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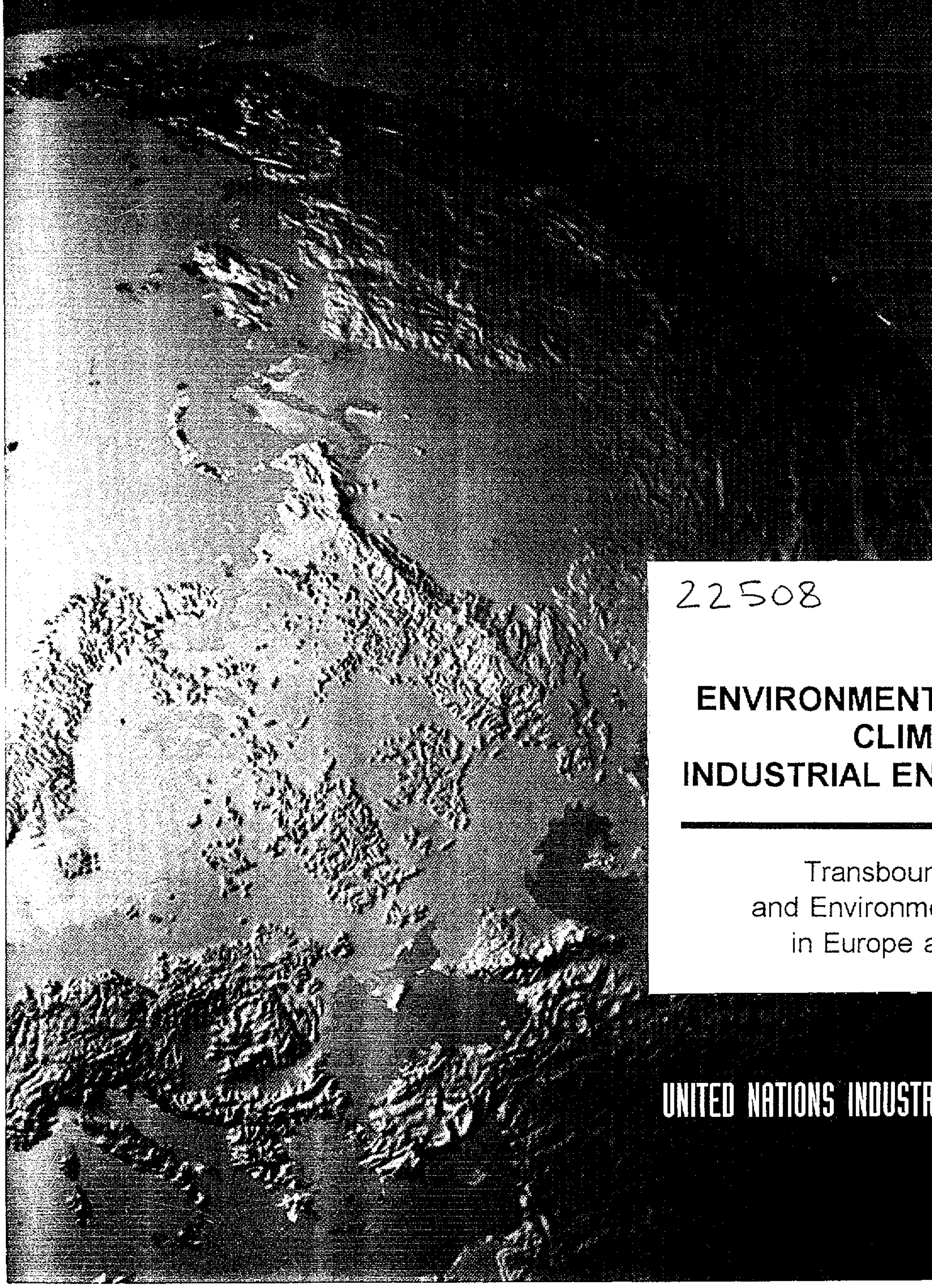

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Session II

ENVIRONMENTAL MANAGEMENT, CLIMATE CHANGE, AND INDUSTRIAL ENERGY EFFICIENCY

Transboundary Pollution
and Environmental Management
in Europe and CIS Region

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Transbounday Pollution and Environment Management in Europe and CIS Region

by Jacqueline McGlade

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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, 2000

Executive summary

A new geography of social and natural processes is taking shape as a result of globalization and the shifts in economic and political activities worldwide. The consequences of this are manifold, ranging from social conflict to environmental degradation. A key issue is the impact that development is having on the materials cycle—the flow of materials from nature to society, and the growing problems of waste and pollution that this brings. Without clear leadership, the growth of pathological syndromes such as "NIMBY" (Not in my Backyard) and "IMP" (Isn't My Problem) will create significant disparities in environmental health.

Ecosystems do not exist in a steady state, and linkages within them can be perturbed in such a way as to lead to sudden, and sometimes dramatic, shifts in their make-up. Examples include changes to the Black Sea, brought about by agricultural run-off, and trophic distortions in many aquatic systems caused by fishing down the food chain. The background pollution in significant rivers such as the Danube is a source of serious concern requiring a shift in thinking from dealing with problems on an ad hoc basis to one based on ecosystems. There is still a high degree of uncertainty regarding environmental issues and the impacts of pollution on human health. Rather than simply ignoring this, managers and policy-makers need to understand the sources of uncertainty and the risks that this poses, and make efforts to communicate these to society at large.

There is an increasing number of legal instruments relating to protection of the environment. These include international and regional conventions, and regional and national laws such as those derived under the aegis the European Union. In particular, there is now a large body of legislation concerning biodiversity and environmental assessment which will have a significant effect on sustainable industrial development, especially in countries due to become members of the EU under enlargement.

Effective management of industrial processes requires that the true environmental costs of pollution are taken into account. In the Danube River Basin there are a variety of point source and diffuse sources of pollution which are of concern. In moving towards a legislative regime in which the concept of polluter-pays is embedded, many industries will now need to re-examine their cost-effectiveness in terms of their environmental liabilities.

There are a number of different forms of governance which can be applied to environmental protection and the management of industrial processes. It is also important to recognize that the different forms of governing, such as markets, hierarchies and networks, are not intrinsically good or bad for allocating resources authoritatively. They area also not inevitably a matter of ideological conviction, but rather one of practicality. However, in today's globalized economy, there is a significant hollowing out of the state. The consequences for local management must therefore be carefully developed and integrated with each other, so that environmental liabilities are not obfuscated.

Pollution impacts society differentially. Without a strong legal and social framework for the environment, social exclusion will increase. A regulatory ladder tied closely to industrial development and economic policies needs to reflect the public goods that the environment provides. To ensure that this is the case, the role of international bodies such as UNIDO, is vital.

