an important tool supporting the implementation of IPPC principles. The GHS creates a uniform standard for the labeling and classifying of chemicals by hazard level.[33] It allows harmonization of communication about chemical hazards, including labels and safety sheets. The GHS also facilitates the harmonization of rules and regulations at the national and international level.

Another component of the IPPC Directive is the implementation of the European Pollutant Emission Register (EPER). As set out by the UN Conference on Environment and Development in Rio de Janeiro in 1992, the establishment of Pollutant Release and Transfer Registers has been advocated by the OECD. Through the IPPC Directive the EPER was established in order to track national environmental information on harmful releases to air, water, land and waste.[34]

The majority of the IPPC principles have been in place within Norway since the early 1990s, with the implementation of the Norway Pollution Control Act. Therefore, it makes sense for Norway, along with the EU member countries, to promote the progressive environmental protection themes of IPPC through its programs in developing countries. This integrated approach to chemicals management can ensure environmental and industrial sustainability in both the EU and the rest of the world.

Regulation of chemicals in industrialized countries, through harmonized framework regulation (IPPC and other instruments), can have beneficial effects in developing countries. By restricting the use of certain chemicals, producers in developing countries can be forced to use less hazardous chemicals in order to have access to the western market. This can lead to improved conditions in and around production sites. In addition, the ability to show that production is environmentally sound will frequently give producers a marketing advantage.

2.2.1 Cleaner Production[35]

Cleaner production (CP), also referred to as pollution prevention, is an approach that emphasizes preventing pollution from the outset, rather than cleaning it up after it has been produced. Agenda 21 identifies cleaner

[32] ISO 14000 Environmental Management Toolkit, http://www.iso14000–iso14001-environmental-management.com/14000.htm.

[33] Globally Harmonized System of Classification and Labelling of Chemicals, http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html.

[34] The European Pollutant Emission Register, http://europa.eu.int/comm/environment/ippc/eper/index.htm

[35] This discussion is adapted from Rachel Massey, "Building a Healthy Economy: Chemicals Risk Management as a Driver of Development," (Swedish Chemicals Inspectorate, 2005).

production as an integral component of sustainable development.[36] Aspects of cleaner production include

> "conserving raw materials, water and energy; eliminating toxic and dangerous raw materials; and reducing the quantity and toxicity of all emissions and wastes at source during the production process. For products, Cleaner Production aims to reduce the environmental, health and safety impacts of products over their entire life cycles, from raw materials extraction, through manufacturing and use, to the ''ultimate' disposal of the product."[37]

Substitution of safer chemicals or processes in place of highly toxic ones can be an important component of cleaner production measures.

Cleaner production is an important complement to other efforts at sound chemicals management, including pollution control. Traditional pollution control may include such activities as installing scrubbers on smokestacks, operating a water purification system to clean dirty effluent as it leaves a facility, or disposing of hazardous wastes in a specially designated landfill or other waste storage or treatment facility. Cleaner production, in contrast, examines the causes of pollution and explores options to change production processes and inputs to eliminate or reduce that pollution.

In addition to its benefits for environmental quality and human health, cleaner production can be an excellent way to cut costs, because it often increases efficiency and reduces the total volume of inputs required. Cleaner production audits often allow facilities to identify areas of inefficiency in their production processes, such as loss of raw materials through leaks and fugitive emissions, or disposal of materials that could be used productively. In addition, the audit process sometimes has broader benefits for the facility in terms of improved communication among workers and management, increased knowledge of shop floor conditions by managers, and better worker health.

Cleaner production and pollution control are tools that can be implemented side by side. Both have a role to play; they are not necessarily in competition with one another. However, in designing industrial development and investing in future facilities, it makes sense to prioritize pollution prevention explicitly, encouraging its adoption wherever possible.

Strategies in the cleaner production toolbox include:[38]

- *Good housekeeping:* Pollution prevention can be as simple as closing leaks, identifying and eliminating fugitive emissions, and cleaning up spills.

[36] European Topic Centre on Resource and Waste Management, http://waste.eionet.eu.int/prevention/3

[37] UNEP Cleaner Production Website: http://www.uneptie.org/pc/cp/understanding_cp/home.htm#definition.

[38] This text is drawn from Rachel Massey, "Building a Healthy Economy: Chemicals Risk Management as a Driver of Development," (Swedish Chemicals Inspectorate, 2005).

- *Equipment modification:* Low-tech changes in equipment can eliminate hazards resulting from accidental mixing of incompatible chemicals (chemicals that may react with one another in dangerous ways) or can allow more efficient use of inputs.
- *Recovery and reuse of raw materials:* There are many options for reducing pollution simply by reusing chemicals, rather than discharging them in wastewater.
- *Substitution:* Often, an alternative input can be used in place of a toxic chemical. In other instances, changing production processes can eliminate the need for a toxic chemical.

2.2.2 Successes and failures of cleaner production programs

A recent article points out that there have been few systematic evaluations of cleaner production programs. To help fill this gap, the authors provide overviews and assessments of several such programs.[39]

Among other findings, the assessments show that successful completion of a demonstration project does not automatically lead to broader adoption of cleaner production methods. Over all, the authors observe, "the hoped-for changes in corporate practices have not happened at the rate expected or needed." The authors also note that there has been little "analytical basis" to resolve the debate about how to make cleaner production programs more effective.

The authors note that certain weaknesses are common among cleaner production programs. In particular, programs tend to focus on industry groups while neglecting to involve government authorities. In general, the authors find that programs often "fail to factor in the importance of public policy in the equation," and overlook the need for strategy development involving government agencies at the national level. However, at least one of the country-level programs reviewed, the EP3 project in Ecuador, did lead to "major changes in regulations after completion of the demonstration project." The authors suggest that "future CP projects should consider how to more effectively involve the owners and production managers of the demonstration companies as advocates for CP."

Another review of cleaner production activities suggests that governments tend to focus on traditional measures of economic growth, potentially overlooking the value of natural resources and human capital. In this context, the concept of cleaner production can help to bridge the perceived conflict between environmental protection and industrial competitiveness. However, the authors suggest that the "concepts and practices needed to achieve cleaner production on a wide scale" have not spread as rapidly as had been hoped, possibly because of a lack of strategic planning at national level involving policies and cross-sectoral collaborations. In their view,

[39] R. A. Luken, et al.. "ntroduction to the special issue on building institutional capacity for cleaner production in developing and transition economies." *Journal of Cleaner Production* 12, no. 3 (2004): 189.

donors have sometimes contributed to the problem by funding programs that emphasize technical skills while neglecting "institutional, policy and political emphases." The authors recommend "careful institutional analysis as part of a national CP policy and action planning" with donors coordinating their activities within this country framework.[40]

2.3 Financing Pollution Prevention and Control

A number of studies have found the lack of access to adequate financing to be a major factor impeding widespread adoption of cleaner production. Difficulties can also arise in efforts to finance pollution control, which may require significant infrastructure.

Barriers to the systematic adoption of cleaner production measures include resistance to change, risk aversion, lack of organizational capacity, and absence of investment capital to support cleaner production projects.[41]

As a result, assistance programs have begun to focus on building up institutional capacity and assisting governments in drafting policies that support cleaner production and other elements of sound chemicals management. A similar shift to addressing the other serious obstacle – failures in financial markets – is still in its early stages. Recent studies confirm that the presence of an enabling financial infrastructure is as important as a legislative framework in providing incentives to firms to implement cleaner production principles.[42]

The financial barriers facing enterprises in developing countries remain substantial. To address them, UNEP launched the "Strategies and mechanisms for promoting cleaner production investments in developing countries" project in 1999, with financial backing from Norway. UNEP conducted a study of past investment practices in eight countries and among 50 global financial institutions to investigate the climate and constraints for investment in cleaner production. Four-year demonstration projects were then launched in five countries: Tanzania, Zimbabwe, Vietnam, Nicaragua and Guatemala.[43]

Study results found that the language for cleaner production had not yet been imbedded in the financial services industry in a consistent manner, and that the time lag between loan agreement and disbursement was a sig-

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[40] R. S. Stevenson and J. W. Evans. "Editorial to: Cutting across interests: cleaner production, the unified force of sustainable development." *Journal of Cleaner Production* 12, no. 3 (2004): 185.

[41] Staniskis, J. K. and Z. Stasiskiene (2003). "Promotion of cleaner production investments: international experience." *Journal of Cleaner Production* 11(6): 619; also see UNEP, *Cleaner Production: Global Status Report 2002*, available at http://www.uneptie.org/pc/cp/library/catalogue/regional_reports.htm, and European Topic Centre on Resource and Waste Management, http://waste.eionet.eu.int/prevention/.

[42] Ciccozzi, E., R. Checkenya, et al. (2003). "Recent experiences and challenges in promoting cleaner production investments in developing countries." *Journal of Cleaner Production* 11(6): 629.

[43] UNEP, "Cleaning Up: Experience and Knowledge to Finance Investments in Cleaner Production." Division of Technology, Industry and Economics, United Nations Environment Program, 2003. Available at http://www.financingcp.org/library/library.html

nificant barrier to implementing low-cost cleaner production solutions when they were integrated into longer capital budgeting processes, among other problems.[44]

The UNEP demonstration project activities also revealed the persistence of a host of barriers to cleaner production. On the demand side, firms lack experience in preparing creditworthy applications. Furthermore, accounting systems often hide the costs of waste management and external environmental costs, so that the potential savings from cleaner production are not necessarily clear to firm managers at the outset. On the supply side, local financial and capital markets are often poorly developed, and investment capital may be scarce. Political instability, low credit ratings and a poor macroeconomic record can limit access to finance on international financial markets and result in high interest rates, short repayment periods and requests for guarantees. Bank assessors often lack systematic environmental expertise.[45] For all these reasons, enterprises lack access to capital at reasonable rates.

These same constraints were identified as early as 1995 in an OECD publication[46] that addressed finance issues for Cleaner Technology promotion in developing countries – suggesting the problem has been a persistent one. It has also steadily been gaining prominence, with increasing effort devoted to developing innovative financing mechanisms. Nevertheless, now more than ever there is a need for substantial capacity development within the financial community to build technical knowledge and raise awareness of the overall benefits of CP investments.

Development assistance programs and development banks have supported financial efforts both by offering technical assistance to foster financial development on the local level, and by providing donor-assisted financing mechanisms. These programs tread a fine line between catalyzing investment and suppressing innovation: the danger is in substituting for or creating disincentives towards the establishment of indigenous financing mechanisms. A range of approaches are now being piloted, generally focusing on short- and medium-term solutions to fill the immediate need for financing. These include the establishment of revolving loan funds, dedicated credit lines, financial leasing and loan guarantee schemes as well as direct grants.[47]

For example, in 1998 the Nordic Environment Finance Corporation established a special revolving facility to finance cleaner production investments in Central and Eastern Europe. The fund was designed to serve as a

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[44] Huhtala, A. (2003a). "Promoting financing of cleaner production investments: UNEP experience." *Journal of Cleaner Production* 11(6): 615.

[45] Ciccozzi, E., R. Checkenya, et al. (2003). "Recent experiences and challenges in promoting cleaner production investments in developing countries." *Journal of Cleaner Production* 11(6): 629.

[46] OECD (2005), Promoting Cleaner Production in Developing Countries: the Role of Development Cooperation (Paris: Organisation for Economic Cooperation and Development, 1995).

[47] Huhtala, A. (2003b). "Special issue on cleaner production financing." *Journal of Cleaner Production* 11(6): 611; Staniskis, J. K. and Z. Stasiskiene (2003). "Promotion of cleaner production investments: international experience." *Journal of Cleaner Production* 11(6): 619.

new financing model that would attract financial participation from other sources while supporting projects with short payback periods.[48] The European Bank for Reconstruction and Development is developing a similar fund for SMEs in Poland.[49] Along the same lines, the Multilateral Investment Fund has developed a cluster financing program in Latin America and Caribbean region. Future efforts could focus on providing incentives for cleaner production by requiring a CP audit as a prerequisite for investment in any development project.

Donors and development banks have also established technical assistance programs to promote investment in both cleaner production and pollution control. Notable among these are the World Bank's Industrial Pollution Control and Prevention Project in India, which worked with both the banking sector and industry to promote cost-effective pollution abatement, and certain World Bank projects in Brazil and in China, which worked with commercial and national banks to build familiarity and capacity in providing pollution control loans. The Bank has also published a technical handbook to assist banks in project appraisal.[50]

While these types of targeted financing schemes and assistance programs have a role to play in jump-starting the implementation of CP investments, they do not constitute a long term secure source of financing.

Meanwhile, developing countries can mobilize domestic resources using a number of approaches. Capacity in the private banking sector needs to be systematically developed to improve local banks' ability to evaluate proposals for cleaner production investments. Toward this end, the financial advisory capacity of National Cleaner Production Centers can be developed. These Centers can potentially both assist enterprises in generating proposals and advise banks in the review process. Domestic banks can improve access to cleaner production financing by providing dedicated credit lines for cleaner technology investments and setting up green investment funds. Governments can partner with the private banking sector by providing credit guarantee schemes in order to reduce the perceived high risk of cleaner production investments, at least initially. National banks, and eventually private banks, can create incentives for pollution prevention by requiring cleaner production assessments prior to project review, and by integrating cleaner production into standard project appraisal processes.

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[48] "Nordic Environment Finance Corporation (NEFCO): Revolving Facility for Cleaner Production Investments," program summary available at http://www.nefco.fi/documents/CP_write_up_2004_2.pdf. Also see Staniskis, J. K. and V. Arbaciauskas (2004). "Institutional capacity building for pollution prevention centres in Central and Eastern Europe with special reference to Lithuania." *Journal of Cleaner Production* 12(3): 207–214.

[49] European Topic Centre on Resource and Waste Management, http://waste.eionet.eu.int/prevention/

[50] See World Bank National Industrial Pollution Control Project, Brazil. (www.worldbank.org), and The World Bank, Pollution Prevention and Abatement Handbook – *towards Cleaner Production*, http://www-wds.worldbank.org/servlet/WDS_IBank_Servlet?pcont=details&eid=000094946_99040905052283

Governments can further support these efforts by tailoring fiscal policies to support cleaner production initiatives, for example through the creation of a national fund for cleaner production technologies tied to fiscal revenues from environmental fees and taxes. Governments can also create revolving loan funds for cleaner technologies and provide loans at below market rates for promoting investments of this kind.

2.4 Mobilizing the Supply Chain

Improvements in chemicals management at the firm level can sometimes be motivated by standards imposed by multinational purchasers. The concept of "greening the supply chain" refers to the process by which buyer companies impose environmental performance requirements on their suppliers.[51]

The United States Agency for International Development (USAID) is working with the World Environment Center (WEC) and PA Consulting on a Greening the Supply Chain initiative.[52] The focus of this program is the promotion of cleaner production and energy efficiency improvements among the small and medium sized enterprises that supply the large multinational members of the WEC.[53] Pilot programs have been launched in Mexico and Brazil.

In 2005 Alcoa, the largest aluminum producer in the United States, began a USAID-funded program with the WEC to green the supply chain for automobile parts production. The program focused on improving environmental standards among suppliers in Mexico. Alcoa held trainings on cleaner production and energy efficiency for twelve suppliers. The suppliers then performed self-audits and developed individual action plans. In one example, supplier created a system for filtering and recycling anti-freeze. The system reduced total anti-freeze consumption and saved about $30,000 annually.[54]

USAID has also been involved in greening the supply chain activities in the Philippines. The USAID program has worked to educate producers about the benefits of cleaner production through training sessions, workshops, and mentoring. One participating company is Central Azucarera de Don Pedro (CADP), the largest producer of raw sugar in the country. CADP has set up a facility to process organic waste and adopted energy conservation measures, leading to annual savings of 33 million pesos

[51] United States Agency for International Development, Philippines, "Case Study: Greater Savings, Cleaner Air," available at http://www.usaid.gov/stories/philippines/cs_ph_greening.pdf

[52] World Environment Center website: http://www.wec.org/about.htm

[53] World Environment Center, "Greening the Supply Chain Initiative Frequently Asked Questions," available at http://www.wec.org/docs/web/FAQ-GSC.pdf.

[54] Alcoa, "Greening the Supply Chain," available from http://www.alcoa.com/global/en/environment/initiatives/AFL_Greening.asp?initCountry=12.

($600,000). The multinational company Nestle has granted CADP preferred procurement status as a result of these measures. [55]

Hennes and Mauritz, or H&M, is a Swedish company that produces relatively low-cost clothing and cosmetics. H&M has explicitly included sound chemicals management in its broader corporate social responsibility agenda.