Contents

	Page
Executive summary	iii
1. Introduction	1
2. Environmental knowledge and uncertainty	3
2.1 Ecosystem dynamics and integrity	3
2.2 Ecosystem productivity and environmental health	4
2.3 Ecosystem-based management	6
2.4 Understanding the sources of uncertainty	6
2.5 Communicating an understanding of environmental risks	8
3. International and regional environmental legal instruments	11
3.1 The international regime	11
3.2 The Convention on Biological Diversity	12
3.3 European Community law and regional conventions	14
4. Environmental management of industrial processes	17
4.1 The Danube River Basin—regional perspective	17
5. Governance of the environment	21
5.1 Types of governance	21
5.2 Governing without government	22
5.3 Locally responsive environmental management	23
5.4 Environmental costs, social choice and the determination of liability	24
6. Conclusions	27
6.1 Social exclusion from environmental health	27
6.2 The regulatory ladder and industrial policy	27
6.3 The role of international organizations	28

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1 Introduction

One of the most striking aspects of today's world is the shift from national, to regional and global economies. Invisible on maps, a new geography of social and natural processes is taking shape, that is largely determined by people moving in response to economic need and political activity. Historical disparities in economic development are being exacerbated by large numbers of political and economic refugees, who for no other reason than simple survival, migrate towards urban centres in politically stable regions. The consequences of this are manifold, ranging from social conflict to environmental degradation.

Until recently, the environmental movement was dominated by concerns about the future. The earth's resources needed to be used prudently and in a way that did not lead to their premature destruction. We had to act now, to prevent a whole series of damaging trends (global warming, water and air pollution, fish stock depletion and transport congestion) getting worse, leaving our children and grandchildren to suffer.

Nowadays, the language of the future has been replaced by the present, because changes for the worse are already being observed—something national leaders ignore at their peril.

Indeed, few now doubt that the continuing degradation of the natural environment poses one of the deepest challenges to modern industrial societies. Both governments and the business sector have accepted that action must be taken to tackle the most urgent problems, such as global warming, urban transport and industrial waste. But the inexorable drive to produce and manufacture goods and improve the living conditions of so many people, will inevitably force us to make hard choices as continued growth pushes up against a range of environmental limits. A more profound thinking about how production and consumption patterns can be restructured and about the political and societal processes which can bring this about, is now needed.

For example, the flow of materials from nature to society and back—the materials cycle—is fundamental to all economies. In some places the scale of the cycle is quite remarkable: in industrial economies, for example, the per capita requirement has been estimated at 45—85,000 kg of natural resources per year—the equivalent in weight of one luxury car per week per person. The withdrawal of resources from the environment generally involves some type of transformation to generate the products and services we use: the return of these "waste" resources to nature then demands a further set of resources to convert them into environmentally acceptable forms. If we are to properly manage these processes, we need to determine not only the flows of materials and wastes but also patterns of societal behaviour. Without this type of information, governments and society will not be able to decide whether a particular economic development is sustainable or where the environmental liabilities lie should something go wrong.

In 1992, the United Nations Conference on Environmental Development launched Agenda 21—an action plan aimed at addressing issues of resource limitation, human development and environmental protection. Nearly a decade later, we are only just beginning to consider how the world's materials cycles can be harnessed appropriately to sustain a larger and more prosperous set of global and local economies.

The reasons for this are complex. They lie partly in institutional fatigue and lack of political will, and partly in the uncertainty surrounding our understanding of the long-term consequences of many industrial and human activities, made worse by the fact that as the world integrates economically, its component parts become more numerous.

The temptation is to study local events, which are often the easiest to observe, and extrapolate from these. But, as studies of many natural systems have shown, local events often do not provide a good indicator of what will happen to the whole system. We must therefore learn how to balance decisions concerning the role of small-scale events in determining large-scale processes, and look more closely at the relationships between environmental policy, industrial development and social inclusion.

In the meantime, activities such as natural resource extraction, industrial development, waste disposal and landscape modification continue, often unconstrained by sufficient consideration of the environmental liabilities and accompanied by pathological syndromes, such as "IMP" (Isn't My Problem) and "NIMBY" (Not In My Back-Yard). These are so firmly entrenched in today's global society, that it will require strong leadership to move the agenda on. In this paper, some of the key issues underpinning the adoption of an environmental approach to industrial development are examined, using examples from the Central European Region and from UNIDO's activities in the region.

2 Environmental knowledge and uncertainty

2.1 Ecosystem dynamics and integrity

Ecosystems do not exist in a steady state, but exhibit continuous changes in production and species composition. The viability of many natural resources relies on the maintenance of specific trophic linkages and/or keystone organisms that are often hidden within the complex set of species assemblages and community dynamics. These are generally overlooked until such time as their loss causes dramatic changes to the community or collapse of the trophic cascade.

Our awareness of the role of these linkages has increased significantly during the last decade, as long-term data sets on various organisms, ostensibly collected to examine the effects of human (mis)use on the ecosystem, have been brought together. Striking and sudden changes have now been identified in a number of systems, which are quite different from those expected from any gradual, linear response to human activities (see box 1).

Box 1. The Black Sea and Sea of Azov

It was widely believed that over-exploitation of local fisheries caused major changes in the ecosystems of the Black Sea. However, it is now clear that agricultural inflows from the Danube, Dnepr, Dnestr, Don and Kuban rivers caused high phytoplankton production throughout the surface waters of the Black Sea. The lack of nutrient limitation on production, which is in stark contrast with the eastern waters of the Mediterranean Sea, was supported by evidence which showed that, despite a growing fishery in the 1970s, small pelagic fish increased in abundance just as the effects of enrichment were first being noticed. There was also a decline in many demersal fish and benthic invertebrates, a drastic drop in the diversity of demersal species as well as reduced entry of migratory species (bonito, bluefish and mackerel) into the northern Black Sea, and the benthic systems of the shelf and nearshore areas became dominated by species such as *Mya arenaria*, which were better adapted to low-oxygen conditions than the native species. Swarms of jellyfish (*Aurelia ayrita*) were also replaced suddenly in 1988-1989 by very high densities of ctenophores (predators on fish eggs and larvae). Blooms and red tides of various phytoplanktonic organisms are now widely reported in the north and west of the basin, indicating the dramatic changes in the pelagic ecosystem that have occurred. In the Sea of Azov, hydrographic changes caused by increased use of freshwater from rivers for domestic, industrial and agricultural purposes have also increased significantly the salinity in recent times and changed its dominant fish species.

Long-term data series can help to answer questions on the variability of ecosystems and as such any environmentally-based management framework must have at its core a commitment to the continuous collection of data for assessment and monitoring. These long-term data sets, in combination with the results of experimental laboratory and field studies, form a necessary part of an environmental approach helping managers to know whether the observed phenomena can be explained with clear cause-effect relationships or are more or less random and unpredictable.

2.2 Ecosystem productivity and environmental health

One of the key aspects of an environmental approach to industrial development is to provide assessments of the impacts of various human activities on system productivity and conservation. A striking example of just such an assessment was the analysis of the United Nations Food and Agriculture Organization (FAO) fisheries statistics which showed that as a result of global fishing there had been a gradual transition in landings from long-lived, high trophic level, piscivorous bottom fish towards short-lived, low trophic level invertebrates and planktivorous pelagic fish. This "fishing down of the food webs" at first gave rise to increased catches, but was then followed by a phase associated with stagnating or declining catches, leaving every indication that the present levels of exploitation were unsustainable. The conclusion that we may have reached a global maximum in primary productivity in supporting fisheries is a clear reason why an ecosystem-based approach is essential, for it is very likely that any further increases will only derive from lower trophic levels, which will in turn affect the economic livelihoods of those communities dependent on incomes from high quality fish.

The productivity of ecosystems can be altered directly and indirectly by a large number of human-derived processes, including excessive nutrient loading from agriculture, industrial pollution, changes in freshwater fluxes and sedimentation. Because biogeochemical cycles and the availability of organisms to make best use of them are tightly coupled, it is hardly surprising that variability in the former can lead to trophic cascades that can have significant economic impacts. By adopting an approach that seeks to control the cause of these changes, we are implicitly adopting an ecosystem-based approach (see box 2).

Another consistent and growing problem affecting not only the productivity and health of coastal and freshwater ecosystems but also the health of human populations is the unintentional introduction of non-indigenous organisms arising from the transferral of ballast water from a variety of ships and vessels into rivers and coastal waters. The IMO Assembly has issued guidelines for the control and management of ballast water, but the problem is enormous. It has been estimated that the major 40,000 cargo vessels of the world transfer 10 billion tons of ballast water globally each year, and it has been demonstrated that on average 3,000-4,000 species are transported daily, with severe consequences for the ecosystem as well as for public health (International Maritime Organization, 1998). For example, ballast waters are known to be the source of spread of human disease agents, such as the parasite *Paragonimus westermani* which causes fatal lung disease, the *Vibrio cholera* and other toxin producing organisms.

No one single definition of ecosystem health exists, although a range of indicators and criteria have been proposed (e.g. FAO Technical Guidelines 8, 1999). The main approach to maintaining or restoring the health of an ecosystem is generally accepted to be via assessment and monitoring of changes in ecosystem performance in relation to multiple-state comparisons of ecosystem resilience and stability. To be healthy, an ecosystem must maintain its metabolic activity level and its internal structure and organization, and must show resistance to external stresses through time. Indicators of ecosystem health thus include biodiversity, stability, yields, productivity and resilience.

Box 2. Environmental status of the Danube River

The main problems that effect the water quality of the Danube include: high loads of nutrients and eutrophication; contamination with hazardous substances, including oils; microbiological contamination; contamination with substances causing heterotrophic growth and oxygen depletion and competition for available water. These are largely caused by urbanization, agricultural and industrial processes. In particular, 20-30 per cent of the problem of excessive nitrogen and phosphorus arise from industry and atmospheric deposition. Old-fashioned fertilizer factories are major dischargers of nitrogen and their outdoor piles and lagoons of phosphor-gypsum are a special source of nutrient pollution. Even if production on these sites is reduced or stopped, the gypsum stores will continue to be serious pollution sources in the future.

Industry and mining are responsible for most of the direct and indirect discharges of hazardous substances into the Danube Basin. Depending on the type of industry, the effluent might contain heavy metals (smelting, electroplating, chlorine production, tanneries, metal processing, etc.), organic micro-pollutants (pulp and paper, chemical, pharmaceuticals, etc.) or oil products and solvents (machine production, oil refineries, etc.). Mining activities result in drainage water from the mines, run off from tailings and from process water containing metals and sometimes-organic solvents (see box 4). Data are available on the loading of hazardous pollutants from individual enterprises, but in most cases data are lacking or are unreliable. Sewage is a major source of ammonia.

Organic materials discharged by human settlements and industry consume much of the available dissolved oxygen. The impact depends on the total load, the type of organic substances, the water temperature, and the dilution capacity and the initial oxygen concentration of the receiving waters. As indicated in box 1, the high level of nutrient loadings in the Danube are causing serious environmental problems in the Black Sea. The high nutrient loadings are also of transboundary importance within the Danube River Basin itself. Serious oxygen deficiencies are most likely to occur in slow-flowing and stagnant waters. Downstream of major outlets, the oxygen concentration may drop below the level that can support aquatic life forms including fish populations and render the receiving waters unsuitable for drinking water supply and recreation. Such situations already occur in the Danube tributaries: for example, the Vit River in Bulgaria is unable to support fish downstream of the city of Plevin, primarily due to discharges from a sugar factory. Discharges from the pulp and paper factory in Pietra Neamt have made one of the Siret tributaries unfit for most uses. The main watercourse of the Danube, however, has a very large dilution and oxygen mixing capacity which enables it to cope with heavy loads of organic materials.

The specifics of the transboundary nutrient inputs in the Danube River Basin and Black Sea originating from industrial plants are known in some instances. In relation to plants contributing to nutrient loadings of 50 t/yr or more, Bulgaria has 8 plants, Croatia has 3 plants and 4 plants with other pollutant loadings affecting a neighbouring country; Hungary has 4 plants and 3 plants with other pollutant loadings affecting a neighbouring country; Romania has more than 35 plants and 12 plants with other pollutant loadings affecting a neighbouring country and Slovakia has 2 plants and 10 plants with other pollutant loadings affecting a neighbouring country. The major polluting industrial sectors in terms of enterprises are food, paper, chemicals and iron. Together these four subsectors account for more than 75 per cent of the significant industrial pollutant discharges.

Thus, despite the period of transition in most of Central and Eastern Europe that has lead to a significant decrease in the level of industrial and agricultural activity, industrial pollution still remains a significant problem that needs to be addressed by the Danube Countries. More importantly, as the economies in the region and industrial production increases, industrial pollution will significantly increase unless the source of pollution is adequately addressed beforehand.

Source: UNIDO 2000.

2.3 Ecosystem-based management

The overarching principle for guiding an ecosystem-based approach is to ensure the intergenerational sustainability of ecosystem goods (e.g. food, hydrocarbons, minerals) and ecosystem services or processes, including productivity and hydrological cycles. Implied in this is a movement from the management of commodities to the sustainability of the productive potential for ecosystem services and goods, including the need to support the welfare of both ecosystems and human societies (see table 1). Ecosystem-based management must include knowledge about the ecosystem, its health and adaptation to changing uses, and should involve all the stakeholders in an active partnership of decision-making. Such an approach will necessarily require significant changes in the way that management boundaries are drawn up and institutions constituted.

Table 1. Ecosystem management

From	*To*
Individual species	Ecosystems
Small-spatial scales	Multiple scales
Short-term perspective	Long-term perspective
Humans: independent of ecosystems	Humans: integral part of ecosystems
Management process separated out	Adaptive management
Managing commodities	Sustaining production potential for goods and services

Source: Lubchenko, 1994.

The ecosystem approach assumes the application of appropriate methodologies focussed on levels of biological organization which encompass the essential processes, functions and interactions among organisms. This emphasis is consistent with the definition of ecosystems in Article 2 of the Convention on Biological Diversity of UNCED given as: "a complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit". This definition does not specify any particular scale or spatial unit, and as such contrasts from the CBD definition of habitat, and does not, necessarily correspond to the terms "biome" or "ecological zone".

2.4 Understanding the sources of uncertainty

What triggers a particular system response is not always clear: some of the very longest environmental data sets indicate periods with cycles interspersed with rapid changes, aperiodicities, and interannual and decadal variability. Some of these are caused by changes in short-term or large-scale weather patterns, leading to shifts in seasonal temperatures, changes in freshwater flows, mixing and sediment exchanges and fluxes. Others, however, are less clear. To determine the presence of any real underlying causal relationship, so as to correct it, is therefore often very difficult as many different processes, including human disturbance and exploitation, can produce similar effects.