Within Europe, this has included supporting a strong version of the proposed REACH legislation.[56] H&M also maintains its own list of chemicals that are banned or limited for use in H&M brand clothing. Chemicals on H&M's list are either prohibited completely or permitted only in limited quantities, depending on the chemical. Examples of restricted chemicals include toxic metals such as cadmium, lead and mercury; certain dyes; and formaldehyde. H&M's list matches the most stringent of the national standards among countries where H&M products are sold. In addition, H&M has taken the initiative to restrict certain chemicals, such as polyvinyl chloride (PVC) and brominated flame retardants, of its own accord.[57]

H&M's chemical restrictions focus not on the production process, but on the product. Suppliers must guarantee that all clothing complies with H&M's restrictions. This generally means that suppliers will not use these chemicals, although use of the chemicals is not prohibited so long as residues do not remain in the clothing. H&M tests clothing before sale to ensure that it does not contain prohibited chemicals. [58]

In a logical extension of its work to ensure that the clothing it sells is safe, H&M has a code of conduct that applies to all of its direct suppliers and their subcontractors and is enforced at the factory level. For example, H&M prohibits the use of certain chlorinated organic solvents in production, even though these solvents would probably not be found in the final product due to evaporation. Most of these chemicals are known or suspected carcinogens. Code of conduct auditors verify compliance at individual factories.[59]

In addition, H&M has developed a program to encourage safer production processes in its supplier companies in developing countries. This work began with a pilot project, the Supplier Environmental Motivation Strategy (SEMS), which worked with four suppliers to evaluate the possibilities for reducing the environmental impact of fabric production, especially addressing water pollution from fabric dyeing. Based on the results of this pilot project, H&M decided that the most effective approach is cleaner production, both because cleaner production is a preventive approach and

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[55] United States Agency for International Development, Philippines, "Case Study: Greater Savings, Cleaner Air." Accessed January 17, 2006. Available from http://www.usaid.gov/stories/philippines/cs_ph_greening.pdf

[56] "Business Benefits for H&M Within REACH." In International Chemical Secretariat, "What We Need from REACH: Views on the Proposal for a New Chemical Legislation within the EU," (Gothenburg, Sweden: International Chemical Secretariat, 2005).

[57] H&M Fact Sheet: "Quality Testing and Chemical Testing," viewed at http://www.hm.com/csr.

[58] H&M Fact Sheet: "Quality Testing and Chemical Testing," viewed at http://www.hm.com/csr.

[59] Henrik Lampa, Environmental Coordinator, H&M, personal communication, December 2005.

because savings on energy, water, and chemicals "can result in a financial incentive for the mills to participate without the commercial pressure from a direct buyer."[60]

H&M followed up with a pilot cleaner production project working with six fabric mills in India. H&M does not have a direct business relationship with these mills, so it cannot impose specific requirements. Instead, H&M promotes cleaner production at these mills through a voluntary program. The National Cleaner Production Centre in India provided assistance in the initial design of the project.

The project focuses on reducing use of energy, water, and chemicals.[61] The process begins with an assessment of the potential for improvement in energy, water, and chemical use. H&M's evaluation system includes 40 technical measures that evaluate a range of processes within a fabric mill, including dyeing, knitting, weaving, and steam production, among others. The system also includes protocols for tracking chemical use (both type and volume).[62]

Most of the cleaner production options introduced through H&M's program draw upon the "e-textile" online resource.[63] This resource was developed collaboratively by organizations in both Asia and Europe to help improve efficiency and reduce costs of textile production while boosting product quality and improving environmental performance. The website offers technical solutions to companies in developing countries, with a particular focus on India and Vietnam. It promotes cleaner textile production as a means for companies to reduce costs and increase efficiency while meeting international product quality standards.

This example illustrates how individual companies, as well as broader regional programs, can stimulate adoption of cleaner production options in developing countries. At the same time, this example highlights the importance of having a legislative framework to increase the incentives for firms to improve chemicals management. Despite H&M's commitment to achieving high standards, the company has limited ability to influence suppliers further down the supply chain.

[60] H&M, "Our Environmental Responsibility 2004," viewed at http://www.hm.com/csr.
[61] H&M, "Our Environmental Responsibility 2004," viewed at http://www.hm.com/csr.
[62] Henrik Lampa, Environmental Coordinator, H&M, personal communication, December 2005.
[63] http://www.e-textile.org/

PART II – Cleaner Production in Practice

3. Country Case Studies

In this section we look in detail at several country-specific case studies. We examine the interplay between legislative initiatives and efforts to promote cleaner production in specific industry sectors. We also look at related topics such as infrastructure, health and economic benefits, and the role of aid agencies.

We present case studies drawn from South Africa, Tanzania, China, Thailand, Vietnam, India, and one multi-country case study of economies in transition. South Africa's three-pronged, comprehensive approach to cleaner production consists of national legislation and regulation, implementation at the industry and company level, and enforcement at the local level. Tanzania has recently adopted framework legislation on chemicals; its cleaner production program has developed separately from this legislative initiative, and is based primarily in its National Cleaner Production Centre. China's experience in promoting cleaner production combines legislative work with direct assistance to industry. In Thailand and Vietnam, projects to reduce use of hazardous pesticides improved rural health and opened new avenues for economic development. In India, we examine a multi-level effort to address toxic pollution from incineration of medical waste. The experience of Ukraine, Belarus, and Russia in addressing pollution in the Dnipro River Basin is interesting as an example of collaboration among three countries, each of which worked to improve its chemicals legislation and its administrative capacity as part of the effort to clean up a water source.

3.1 Cleaner Production in South Africa

South Africa has seen the development of cleaner production activities both at the individual company level and in legislative initiatives. The South African experience shows how small, early demonstration projects in key industries can raise understanding and awareness of the possibilities for cleaner production. This awareness can then inform the development of broader national strategies and legislation. New legislation can, in turn, shape and guide further implementation efforts.

This case study also highlights the importance of a range of actors and initiatives in developing a country's cleaner production potential. For example, government initiatives at both the municipal and national levels provided support and incentives to industry efforts at waste minimization. Bilateral aid from Denmark and Norway has supported important cleaner production demonstration projects as well as efforts to build a national

cleaner production strategy. Finally, the country has been developing local capacity for sustainable cleaner production initiatives through the National Cleaner Production Centre and the University of Natal's Pollution Research Group. Both industry-level cleaner production efforts and national legislative planning benefit from technical support from these national and international sources.

We begin our discussion by looking at South Africa's existing environmental legislation and its cleaner production capacity. We then look at the role of two aid agencies in helping to boost and expand that capacity through targeted interventions.

3.1.1 Environmental legislation

South Africa's constitution establishes the right to a clean environment. The National Environmental Management Act and the Water Act are two key pieces of legislation intended to secure these rights in practice.[64] A White Paper on Integrated Pollution and Waste Management for South Africa, developed in 2000, proposed legislation to increase cooperation and coordination on waste management, and recommended that pollution prevention and waste minimization be prioritized. [65]

3.1.2 Cleaner Production Capacity

Structures that have helped to promote cleaner production in South Africa over a number of years include a network of Waste Minimization Clubs, the Pollution Research Group at the University of Natal, and the South Africa National Cleaner Production Center. These organizations involve industry, government, and academia in pursuing the goals of cleaner production.

Waste minimization clubs bring together representatives from multiple businesses within an industrial sector, or from neighboring firms from different sectors. Members meet regularly with the explicit purpose of exchanging information on pollution prevention options. Since 1998, some thirty waste minimization clubs have been formed in South Africa. Much of the support for these clubs has come from the Water Research Commission which, as the agency charged with protecting both water quality and preventing water shortages, has incorporated cleaner production as one of its areas of interest and intervention. The Cape Town City Council has provided additional support for some groups.[66] Development of these clubs has also been stimulated through the National Waste Management Strat-

[64] Report On The First Africa Roundtable On Cleaner Production And Sustainable Consumption, p. 50.

[65] Department of Environmental Affairs and Tourism (DEAT). March 17, 2000. White Paper On Integrated Pollution And Waste Management For South Africa. Accessed January 3, 2006 at: http://www.polity.org.za/html/govdocs/notices/2000/not0227a.html; Report On The First Africa Roundtable On Cleaner Production And Sustainable Consumption, p. 51.

[66] Dokument 2, p. 45.

egy, established by the Department of Water Affairs and Forestry and the Department of Environment and Tourism (DEAT), which promotes them as a vehicle for sustainable cleaner production.[67]

The clubs serve as a forum for communication among managers of small, medium-sized, and micro-enterprises. These enterprises are an important engine of economic growth, but are also a significant source of pollution, particularly water pollution.[68] Larger industries have also made use of the club model, in some instances creating clubs that bring together different branches of a single business to strategize about options for reducing pollution. Club sizes range from six or seven companies up to more than twenty, and include firms from the food and beverage industry, metal finishing, plastic companies, chemical suppliers, tanneries and abattoirs, power stations, and others.[69]

The Pollution Research Group (PRG) at the University of Natal has also been an important resource for cleaner production activities. Notably, its work with specific industries has occurred in parallel with work on national legislation. Among other activities, the PRG has helped to promote and manage the waste minimization clubs; was a partner in demonstration projects in the textiles and metals finishing industries; and contributed to the drafting of water quality guidelines and the National Waste Management Strategy, which has focused policy toward cleaner production. The PRG also provides support to the National Cleaner Production Centre and prepares engineering graduates for roles promoting and implementing cleaner production in government and industry.

South Africa's National Cleaner Production Centre (NCPC) was inaugurated in 2003, and is based at the Council for Scientific and Industrial Research. The Centre is a cooperation program between UNIDO and the South African Department of Trade and Industry (DTI). Financing for its initial three-year program comes from Switzerland, Austria and DTI. The NCPC works to implement international conventions on chemicals as well as the cleaner production goals laid out in the Integrated Pollution and Waste Management Policy and the National Waste Management Strategy. The NCPC emphasizes support to small and medium-sized businesses in the food, chemical and textiles industries.[70]

3.1.3 Bilateral aid

Both the Danish aid agency DANIDA and the Norwegian Pollution Control Authority (SFT) have supported projects to enhance cleaner production capacity in South Africa. The projects highlighted here illustrate some in-

[67] Steenveld, G.N. *Industrial Water Management.* Water Research Commission. p.109. Accessed 3 January 2006 at http://www.wrc.org.za/downloads/knowledgereview/2002/Industrial.pdf

[68] Steenveld p. 105.

[69] Dokument 2, pp. 87–90.

[70] "Media Release: Official Inauguration of CSIR-based SA National Cleaner Production Centre," http://www.csir.co.za/plsql/ptl0002/PTL0002_PGE013_MEDIA_REL?MEDIA_RELEASE_NO=7075969 (viewed January 2006)

triguing approaches to developing cleaner production. These include a life-cycle approach to cleaner production in the textiles industry that involved cotton growers as well as textile manufacturers; the development of a score system to rank chemicals according to volume, toxicity, and other factors; and a three-part program to promote cleaner production comprehensively at the local, national, and industry-specific levels.

DANIDA projects

DANIDA has played an important role in funding cleaner production demonstration projects and making Danish experience on cleaner production available to South African government and industry. The Department of Environment and Tourism and the Department of Trade and Industry have received support and collaboration from the Danish Government, including capacity building and practical demonstrations, for cleaner production projects in the textiles, fish processing, and metal finishing industries.[71]

Cleaner production of textiles

The DANIDA-supported Cleaner Textile Production Project began in 2000. In this project, experts from the Danish Institute for Product Development visited South African textile facilities to help them implement cleaner production options. Training included a set of widely replicable cleaner production options such as liquor displacement; direct water reuse; rinsing without surfactants after reactive dyeing of cotton; recycling of process water; and the reclamation and reuse of rinsing water to decrease water and energy use and reduce color in effluent.[72] By 2003, participating facilities showed an average savings of about US $187,000 each through reduced use of water, energy and chemicals and lower effluent charges.[73] Results from the facilities that have implemented the most extensive CP measures suggest that there is potential for industry wide savings of at least 1.5% of turnover annually.[74]

A key element of the project is its use of a life cycle approach to cleaner production. The project began with an examination of each phase of the life cycle — cotton cultivation, textile production, and the product's sale, use and ultimate disposal — to identify CP opportunities. Based on this analysis, the two most environmentally significant phases, cotton growing and textile manufacturing, were selected for interventions.[75]

The project worked with cotton farmers to promote cleaner production concepts and IPM methods. Participating farmers achieved small savings (roughly $35/ha) from reduced spraying while their yields increased

[71] Draft Report, "Cleaner Textile Production project South Africa Covering the period 1 July 2000 to 30 June 2003."

[72] DANIDA, "The Cleaner Textile Production Project," http://www.nu.ac.za/cleanerproduction/.

[73] 1.2 million Rand, converted at 2005 exchange rates, no adjustment for inflation.

[74] Rogers. 8 November 2004. National Cleaner Production Strategy: Draft for Comment: National and Regional Workshops. CSRI, Government of South Africa. Accessed at http://www.info.gov.za/otherdocs/2004/cleaner.pdf, December 2005.

[75] Dokument 2, pp. 5–7.

15–20%.[76] The life-cycle approach also led to important collaborations and cooperation among cotton farmers, textile producers, and retailers. Each of these sectors worked to make the necessary environmental improvements to qualify for international eco-labels such as the EU flower.[77] One textile mill has obtained this certification, which brings benefits to some cotton suppliers as well as to the mill itself. The government has responded to this shared goal of improving competitiveness through cleaner production by creating a Clothing and Textile Environmental Linkage Centre, funded by DTI and DANIDA.

Another important element of the textiles project has been the use of the Score System, a tool for chemical substitution developed in Denmark and further modified in South Africa.[78] The Score System is a method of ranking chemicals based on quantity used, biodegradability, bioaccumulation, and toxicity in order to prioritize areas of greatest concern and identify opportunities for substitution. The system was initially introduced as a demonstration project at nine textile facilities in 2001; it has now been extended as a project managed by the Pollution Research Group at the University of Natal, with sponsorship from the Water Research Commission. Companies use the system to find ways to lower their chemical scores and thus the environmental impact of their business.[79]

Some difficulties arose in implementation of the Score System due to lack of information on some chemicals. These problems are now being addressed through increased cooperation with chemical suppliers, making use of links between chemical supply companies in South Africa and their counterparts in Denmark.[80]

Other DANIDA projects

A DANIDA-supported demonstration project in the canning and whitefish industries is also worth mentioning. Although it did not work primarily with chemicals, it clearly demonstrates the scope for benefits for both the environment and the business "bottom line." Participating canneries reduced freshwater use by 30 to 80% and saltwater use by about 75% while also removing some 360 tons of organic matter from the effluent per 10,000 tons of fish processed. In the whitefish industry, the two participating factories cut freshwater consumption nearly in half and reduced saltwater consumption by 60%. Project reports note that the financial benefits from these water savings are an essential incentive for firms' participation.[81]

[76] Dokument 2, pp. 29–30.
[77] Dokument 2, pp. 15, 31.
[78] Hans Henrik Knudsen, personal communication.
[79] Dokument 2 p 14
[80] Dokument 2 pp. 14–15
[81] Dokument 2 pp. 33–34

Partnership with Norway

The partnership between the Norwegian Pollution Control Authority (SFT) and the Department of Environmental Affairs and Tourism (DEAT) is another interesting example of bilateral cooperation to promote cleaner production.[82] This program works to promote cleaner production comprehensively, addressing national legislation, implementation programs with specific industries, and local enforcement. The initial project goals included three outputs: development of an overarching national cleaner production strategy; demonstration projects at pulp and paper facilities; and guidance for local governments on enforcement of environmental legislation.[83]

At the national level, tools available to the government include economic instruments such as taxes, levies, loans and subsidies; regulatory instruments such as recycling or waste reduction targets; and legislative instruments.[84] A draft version of the national cleaner production strategy has been completed and is awaiting final approval.[85]

At the facility level, the project included a demonstration program in the pulp and paper industry. The pulp and paper industry was chosen for several reasons. First, the industry is a major source of water pollution. Second, the structure of the sector, with relatively small number of plants organized in two large industrial groups, suggested that it would be relatively easy to establish the necessary collaborative relationships. Finally, Norway has technical expertise in the industry and there are economic links between companies in the two countries.[86]

Reluctance in the industry limited participation in this demonstration project to only two firms, but both reported successful identification of cleaner production opportunities which will provide both financial and environmental benefits. These results are being disseminated to others in the industry.[87]

The demonstration projects were designed in part to give firms practical experience in meeting cleaner production goals. In this way, national policy development is integrated with industry level implementation as lessons from the demonstration projects inform new policy, and as policy goals are tested during demonstration projects. Cleaner production projects

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[82] Norwegian Environmental Assistance website, "Institutional Cooperation between DEAT and SFT," http://environment.norad.no/projects.cfm?projectid=1083 , viewed January 2006; and South African Department of Environmental Affairs and Tourism (DEAT), Business Plan on Cleaner Production, Enforcement and Compliance (April 2003). p.7.

[83] http://environment.norad.no/projects.cfm?projectid=1083

[84] South African Department of Environmental Affairs and Tourism (DEAT), Business Plan on Cleaner Production, Enforcement and Compliance (April 2003) p 9.

[85] Barbro Thomsen, Norwegian Pollution Control Authority, personal communication, December 2005.

[86] South African Department of Environmental Affairs and Tourism (DEAT), Business Plan on Cleaner Production, Enforcement and Compliance (April 2003) p.12.