An ecosystem approach requires adaptive management to deal with the complex and dynamic nature of ecosystems, even when knowledge about the system and the range of possible states linking cause-and-effects is sparse. Unfortunately, in many of today's institutions there is still a belief that the effects of intervention can be predicted. This supposition occurs because most existing resource and economic planning models allow managers to simulate or in a crude way anticipate the future. But this implies not only that all the interactions within the system are adequately understood, but also that these are the processes that will direct its forward evolution. The assumption is that all future states are contained within the dynamical description of the present system.

This is generally not the case. For example, the inner dimensions of a regional planning model that included all possible future states would contain so much working detail that in practice it could not be developed. Secondly, the outer dimensions would have to reflect the fact that complex living systems are open and hence have significant exchange of materials across their boundaries. Remarkably most planning decisions have ignored these two issues, concentrating instead on a highly restrictive view of what is actually happening. Thus in many parts of the world we see situations where scientists and planners have been forced unremittingly into a role where they are trapped by their own knowledge; they might think they know what the system is doing, but rarely do know why or even how it is doing it.

In areas outside policy and planning, scientists and technologists have learned to cope with such problems. One way has been simply to use error bars when estimating variables. But errors can derive from uncertainties in a wide range of processes and objects, e.g. in the instruments themselves, calibration, design, lack of skill and general confusion about the theoretical foundations of particular measurements. When a problem becomes more and more complex, simple inexactness cannot fully describe the situation, and uncertainty must be dealt with explicitly.

Uncertainty is not merely the spread of data around some arbitrary mean known with confidence, but rather a systemic form of error that can swamp an otherwise easily calculated random counterpart. Achieving certainty then, even in a quantitative science, relies largely on managing the different sorts of uncertainty affecting performance. Because uncertainty cannot be removed it has to be clarified.

The errors associated with data points represent the spread, i.e. the tolerance or random error in a calculated measurement. Confidence limits refer more to risk; for example, in a risk analysis of future scenarios resulting from different policies, confidence limits are reflected in estimates when they are qualified as optimistic, neutral or pessimistic. An assessment based on historical estimates of some quality or resource thus acts as a qualifier on the numbers used and on the spread of data points. An assessment represents the unreliability and relates to our knowledge about the processes involved, whereas the spread represents inexactness and relates to our knowledge of the behaviour of the data. Finally, there is ignorance; this is a measure of the gaps in our knowledge. These gaps may simply be anomalous results that are exposed when a new advance in understanding occurs or reflect the maturity of the subject.

The boundary of ignorance is very difficult to map. One approach has been to assess the pedigree of knowledge (see table 2). This describes the state of art of a particular field from which an observation derives. For example, in the case of theory of relativity, there was a progression from an embryonic field in 1905 through to the 1950s when experimental results had corroborated the theory and all but cranks had accepted it. Environmental management on the other hand relies on data that are highly qualitative and heterogeneous. Well-structured theories, common in many branches of science, are conspicuous by their absence.

Table 2. Pedigree of knowledge

Pedigree score	*Theoretical structures*	*Data*	*Peer acceptance*	*Colleague consensus*
4	Established	Experimental	Total	All but cranks
3	Theoretical model	Historical/field	High	All but rebels
2	Computer model	Calculated	Low	Competing schools
1	Statistical procedures	Educated guess	Low	Embryonic field
0	Definitions	Uneducated guesses	None	No opinion

Thinking that we can make exact predictions under highly complex circumstances, leads those involved in decision-making towards a misdirected sense of concreteness in overall policy judgement. Worse still, the credibility of science is put at risk because of the dilemma of uncertainty and responsibility. Neither can be eliminated, nor indeed would it be desirable: managing uncertainty in the context of responsibility cannot be side-stepped. Unfortunately, many of today's institutions have been developed to undertake planning and policy development from the standpoint of determinancy rather than complexity.

2.5 Communicating an understanding of environmental risks

One of the major difficulties in environmental management is that it is highly interdisciplinary, involving fields of varying states of maturity and with very different practices in their theoretical experiments and social dimension. Those involved in planning thus often find themselves having to use inputs from research areas with which they are potentially unfamiliar, consequently find it difficult to make the same sensitive quality judgements as in their own field.

The result is a dilution of quality control on the planning and policy process and a weaker quality assurance of results.

Scientists and technologists tend to develop a healthy prudence about passing judgement on the results of others in areas outside their own expertise, with the result that any interference in others' fields is discouraged. Unfortunately, in an interdisciplinary policy-related area such an approach rapidly becomes counterproductive, because criticism, the lifeblood of science, does not occur in sufficient strength.

The problems created in policy-related research are increased by its societal dimension. Science is judged by the public, including bureaucrats, on its performance in sensitive areas such as the economic returns on foreign aid, returns from the exploitation of natural resources, the dumping of hazardous wastes, the dangers of oil spills, food additives and environmental pollution. All involve much uncertainty, as well as inescapable social and ethical aspects, so simplicity and precision in predictions or even setting safe limits are not always feasible.

Yet policy-makers tend to expect straightforward information to use as input into their own decision-making process. In such circumstances, the maintenance of confidence among policy-makers and planners and the community becomes increasingly strained, with the scientist often caught in the middle.

The problems become manifest at several levels, the simplest one being the representation of uncertainty in only qualitative estimates. Any scientific advisor knows that a prediction such as a "one in a million" chance of a serious accident or health incident should be hedged with statements about the different sources of uncertainty so as to caution any user on the reliability of the numerical assertions. But if these were all expressed, policies would become tedious and incomprehensible, yet if omitted then the same policies could convey a certainty unwarranted by the facts.

Besides low-frequency hazards, there are also problems relating to higher probability events such as the failure of an investment/development programme, diffused hazards such as the long-term usage of chemicals or possible large-scale environmental perturbations such as global warming. The dilemma is that any definite advice is liable to go wrong: a prediction of danger will appear alarmist if nothing happens in the. short term, whilst reassurance can be condemned if it retrospectively turns out to be wrong. Thus the credibility of science, based on the supposed certainty of its conclusions, is endangered by giving any scientific advice on inherently uncertain issues.

On the other hand, if a scientist refuses prudently to accept vague or even qualitative expert opinions as a basis for quantitative assessments, and declines to provide definitive advice when asked, then science itself is regarded as obstructionist, not performing its public functions and its legitimacy is called into question.

It is not surprising then that most policy and planning institutions have been unable to respond in a locally adaptive way. In many cases the organizations are suffering from a chaotic mixture of hierarchical, non-hierarchical, academic and industrial operational modes. A major component of environmental management must therefore be to create new settings in which to evaluate evidence from a broad array of sources, so as to provide clear and explicit guidelines for analysis and public action.

3 International and regional environmental legal instruments

Achieving a more integrated environmental approach to industrial development will require a shift from the current system of sectorally-based knowledge to one which can be adapted across a range of socio-economic and physical scales. In this sense, it is appropriate to look at international legal instruments, as many of these are cross-sectoral and enshrine the key principles needed for environmental protection.

3.1 The international regime

One of the key steps in determining the environmental benefits and burdens of different industrial processes is to define the environmental scale at which they are to be assessed. In legal terms, the use of the term "ecosystem" has been widely accepted as valid, and despite long, some would say sterile, debates within the scientific community, the term is now widely used in conventions and other legal instruments.

One of the first international conventions and declarations where the concept of managing the environment at an ecosystem level was engendered was the 1972 Stockholm Declaration of the United Nations Conference on the Human Environment, where States were called on to safeguard natural ecosystems by adopting an integrated and coordinated approach to development. A decade later, one of the most important conventions for the marine environment, the 1982 United Nations Convention on the Law of the Sea was adopted, in which States agreed to a set of conditions for the extraction of living marine resources within EEZs, which included their conservation and management and the promotion of optimum utilization.

Since Stockholm, a number of other relevant international instruments supporting the ecosystem approach were established, including:

- The 1971 Ramsar Convention on Wetlands of International Importance. The need for an international convention to protect wetlands was recognized by IUCN, the International Council for Bird Protection and the International Wild Fowl Research Bureau in 1962. The convention requires parties to conserve wetlands, *inter alia,* as habitats of distinctive ecosystems, that constitute a resource of great economic, cultural, scientific and recreational value, the loss of which would be irreparable.
- The 1973 Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) which recognized the important impact that introductions could have on marine ecosystems.

- The 1979 Bonn Convention on the Conservation of Migratory Species of Wild Animals which recognizes the importance of managing habitats for their support.
- The Convention on the Conservation of European Wildlife and Natural Habitats which was negotiated under the auspices of the Council of Europe to overcome the inadequacies of the piecemeal and outdated European Conventions and to provide for cooperation among States. The aims of this Convention are to conserve natural habitat, especially those which require the cooperation of several States, and to promote cooperation.
- The 1992 Helsinki Convention on the Protection and Use of Transboundary Watercourses, the first to codify on a regional basis rules governing the protection and use of international watercourses down to where they flow directly into the sea, thereby linking human activities to these orphan ecosystems.
- The United Nations Framework Convention on Climate Change (UNFCC) is also concerned with ecosystem-based management. The objective of the Convention is that Parties should reduce greenhouse gas emissions to allow ecosystems, including marine ecosystems, to adapt naturally to climate change. Further, article 4.1(d) commits Parties to promote sustainable management and cooperate in the conservation of sinks and reservoirs of greenhouse gases, including oceans as well as other coastal and marine ecosystems.
- The 1992 Declaration of the United Nations Conference on Environment and Development, involving the action plans of Agenda 21, the Convention on Biological Diversity and the non-legally binding Statement of Principles on Forests.

It is this last convention that now occupies centre stage in the growing debate about the nature and role of biodiversity in the materials cycle itself. As with the 1972 Stockholm Declaration, the Rio Declaration is not formally binding, but it introduces important new principles which are relevant to any discussion on sustainability and environmental liability. These include the adoption of a precautionary approach (15), the polluter pays principle (16), environmental impact assessment (17) and public participation (10). The document represents a fine balance between proposals from developed States for a more overtly ecological set of principles, affirming the promotion of integration of environment and development, and those from developing States for a more anthropocentric stand. Agenda 21 sets out a basis of actions to provide for an integrated policy and decision-making process, including all involved sectors, to promote compatibility and a balance of uses, identify existing and projected uses, apply preventive and precautionary approaches to project planning and implementation, promote development and application of techniques to value loss of environmental services and to provide access to information for all concerned individuals.

3.2 The Convention on Biological Diversity

Since its inception, the Conference of the Parties to the CBD has worked to establish the principles and operational guidance for the application of an ecosystem approach (see UNEP/CBD/CPO/5/3 p. 78). There are now moves to encourage the take up of the Jakarta Mandate on Marine and Coastal Biological Diversity and other action plans through regional programmes such as those in the Baltic, Mediterranean and Black Seas. The work programmes are founded on six basic principles: i.e. the ecosystem approach; the precautionary principle; the importance of science; the full use of the roster of experts; the involvement of local and indigenous communities (traditional knowledge); and three levels of implementation—national, regional and global.

By implication this means that within any legal context: management boundaries must designed with particular environmental issues in mind; ecological integrity must be conserved i.e. protection of biodiversity and the ecological processes that maintain it; data collection must be incorporated in order to ensure a good scientific basis for management decisions; monitoring programmes are needed to track the results of actions; interagency and/or transboundary cooperation is essential; structural changes in resource management agencies are necessary; humans must be recognized as a component of the ecosystem, and human values must play a dominant role in the establishment of management goals.

The twelve principles adopted by the CBD (UNEP/CBD/SBSTTA/5/11) are complementary and inter-linked, and need to be applied as a whole:

Principle 1. The objectives of management of land, water and living resources are a matter of societal choice

Principle 2. Management should be decentralized to the lowest appropriate level

Principle 3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems

Principle 4. Recognizing potential gains from management, there is a need to understanding the ecosystem in an economic context

Principle 5. A key feature of the ecosystem approach includes conservation of ecosystem structure and functioning

Principle 6. Ecosystems must be managed within the limits of their functioning

Principle 7. The ecosystem approach should be undertaken at the appropriate scales

Principle 8. Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for long term

Principle 9. Management must recognize that change is inevitable

Principle 10. The ecosystem approach should seek the appropriate balance between conservation and sue of biological diversity

Principle 11. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices

Principle 12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines

In applying these principles, the CBD proposes that the following five points should be used as operational guidance: focus on the functions of biodiversity in ecosystems; promote the fair and equitable sharing of the benefits derived from the functions of biological diversity in ecosystems; use adaptive management practices; carry out management actions at the scale appropriate for the issue being addressed, with decentralization to the lowest level; and ensure inter-sectoral co-operation.

3.3 European Community law and regional conventions

The main Community institutions involved in adopting European Community laws are the European Commission, the European Parliament and the Council of the European Union. Amongst the 20 Commissioners, there is one for the environment (Directorate-General XI), although others including industry (DG III), agriculture (DG VI), transport (DG VII), fisheries (DG XIV), energy (DG XVII) and consumer policy (DG XXIV), play an important role The specific institutions dealing with environmental law includes the Council, the Parliament via its standing committee on environment, nuclear safety and civil protection, the European Court and the Court of First Instance. Various types of environmental cases will come to the European Court, including actions by the Commission against member States which are breaking EC environmental laws. The European Environment Agency, which was established in 1994, provides the Community and the member States with objective, reliable and comparable information relating to the environment and to ensure that the public is informed about the state of the environment. It does not have a role in enforcing compliance. Participation in the agency is open to non-EC members, such as countries of the European Free Trade Association and the Central and East European States.

When the treaty setting up the EC was signed in 1957, environmental degradation was not generally recognized as an important problem. However, since 1972 five action programmes for the environment have been adopted. These are not binding measures in themselves but are useful indicators of the framework within which the Commission is working to bring about new environmental laws. Recent priorities have been to improve the enforcement of legislation, the integration of environmental considerations into other policies, use of a wide range of policy instruments (such as environmental charges and liability), the raising of public awareness and reinforcement of the Community's international actions to protect the environment. In the environment field, there are now three forms of legally binding measures—directives, regulations and decisions.