[87] Technical Association of the Pulp and Paper Industry of South Africa (TAPPSA). Cleaner production gives financial and environmental benefits. Accessed January 3, 2006 at: http://www.tappsa.co.za/html/cleaner_production.html

funded by DANIDA in the textile, fishing and metal finishing industries provide additional experience to guide policy formation.[88]

Finally, the program aims to enhance the capacity of local environmental authorities to understand and implement national environmental legislation. The collaboration between SFT and DEAT in this area is coupled with a separate institutional co-operation agreement between eThekwini Municipality (Durban) and SFT to reduce industrial pollution through improved regulatory systems for permitting, auditing, and information management.[89]

One important achievement has been the unprecedented collaboration between two divisions of the municipal administration, despite the fact that each division reports to a different ministry and works under a distinct set of legislation. The two divisions have now harmonized their systems for licensing and monitoring compliance. One source of success for the eThekwini cleaner production program comes from its association with the Multi Point Plan on Air Quality in the city, a program with solid support in the local community.[90]

3.2 Chemicals Legislation and Cleaner Production in Tanzania

The Tanzanian government has identified six major environmental problems that require urgent attention: land degradation, limited access to safe water, pollution, loss of wildlife habitats and biodiversity, deterioration of marine ecosystems, and deforestation. All of these are due at least in part to the unsustainable extraction and overuse of natural resources. Only pollution and limited access to clean water can be directly linked to industrial pollution. However, around large urban centers there does exist a growing problem of industrial pollution coupled with unsustainable production processes.

The National Cleaner Production Centre is Tanzania's leading institution for cleaner production information and demonstration projects. Tanzania has also recently adopted new legislation for environmental management and chemicals regulation. This legislative work is largely uncoupled from the country's cleaner production program. Competitive pressures for SMEs to align with international standards seem to be providing a strong impetus for cleaner production in sectors such as agro-processing.

3.2.1 Cleaner Production Activities

Formal cleaner production activities began in Tanzania in 1994, with a one-year pilot project launched in the Ministry of Tourism, Natural Re-

[88] South African Department of Environmental Affairs and Tourism (DEAT), Business Plan on Cleaner Production, Enforcement and Compliance (April 2003) pp. 11–12.

[89] http://environment.norad.no/projects.cfm?projectid=1084

[90] Barbro Thomsen, Norwegian Pollution Control Authority, personal communication, December 2005.

sources and the Environment. The DANIDA-financed project, known as Cleaner Environmental Production in Industry in Tanzania (CEPITA), initiated cleaner production demonstrations in more than ten companies in Tanzania.

Tanzania's Cleaner Production Centre was established a year later in 1995, and received operational funding from UNIDO through 1998 and thereafter from NORAD through 2004. Several demonstration projects were set up in a number of industrial sectors, including soap and detergents, steel rolling, beverage, electroplating, cement, tobacco, essential oils, food, motor repair and service workshops, and textiles.[91]

With the Norwegian Institute of Technology (TI) as a new partner, the Cleaner Production Centre is working in four main areas: in-plant assessments and demonstrations; training; information dissemination; and policy advice. Part of the focus is on building national capacity in the field of cleaner production and other environmental management tools such as environmental management systems, eco-design, life cycle assessment, and ISO14000.

3.2.2 Legislation

In 2003, Tanzania passed the landmark Industrial & Consumer Chemicals Act, under the jurisdiction of the Government Chemist Laboratory Agency. The new legislation creates a first-ever infrastructure for chemicals management in the country. It creates a framework for chemicals production, handling, storage, transportation, import and export. Many challenges remain to implement the provisions of the Act adequately. Tasks include developing a chemicals register, an inspection system, and a licensing and approval system; adopting sound information management systems; and establishing technical committees, including emergency response committees.[92]

More generally, Tanzania's 2004 Environmental Management Bill provides a unified regulatory framework for natural resource and environmental management, coordinating previously disparate mandates among different government institutions.

3.2.3 Barriers

Substantial barriers to the widespread adoption of CP practices in Tanzania remain. Some of these can be attributed to the lack of regulatory infrastructure, including a lack of enforceable legislation and of environmental standards. Other constraints are due to the macroeconomic environment, where

[91] UNEP. *The Report on the First Africa Roundtable on Cleaner Production and Sustainable Consumption.* August 9–11, 2000. Available at http://www.uneptie.org/pc/cp/events/africa.htm

[92] The Act cites resource pricing as a potential economic instrument to be used in the interest of sound chemical management. See chapter 28, http://www.parliament.go.tz/Polis/PAMS/Docs/3-2003.pdf.

privatization of state-run enterprises has slowed CP efforts, and investment capital for cleaner production projects is lacking.[93]

Some studies have noted that cleaner production programs in Africa often focus on the industrial-manufacturing sector, despite the low level of industrialization in many countries. Untapped opportunities for cleaner production may exist in the agricultural and agro-processing sectors, and in extractive industries. [94]

3.2.4 Trade: fish processing in Lake Victoria and the EU ban

Fish processing is one of Tanzania's major agro-processing activities, with all nine of Tanzania's fish processing plants located on Lake Victoria. With an annual output of over 25 billion tons of fish fillets, the industry has been identified as high growth by the government. Every plant has planned or is undergoing expansions to continue serving the EU, US and Middle Eastern export markets – to which nearly the entire output is destined.

Concerns arose, however, about fishermen's use of toxic chemicals to kill fish. Due to concern about contamination, in 1997 the EU banned freshwater fish imports from the member states of East African Cooperation (EAC), which includes Tanzania.

In response to the ban and the EU demand for compliance with Hazard Analysis and Critical Control Point (HACCP) food safety principles in fish exports, several of Tanzania's fish processors elected to work with the country's national Cleaner Production Centre to get assistance in the implementation of ISO 9002 and HACCP in their industrial practices. Investments were made to integrate these standards into industrial practices. In addition, fish producers formed a regulatory body known as the Lake Victoria Fish Processors' Association (LVFA) to monitor practices among fishermen, processors, packagers and exporters and ensure export quality standards were being met. According to a UNEP report on CP investment practices in Tanzania, "companies have begun to identify the implementation of the HACCP/ISO principles as a way of remaining competitive by ensuring uninterrupted exports in the future." [95]

Due to a lack of resources LVFA has not been able to achieve the industrial watchdog role it originally envisaged. The case of Tanzania's fish processors is instructive, however, in demonstrating how international market pressures can prove to be a force for change.

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[93] UNEP. *The Report on the First Africa Roundtable on Cleaner Production and Sustainable Consumption.* August 9–11, 2000. Available at http://www.uneptie.org/pc/cp/events/africa.htm

[94] UNEP. Sustainable Production and Consumption in Africa. The Third African Roundtable on Sustainable Consumption and Production. Casablanca, Morocco, 17–20 May 2004. Available at: http://www.uneptie.org/pc/cp/events/africa.htm. Also UNEP. Cleaner Production: Global Status Report 2002. http://www.uneptie.org/pc/cp/library/catalogue/regional_reports.htm

[95] UNEP. 2000. "Tanzania: Study of Past Investments," in "Financing Cleaner Production: Study on Past Investment Practices", p 63.

3.3 Cleaner Production in China

China has experienced rapid industrialization in the past two decades, sustaining an annual economic growth rate of 9%. Increases in the scale of production and in the number of small and medium sized enterprises (SMEs) have driven this rapid industrial development. Following a traditional industrial growth model of heavy resource consumption, the sector's swift expansion is contributing to natural resource depletion and the generation of large quantities of industrial pollutants.[96]

Small and medium sized enterprises overwhelmingly dominate China's industrial sector. In particular, the expansion of small state-owned enterprises on the local level (township and village enterprises, or TVEs) has been a driving factor in the country's economic development. Facilities in this sector frequently employ outdated technologies that make inefficient use of energy and raw materials. As a result, TVEs are a significant source of pollution.[97] Pollution prevention programs and policies have sought to target this sub-sector in spite of the logistical challenges associated with information and technology dissemination to the country's 467,000 SMEs.

In this case study, we look at China's legislative initiative to establish cleaner production as a central component of the country's environmental policies. We examine the relationship between China's cleaner production legislation and specific efforts to promote cleaner production at the facility and sector level. Interesting cases that emerge from this examination include an instance of an enterprise that was able to expand production thanks to the financial savings from its cleaner production project; and successful combination of a cleaner production project with an effort to improve the situation of women in industry. The positive effects of cleaner production methods are, however, tempered by enforcement problems and other difficulties.

An initial, project-focused phase in China's development of cleaner production programming (1992–1997) gave way to a subsequent policy-centered phase (1997 to the present).[98] The progression from primarily assistance-driven projects to comprehensive policy formulation and the creation of indigenous institutional capacity for promotion of cleaner production appears to follow an established pattern across countries that have sought to integrate cleaner production into national environmental management and sustainable development strategies.

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[96] Zhang, Tianzhu and Jining Chen. *Promoting Cleaner Production in China.* Department of Environmental Science and Engineering, Tsinghua University, Beijing. Presented at the International Conference on Cleaner Production, Beijing, September 2001. Available at http://www.chinacp.com/eng/cpconfer/iccp01/iccp26.html.

[97] Zhang, Tianzhu and Jining Chen 2001.

[98] Zhang, Tianzhu and Jining Chen 2001.

3.3.1 Pollution in China

In 2002, China possessed six of the world's ten cities with the worst air pollution, one third of its land suffered from the effects of acid rain, and many rivers were so polluted that they no longer supported a population of fish.[99] Respiratory diseases are on the rise, fueled by indoor and outdoor air pollution. The World Bank estimated in 1997 that China loses 8% of its annual GDP growth in direct environmental damages.[100]

A petrochemical plant explosion in November 2005 released benzene into the Songhua River, contaminating water supplies downriver. According to government statements, benzene levels in the river were more than 100 times above national safety levels. Another chemical disaster was reported in December 2005, in which a state-owned smelter released large amounts of cadmium.[101] Mining accidents are another major hazard, with thousands of deaths among miners reported in 2004 and 2005.[102]

3.3.2 Legislative initiatives

China initially developed pollution prevention policy in the early 1980s with its National Environmental Policy. Subsequently a national regulatory framework for industrial environmental management was formulated with air and water quality standards that focused on end-of-pipe solutions. In 1993, the National Environmental Protection Agency and the State Economic and Trade Commission shifted from end-of-pipe strategies to cleaner production strategies, adopting the language of cleaner production at the Second National Conference on Industrial Pollution and writing it into China's Agenda 21 for sustainable development. Promotion of cleaner production then became integrated into National Action Plans for achieving strategic environmental targets in national water, air and solid waste pollution prevention laws.

In June 2002, the National People's Congress approved the passage of comprehensive legislation that established cleaner production as a central pillar in China's sustainable development strategies. The 2002 Law was intended to provide a policy framework for Cleaner Production, building on the back of a patchwork of sectoral, region and resource-specific initiatives promoting CP principles.[103]

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[99] Edward O. Wilson, *The Future of Life* (New York: Alfred A. Knopf, 2002), 34.

[100] World Bank, Clear Water, Blue Skies: China's Environment in the New Century (Washington, D.C.: World Bank, 1997), 10; Elizabeth C. Economy, The River Runs Black: The Environmental Challenges to China's Future (Ithaca & London: Cornell University Press, 2004), 18–19.

[101] BBC News, "Toxic Spill in Second China River," http://news.bbc.co.uk/2/hi/asia-pacific/4548046.stm.

[102] BBC News, "China acts on mine safety lapses," http://news.bbc.co.uk/2/hi/asia-pacific/4554912.stm.

[103] Dan Millison, "Waste Management and Cleaner Production Programs," in Kristen A. Day, ed., *China's Environment and the Challenge of Sustainable Development* (Armonk, N.Y.: M.E. Sharpe, 2005), p. 201.

3.3.3 Integration of CP promotion into policy frameworks

Cleaner production practices in China's industrial sectors were first introduced via individual demonstration projects, and later began to be institutionalized in policy frameworks. Bilateral and multilateral assistance programs supported the implementation of CP audits, training and demonstration projects at individual facilities across different regions in the initial period. Preliminary institutional frameworks were created to promote and coordinate CP activities in China.

In recent years, donor governments have worked with Chinese authorities to support policy study and formulation. The Canadian-established China Council of International Cooperation on Environment and Development has recently carried out policy study work on CP. It backed the implementation of pilot projects of CP policy at the local level such as the use of fiscal policy instruments in selected regions and has more recently issued comprehensive CP policy recommendations to the State Council.[104]

Other programs funded by the Asian Development Bank, CIDA and the EU have recently focused on supporting the integration of CP into China's Agenda 21 program, the development of financing mechanisms for CP in TVEs, the expansion of monitoring capacity, and other forms of institutional capacity building. A cross-sectoral integrated policy framework for CP that operates at different levels of government is now emerging, comprising a range of policy instruments including fiscal and financial support instruments, compulsory regulations, and social pressure mechanisms.

3.3.4 Activities of the National Cleaner Production Center

With assistance from UNEP/UNIDO, a China National Cleaner Production Centre (CNCPC) was created in July 1995 within the Chinese Research Academy of Environmental Sciences in Beijing. As a technical support institution, the CNCPC guides local Environmental Protection Bureaus in the development of cleaner production programs, offers training courses, develops educational materials and oversees the implementation of demonstration projects. In 1997, eight regional centers were also established. These are now coordinated via a National Cleaner Production Network. The network also includes centers that help to promote cleaner production in the petrochemical, chemical, metallurgical, light industry, and shipbuilding sectors.

The CNCPC has overseen the implementation of several dozen CP demonstration projects in over 15 industrial sectors such as chemical and petrochemicals, pulp and paper, textile, printing and dyeing, electroplating, metallurgy, brewing and distilling, leather, building and electronics. It has also carried out cleaner production audits in 130 Chinese enterprises. The-

[104] Task Force of Circular Economy and Cleaner Production, CCICED. *Main Conclusions and Policy Suggestions.* 2004. Available at: http://eng.cciced.org/cn/company/Tmxxb143/fl143.asp?siteid=1&lmid=5209.

se audits, along with implementation of low cost cleaner production options, produced a 20% reduction in total pollution generated by those facilities as well as an average economic benefit of US$121,000 per enterprise.[105]

The CNCPC collaborates with government agencies to formulate regulatory and fiscal policy. In Shaanxi Province and Benxi City the Center assisted the formulation of a successful CP economic incentives package, and is working with agencies in the State government to formulate national and local CP legislation. The Center is also involved in capacity-building projects such as supporting the development of environmental management systems in 20 enterprises and establishing a comprehensive national CP information network.

3.3.5 Bilateral and multilateral programs: NORAD and CIDA activities

A number of bilateral and multilateral aid institutions are involved in supporting cleaner production activities in China.[106] Here, we look at the experience of two bilateral aid programs: NORAD and CIDA. NORAD's involvement has focused primarily on demonstration projects. CIDA's work has included broader capacity building efforts as well as demonstration projects.

NORAD

Like many early donor-assisted efforts, the Sino-Norwegian cooperation program on Cleaner Production supported the establishment of demonstration projects. The program worked with 35 industrial facilities in Beijing, in a number of sectors: chemical, petrochemical, materials, printing and dyeing, metallurgy and brewery. The project was implemented by the Beijing Municipal Center for Education and Public Publicity and the State Science and Technology Commission in partnership with the Norwegian Society of Chartered Engineers and NORAD.

The first phase of the project (1994–1995) focused on developing expertise via the creation of a China International Centre for Sustainable Development, the establishment of 15 demonstration projects, and the intensive training of 30 auditors. In the demonstration projects, companies adopted a range of low- or no-cost cleaner production options, yielding savings of about US$ 1.65 million across the projects. The implementation of longer term CP options was expected to triple these baseline savings. The projects demonstrated that current industrial water discharges in Beijing could be reduced by 10–20% with modifications characterized by small investments and short payback periods. These include recycling, minor production process modifications, and improved monitoring.

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[105] CNCPC. *Field of Services and Achievements (update from the CNCPC).* Available at: http://www.chinacp.com/eng/cporg/cporg_cncpc_01.html. Cost figures are converted from RMB to USD at 2005 rates with no adjustment for inflation.

[106] For a list of donors, see http://www.chinacp.com/eng/cp_donors.html.

The project further estimated that an additional 25–30% of pollution reduction in these facilities could be achieved with the implementation of medium and longer term CP options. The second phase of the project (1997–1998) sought to establish Beijing as a CP pilot city, building on its prior experience in order to assist with the formulation of a government CP policy, while also setting up an additional 20 demonstration projects. Chemical and brewery facilities were targeted as pilot industrial sectors in this phase.[107]

CIDA

The China-Canada cooperation project (1996–2005) focused on policy development, information systems, training, and gender programming. The project established an in-country policy working group, supporting the 2002 passage of the Cleaner Production Promotion Law and the integration of CP into new policy initiatives. It trained over 1500 people in CP methodology of which one third were women, established links to a dozen training institutes to further disseminate knowledge, and produced several CP manuals and audit guidelines. It stimulated the creation of a highly visible and active Women and Environment Network as a result of its focus on gender equality at every stage of its programming activities. A Chinese and English language website on CP was established and now serves as the country's official CP web site.

The project also supported the implementation of CP solutions in six targeted sectors: fertilizer, brewery, pulp and paper, PVC/chlor-alkali, non-ferrous metal smelting, and oil and gas. The implementation of CP measures led to ammonia, sulphur and waste oil recovery in the fertilizer sector; reductions in water and energy consumption, reductions in chlorine loss and product (PVC) recovery in the PVC plant; reductions in water and energy consumption and product (fibre) recovery in the pulp and paper plant; and water conservation in non-ferrous smelting.