Directives are the most common form of legislation and to comply, States have to pass national laws within the timetable laid down in the directive (normally within two years). Regulations are directly binding and applicable in all members States; i.e. no further national legislation is necessary or permissible. Decisions are directly binding on the persons to whom they are addressed, including member States, individuals and legal persons. International agreements are entered into by the EC and they then become part of EC law. This has three consequences: first, it means that the international agreement can give rise to rights and duties which may be relied upon by individuals in national courts. Secondly, decisions of organizations created by the agreement will also become part of community law. And finally, the European Court is able to interpret and apply the agreement and decisions of the organization created by the agreement. Judgements of the European courts are important as they affect the way in which EC environmental laws are applied.

The EC laws for the protection of the environment can be grouped into six main categories: general, air and noise, chemicals and industrial risks; nature conservation; waste; and water (annex 1). From these it can be seen that EC environmental law is now a pervasive part of the legislation affecting business, government agencies, the voluntary sector and individual citizens across the whole of the European Union. Its enforcement has also become stronger, with many individuals as well as organizations taking cases to the European Courts.

In addition, a range of regional conventions are emerging out of a general concern for shared environments, including:

- the Convention for the Prevention of marine pollution from land-based sources (Paris Convention), aimed at preventing pollution of the North-East Atlantic and Arctic Oceans, the North Sea and the Baltic Sea from pollution arising in rivers, estuaries, pipelines or man-made structures and emissions to air from land or man-made structures. This is now being replaced by the OSPAR Convention which extends pollution to include dumping and incineration.
- Agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances (Bonn Agreement).
- Convention on protection of the marine environment of the Baltic.
- Convention for the protection of the Mediterranean Sea against pollution.
- Convention for the protection of the Rhine against chemical pollution. Limits on discharges of substances in annex I of the convention are laid down by the International Commission for the Protection of the Rhine against Pollution, which was set up to implement the convention. Annex II substances are to be controlled by governments under the commission's supervision.
- Convention on Cooperation for the Protection and Sustainable Use of the Danube River (see box 3).

Box 3. Danube River Protection Convention (1998)

The Danube River Basin is in the heartland of south-central and south-eastern Europe. The river flows for a distance of 2,857 km and drains an area of 817,000 km^2. The area includes all of Hungary and Romania, most of Austria, Croatia and Slovenia, nearly half of the Czech Republic and Slovakia, a third of Bulgaria, and significant areas of Germany and Ukraine. Land use in this large basin is highly diversified including a wide range of agricultural practices, forestry, mining, natural areas, settlements and industries (see box 4). The critical interdependence of upstream and downstream neighbours for managing the environmental quality of the Danube can be seen at all levels of the basin. In addition, there is an important linkage with the Danube River, its delta, and the environmental quality of the Black Sea.

Amongst the transboundary issues are the quality of water (pollutant hot spots, waste water, agricultural practices, toxic substances); the quantity of water (dams, flood control); river navigation (dams, regulation); and fisheries.

Recognizing the growing regional and transboundary character of water management issues and related environmental problems, the Danube countries together with interested parties from the international community met in Sofia in September 1991 to consider a new regional initiative to support and enhance the national actions that would be required. The countries agreed to develop and implement a programme of priority actions and studies in support of a new Environmental Programme for the Danube River Basin and to form a Task Force to oversee its work. The European Commission, in its role as G-24 Coordinator, agreed to provide support and coordination for the Task Force. The main objective of the environmental programme has been to strengthen the operational basis for environmental management in the Danube River Basin.

To secure the legal basis for protecting the water resources, the Danube River Basin countries and the European Union signed the Convention on Cooperation for the Protection and Sustainable Use of the Danube River in Sofia, on 29 June 1994. The main objective of the Convention is that all parties cooperate by taking all appropriate legal, administrative and technical measures to maintain and improve the current environmental and water quality conditions of the Danube river and of the waters in its catchment area. This includes among others the improvement and rational use of surface and ground water, pollution reduction from point and non-point sources and loads to the Black Sea, as well as accidental prevention and response measures.

The Convention entered into force on 22 October 1998. Thus far it has been ratified by 11 parties: 10 Danube countries (Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Republic of Moldova, Romania, Slovakia, Slovenia) and the European Union.

Source: UNIDO 2000.

Over the next two years, it is expected that an additional 25 new environmental directives will come into effect. In particular there will be a Directive on Strategic Environmental Assessment (SEA), which will serve both as an instrument for promoting sustainable development and a means of strengthening and streamlining environmental impact assessment of projects. Many challenges remain to implement this Directive, not least methodological ones. However, it has wide political support, and has now gone through its second reading and is expected to go to Plenary vote in September 2000 to come into effect in 2007. The critical element of this Directive is that EU structural funds, which many countries in the region will be eligible for, will be subject to SEA.

4 Environmental management of industrial processes

Environmental degradation is one of the features of globalization. This is true in two different senses. At its simplest, it is obvious that pollution does not recognize national boundaries. Phenomena such as global warming and the depletion of the ozone layer are truly global and are caused by economic activities in every part of the world. Other environmental issues cross boundaries and require international cooperation to tackle: pollution of rivers and seas, fish stock depletion, acid rain, nuclear radiation, chemical releases. Toxic PCBs have been found in Antarctica, emitted by industrial plants located thousands of miles away. But there is a stronger sense in which the environment and globalization are bound together: the new global economy, which has increased the range and extent of environmental degradation, is also beginning to develop responses to it.

4.1 The Danube River Basin—regional perspective

Industrial point sources of pollution

Within the UNDP/GEF Pollution Reduction Programme (1998/1999), country expert teams, under the guidance of the respective country programme coordinators, undertook a new, comprehensive review of the sources of pollution and their effects on the Danube River Basin and Black Sea. Each national team developed a national review for their respective countries based on a common methodology. The results were then compiled and analysed at a regional level. A total of 130 industrial enterprises of concern (known as hot spots) within the Danube River Basin were identified (table 3).

UNIDO's response to this challenge has been to design a project to build capacity in existing cleaner production institutions to apply the UNIDO transfer of environmentally sound technology methodology to technology transfer to twenty pilot enterprises that are contributing to transboundary pollution, primarily nutrients, in the Danube River Basin and the Black Sea. The planned outcome is that these twenty pilot enterprises will be on their way or even may have achieved within the lifetime of the project a significant reduction in their discharge of transboundary pollution/nutrients into the Danube River and Black Sea. It is then planned to disseminate the results from the pilot enterprises to other enterprises in the participating countries as well as to other Danubian countries.

It is well known that the mining industries have created a number of environmental problems, which have been brought to the public's attention as a result of the environmental damage caused by the disposal of wastes. Box 4 presents the case of the Tisza River, where the UNIDO response is to cooperate with concerned governments and industrial plants in the catchment area of the Tisza river to identify persistent industrial environmental pollution sources in the upper region of the Tisza river and make recommendations for the prevention of future accidents.

Table 3. Major Manufacturing Discharges identified by the GEF Danube River Basin Pollution Reduction Programme, 1998

Type	*Bosnia Herze-govina*	*Bulgaria*	*Croatia*	*Czech Republic*	*Hungary*	*Romania*	*Slovakia*	*Slovenia*	*Ukraine*	*Yugo-slavia*	*Total*
Food		5	14		2	5		5			31
Textiles						2	1				3
Leather	1	2		1	1		1				6
Wood processes					1		1		2	1	5
Furniture						1					1
Paper	1		1		3	3	2	5	2	1	18
Industrial chemicals and fertilizers		2	2	1	3	23	6			2	39
Other chemicals		2	2			3					7
Petrol					1	1					2
Iron	1	1			2	5					9
Non-ferrous		1	1			1					3
Metals		2									2
Other industrial	1	1		1			1				4
Total	4	16	20	3	13	44	12	10	4	4	130

Source: UNIDO.

Diffuse sources of pollution

Agriculture is one of the main sources of diffuse pollution in the region. Agriculture occupies much of the land in the Central European region and has the greatest environmental impact on the rural environment. Agricultural activities give rise to point source and extensive diffuse pollution, that is lower in level but is widespread, so that its overall impact on the environment is large. The primary resources of good quality air, land and water are the basis for successful agriculture; their sustainable management is important to the longer-term success of the industry as well as to the environment itself, and biodiversity is influenced profoundly by agricultural practices.

As indicated above, the major source of ammonia emissions to the atmosphere in the region is agriculture. Ammonia contributes to acidification and nutrient enrichment of sensitive habitats; agriculture is also a major source of greenhouse gases, especially methane and nitrous oxide. Soil is a valuable economic resource that is damaged when it is not managed or protected correctly. Locally, soil erosion arising from over-grazing or intensive cultivation is a problem. Apart from the loss of soil resources, this erosion causes serious damage to aquatic habitats. Excess application of livestock manure and fertilizers can lead to a build up of nutrients that the transfer to water and air causing pollution (see box 1). The application of sewage sludge and other organic wastes to land on farms can lead to the accumulation of potentially toxic contaminants in soils. Changes to the hydrological properties of soils caused by agriculture can also affect surface run-off and flooding. In many instances, it is now likely that agriculture is doing much to undermine the real advances being made through investment in water quality improvement.

Agriculture has enjoyed exemption from a range of general environmental legislation as well as aspects of planning (development control) that would otherwise require environmental consideration. EU Directives are driving present and future environmental protection legislation towards more control of this activity. For example, there are new regulations under the EU Directives on Nitrate Vulnerable Zones, Groundwater, Integrated Pollution Prevention and Control and proposed regulations to control non-natural agricultural wastes that are currently exempt from regulation. In addition there is a need to control wastes and the overuse of nutrients.

Box 4. Tisza river pollution incidents

Early in 2000, several spills of hazardous chemicals from mines in northwest Romania poured into rivers in Romania, Ukraine and Hungary that make up the catchment area of the Tisza (Tisa) river. The Tisza rises in the Carpathian Mountains in Ukraine, follows a short section of the border with Romania, and then flows mainly through Hungary until it joins the Danube in Serbia.

Due to heavy rainfall and melting snow the tailings dam of a mining lagoon broke on 30 January 2000 and spilled almost 100,000 m^3 toxic waste water with high concentration of cyanide and heavy metals, such as zinc, lead and mercury, into the Lapus river which joins the Somes (Szamos) river, a tributary of the Tisza. As a result, 200 tons of fish were killed and water supplies for many towns were rendered problematic. The burst dam was repaired the day after and the discharge stopped.

The mining lagoon is situated near Baia Mare in the Maramures region and belongs to the Australian-Romanian joint venture company Aurul S.A., which extracts gold and other non-ferrous metals from the waste rock piles of mines in the area, using metal enrichment technologies. The process involves extraction with cyanide after grinding the refuse ore, and requires a high volume of water. Consequently, after storage the washing water containing cyanide is recycled into the extraction process again. The environmental accident was the result of a rupture of the containment dam of the reservoir containing the waste water.

Only six weeks later, on 10 March 2000, the tailings dam of the state-owned Novat mine in Baile Borsa, further to the east of Baia Mare, ruptured, again due to heavy rainfalls and melting snow. The breech in the dam allowed a spill of approximately 20,000 tons of toxic mine waste, including zinc, lead, copper and small quantities of cyanide, into the Vise river, another tributary to the Tisza. The mineral waste was stored in the decantation reservoir for processing complex ores of lead and zinc by the Baile Borsa Preparation Enterprise, which is a local branch of the state-owned company Remin S.A. in Baia Mare. This spill affected the upper part of the Tisza, the part which was saved from the impacts of the first spill and which was since the main source for biological revitalization of the water quality downstream. Since then two more spills have occurred at the same mine in Baile Borsa, with mine waste of the same composition.

As cyanide breaks down in sunlight and is quickly diluted, the Tisza has recovered much faster than originally thought from the spill at the Aurul mine, and the cyanide concentration has dropped to levels considered safe. However, pollution by heavy metals has a long lasting, poisoning effect together with problems linked to bioaccumulation. It remains unclear how much heavy metals from the spills at Baile Borsa remain in the river-bed. After temporary settling in the river-bed, some of the contamination may be flushed downstream at a later period, especially by floodwater. A mission by UNEP and the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) provided a scientific assessment on the environmental impact. However, as yet no conclusions have been drawn by this mission. The accidents polluting the Tisza are only the most recent in a series of mine spills which occurred in Romania over the past several years. In February 1998, 43 hectares of soil and 200 kilometres of river were contaminated by toxic sulphur oxide released from precious metal works in Zlatna. In May and December 1999, thousands of cubic metres of cyanide sludge spilt from two gold mines near Brad and Baia de Aries in the western Carpathians, causing major fish kills.

In recent years an increase in gold mining in the Romanian and Ukrainian Carpathians has been observed. Australian, Canadian and British companies are currently taking over old, state-owned companies in the region, where they extract, by cyanide leaching, the last residues of gold from the soil or from the remnants of their new partners' previous mining operations.

Source: UNIDO 2000.

5 Governance of the environment

5.1 Types of governance

The term governance has a number of meanings: it can be the activity or process of governing, a condition of ordered rule, those people charged with the duty of governing or the manner/method/system by which a particular society is governed. It is not a synonym of government, but rather signifies a change in the meaning of government. There are at least six separate uses for the term in current use:

- The minimal state—reducing the extent and form of public intervention and the use of markets and quasi-markets to deliver public services.
- Corporate governance—referring to the system by which organizations are directed and controlled. There are usually three principles associated with successful governance: openness or disclosure of information, integrity or straightforward dealing and accountability.
- New public management—has two meanings: managerialism and new institutional economics. Managerialism involves hands on professional management, explicit standards, measures of performance, managing by results, value for money and closeness to the user. New institutional economics implies incentive structures, disaggregating bureaucracies and greater competition through contracting out and quasi-markets. This type of management is relevant to natural resources because steering is central and synonymous to governance. This type of governance promotes competition between providers; empowers citizens by pushing control out of the bureaucracy; measures performance by outcomes; is driven by goals and a mission, not rules and regulations; anticipates problems; decentralizes authority—participatory management; prefers market mechanisms; and catalyses all sectors into action to solve community problems.
- Good governance—there is a worldwide trend towards good governance. This is seen as the exercise of political power to manage a nation's affairs, and is achieved via encouragement of competition and markets, privatization of public enterprise, reform of the civil service and greater use of non-governmental organizations. Good governance involves an efficient public service, an independent judicial system and legal framework to enforce contacts, accountable administration of public funds, and independent public auditor, respect for law and human rights and pluralistic institutional structure.
- Socio-cybernetic system—the pattern or structure that emerges in a socio-political system as an outcome of the interacting intervention efforts of all persons involved. In this sense, central government is no longer supreme, the system is increasingly differentiated, i.e. a polycentric state

with self and co-regulation, public-private partnerships, cooperative management and joint entrepreneurial ventures. It highlights the limits to governments.