3.3.6 Other CP programs

Contrasting with the apparent success of the projects described above, a 1999 study of a showcase implementation projects supported by the State Environmental Protection Agency (SEPA) in several factories concluded with doubt about the feasibility of these programs. The factories in the studies could present only ambiguous information about the financial benefits. The authors suggested that other plants might not implement CP if there continued to be a lack of clear documentation of financial benefits.[108] Another study in the same year of firms that implemented pollution prevention on their own initiative concluded that some managers took on this

[107] http://www.chinacp.com/eng/cpdonors/cp_norad.html

[108] Katherin Cao Cushing, Peter L. Wise and Janet Hawes-Davis. "Evaluating the Implementation of Cleaner Production Audit Demonstration Projects." *Environmental Impact Assessment Review* (New York: Elesvier Science Inc, 1999)

task voluntarily. However, a lack of training and awareness, combined with low water prices and low pollution discharge fees, work against incentives for implementation.[109]

3.3.7 Gender integration

In the industrial plant or laboratory environment, women workers may experience greater occupational health hazards, and may be poorly represented in higher management, hindering their ability to address this concern. Gender programming was therefore introduced under the bilateral China-Canada Cooperation Project. Program objectives included increasing awareness of gender issues and support for women's full participation in the workforce, and achieving targets for female participation in program activities.[110]

In concert these activities served as a catalyst for the mobilization of women in environmental protection activities, leading to the organization of a national workshop on Gender Equality and Development in Beijing in 1999 and the subsequent creation of a new NGO (the Women and Environment Network) to publicize national gender and environment issues. In addition, at the Fuyang General Chemical Works demonstration site, efforts of the Gender Equality Working Group led to substantial health and safety improvements such as expanded daycare services.[111] More subtle impacts such as empowerment or the sensitization of senior management are more difficult to measure, but potentially important as well.

3.3.8 Driving and restraining factors

China's state controlled enterprises have traditionally emphasized production capacity and quotas rather than efficiency**.** Much of the learning in CP assistance programs has taken place around the first-time creation of partnerships between government, industry, environmental organizations and other stakeholders. The programs have also created space and incentives for the emergence of localized solutions at the facility level and across sectors with the support of central authorities. In other ways, the government's strong presence has also been an enabling factor, allowing for a unified commitment to CP principles across ministries which has also been reflected in policy at all levels of government.

A 2003 study of waste management and cleaner production programs concluded that the development of capital markets is one of the biggest obstacles to CP implementation, but that they are slowly expanding. Fur-

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[109] Kimberly A. Warren, Leonard Ortolano, and Scott Rozelle, "Pollution Prevention Incentives and Responses in Chinese Firms." *Environmental Impact Assessment Review* (New York: Elsevier Science Inc, 1999)

[110] "China Canada Cooperation Project in Cleaner Production: Gender Equality Strategy," available at http://www.chinacp.com/eng/cpprojects/canada/cccpcp_gestrat.html.

[111] "Fact Sheet on Gender Equality in the China Canada Cooperation Project in Cleaner Production," available at: http://www.chinacp.com/eng/cppub/factsheets/fs02.pdf

ther, membership in the WTO has added some market pressure for enterprise reforms and should make technology transfer easier.[112] Further signs of progress included a provision in the new SME law, effective 2003, providing for development funds that could support CP technology implementation. Other potentially important initiatives include increased use of low-sulfur coal in large power plants and increased use of natural gas, and the promotion of "Enterprise Development Zones" on the local level which have more efficient waste, water and energy management systems. On the other hand, a "culture of compliance" for environmental standards is still in the early stages and the legal framework does not provide adequate incentives to clean up pollution.[113]

Limitations in administrative capacity

As recently as 2003, an official at SEPA admitted that local Environmental Protection Bureaus cannot keep pace with development and that local officials often turn a blind eye to violations of environmental laws.[114] Limited environmental personnel and budgets, low training, and contradictions or ambiguities in regulations are the main hindrances to efficient implementation.

The central government periodically conducts campaigns against pollution, but once the campaign is over, the factories in question often revert to earlier practices. For example, in 2000 SEPA sent teams around the country to report on pollution discharges. While the inspections teams were present, the factories worked on changing their practices to meet standards; but once the teams left, the factories stopped employing their pollution control technologies and stopped trying to meet state standards.[115] A 2001 World Bank/SEPA report noted that "Cleaner Production and ISO 14000 programs are not a substitute for the budgets and manpower needed to effectively enforce pollution laws and regulations." A SEPA study from 2000 estimated that one third of pollution abatement facilities in Chinese enterprises operate only during inspections and another third are never operated.[116]

3.4 Integrated Pest Management in Thailand and Vietnam

As we saw in Chapter 1, pesticides are a major source of toxic chemical exposures in developing countries.[117] Integrated Pest Management (IPM)

[112] Dan Millison, "Waste Management and Cleaner Production Programs." In *China's Environment and the Challenge of Sustainable Development.* ed. Kristen A. Day. (Armonk, N.Y.: M.E. Sharpe, 2005), p. 228.

[113] Millison 2005, p. 222.

[114] Elizabeth C. Economy. "Environmental Enforcement in China," in Kristen A. Day, ed., *China's Environment and the Challenge of Sustainable Development* (Armonk, N.Y.: M.E. Sharpe, 2005), p. 103.

[115] Economy 2005, p. 106.

[116] Economy, *The River Runs Black*, p. 200.

[117] Yáñez et al. 2002.

is a methodology to reduce use of toxic chemicals in agriculture through a combination of cultural, biological, and mechanical methods.

IPM projects have benefits beyond the obvious advantage of improving farmers' occupational health. These benefits can include financial advantages for producers, stimulation of new domestic markets, new opportunities in international markets, and improved gender dynamics in farming communities.

We examine IPM projects in two countries: Thailand and Vietnam. The project in Thailand has produced documented health benefits, in particular by making effective use of participatory training. Farmers learned to carry out health surveys, make informed decisions about pesticides, and reduce their pesticide exposures. The project has had the additional benefit of providing safer food options for consumers. In Vietnam, we look at the experience of a national IPM program that has improved health indicators, has successfully integrated gender issues into program activities, and may lead to trade-related benefits.

3.4.1 IPM project in Thailand

To boost productivity on limited land holdings, Thai grain, vegetable and fruit growers have been making increasingly intensive use of pesticides. Pesticide use in Thailand has increased tremendously in the last two decades. Some 39,000 tons of concentrated active ingredient were legally imported into the country in 2002; an unknown amount also enters the country illegally.[118]

According to government figures, during the 1990's, several thousand people sought hospital treatment for pesticide poisonings each year, and several dozen died. These figures are a low estimate of the incidence of hazardous pesticide exposures since most farmers do not seek treatment for mild or moderate symptoms. Another study suggests that there could be as many as 40,000 cases of poisonings each year, and that over 90% of agricultural workers in Thailand are affected by pesticides and other agrochemicals.[119] Exposures occur through food as well. Studies have found pesticide residues on anywhere from 45% to 85% of tested produce.

Thai-Danish cooperation

The Danish aid agency, DANIDA, has sponsored a five-year program on "Strengthening Farmers' IPM in Pesticide Intensive Areas." The project has worked to promote the adoption of IPM methods over the period 2001 to 2006. As a corollary, the project has also worked to increase the supply of low-pesticide and certified organic produce in the Bangkok and Chiang Mai markets, and to increase demand for these products.

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[118] IPM DANIDA Project, "Did you take your poison today?" 2003, available at http://www.ipmthailand.org/documents/Your_poison_today_(English).pdf.

[119] IPM DANIDA Project, 2003.

Among other activities, the project has developed IPM trainings and promoted the use of bio-pesticides as an alternative to toxic chemicals. Other activities have included testing produce for pesticide residues, certifying farms in IPM and organic production, and educating consumers about pesticide hazards. The project has made particularly successful use of participatory training methods. Project leaders conduct "Training of Trainers" courses; graduates of these courses then lead practical training sessions in IPM methods. Through these participatory trainings, farmers have learned to conduct health surveys and to develop monitoring and risk reduction programs in their communities.

Monitoring

Trainings were conducted in which farmers learned how to assess pesticide exposures within their communities. At the end of trainings, the farmers presented the test results to members of the community and resolved to create action plans to monitor pesticide impacts and to reduce these risks.

Baseline health surveys carried out over the course of the project indicated widespread health problems associated with exposure to hazardous pesticides. Farmer groups carried out pesticide health surveys in 2002, 2003 and 2004. One survey looked at pesticide use among farmers in six Thai provinces. The survey found that of about 600 farmers surveyed, a significant number were using WHO class 1a chemicals (defined as "extremely hazardous"), and nearly forty percent were using class 1b chemicals ("highly hazardous"). Many farmers were also using pesticides that are actually banned in Thailand. The survey found that 56% of farmers experienced moderate symptoms of pesticide poisonings. Of a smaller subsample, more than one in ten farmers tested positive for "dangerous" levels of acetylcholinesterase inhibition.[120]

Earlier surveys of small mango and vegetable producers had previously documented that producers were using up to 50 different brands of pesticide products, many of which contain active ingredients classified as WHO class 1a or class 1b products. [121] Poor storage and disposal practices were common.

Health benefits

A follow-up survey undertaken in March 2005 among a small sub-sample of farmers who had participated in the five-day pesticide health training found that one year later, farmers had increased their knowledge and changed their behaviour.[122] Farmers improved their storage of pesticides,

[120] IPM DANIDA Project, "Pesticide Health Surveys: data of 606 farmers in Thailand," IPM DANIDA Report #62, November 2004, available at http://www.ipmthailand.org/documents/Health_data_606_(English).pdf.

[121] IPM-DANIDA Project, "Farmers present results of pesticides-health survey to their community," Newsletter, 8 February, 2003, available at: http://www.ipmthailand.org/en/IPMDANIDA/18.htm

[122] IPM DANIDA Project, "A study of the impact of Pesticides-Health training: Mae Wang, Chiang Mai, Thailand," Summary of Thai report, April 2005.

disposal of empty bottles, and spraying practices. They also reduced their total use of pesticide and made more informed decisions about what chemicals to use.

Indirect benefits

Although the project was designed primarily to address occupational exposures among farmers, it also had other important benefits. For example, the project increased the availability of produce free of dangerous chemical residues and raised awareness of chemical safety issues among consumers. Thus, the project helped lay the groundwork for the gradual development of markets for "green produce." In the future, the sale of higher-priced organic and IPM-certified fruits and vegetables may also improve farmers' livelihoods.

3.4.2 IPM projects in Vietnam

A decade ago, Vietnam launched a national IPM program in response to the rising public costs of poor chemicals management in agriculture. Intensive and unregulated pesticide use in paddy rice and other crops had created severe occupational hazards for farmers. Poor chemicals management in agriculture also creates difficulties for trade: Vietnamese exports often have not met the increasingly stringent sanitary and phytosanitary (SPS) standards in export markets for horticultural and agricultural products.[123] The IPM program has significantly improved health indicators and may lead to trade-related benefits as a result of improving management in this area. The integration of gender issues into program activities has also resulted in improved female participation and leadership.

IPM program

In 1992 Vietnam began to participate in a regional FAO initiative on IPM, with support from Norway.[124] The program established six IPM training centers and opened Farmer Field Schools throughout the country. By 1999, Vietnam's National IPM Program had trained nearly 1500 trainers and 400,000 farmers in IPM methods for paddy rice.[125] Bilateral assistance from Australia, Switzerland, Denmark and the Netherlands has complemented these efforts, and additional programs funded with local or NGO resources have expanded training to crops such as vegetables, tea, coffee, groundnuts, cotton and soybeans. The Vietnamese government has also

[123] Bengt Bucht, Swedish Chemicals Inspectorate, personal communication, December 2005; Nguyen Him Huan, "Viet Nam promotes solutions to pesticide risks," Agro-Chemicals Report Vol. II, No. 1, January–March 2002; UNCTAD. *Draft Conclusions.* Sub-regional Workshop of UNCTAD on Environmental and Health-related Requirements, Market Access/Entry and Export Competitiveness in the Horticultural Sector. Institute for Trade and Development, Bangkok, 29 September – 1 October 2004. Available at: http://r0.unctad.org/trade_env/test1/meetings/bangkok6/Draft%20Conclusions%202nd.pdf.

[124] The FAO South-East Asia Inter-country Programme (ICP) on IPM.

[125] Nguyen Him Huan, "Viet Nam promotes solutions to pesticide risks," Agro-Chemicals Report Vol. II, No. 1, January–March 2002.

progressively increased the number of restrictions and bans on highly toxic pesticides since the early 1990s, and has dramatically reduced its imports of restricted chemicals.

Health and economic impacts.

Impact assessments from the IPM trainings showed that farmers' pest management skills were enhanced, decreasing pesticide use by an average of 75% and yielding cost savings on chemicals and seeds as well as improved community health.[126] The programs have also had notable economic impacts: farmers with IPM training were found to have increased their net profits by 20 percent, as a result of decreased costs and higher yields. Farmers also reported a decrease in medical costs.[127]

The restriction or banning of a number of highly toxic pesticides has also reduced health impacts. For example, a 1994 ban on methamidophos led to a sharp reduction in cases of food poisoning from residues of this pesticide in vegetables.[128]

Improved chemicals management could also lead to benefits in the area of international trade. Vietnam's access to international markets for agricultural products is dependent on its success in addressing pesticide residues on food.

Gender

In rural Vietnam, men often work in construction and as day laborers outside the village, while women take on the primary responsibility for farming in more than half of all farming households.[129] Women play an especially important role in transplanting, weeding and field maintenance activities, while men traditionally control soil preparation, seeding and chemical applications. Due to this gendered division of labor, a woman's capacity to alter production methods in the field directly depends on her ability to assert decision-making power in the household. The success of any technical assistance project in agriculture thus hinges on its ability to address gender issues in the course of its programming.

In one project, the Vietnam Women's Union (VWU) worked with the Australia-based International Women's Development Agency in an effort to reduce toxic chemical use in vegetable production. The project received support from the Australian aid agency, AusAID. In addition to conducting field-based IPM trainings with small vegetable producers, the project also included gender awareness activities. Through a series of Farmer Field

[126] Nguyen Huu Dung and Tran thi Thanh Dung, "Economic and health consequences of pesticide use in paddy production in the Mekong delta, Viet Nam," Economy and Environment Program for South East Asia (EEPSEA), Singapore, 1999.

[127] Nguyen Huu Dung and Tran thi Thanh Dung. *Economic and health consequences of pesticide use in paddy production in the Mekong delta, Viet Nam.* Economy and Environment Program for South East Asia (EEPSEA), Singapore, 1999.

[128] Nguyen Him Huan. "Viet Nam promotes solutions to pesticide risks," Agro-Chemicals Report Vol. II, No. 1, January–March 2002.

[129] FAO. "Field Guide on Gender and IPM," Vietnam National IPM Programme, 1996. Available at: http://www.communityipm.org/docs/gender.pdf

Schools, the project trained 360 producers in both IPM techniques and gender. In addition to raising community awareness of the health and environmental effects of pesticides, the project increased gender awareness in farming households.[130]

FAO's regional initiative on IPM, supported by Norway, also integrates gender into its training manuals and activities. Concerned that female participation in Farmer Field Schools was low, the Hanoi-based Center for Family and Women's Studies conducted a nationwide study to uncover the constraints to women's participation in the program. The study identified a number of barriers to women's participation, including time, family support, and selection criteria for the Farmer Field Schools. As these barriers were addressed, female participation in the program rose significantly, to 40 percent of all technical staff in some regions.[131] Gender programming is now considered vital to the overall success of the national IPM program.

The IPM case discussed here is just one example of the wide variety of on-going projects to achieve sound chemicals management in Vietnam. We discuss additional projects in Vietnam in our section on the role of bilateral aid programs, in Chapter 4.

3.5 Managing Medical Waste in India

Health care facilities are significant sources of persistent organic pollutants (POPs). Incineration of medical waste can release significant quantities of pollutants such as mercury and dioxins. Work in the US and Europe over the last two decades has focused on gradually moving away from incineration and introducing safer technologies for treatment of medical waste, such as autoclaving. Little has been done, however, to address these problems in the growing health care sectors in the rest of the world.[132]

India provides an example of one country that is beginning to address this problem. This case study describes a situation in which a developing country may be able to bypass a polluting technology and leapfrog to a safer technology at the outset. Thanks to the efforts of NGOs and international organizations working with local and national government agencies, opportunities have been created for regulators, industry, and environment and health advocates to work together. There is also a clear relationship between legislative work and other aspects of this effort to introduce sound chemicals management. Two organizations in particular have been very active on this issue in India, the India-based organization Toxics Link-Srishti and the international organization Health Care Without Harm.

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[130] http://www.iwda.org.au/work/vietnam/safefarming1.htm

[131] FAO 1996.

[132] GEF Concept Paper Summary prepared by Health Care without Harm, "Promoting Best Practices to reduce Health Care Waste and Avoid Dioxin and Mercury Releases" (Updated February 2005).

3.5.1 Hazards of medical waste incineration

Disposal of medical waste poses a unique set of challenges because of the need to control pathogens that may be contained in that waste. Incineration of medical waste destroys pathogens, but creates severe pollution problems. Many instruments regularly used in medical facilities, such as thermometers, blood pressure monitors, dental amalgam, and thermostats, contain mercury. Mercury is also used in laboratory reagents and in procedures such as x-rays. Mercury from medical waste enters the environment when it is incinerated. Dioxins can also be released through the improper incineration of medical waste, which often contains PVC.[133]

There are two main options for reducing or eliminating the hazards associated with incineration of medical waste. First, eliminating the most toxic substances from medical devices can make the waste stream less hazardous to incinerate. Priorities in this arena include eliminating mercury as a component of medical devices, and eliminating the use of PVC medical devices. Non-burn technologies for treatment of medical waste include autoclaves (which sterilize medical waste using heat) and microwave devices. Medical waste that has been sterilized using one of these technologies can be landfilled.

3.5.2 Legislative initiatives

Until 1996, all hospitals in India were required by law to have an incinerator on site. An intervention by Toxics Link-Srishti and ongoing public interest litigation in the Supreme Court relating to waste disposal in Delhi led to new legislative initiatives culminating in 1998. However, there is still room for improvement in practice, particularly in state-run hospitals.

In 1998, India promulgated its national legislation on medical waste. Under the amended legislation, hospitals and other health care facilities had the option to treat biomedical waste at a common waste facility, rather than disposing of all waste on-site. The legislation also banned the incineration of all chlorinated plastics such as PVC.[134] A further amendment in 2000 made local authorities responsible for providing suitable sites for centralized facilities.[135] Although many of these centralized facilities continue to use incineration, they are generally superior to the facilities at individual hospitals. Most centralized facilities have autoclaves and shredders in addition to incinerators. At least in principle, hospitals are required to segregate waste before sending it to these centralized facilities. Centralized facilities are also easier to monitor for total pollution levels.[136]

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[133] HCWH, "Promoting Best Practices to Reduce Health Care Waste," p. 3.

[134] Ravi Agarwal, Toxics Link, Personal communication, January 2006.

[135] Toxics Link, "Bio-medical waste: Centralized Solution for a Decentralized Problem," Factsheet No. 17, July 2003, p. 1.

[136] Toxics Link, "Bio-medical waste: Centralized Solution for a Decentralized Problem," Factsheet No. 17, July 2003, p. 1–2.

However, these amendments were not sufficient to end incineration. A 2000 study showed that Delhi alone had 59 incinerators, most of which were burning mixed waste and causing toxic pollution. Furthermore, surveys in 2001 and 2002 of hospitals in Delhi showed that none of their incinerators were meeting emission requirements. [137]

In 2004, India adopted new guidelines for incineration that strongly discouraged the use of incineration. The guidelines raised the standards for design and operation of an incinerator, making use of incineration technology more expensive, and created new limitations on the types of waste designated for incineration. In addition, the guidelines stated that on-site incinerators were permitted only under exceptional circumstances and with special permission.[138]

Following the adoption of the new Guidelines for incineration in Delhi, very few health care facilities continue to use incinerators, as the costs in fines for sub-standard emissions as well as for maintenance, and electricity has become more costly than separating the waste and sending it to a private or centralized facility that specializes in medical waste disposal. In fact, only 17 state facilities continued to operate their own incinerators.

In a significant additional step forward in 2005, new rules were adopted prohibiting the incineration of syringe waste resulting from government immunization drives. Over 300 million syringes are used for immunization in India of a total of 4.2 billion plastic syringes used annually. The government also commissioned a consultancy project for monitoring emissions of dioxins and furans in the emissions of incinerators from major hospitals.[139] Guidance materials on waste handling have also been widely disseminated, many training courses have been developed, and hospital suppliers have begun manufacture of non-PVC blood bags, autoclaves, needle cutters and other worker safety devices.[140]

Many challenges still remain. In 2004, Toxics Link reported continued problems with incinerators due to a variety of causes. The 2004 guidelines had not yet been incorporated into formal legislation and were thus not enforceable. Some state pollution control boards continued to recommend incineration for medical waste disposal as late as 2003. Also, government hospitals in Delhi were less responsive than other health care facilities to financial considerations and thus continued to use on-site incinerators despite rising operating costs. These incinerators had poor emissions standards and indirectly encouraged poor segregation before burning. In addition, there have been some attempts to push for small-scale incinerators and open burning for immunization waste disposal, which again do not meet emission standards.[141]

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[137] Toxics Link "Incinerators in Delhi-State the Biggest Polluters," p. 4.

[138] Ravi Agerwal, Toxics Link, personal communication, January 2006.

[139] "India: Medical Waste Incineration (Alternatives and Segregation)," *The Hindu* (November 11, 2005).

[140] Ravi Agerwal, Toxics Link, personal communication, January 2006.

[141] Toxics Link "Incinerators in Delhi-State the Biggest Polluters," p. 4–5

3.5.3 Voluntary initiatives

Alongside these legislative initiatives, some hospitals have undertaken voluntary initiatives to reduce use of toxic substances. A 2004 report highlighted the dangers of mercury and pointed out that healthcare workers in India were generally ill-equipped and ill-trained to deal with mercury. Between 2003 and 2005, several leading health care facilities in Delhi and Chennai have begun phasing out mercury.[142] The first hospital to undertake a mercury phase-out, St. Stephens Hospital, began by phasing out mercury-containing thermometers and blood pressure gauges and has stated a commitment to phasing out mercury completely. A leading healthcare chain, Max Healthcare, does not have a formal policy on mercury but announced in 2004 that it would only purchase non-mercury thermometers and blood-pressure gauges. In 2004 two other large hospitals also began programs to reduce or eliminate mercury use and to improve staff training in handling of mercury waste and spills. Voluntary initiatives of this kind reinforce the gains achieved through legislation.

3.5.4 Centralized waste treatment facilities

With efforts to reduce on-site incineration, centralized facilities for medical waste disposal have become increasingly important. Disposal of hazardous medical waste can be a commercial venture, and is also easier to monitor in a central facility. However, it does not solve the incineration problem entirely. As of 2003, all of the centralized facilities used incineration. Furthermore, many have encountered problems in achieving financial viability; many facilities are too large relative to the demands for their services; and insufficient regulatory control allows hospitals to deliver unsorted waste.[143]

3.5.5 Alternative technologies

Although centralized facilities are beginning to meet the disposal needs of urban medical facilities, rural areas are in need of simpler technologies to help with the safe disposal of hazardous waste with minimal cost. As auto-disable syringes are being pushed in immunization campaigns, there is an increasing need for solutions for treating the syringes used during these drives, as well as other potentially hazardous biomedical waste. Scientists have invented several devices, some designed in India, which could potentially provide low cost, low management sterilization technology in the developing world. For example, the international nongovernmental organization Health Care Without Harm launched a competition in 2002 in order

[142] Toxics Link, "Success Story: Delhi Hospitals phase out mercury," www.toxicslink.org August 16, 2005.

[143] Toxics Link, "Bio-medical waste: Centralized Solution for a Decentralized Problem," Fact-sheet No. 17, July 2003, p. 3.

"to promote clean, efficient, and low-cost treatment technologies for rural areas."[144] The first prize went to a solar powered autoclave. Honorable mentions from India included the Scheffler Reflector, which provides heat from a rotating solar reflector for sterilization; and the Box-Type Solar Cooker, an autoclave with an internal shredder, which treats and disinfects previously separated waste.

3.6 Building capacity in the Dnipro River Basin

The Dnipro River is more than two thousand kilometers long and covers a drainage basin of more than 500,000 square kilometers.[145] The river and its tributaries flow through Russia, Belarus and Ukraine, serving as a vital artery for these three countries and as Ukraine's primary water source. While most of the annual river flow is collected in the upper parts of the basin, agricultural and industrial activities in the middle and lower stretches of the river in Ukraine consume the lion's share of the water. The Dnipro is a critical source of freshwater, serving as a source of drinking water for more than 33 million people living in its Basin. A full 70 percent of the Ukrainian population relies on the Dnipro for drinking water.

The river's water quality has been seriously degraded over the years due to a number of factors. These include excessive damming of the river system leading to the accumulation and frequent resuspension of contaminated sediments; large-scale water extraction for agricultural and industrial uses; discharge of untreated or inadequately treated process water (in particular from metallurgic industrial complexes); chemical runoff from intensively farmed agricultural tracts; contamination of river sediments with radioactive cesium from the Chernobyl accident; and discharge of more than half of total wastewaters without treatment. Nearly 20 billion cubic meters of untreated effluent were being dumped on a yearly basis in the Dnipro, over a third of its annual flow.[146] As a result, the Dnipro has suffered from dangerously high nutrient and bacterial loads and is contaminated with heavy metals and toxic organic contaminants such as PCBs, polyaromatic hydrocarbons (PAHs) and pesticides.

In this case study, we look at the experience of a tri-country effort to address pollution of a crucial water resource. In this project, the Canadian International Development Agency (CIDA) provided aid to three countries to work simultaneously on this transnational problem. The program fo-

[144] Toxics Link – "Non-incineration treatment technologies for rural areas" Factsheet Number 18, October 2003.

[145] This section draws in part on information provided by Myron Lahola, Office for Central and Eastern Europe Initiatives, International Development Research Centre, Ottawa; OCEEI Programs in Central and Eastern Europe: http://www.idrc.ca/en/ev-27695-201-1-DO_TOPIC.html. UNDP-GEF Dnipro Basin Program: http://www.dnipro-gef.net/ .

[146] Guilmette, Jean-H. "Lessons learned from the EMDU project," 1998. Office for Central and Eastern Europe Initiatives, International Development Research Centre. Third International Congress and Technical Exhibition. "Water : Ecology and Technology". Moscow, 25–30 May 1998. Available at: http://archive.idrc.ca/oceei/papers/lessons-ecwatech_e.cfm

cused primarily on capacity building at the government level, but also included technical assistance to individual municipal and industrial plants on the Dnipro River as a subcomponent of the program. Because technical activities were administered by a newly established fund in Kiev responsible for grant-making to program beneficiaries, less information is available on these activities.

The project led to significant improvements in administrative capacity, as well as some important legislative initiatives. Information on environmental and human health outcomes is limited, both because there was little baseline information at the outset of the project, and because results are likely to become evident only gradually.

The CIDA program was implemented in two main phases. The first, the Environmental Management Development in Ukraine (EMDU) Project, focused on institutional reform and environmental management in Ukraine, while the second, the UNDP-GEF Dnipro Basin Environment Program, dealt with transboundary management of the Basin. During this second phase, CIDA also launched two smaller national programs in Belarus and Russia to enable these countries to participate effectively in the UNDP-GEF Dnipro Program.

3.6.1 Environmental and health indicators

The results of environmental and human health assessments conducted under the former USSR regime were kept classified and never released, so reliable baseline epidemiological and environmental information for the Dnipro Basin was lacking. The first Water Quality Survey of the Lower Dnipro River Basin, undertaken in 1994 by a Canadian-Ukrainian team, identified 3 major problems: accelerated eutrophication due to municipal and agroindustrial discharge; industrial pollution; and radionucleide contamination of reservoir sediments. The lower basin area was found to be affected by pollutants from a range of industries, including heavy industry, oil refining, mettalurgy, petrochemistry, mining and power generation. More than two thirds of industrial wastewater samples were found to contain elevated levels of toxic chemicals. The majority of tributaries was found to suffer from poor water quality and exceeded local pollution standards. Biotic communities such as plankton were severely reduced as a result, and fish populations found to suffer from serious chemical contamination.[147] In addition, anecdotal evidence such as an increasing frequency of cholera and hepatitis outbreaks among the Basin's human population suggested important health impacts. The situation was labeled as critical.[148]

[147] Vasenko, O.G. "Environmental Situation in the Lower Dnipro River Basin," *Water Quality Research Journal of Canada*, 33:4 (1998), 457–487.

[148] Babcock, Ken and Jan Barica, "Why the Dnipro?" *Water Quality Research Journal of Canada* 33:4 (1998), 453–455.

3.6.2 A tri-country assistance project

The EMDU Project was launched in 1994, a few years after the declaration of Ukrainian independence from the USSR, and continued until 2000.[149] The objective was to assist the Ukrainian government in its rehabilitation of the country's environment and its revival of environmental research activities.

The CIDA-funded environmental assistance package to Ukraine focused on generating indigenous environmental management capacity across relevant government ministries, municipal departments, research and educational institutions, and local organizations. The project used a multi-pronged approach to institutional development and environmental management, including human resources and information systems development, building financial capacity, implementation of demonstration projects, and introduction of technological reform.

Under the Soviet regime, coordination of activities across relevant ministries was poor and characterized by secrecy and duplication of efforts; data collection, analysis and management practices were outdated; and technologically advanced equipment was scarce. Instead of focusing activities on technical assistance targeted to specific polluting industries, the CIDA project sought to stimulate the development of a broad-based environmental management capacity in Ukrainian institutions as a first step towards the institutionalization of cleaner production practices across industries.

The first phase (1994–1997) of the EMDU project aimed to contribute to the environmental rehabilitation of the Dnipro River system by building environmental management capacity in Ukrainian institutions. A second phase (1998–2000) focused on supporting and strengthening the on-going reform process in Ukrainian institutions for better environmental protection activities, including promoting industrial activities with a favorable impact on the Dnipro Basin environment. Finally, building on achievements from EMDU and based on a transboundary diagnostic analysis of the entire Dnipro River Basin, Canada's International Development Research Council (IDRC) developed the UNDP-GEF Dnipro Basin Environment Program in partnership with the United Nations Development Program (UNDP), the Global Environment Facility (GEF), and Ukrainian, Russian and Belarusian authorities. The partnership with IDRC is meant to facilitate continuity with ongoing projects in the region.[150]

CIDA also addressed environmental management capacity in Belarus and Russia by funding a parallel project, the Environmental Management

[149] The program was implemented by the Office for Central and Eastern Europe Initiatives in the Ottawa-based International Development Research Centre (IDRC) in partnership with the Ukrainian Ministry for Environmental Protection and Nuclear Safety along with other organizations.

[150] IDRC. Final Report to the Canadian International Development Agency: Environmental Management Development in Ukraine, 01 January – 30 September 1997. 1997: IDRC File No. 93-0905-000-CE, Office for Central and Eastern Europe Initiatives, IDRC. Report No. OCEEI.54. 21 October 1997. Available at: http://archive.idrc.ca/oceei/emdu1/finalrpt_e.cfm

Development of the Dnipro for Belarus and Russia from 2000 to 2003. The project was developed to allow these two countries to participate effectively in the UNDP-GEF Dnipro Program despite Ukraine's advance lead in capacity development as a result of the EMDU projects.

3.6.3 Activities

Activities in the first phase of the project focused on environmental management capacity building with municipal and federal authorities, and water pollution control activities, with an emphasis on "short-term, relatively low-cost, high payoff solutions bringing immediate improvement."[151] The capacity-building component of the program emphasized human resources development, public education and the development of information systems. Selected Ukrainian policymakers and senior inspection and technical managers were offered training in modern river basin and water quality management as well as economic analysis methodologies. Pilot information systems incorporating remote sensing and GIS were also tested and manuals and training courses provided. Finally, public education activities supported the development and distribution of environmental education materials in various media.

Meanwhile, pollution control and prevention activities focused on environmental auditing in the agro industrial sector and the introduction of green technologies, in addition to undertaking a large scale water quality survey of the Ukrainian portion of the river basin. Technical assistance activities focused on Zaporizhzhia city in the southern Dnipro sub-basin, one of two major industrial cities located on the southern Dnipro, where municipal and industrial plants are major sources of water pollution. Based on the results of the audits, a Ukrainian-Canadian team developed a list of recommendations for plant safety procedures, in-plant cleaning programs, equipment repair to reduce leaks and emissions, identification of opportunities to minimize waste, energy, and water use; and demonstration of appropriate new technologies. In the area of municipal water pollution control in Zaporizhzhia, the program supported an audit of municipal water authorities to identify areas for improvement; training and technology demonstration activities; and leak detection and water metering to promote water conservation.

Activities in the second phase of the project built on those initiated during the first phase. They involved further capacity building activities such as strengthening professional development and training programs in project and environmental management; strengthening research, monitoring and reporting capacity on water toxicology; and promoting public outreach and education through the use of electronic media. On the technical side, a program of environmental audits and clean production was initiated in

[151] EMDU-1 Project summary, IDRC. Available at: http://reseau.crdi.ca/en/ev-28216-201-1-DO_TOPIC.html

major Dnipro Basin industrial plants. Plant managers were trained in cleaner production principles as a tool for problem solving, cost reduction and waste minimization in the facility. Follow-up visits by Ukrainian auditors documented implementation of low and moderate cost recommendations. Other technical activities centered around improving drinking water quality and reducing groundwater contamination from landfills.

3.6.4 Outcomes

Important outcomes of the EMDU project included creation of new institutional frameworks; development of improved institutional capacity in government ministries; creation of new data systems; technical advances in monitoring and maintenance of water quality; interministerial, international and transboundary collaboration; and passage of new environmental legislation. The Ukrainian Scientific Centre for Protection of Water and other institutes undertook a Baseline Water Quality Study of the Dnipro river, and a computer-based information system was established. Internationally recognized water quality standards were adopted; water purification systems were installed in 30 schools and clinics in Kiev; municipal water quality control practices were adopted in Zaporizhzhia; and environmental auditing of selected polluting industries was introduced.

3.6.5 Legislation

One important outcome of the project was the adoption of new legislation in all three participating countries. Belarus and Russia developed National Action Plans for the Dnipro River Basin, building in part on the work that was accomplished through this project. Ukraine adopted a National Environmental Plan[152] with formal recognition of the EMDU Project and IDRC. Some of the leaders of EMDU were heavily involved in the Plan's preparation and acceptance. Ukraine also used the results from the Baseline Water Quality Survey to help formulate policy in the areas of municipal regulations governing water quality, metering, and standards for environmental auditing.

3.6.6 Driving and restraining factors

The volatile post-Soviet environment posed one of the major constraints to successful implementation of the EMDU program. The absence of common concepts and terminology around economic management principles also presented initial obstacles to establishing local financial management of the program.

[152] Also known as the National Program on the Improvement of Ecological State of the Dnipro River Basin and Quality of Drinking Water.

The lack of cooperative relationships among sister organizations in government ministries presented obstacles to information sharing, project management and overall transparency. For example, IDRC commonly found two or three organizations carrying out parallel monitoring work on water quality. Decades-long isolation from international scientific networks meant that internationally recognized research standards were not routinely employed, and technologically advanced equipment and computerization was not in place.

These aspects presented obstacles to developing a demand-driven programming methodology based around local ownership and management and operating according to internationally recognized standards. It also slowed the development of long term collaborative partnerships.

In the UNDP-GEF Dnipro Basin Program, a lack of harmonization of environmental legislation among Belarus, Russian and Ukraine hampered progress towards transboundary coordination. Harmonization of the national Water Codes of the Dnipro River countries, as is now being planned in the context of the Strategic Action Plan, should facilitate further cooperation.

Information gaps

An enormous amount of diagnostic information is being generated in the context of the GEF Dnipro Program, both in the form of environmental assessments and audits as well as policy analyses. Areas studied include: ground drinking water reserves, radioactive contamination of the Basin, agricultural waste management, analysis of industrial waste storage facilities and environmental legislation and impact assessment reviews. Ongoing monitoring of surface river water quality in addition to other environmental indicators is taking place, but the resulting data is tailored to internal program uses and has not yet been presented in a format that allows us to isolate and assess the impacts of the project activities. In addition, effects are likely to be measurable over the course of years if not decades.

To our knowledge no population-wide epidemiological study of baseline or ongoing health impacts of the EMDU or other Dnipro Basin projects has been conducted. Likewise, it may be too early to discern these types of impacts at a broad scale. For individual cleaner production projects, facility-level case study information was not documented systematically.

4. Role of Bilateral Aid and Institutional Cooperation

Several bilateral and multilateral aid agencies have been working for a number of years to facilitate, promote, or provide direct support to efforts at sound chemicals management in recipient countries. Other aid agencies have dealt with chemical problems occasionally, in an ad hoc fashion, and in the course of other programs.

In this section, we look at the range of approaches that aid agencies have taken to promoting sound chemicals management in recipient countries and offer some observations on approaches that seem particularly promising. Some projects have taken the form of direct support to individual cleaner production projects; others have consisted primarily of technical assistance; and still others have focused on creating the conditions for bilateral cooperation on legislative initiatives.

It is important that bilateral aid agencies communicate effectively with recipient countries about the possibilities for addressing chemical exposures. NGO representatives have observed that some opportunities are missed because recipient countries are unaware they can request aid for chemicals management, and aid agencies are unaware that this aid is needed.[153]

4.1 Legislation

Countries that are currently developing their legislation on chemicals have the opportunity – at least in principle – to adopt rational and effective legislation from the outset. Many developing countries are producing, importing, and using industrial chemicals and yet they lack sufficient regulatory and administrative structure to control those chemicals. Furthermore, some countries lack the regulatory capacity to implement international agreements on chemicals to which they are signatories. More generally, developing countries are often poorly equipped to deal with chemicals – they lack systems for controlling exposure, systems for distributing information about chemical hazards, regulations to prevent chemicals from being disposed of in water sources, systems for enforcing bans, systems for administering fines when chemicals are released illegally, and so on. Thus, some countries have developed institutional cooperation agreements to share

[153] Joseph DiGangi, Environment Health Fund, personal communication, 2006.

expertise and experience on the legislative and administrative aspects of chemicals management.

4.1.1 Case study: Institutional Cooperation for Chemicals Legislation in Vietnam

Vietnam is engaged in a range of projects to improve chemicals management, including legislative initiatives and cleaner production projects. Projects of interest in Vietnam include a nationwide phaseout of leaded gasoline; improved hazardous-waste management by Vietnam's largest electricity provider; and a project to improve disposal of waste from leather production facilities, among others. Vietnam is receiving assistance from Denmark on a range of environmental issues, including cleaner production. In addition, Vietnam has requested international assistance with management of some persistent organic pollutants (POPs). Goals include finding ways to manage more than 4,000 pollution "hot spots," including industrial sites, pesticide storage sites, and war sites.

Here, we look at two relationships that Vietnam has developed for international cooperation on development of legislative standards. Vietnam is currently involved in an institutional collaboration with Sweden, in which Sweden is advising Vietnam on the development of its chemicals legislation. Vietnam is also working with Norway to improve environmental standards in oil extraction.

Institutional cooperation with Sweden

Swedish collaboration with countries that are working on creating or strengthening their chemicals legislation emphasizes the importance of creating strong institutions. The Swedish Chemicals Inspectorate (KemI) has defined a set of priorities for development of new legislation, for purposes of its international collaborative relationships, as follows: development of a framework law including concepts such as precaution; secondary legislation providing more detailed guidance; ministerial coordination; and clear division of responsibilities and mandates for enforcement.[154]

Vietnam is currently in the process of drafting a framework law on chemical safety. The framework law sets out general principles and basic rules. Vietnam is also developing secondary legislation on issues such as labelling, safety data sheets and prohibition of certain particularly dangerous substances (including implementation of the POPs convention). Institutional cooperation between Vietnamese officials and their Swedish counterparts began in June 2005. In this collaboration, KemI shares Swedish and European experience on this kind of legislation, informing the drafting process.

[154] Torbjörn Lindh, Swedish Chemicals Inspectorate (KemI), personal communication, November 2005.

This work takes place in the context of long term cooperation between Sweden and Vietnam with the objective of strengthening environmental management in Vietnam. The Swedish International Development Agency (Sida), the Swedish EPA, and KemI all play a role in this work.

Standards in oil and gas extraction: Petrovietnam and SFT-Norway

Norway's institutional collaboration with Vietnam's publicly owned oil and gas company, Petrovietnam, is an example of a cooperation program focused on supporting the development of legislation and regulatory frameworks for improved environmental management in polluting industries. The project also contains technology and knowledge transfer components.

The VietNam Oil and Gas Corporation (Petrovietnam, or PV), the Norwegian Petroleum Directorate and the Norwegian Pollution Control Authority (SFT) have been working as partners in the cooperation project which was launched in 1996 and entered its second phase in 2001. The Norwegian Coastal Administration has also been involved with key aspects of the project in phase 2.[155] Because PV is publicly owned and serves as both the government's "primary commercial instrument in the oil and gas sector" as well as its regulatory and administrative body for the sector, it became Norway's natural institutional ally for a technical assistance and institutional collaboration project of this sort.

The first phase of cooperation was organized around three main axes: safety management, environmental management, and institutional cooperation. As part of this work, Norway provided expertise and assistance in the development of key elements of a national oil and gas regulatory infrastructure. A Safety Management Regulation was signed into law in 1999; official Guidelines on risk management, work environment, supervision, and environmental and chemicals use monitoring were elaborated and presented to industry; an Oil Spill Contingency Plan was prepared; and training programs and transfers of computer technology were conducted including of information management systems. Throughout the project, competence is continually being built among PV staff as well as its subsidiaries and joint venture companies to both support these new regulatory functions and further develop the regulatory infrastructure.[156]

In Vietnam's view, Norway's cooperation in the sustainable development of its oil and gas sector is considered vital to securing broad-based economic growth in the country. Meanwhile, Norway focuses on the project as contributing to the establishment of crucial health, safety and environmental management guidelines in the industry.[157] Both are likely to be

[155] In particular, the Vietnamese Oil Spill Contingency Plan (OSCP). Specific activities include the development of related regulatory guidelines and manuals, training and risk assessment in OSCP implementation, and information systems management.

[156] Petrovietnam. Development of Management Systems on Safety and Working Environment & Pollution Control in the Vietnamese Petroleum Industry. Project Proposal, Phase 2. Hanoi, March 2001.

[157] *Institutional Cooperation between Petrovietnam and SFT*. Access at: http://environment.norad.no/projects.cfm?projectid=1085

true: the technology transfer and institutional development aspects of the project are likely to contribute to both better environmental management and sustained growth in Vietnam's petro-gas sector with the adoption of modern technologies and management systems.

4.2 Cleaner Production

Bilateral aid programs can support cleaner production by sponsoring national or regional programs, providing technical or financial assistance to a specific industry sector, or facilitating demonstration projects at individual facilities.

4.2.1 Support to cleaner production programs

Aid programs can provide funding for cleaner production training and capacity building programs. This may include support for training programs, workshops, or employment of technical experts who provide facility-specific advice. To name one example, the Industrial Pollution Prevention Program (IPPP) in Zambia, financed by the Norwegian Agency for Development Co-operation (NORAD), includes local capacity building for cleaner production through "train the trainer" programs and the establishment of a National Cleaner Production Centre. In the most successful cases, services of this kind tend to be combined with other existing technical services to industry. Providing cleaner production information along with mainstream technical services tends to increase the likelihood that firms will adopt cleaner production options.[158]

4.2.2 Support to individual facilities

In other instances, aid agencies may help to pay for specific measures at individual companies, such as acquisition of new equipment that allows a reduction in use of toxic chemicals. This can be important in an instance where a facility is considering a cleaner production option that has a several year payback period.

For example, Msasa Plating, a small electroplating facility in Zimbabwe, had problems including high water use and discharges of highly polluted waste water, including cyanide and heavy metals, into the municipal sewer. A cleaner production assessment found that the company could significantly reduce total use of toxic chemicals by investing in a semi-automatic electroplating rack system. DANIDA shared the cost of this new system with the company, each investing half of the total cost.[159] DANIDA

[158] Massey 2005, pp. 58–61; James Gallup and Betsy Marcotte, "Technology Transfer and the Environmental Pollution Prevention Project (EP3)," *Journal of Cleaner Production* 12:3 (April 2004).

[159] H. Anyway Munjoma, "Msasa Plating Ltd: Report of the Cleaner Production Demonstration Project: Installation of a Semi Automatic Electroplating Rack System." (January 2002). Cleaner Pro-

also supports the Cleaner Textile Production Project in South Africa, which we describe in detail in Chapter 3.

4.2.3 Case study: NORAD in Zambia

In Zambia, NORAD has been working with the Environmental Council of Zambia (ECZ) since it was created in 1992.[160] This partnership has included activities to build administrative capacity within government, and to build capacity for cleaner production in a number of industrial sectors, as well as among mining companies and water and sewerage facilities.[161]

Early NORAD-supported projects established a National Environmental Information System, an Environmental Management System for Zambian industry, and air pollution standards and regulations.[162] Since 1997, NORAD has supported the Industrial Pollution Prevention Program (IPPP) which promotes pollution prevention and control through two subprograms.[163] One subprogram is a collaboration between the Norwegian Pollution Control Authority (SFT) and ECZ and involves capacity building within ECZ's pollution control division in the areas of regulation of air pollution and hazardous wastes, water quality guidelines, and environmental information systems.

The other subprogram builds industry capacity for cleaner production and is managed by the Zambia Association of Chambers of Commerce and Industry with technical support provided by the Norwegian consulting firm Det Norske Veritas (DNV). It works with mining and other industries to address problems of waste generation, air, water and land pollution, and excessive energy consumption. The goal of this subprogram is to help Zambian industry to reduce raw material use and waste generation "while improving competitiveness and profits."[164]

The cleaner production subprogram has boosted local capacity building through "train the trainer" programs and the establishment of a Zambian Cleaner Production Centre. It carried out a number of training programs between 1998 and 2004, and implemented cleaner production projects in 75 companies,[165] including the former Zambia Consolidated Copper Mines and Maamba Collieries, among others. The program claims "good, measurable environmental improvements" complemented with financial

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duction Project Report produced through a joint project between Zimbabwe and DANIDA. Available through UNIDO at https://www.unido.org/NCPC/ReportTexts/NCPC00001017.pdf. Also discussed in Massey 2005, pp. 29–30.

[160] http://environment.norad.no/projects.cfm?projectid=1015

[161] Environmental Council of Zambia (ECZ) and Zambia Association of Chambers of Commerce and Industry (ZACCI). (14 MARCH 2000). Proposal for Industrial Pollution Prevention Programme (IPPP) Phase II. p27.

[162] ECZ and ZACCI 2000, p4.

[163] Norwegian Environmental Assistance: Industrial Pollution Programme in Zambia, described at http://environment.norad.no/projects.cfm?projectid=1015.

[164] ECZ and ZACCI, p. 62.

[165] Environmental Council of Zambia, "Cleaner Production Programme in Zambia," available at http://www.dnv.com/consulting/generalindustries/devass/cleanerprodprogrzambia.asp, viewed December 2005.

benefits to participating local industries of US$32 million in savings annually and an average payback time of 4 months.166

4.3 Research

Some aid agencies support research efforts in developing countries, as well as occasional research projects in the donor country that are clearly relevant to developing countries. This approach reflects an understanding both that research can help to further development goals, and that the development and maintenance of research capacity within developing countries is an important goal in itself.

For example, one of the core activities of the Swedish Agency for International Development Assistance (Sida) is to sponsor research programs that are based in, or have important implications for, aid recipient countries.[167] Among its many sponsored research programs, Sida has supported a number of research projects on cleaner production options.

For example, one current project is looking at options for reduction or elimination of toxic chemical use in tanneries. Another research project is investigating options for eliminating mercury and other toxic substances in gold processing. In Zimbabwe, Sida supports a project to monitor pollution associated with disposal of urban solid waste and mining waste. A research program in Nicaragua focuses on the environmental impacts of mining activities and of pesticide and fertilizer use and aims to strengthen domestic research capacity "in assessment of environmental impact of pollutants and in mitigation of environmental damage and risks." In India, Sida supported a project examining arsenic contamination of drinking water. In Vietnam, Sida has provided support for a study of toxic chemicals from pulp and paper industries and their environmental impacts.[168]

Another potentially important area for research is to gather data on indicators of chemical exposures, and to track the links between these exposures and health endpoints. Such research can help to identify areas for risk reduction. We discuss this point further in the section on directions for future research, in Part III.

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[166] ECZ and ZACCI 2000, p. 6; Environmental Council of Zambia, "Cleaner Production Programme in Zambia."

[167] Information on research projects sponsored by SIDA/SAREC can be found at http://www.sida.se/sida/jsp/sida.jsp?d=254&a=4508&language=en_US, viewed December 2005.

[168] Information drawn from the following websites: http://lthtg.tg.lth.se/~tda/newsarec.html; http://lthtg.tg.lth.se/~tda/nicaragu.html; http://www.ait.ac.th/AIT/schools/serd/eep/research.htm.

PART III – Directions for Future Research

5. Directions for Future Research

In this section, we suggest possible areas for future research and action. These include examining the effects of trade relationships on chemicals management, and improving systems for tracking environmental health indicators, among others.

5.1 International trade and investment

International trade and investment relationships have the potential to play either a positive or a negative role in the development of sound chemicals management.

On the positive side, individual companies can take the initiative to improve standards throughout the supply chain. The H&M case discussed in Chapter 2 is an example of one such initiative. In addition, high standards on chemicals in one region can create the incentive for trading partners to raise their standards. For example, the Restriction on Hazardous Substances (RoHS) Directive in Europe, which limits the use of hazardous substances in electronic equipment, has created an incentive for producers of electrical and electronic equipment in many countries to develop safer products. REACH, which requires manufacturers and importers of chemicals to provide information on the environmental and health impacts of their products, is also likely to benefit countries that export to Europe since the information requirements will facilitate risk management in the producing country as well. In another important area, health standards limiting pesticide residues on food in countries that import agricultural products can create incentives for exporting countries to reduce use of hazardous chemicals in agriculture and agroprocessing.

Going a step further, eco-labeling can create incentives for improvements in chemicals management. For example, as we saw in the discussion of the South African textiles industry in Chapter 3, the possibility of gaining certification through a label such as the EU flower can create incentives to reduce use of toxic chemicals, rewarding firms that do so successfully. The same is true of organic certification systems.

On the other hand, international markets and trade relationships can create incentives for developing countries to produce goods that involve the use of toxic chemicals, with the attendant risks of occupational exposures and hazardous wastes. Furthermore, bilateral and multilateral agreements on trade and investment can limit the ability of individual governments to legislate high standards on chemicals. Free trade agreements may contain clauses that constrain the ability of governments to raise standards

on chemicals and other environmental issues. For example, the North America Free Trade Agreement (NAFTA) agreement contains a clause that allows individual companies to sue national governments for losses "tantamount to expropriation." This clause has been interpreted in some instances to allow companies to sue for losses resulting from new environmental legislation that could reduce the expected profits of a foreign investor by curtailing allowable activities.

World Trade Organization (WTO) rules also potentially limit the prospects for improving chemicals management. In some instances, for example, WTO rules can run counter to the goals of greening the supply chain, by prohibiting discrimination among goods based on the process by which they were produced, rather than by content of the goods. For example, a country's decision not to import goods that have been produced using cancer-causing chemicals could be ruled illegal under WTO rules. Multilateral investment agreements can also influence the ability of individual countries to design legal and administrative systems for sound chemicals management.

Thus, one important area for future research is to examine how trade and investment agreements affect the development of sound chemicals legislation in developing countries. This could include investigating whether such agreements limit the ability of individual countries to comply successfully with international agreements on chemicals, such as the POPs treaty and the Basel Convention on hazardous waste. Given the widespread interest in helping developing countries to draft and adopt strong legislation on chemicals, it is worth investigating how trade and investment agreements may help or hinder this process.

5.2 Health indicators

There is significant room for improvement in tracking of health indicators associated with environmental exposures. We suggest that there is room for further research in two areas in particular: broad tracking of indicators of environmental exposures, and tracking of specific health outcomes associated with individual cleaner production projects.

In general, there is a critical lack of data on the relationship between health and environment in the developing world. For example, few data are available on the extent of lead and mercury exposure. An Indian NGO representative pointed out that India has no cancer registries and no system for recording health effects from asbestos exposure. Indian NGOs have suggested that tracking of toxic exposures and their health effects should be incorporated into existing government-run health surveillance systems.[169] Occupational health data are also inadequate.

[169] Ravi Agarwal, Toxics Link, personal communication, January 2006.

The World Health Organization tracks certain environmental health indicators, including pesticide poisonings and some effects from air pollution. But many other indicators could be tracked and are not; for example, there is a lack of systematic tracking of cancers and of exposure to toxic metals, except through certain programs that track exposures associated with a specific industry. For example, an extensive UNIDO-sponsored program tracks mercury pollution and exposures associated with artisanal gold mining.

Decisions about whether or not to track a particular indicator can have a significant effect on priority setting. If there is no monitoring of exposure to toxic metals, for example, the need to address these exposures may be less evident. Thus, a lack of tracking data may contribute to a neglect of chemical exposure issues in the development of national and multilateral agendas.

Cleaner production programs are frequently motivated by an interest in protecting human health. However, these programs seldom track human health indicators over the course of the project. For example, in the dozen or so cleaner production projects that we have looked at closely for this report, only one or two clearly include a discussion of tracking of health indicators. As we noted in the discussion of benefits in Chapter 1, many cleaner production projects track financial indicators but do not track health and environmental indicators.

Again, as noted above, tracking of health indicators may simply be unnecessary in many instances. For example, scientists have established clear relationships between use of leaded gasoline, blood lead levels in children, and effects on intelligence and other measures of normal neurological development. Thus, there is little uncertainty about the expected effects of a program to end the use of leaded gasoline. Tracking blood lead levels is not a necessary prerequisite for designing a program to eliminate use of leaded gasoline, although it may be useful for other reasons.

In some instances, however, tracking of health or environmental indicators is likely to be useful. Ideally, baseline data should be collected on both economic and environmental factors at the outset of a project, in order to make it possible to gauge accurately the effects of an intervention. For projects that attempt to transform small-scale production practices throughout a community, it would be useful to collect baseline data not only on levels of pollution but also on community-wide indicators of well-being, including health and economic status.

In summary, it may be useful to introduce monitoring of health indicators in association with some projects, whereas for other projects, it may not be a priority. Monitoring is particularly important to the extent that the data collected may guide priority setting. In addition, when designing and carrying out cleaner production projects with individual facilities or groups of facilities, it may make sense to collect baseline data on worker and community health. However, it is important to make strategic choices

about monitoring, in order to avoid siphoning off resources that could be used for direct interventions to reduce or eliminate toxic exposures.

One possibility might be to track chemical exposures by piggy-backing on existing surveillance programs, such as those associated with programs to address HIV/AIDS. For example, blood samples collected and stored through HIV surveillance programs could be tested for indicators of toxic environmental exposures, such as pesticide residues or heavy metals.

5.3 Bilateral aid

A potentially important area for further research is to examine the exchange of information between donor and recipient countries regarding the possibilities for improving chemicals management. As we noted in Chapter 4, NGO representatives have observed that some opportunities for aid on chemicals are missed because recipient countries are unaware they can request such aid.[170] It could be worth while to review the communications between aid providers and recipients with regard to chemicals.

[170] Joseph DiGangi, Environment Health Fund, personal communication, 2006.

References

Ashford, Nicholas. “Compliance Costs: The Neglected Issue of Technological Innovation.” European Agency for Safety and Health at Work Magazine (Fall 1999), 30–33.

Babcock, Ken and Jan Barica. “Why the Dnipro?” Water Quality Research Journal of Canada 33:4 (1998), 453–455.

“Business Benefits for H&M Within REACH.” In International Chemical Secretariat, “What We Need from REACH: Views on the Proposal for a New Chemical Legislation within the EU,” Gothenburg, Sweden: International Chemical Secretariat, 2005.

Corvalán, Carlos F. et al. “Health, Environment and Sustainable Development: Identifying Links and Indicators to Promote Action.” Epidemiology 10:5 (September 1999), 656–660.

Ciccozzi, E., R. Checkenya, et al. “Recent experiences and challenges in promoting cleaner production investments in developing countries.” Journal of Cleaner Production 11: 6 (2003).

Cushing, Katherin Cao, Peter L. Wise and Janet Hawes-Davis. “Evaluating the Implementation of Cleaner Production Audit Demonstration Projects.” Environmental Impact Assessment Review (New York: Elesvier Science, 1999).

Dung, Nguyen Huu and Tran thi Thanh Dung. Economic and health consequences of pesticide use in paddy production in the Mekong delta, Viet Nam. Economy and Environment Program for South East Asia (EEPSEA), Singapore, 1999.

Economy, Elizabeth C.. The River Runs Black: The Environmental Challenges to China’s Future (Ithaca and London: Cornell University Press, 2004).

European Environment Agency. Late Lessons from Early Warnings: the Precautionary Principle 1896–2000 (Luxembourg: Office for Official Publications of the European Communities, 2001).

Fresner, J.. “Small and medium sized enterprises and experiences with environmental management.” Journal of Cleaner Production 12:6 (2004), 545.

Goldman, Lynn and Nga Tran. Toxics and Poverty: The Impact of Toxic Substances on the Poor in Developing Countries (Washington, DC: World Bank, August 2002).

Gottlieb, Robert, ed. Reducing Toxics: A New Approach to Policy and Industrial Decisionmaking (Washington, DC: Island Press, 1995).

Grutter, J. M. and H.-P. Egler. “From cleaner production to sustainable industrial production modes.” Journal of Cleaner Production 12: 3 (2004).

Huan, Nguyen Him. “Viet Nam promotes solutions to pesticide risks.” Agro-Chemicals Report II: 1 (January–March 2002).

Hudson, A. and S. Carvalho. Managing Chemicals, Sustaining Livelihoods (New York: United Nations Development Programme, Energy and Environment Group, 2005).

Huhtala, A.. “Promoting financing of cleaner production investments--UNEP experience.” Journal of Cleaner Production 11: 6 (2003), 615.

Huhtala, A.. “Special issue on cleaner production financing.” Journal of Cleaner Production 11:6 (2003), 611.

Kurzinger, E.. “Capacity building for profitable environmental management.” Journal of Cleaner Production 12:3 (2004).

Luken, R. A., R. S. Stevenson, et al.. “Introduction to the special issue on building institutional capacity for cleaner production in developing and transition economies.” Journal of Cleaner Production 12:3 (2004).

Ma, Xiaoying and Leonard Ortolano. Environmental Regulation in China: Institutions, Enforcement, and Compliance (Lanham: Rowman & Littlefield, 2000).

Martuzzi, Marco and Joel A. Tickner. The Precautionary Principle: Protecting

Public Health, the Environment, and the Future of our Children (Copenhagen: WHO, 2004).

Massey, Rachel. Building a Healthy Economy: Chemicals Risk Management as a Driver of Development (Stockholm: Swedish Chemicals Inspectorate, 2005).

Millison, Dan. "Waste Management and Cleaner Production Programs." In Kristen A. Day, ed.,China's Environment and the Challenge of Sustainable Development (Armonk, N.Y.: M.E. Sharpe, 2005).

Mutagwaba, W. "Analysis of the benefits and challenges of implementing environmental regulatory programmes for mining: Tanzania case study." Journal of Cleaner Production 14, no. 3–4 (2006).

Pimenova, P. and R. van der Vorst. "The role of support programmes and policies in improving SMEs environmental performance in developed and transition economies." Journal of Cleaner Production 12, no. 6 (2004).

Porter, Michael E. and Claas van der Linde. "Toward a New Conception of the Environment – Competitiveness Relationship," Journal of Economic Perspectives 9:4 (Fall 1995).

Rennings, Klaus and Thomas Zwick, Eds. Employment Impacts of Cleaner Production, Heidelberg: Physica-Verlag, 2003.

Royston, Michael G. Pollution Prevention Pays, Oxford: Pergamon Press, 1979.

Sarokin, et al. Cutting Chemical Wastes: What 29 Organic Chemical Plants are Doing to Reduce Hazardous Wastes (New York: INFORM, Inc., 1985).

Schettler, Ted et al., Generations at Risk: Reproductive Health and the Environment (Cambridge, MA: MIT Press, 1999).

Schettler, Ted et al., In Harm's Way: Toxic Threats to Child Development (Boston, MA: Greater Boston Physicians for Social Responsibility, 2000).

Sinkule, Barbara J. and Leonardo Ortolano. Implementing Environmental Policy in China (Wesport, CT and London: Praeger, 1995).

South African Department of Environmental Affairs and Tourism (DEAT). Business Plan on Cleaner Production, Enforcement and Compliance, April 2003.

Staniskis, J. K. and V. Arbaciauskas. "Institutional capacity building for pollution prevention centres in Central and Eastern Europe with special reference to Lithuania." Journal of Cleaner Production 12, no. 3 (2004).

Staniskis, J. K. and Z. Stasiskiene. "Promotion of cleaner production investments: international experience." Journal of Cleaner Production 11:6 (2003).

Stevenson, R. S. and J. W. Evans. "Editorial to: Cutting across interests: cleaner production, the unified force of sustainable development." Journal of Cleaner Production 12:3 (2004).

United Nations Development Programme (UNDP). Managing Chemicals, Sustaining Livelihoods: UNDP and Management of Persistent Organic Pollutants, Ozone-Depleting Substances and Other Chemicals (United Nations Development Programme, 2005).

United Nations Environment Programme (UNEP). Cleaning Up: Experience and Knowledge to Finance Investments in Cleaner Production, Division of Technology, Industry and Economics. United Nations Environment Program, 2003.

U.S. General Accounting Office (GAO). Environmental Protection: EPA Should Strengthen its Efforts to Measure and Encourage Pollution Prevention (Washington, DC: GAO, February 2001).

Vasenko, O.G.. "Environmental Situation in the Lower Dnipro River Basin." Water Quality Research Journal of Canada 33:4 (1998), 457–487.

Wang, Ji. "China's National Cleaner Production Strategy." Environmental Impact Assessment Review (New York: Elsevier Science Inc, 1999).

Warren, Kimberly A., Leonard Ortolano, and Scott Rozelle. "Pollution Prevention Incentives and Responses in Chinese Firms." Environmental Impact Assessment Review (New York: Elsevier Science Inc, 1999).

Wilson, Edward O.. The Future of Life (New York: Alfred A. Knopf, 2002).

World Bank. Clear Water, Blue Skies: China's Environment in the New Century (Washington, D.C.: World Bank, 1997).

Yáñez, Leticia, et al. "Overview of Human Health and Chemical Mixtures: Problems Facing Developing Coun-

tries." Environmental Health Perspectives 110:6 (December 2002), 901–909.
Yhdego, M. "Environmental pollution management for Tanzania: towards pollution prevention." Journal of Cleaner Production 3:3 (1995), 143.
Zhang, Tianzhu and Jining Chen. Promoting Cleaner Production in China. Department of Environmental Science and Engineering, Tsinghua University, Beijing. Presented at the International Conference on Cleaner Production, Beijing, September 2001.

Sammendrag

Studien tar for seg de sosiale, økonomiske, miljømessige og helsemessige gevinstene som kan oppnås gjennom en forsvarlig kjemikalieforvaltning. Del 1 introduserer sentrale begreper innen forsvarlig kjemikalieforvaltning, mens del 2 går i detalj på ulike tiltak som er gjennomført for å bedre kjemikalieforvaltningen i utvalgte land. Del 3 foreslår områder for videre undersøkelse. Rapporten fokuserer spesielt på forholdet mellom legale virkemidler på den ene siden og på den andre håndheving og fremgangsmåter og programmer for å bistå industrien i å identifisere tiltak som på samme tid er kostnadsbesparende og har miljø- og helsegevinster.

Del 1: Sentrale Begreper

Miljø- og helseskadelige kjemikalier utgjør en voksende trussel i utviklingsland og overgangsøkonomier, og eksponering fra kjemikalier er en økende kilde til kroniske sykdommer. Eksponering kan skje gjennom en rekke kilder som pesticider, industrielle kjemikalier og farlig avfall. Forbedringer i helse og miljø kan også lede til økonomiske gevinster. God kjemikalieforvaltning kan redusere utgiftene ved sykdom, øke produktiviteten og gi lavere forbruk av råstoffer inkl. vann. Helse- og miljøskadelige kjemikalier er også en trussel mot barns læringsevne. God kjemikalieforvaltning kan også bygge tillit til industrien og gi bedret global markedstilgang. Blant de indirekte gevinstene er de kjønnsrelaterte de mest påtakelige; kvinner er mer sårbare og ofte mer utsatte for kjemikalier.

Studien tar videre for seg hvilke komponenter som inngår i en forsvarlig kjemikalieforvaltning. Lovverk og administrativ kapasitet er nøkkelfaktorer. Integrated Pollution Prevention Control og Cleaner Production er noen av flere internasjonale konsept innen miljøforvaltning. Mangel på finansiering pekes på som én alvorlig hindring for å hindre forurensning, og for å gjennomføre tiltak som gir renere produksjon. Selskaper som opererer internasjonalt kan bidra til forsvarlig kjemikaliepraksis ved å stille miljøkrav til sine underleverandører.

Del 2: Cleaner Production i praksis

I del 2 tar studien for seg en rekke eksempler fra ulike land på prosjekter hvor man har tatt for seg måter å stimulere til forsvarlig kjemikalieforvaltning gjennom legale og tekniske angrepsvinkler. Eksempelstudiene er hentet fra Sør-Afrika, Tanzania, Kina, Vietnam, Thailand, India samt et regionalt prosjekt mellom Ukraina, Hviterussland og Russland.

Denne delen av studien ser også på hvilken rolle bilateral bistand kan spille med henblikk på å få gjennomført prosjekter og å skape varige

endringer i kjemikalieforvaltningen i utviklingsland og overgangsøkonomier.

Del 3: Tema for videre undersøkelser

Siste del av studien behandler mulige tema for videre undersøkelser. Noen områder trekkes særlig frem: internasjonal handel og investeringer, gode indikatorer for helseeffekter samt bedret kommunikasjon mellom donorer og mottakerer om mulig bistand på kjemikalieområdet.

Appendix A: Overview of Bilateral Aid Programs on Chemicals

This Appendix presents detailed information on selected bilateral aid programs. For each program, we offer some general comments about the donor country's approach, focus, or priorities, and then give brief descriptions of specific projects or project areas. This discussion is by no means comprehensive; it simply provides further information on some interesting approaches to bilateral aid for sound chemicals management.

Norway

Environment and natural resource management is an explicit target area of Norway's development assistance agenda. Norway aims both to help strengthen environmental management systems and to improve environmental conditions in partner countries. Norway has designated seven centers for environmental assistance; these centers provide expertise to the Ministry of Foreign Affairs and the Norwegian Agency for Development Co-operation (NORAD), and collaborate with counterpart institutions in partner countries. The Norwegian Pollution Control Authority (SFT) is the center that focuses most directly on issues of chemicals and cleaner production.[171]

Legislation and Administration

NORAD and SFT have implemented a number of projects in southern African countries (South Africa, Zambia, Namibia, Botswana, and Mozambique) aimed at strengthening environmental laws, policy instruments, and systems for enforcement and monitoring compliance. The majority of the programs work with national level agencies to build capacity for regulating and controlling pollution. Projects are often designed to respond to the needs of new or anticipated environmental legislation. In some cases, the national level work is coupled with support for local level or industry specific demonstration projects.

In South Africa, as described in the detailed case study in Chapter 3, SFT partners with the Department of Environmental Affairs and Tourism (DEAT) "to promote Cleaner Production in a wide sense and to improve South Africa's capacity on management of pollution and waste." [172]

[171] http://environment.norad.no/index.cfm

[172] Norwegian Development Assistance, Institutional Cooperation Between DEAT and SFT. Available from http://environment.norad.no/projects.cfm?projectid=1083.

In Zambia, as discussed in Chapter 4, NORAD has been working with the Environmental Council of Zambia (ECZ) since it was created in 1992. [173]

In Botswana, SFT partnered with Botswana's Department of Mines on an "Industrial Pollution Prevention" project to develop a strategy for regulating emissions. This program was part of the preparation for a reform of the Pollution Control Act of Botswana. The Norwegian Institute for Air Research also cooperated on air monitoring.[174]

In Namibia, SFT carried out a Pollution Control and Waste Management program between 1999 and 2001. Part of a broader NORAD-funded program to develop environmental legislation, the project focused on improving data collection on pollution and data; waste management strategies; development of systems for management of medical waste; and legislation.[175]

In addition to its work in southern Africa, SFT, along with the Norwegian Coastal Administration, is involved in a collaborative project with the Vietnam Oil and Gas Corporation (Petrovietnam). The goal of the cooperation is to achieve "a sustained process of further development of health, safety and environment management" in the Vietnamese oil and gas industry, in order to limit environmental damage and avoid major accidents.[176]

Sweden

Sweden's work on chemicals management comes in the context of a long history of environmental aid to developing countries. We do not explore this extensive history here, but simply provide some information on recent projects focused on chemicals.

The Swedish Chemicals Inspectorate (KemI) is initiating several projects to help build administrative capacity and develop or refine legislation on chemicals. In addition, the Swedish International Development Agency (Sida) supports research on safer alternatives to toxic chemicals in a range of industries, and on human health impacts of toxic chemical exposures. Sweden has committed substantial resources to supporting environmental protection internationally, and has identified chemicals as a priority area.[177]

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[173] Norwegian Development Assistance, Industrial Pollution Programme in Zambia. Available from http://environment.norad.no/projects.cfm?projectid=1015

[174] Norwegian Development Assistance, Industrial Pollution Prevention in Botswana. Available from http://environment.norad.no/projects.cfm?projectid=1049.

[175] Norwegian Development Assistance, Pollution Control and Waste Management Programme in Namibia, Available from http://environment.norad.no/projects.cfm?projectid=1014.

[176] Norwegian Development Assistance, Institutional Cooperation Between DEAT and SFT. Available from http://environment.norad.no/projects.cfm?projectid=1083.

[177] Alexandra Wachtmeister, Sida, personal communication, February 2006.

Legislation and Administration

Sida has recently undertaken a collaborative project with KemI which aims to assist developing countries in building capacity for chemicals management. The focus of this program is to support the implementation of the Stockholm, Rotterdam, and Basel Conventions, the Strategic Approach to International Chemicals Management (SAICM), and the Global Mercury Programme. At the global level, Sida and Kemi will support implementation efforts by the United Nations Environment Programme. Sweden also provides support to international non-governmental organizations such as the International POPs Elimination Network (IPEN). In addition, Swedish experts on chemicals regulation are developing relationships with counterpart agencies in partner countries. Sweden is engaged in on-going collaborative efforts with Vietnam and Tanzania on chemicals legislation and institution building.

In Eastern Europe, Sweden has provided advice on chemicals regulation through twinning projects with Poland and Hungary. Sweden has also managed long term projects on capacity building and institutional strengthening in Estonia, Latvia and Lithuania.

Research

One of Sida's core activities is to sponsor research programs that are based in, or have important implications for, aid recipient countries.[178] Among its many sponsored research programs, Sida has supported a few research projects on cleaner production options, as described Chapter 4.

Other projects related to chemicals have included a project to monitor pesticide-related health effects in Costa Rica; support to the Global Environmental Epidemiology Network; and a project on sound management of toxic chemicals in selected countries.[179]

Denmark

The Danish aid agency, DANIDA, is working to promote sound chemicals management in a number of countries. In many cases, DANIDA's work on chemicals is part of a broader collaborative effort on environmental quality.

Selected DANIDA projects, including the IPM in Thailand project, the Cleaner Textile Production Project in South Africa, and aid to an individual facility in Zimbabwe, are described in detail in earlier sections of this report.

Denmark is providing assistance to Vietnam on a range of environmental issues. In Vietnam, economic reform has led to rapid and sus-

[178] Information on research projects sponsored by Sida/SAREC can be found at http://www.sida.se/sida/jsp/sida.jsp?d=254&a=4508&language=en_US.

[179] Inter-Organization Programme for the Sound Management of Chemicals (IOMC), *Fact Sheets on Bilateral Assistance for Chemicals Management* First Edition (May 2001).

tained economic growth; but the resulting pollution, especially of surface waters, and unsustainable use of natural resources threatens the country's long term economic and environmental health. The Danish government believes that the challenge facing the government of Vietnam is to bring "pollution under control and restore environmental quality without undermining economic growth or its development and poverty reduction strategy."[180]

Beginning in 2005, Danish environmental assistance to Vietnam will be carried out through the "Development Cooperation in the Environment Programme" (DCE). Individual DANIDA-funded environmental projects will now be incorporated within this program, which commits approximately $42 million to the program for the period 2005 to 2010. Components of the program will include "pollution control in poor densely populated areas; environmentally sustainable development in poor urban areas; cleaner production in industry; sustainable livelihoods in and around marine protected areas; and capacity development support for environmental planning and management."[181]

Netherlands

The Directorate General for International Cooperation in the Dutch Ministry of Foreign Affairs is responsible for development assistance programs. The broad aim of these programs is poverty alleviation through approaches that build local capacity to develop permanent solutions using approaches that are environmentally sustainable. The Netherlands has financed a range of projects aimed at promoting pollution prevention and reducing toxic chemical exposures in partner countries. Projects are designed to provide broad support to entire sectors, and often address a need shared by a number of developing countries. Projects and programs on chemicals have included[182] a program to support the development of National Profiles to Assess National Infrastructure for Management of Chemicals. (Antigua, Argentina, Bangladesh, Bolivia, Chile, India, Kenya, Sri Lanka, Tanzania, Zimbabwe: National Profile to Assess National Infrastructure); a project providing National Training Activities for Developing Countries on Toxic Chemicals, Environment and Health. (15 countries in Asia, Africa, and Latin America); a program on Implementation of the FAO Code of Conduct on the Distribution and Use of Pesticides in several African nations; an Inter-Country Program for the Development and Application of Integrated Pest Management in Vegetables in

[180] DANIDA, "Environmental Assistance to Vietnam," http://www.ambhanoi.um.dk/en/menu/Developmentpolicy/Environmentprogramme/The+EnvironmentalAssistancetoVietnam.htm

[181] DANIDA, "Environmental Assistance to Vietnam," information available at http://www.ambhanoi.um.dk/en/menu/Developmentpolicy/Environmentprogramme/The+EnvironmentalAssistancetoVietnam.htm.

[182] Inter-Organization Programme for the Sound Management of Chemicals (IOMC), *Fact Sheets on Bilateral Assistance for Chemicals Management* First Edition (May 2001).

Cambodia, Laos, Malaysia, Philippines, Thailand, Vietnam; an Integrated Pest Management program (China, Madagascar, Senegal, Thailand, Trinidad, Viet Nam, Zimbabwe); a three-year program for Disposal of Unwanted Pesticides Stocks in Africa; and support for creation of a Pesticides Action Network in Southeast Asia.

USA

USAID has been involved in a range of projects aimed at promoting pollution prevention and reducing toxic chemical exposures in partner countries. USAID's projects and programs on chemicals have included the following: a six-year Project in Development and the Environment, focusing on chemicals and pesticides, carried out in ten countries and territories in Central and Eastern Europe (the Czech Republic, Estonia, Hungary, Slovak Republic), the Middle East (Egypt, Jordan, Morocco, Palestinian Territories), and Africa (Tunisia); a nine-year project creating an Integrated Pest Management Collaborative Research Support program in four countries (Guatemala, Jamaica, Mali, and the Philippines); and a three-year project on reduction of transboundary pollution in three Danube tributary basins (in Hungary, Romania, and the Slovak Republic).[183]

One area of interest at USAID has been the elimination of leaded gasoline. In 2002, the government of Sri Lanka launched a "100 Days Program," halting the sale of leaded gasoline in the country. USAID helped to support the initiative through several projects. These included a study to measure the effects of the phaseout, as well a study "identifying the country's most polluting vehicles." The program was highly successful, leading to a 90 percent drop in air lead levels.[184]

USAID also supported a project addressing leaded gasoline in Vietnam. In 1999, the US-Asia Environmental Partnership (US-AEP) "jointly sponsored a workshop in Hanoi with the Ministry of Transport and the World Bank to discuss phasing out leaded fuel and learn from the experiences of other East Asian countries that had already phased out leaded gasoline." The workshop helped to resolve concerns about leaded gasoline, and led to the creation of a new partnership of government, industry, and academic experts. The transition was accomplished in July 2001. Following up on this work, "US-AEP provided support for further improvements in fuel quality and vehicle emission standards. US-AEP also sponsored Vietnamese participation in several regional conferences on air quality management, further exposing regulators to best practices neighboring countries."[185]

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[183] Inter-Organization Programme for the Sound Management of Chemicals (IOMC), *Fact Sheets on Bilateral Assistance for Chemicals Management* First Edition (May 2001).

[184] United States Agency for International Development, "Case Study: 100 Days to Cleaner Air, available at http://www.usaid.gov/stories/srilanka/cs_srilanka_100days.pdf.

[185] United States – Asian Environment Partnership, Vietnam Accomplishments. Available from http://www.usaep.org/accomplishments/vietnam.htm#1.

Canada

The Canadian International Development Agency (CIDA) is responsible for carrying out the Canadian Official Development Assistance Programme. CIDA support for projects and programs on chemicals has included an Environmental Management Project for increasing environmental awareness in Bangladesh; a suite of programs in Brazil including two four-year training programs (Environmental Training in Brazilian Industry and Institutional Development Training), a six-year Canada-Brazil Technology Transfer Project, and a six-year Environmental Management Project focused on environmental legislation; programs in Chile to improve the management and use of pesticides in agriculture; the China-Canada Cooperation in Cleaner Production; a villages-based pesticide management program in China; a project in Nigeria in support of a Centre for Agrochemical Technology; a program in Guyana to provide education and raise awareness in the mining industry; education, awareness raising in Indonesia (Environmental Management Development – Phase 3, five years); and Tanzania (Environmental Initiatives, three years); legislative programs in Jamaica and Pakistan; and a Southern Cone Technology Transfer program with Argentina, Brazil, Chile, Colombia, and Uruguay. [186]

[186] Inter-Organization Programme for the Sound Management of Chemicals (IOMC), *Fact Sheets on Bilateral Assistance for Chemicals Management* First Edition (May 2001).

Appendix B:
A Guide to Resources

This appendix provides a selected working guide to online resources related to Cleaner Production and environmental management, with a special focus on chemicals management and the EU. This listing is by no means comprehensive. It was compiled in part by drawing on the European Topic Centre on Resource and Waste Management's page on Pollution Prevention in addition to other sources.

1. Cleaner Production Case Studies

Case studies of individual, facility-level cleaner production efforts are available from a variety of sources, including the following. In the majority of these databases, cases are grouped by industrial sector.

International

The UN Environment Programme (UNEP) maintains a database of 440 CP case studies, the *International Cleaner Production Information Clearinghouse (ICPIC).* About half the case studies are from Europe and a quarter from North America. Most present "full-scale applications of CP options." Available online at: www.emcentre.com/unepweb/

The *UN Industrial Development Organization (UNIDO)* maintains an online database of cleaner production case studies focused on manufacturing and agro-processing industries. Available online at: www.unido.org/NCPC/Sector/Sectors.cfm

A selection of case studies of eco-efficiency and best business practices from members of the *World Business Council for Sustainable Development* (WBCSD) is available online. A range of large and small business enterprises are reviewed: www.wbcsd.org/web/ecoefficiency.htm

Selected case studies collected by the *International Network for Environmental Management* (INEM), with a particular focus on SMEs and Central and Eastern Europe: www.inem.org/htdocs/inem_casestudies.-html

The Chinese government maintains a substantial website on Cleaner Production activities in *China*. The website includes case studies organized by sector and by source, detailing economic and environmental benefits: http://www.chinacp.com/eng/casestudies.html. The main site also contains substantial information on Chinese activities, legislation, policy, donor projects and organizations on cleaner production and circular economy.

OECD countries

Cleaner Production case studies of *EnviroNet Australia*, arranged by more than a dozen industrial sectors. Available at: www.deh.gov.au/settlements/industry/corporate/eecp/case-studies/index.html.

Collection of case studies compiled by the *North Carolina Division of Pollution Prevention* and Environmental Assistance (focusing on regional cases with some international cases), searchable by industry sector, by pollution prevention category, or waste streams, processes, and pollutants: www.p2pays.org/main/case.asp.

The *Canadian Pollution Prevention Information Clearinghouse* (CPPIC) database provides information on more than 1500 cases of pollution prevention in North America, searchable by 14 sectors including agriculture and natural resources, extractive industries, and services. www.ec.gc.ca/cppic/en/index.cfm

A compilation of cases of pollution prevention in North America by the *US Environmental Protection Agency*, including waste reduction guides for small businesses: http://es.epa.gov/cooperative/topics/casestudies.html

A small collection of mostly European cases of pollution prevention across 5 sectors, prepared by *GreenProfit* in the Netherlands: www.greenprofit.net/cases.html

Massachusetts Toxics Use Reduction Program: http://www.mass.gov/envir/ota/publications/case_studies1.htm

2. Information Resources

General

The World Bank's *Pollution Prevention and Abatement Handbook* provides a set of industry sector guidelines on pollution prevention and an analysis of policy instruments: http://lnweb18.worldbank.org/ESSD/envext.nsf/51ByDocName/PollutionPreventionandAbatementHandbook

The *European Topic Centre* on Resource and Waste Management's (ETC/RWM) page on Pollution Prevention provides resources and information on current trends, policy instruments, applications and organizations involved in waste minimization and pollution prevention, focusing on the EU: http://waste.eionet.eu.int/prevention/. It also includes a substantial resource guide.

The *European IPPC Bureau* has produced reference documents which outline best practices applicable to individual industrial sectors. The BREF document is available at: http://eippcb.jrc.es/pages/FActivities.htm

The Pollution Prevention Resource Exchange (P2Rx) provides an online topic-specific resource guide including industrial sectors, pollutants, and environmental management and P2 systems. http://wrrc.p2pays.org/p2rx/

USAID Environmental Pollution Prevention Project (EP3): http://es.epa.gov/ep3/ep3.html

The *P2 Pays* site, hosted by the North Carolina Division of Pollution Prevention and Environmental Assistance, offers technical resources and information targeted to industries, small businesses, and governmental institutions: www.p2pays.org/

The Joint Service *Pollution Prevention (P2) Technical Library* offers a host of primarily US-based P2 resources and information on technical processes, with a focus on US navy and military: http://p2library.nfesc.navy.mil/

Information on Legal Status and Chemical Management

To promote transparency in chemicals management, the UN Institute for Training and Research and the European Chemicals Bureau *(UNITAR/ECB)* maintains a page with voluntarily-submitted National Profiles of several dozen countries: www.unitar.org/cwg/np_homepage/nph2.html

Information on UNITAR's *Chemicals, Waste, and Environmental Governance program* can be found at www.unitar.org/cwg/np/index.html

The Information Exchange Network on Capacity Building for the Sound Management of Chemicals, *INFOCAP*, provides for searches by national priorities, sources of support, projects, and documents by category, key word and country: www.who.int/ifcs/infocap/

Information on health-environment links

WHO and UNEP's Health and Environmental Linkages Initiative (HELI): www.who.int/heli/en/

HELI's chemicals-specific page: http://www.who.int/heli/risks/toxics/chemicals/en/

WHO's page on Children and Environmental Health: http://www.who.int/ceh/en/

3. Key Organizations

The UN Environment Programme *(UNEP)* maintains a CP website: http://www.uneptie.org/pc/cp/. It also maintains a page on Financing Cleaner Production with access to a number of finance-related resources: http://www.financingcp.org/. UNEP's Division of Technology Industry and Economics spearheads the organization's work in cleaner production and pollution prevention.

The UN Industrial Development Organization, *UNIDO***,** maintains a cleaner production website, at www.unido.org/doc/4460. UNEP and UNIDO jointly administer the worldwide National CP Center Programme.

Links to *National Cleaner Production Centers* are available at the UNIDO site: www.unido.org/doc/5133

Other international *Cleaner Production* organizations: www.uneptie.org/pc/cp/network/cp_links.htm

Links to *Pollution Prevention Roundtables* in the USA: www.p2.org/ and internationally: www.p2.org/intl/index.cfm

The *World Business Council for Sustainable Development* is a consortium of 150 multinational companies from 20 major industrial sectors that have declared a commitment to work on environmental protection and social equity. WBCSD developed the concept of eco-efficiency and has implemented various regional initiatives: www.wbcsd.org/

Coordinated by the US Environmental Protection Agency's EnvirSense program, the *International Cleaner Production Cooperative* supports communication and the exchange of information between players in cleaner production. Resources offered include a business assistance guide, a member directory of participating members; and a general information resource guide on an array of P2 topics: http://es.epa.gov/cooperative/international/

The Institute for Prospective Technological Studies (IPTS) based in Spain hosts the *European IPPC Bureau*, providing support on the implementation of the EU Directive on Integrated Pollution Prevention and Control. It includes a page on the activities of industrial partners engaged in implementing the directive and provides technical information on best practices: http://eippcb.jrc.es/

Many other EU-wide and national organizations are involved in programs on cleaner production and environmental management in Europe, several of which are described by the ETC on Resource and Waste Management's webpage: http://waste.eionet.eu.int/prevention/4 and by UNEP's online resource guide: http://www.uneptie.org/pc/cp/reportspdf/10.pdf

4. International NGO Networks

The International POPs Elimination Project (IPEP) is a network of NGOs that are working in some 40 countries throughout the world to facilitate and move forward the goals of the Stockholm Convention on POPs. IPEP's purpose is to "help support small and medium-sized country-based NGOs" in their work to "reduce and eliminate chemical pollution."

IPEP produces the following resources:

- *Country Situation Reports,* which describe the ratification process, Convention enabling activities, POPs sources, and recommended measures to reduce and eliminate POPs.
- *POPs Hotspot Reports,* which raise public and governmental awareness of contaminated sites or a pattern of activities that release POPs to the environment.
- *POPs Policy Briefs,* which represent national policy proposals relevant to implementing the Stockholm Convention.