- Self-organizing networks—involving the transformation of a system of local government into a system of local governance, with complex sets and networks of organizations drawn from the public and private sector. The key to understanding the importance of this type of governance comes from the observation that integrated networks resist government steering, they develop their own policies and mould their environment. This leads to interdependence between organizations (governance is broader than government), continuing interactions between network members caused by the need to exchange resources and negotiate shared resources, game-like interactions, a significant degree of autonomy and a hollowing out of the state.

5.2 Governing without government

In managing the environment and industrial development, it is possible to choose between governing structures such as markets, hierarchies and networks. None of these structures are intrinsically good or bad for allocating resources authoritatively or for exercising control and coordination, and the choice is not inevitably a matter of ideological conviction, rather practicality. However, given a world where governance is increasingly operative without government, where lines of authority are increasingly more informal than formal, where legitimacy is increasingly marked by ambiguity, society is increasingly capable of holding its own by knowing when, where and how to engage in collective action. For resource management this is a critical issue, because as has been witnessed in many areas, social constraints on over-exploitation of resources are rapidly diminishing

In recent years there have been a number of instances where the incompatibilities and interplay between policy, politics and science have had serious consequences in terms of natural resources and human health. They include the emergence of evidence on bovine spongiform encephalopathy (BSE) in cattle in the United Kingdom and the significant effect it had on EU agricultural policies, human-induced effects on climate change and genetically-modified food crops. It is quite obvious, that despite a wide debate, there is still no clear consensus in the collective mindset of policy makers as to how to mitigate against such problems.

Looking more closely at governing structures, it is clear that good governance effectively means that a balance has been achieved between governing needs (problem situations or the impact of new opportunities) and governing capacities (creating patterns of solutions or developing new strategies). But the governing needs and capacities of common pool resources, (i.e. those which are difficult to bound or divide) are very different from non-common pool resources (i.e. those bounded and to some extent private). On a global level, an external perspective generally exists i.e. there is sufficient understanding of the various price and property mechanisms that goals, such as maximum sustainable yields, can be determined externally and operate through negative reciprocity or self-interest. However, in the case of international public goods, this is generally not the case; rather generalized or positive reciprocity exist, which rely on mutual agreements. At a local level many local communities operate solely with an internal perspective; they reject objective efficiency and presume that any market failure can be determined independently of the existence or magnitude of an external cost. Indeed they avert many of the problems by operating through generalized reciprocity arrangements, relying on mutual help and solidarity amongst individuals. Thus in the face of uncertainty about natural resources and ecosystem dynamics, the level and type of participation in the governance of resources is critical.

With regard to natural resource and waste management there is a continuum from total state control, liaison with industry, consultation by industry, representation, co-management, community based management and individual control. Co-management, communal control and community-based management are all bottom-up rather than top-down and participatory forms of governance, and the type of knowledge that is used to inform the management of resources is quite different from that used in top-down or state controlled management. It is widely recognized that it has been the absence of communal control that has caused the collapse of many environmental resources, but to support any move towards more local governance it will be important to provide advice based on clear environmental principles. Without such a transition, the form of governance controlling the environment will rapidly move away from regulation and conservation, based on the formal authority of the state or economic controls based on the market, to one of communicative governance based on the force of the argument and political rhetoric.

Hollowing out of the state is already occurring as result of transitions in society towards self-organizing networks at one end of the scale and globalization at the other. The danger is that without a sustained effort on the part of governments, the impacts of human activities on the biosphere will not be made clear to society. The challenge is therefore to ensure that any decision-making processes are not only set-up to encourage industry but also to protect the environment.

5.3 Locally responsive environmental management

Many communities in Europe as a whole are now faced with an alarming array of risks arising from a variety of sources. These include environmental uncertainty, changes in resource distribution, regulatory changes, supply and demand fluctuations and geopolitical instability. For many communities, the only possible adaptive reaction is to concentrate on local issues. This represents not so much a withdrawal from the issues of the world, but rather a pragmatic participation which maintains a focus on day-to-day problems and tasks. In subsistence farming, communities which rely totally on the small amount of agricultural produce from their land, are not going to worry unduly about the price of produce elsewhere in Europe. Only if alternative livelihoods were found for such a family, could preferences and issues about precaution and sustainability of the food resources be explored.

Even amongst governments, pragmatic acceptance is common because so much goes on in the economy which is outside their control: temporary gains are all that are planned or hoped for, and the enormous investment of human resources, financial capital and institutional reputation, which can render certain development trajectories effectively irreversible, are allowed to run on until either the resources or prices collapse.

There are a number of approaches which could be used to properly embed the analysis of local issues and risks into environmental management and thereby open up the possibility for a precautionary stand to be adopted when considering industrial developments; these include decision trees, value trees, multi-criteria analysis, sensitivity analysis and scenario building. However, to be effective, they need to be accompanied by procedures to involve interested groups, such as consensus conferences, citizen's juries, scenario workshops, focus groups and deliberative polls. But few of these have been applied because so many people reside in the periphery of society and are thus disenfranchised from the debate.

Embedding the concept of precaution into an environmental framework for sustainable development is only likely to succeed where there are real—not just perceived (by experts)—risks of serious irreversible damage. Lack of scientific certainty is unlikely to be the reason for postponing cost-effective measures to prevent environmental degradation, rather a lack of detailed analyses that show otherwise. This is of course contrary to the general notions of precaution, first enunciated in the *Vorsorgeprinzip* of German environmental policy.

Responsible management requires participants to recognize and acknowledge the limitations of science; anticipate surprises; recognize the vulnerability of the natural environment; uphold the rights of those who are adversely affected by over-exploitation; take into account availability of alternative livelihoods; consider the complexity of behaviour in different organizations; pay attention to the variability of local and other contextual factors; assign equal legitimacy to different value judgements and adopt long-term, encompassing and inclusive perspectives in assessment. These are all often best done at a local level.

Responsible environmental management also implies social choice about a set of incremental measures, that include clear appraisal techniques (e.g. peer review of science, validation of framing assumptions of consensus workshops, freedom of information about the full range of options); capacity building; development of strategies for markets, monitoring, conservation and surveillance; introduction of appropriate financial instruments (e.g. incentive schemes, removal of perverse subsidies; introduction of take-back schemes); and legal provisions (e.g. property rights, safe minimum standards; personal legal responsibility on individual decision-makers, forcing targets).

5.4 Environmental costs, social choice and the determination of liability

Environmental laws are now beginning to take effect in the European courts, as the concept of the polluter pays moves from theory into reality. One of the first problems to be faced in cases of environmental damage and liability is who owns the resource and who is affected by its loss or damage. There is obviously a need to distinguish the type of resource and the property rights associated with it. A well-worn debate in natural resource systems is the tension between defining common and non-common pool resources. Economists generally use three broad categories: natural and free for all to use, human and capital resources, including those privatized utilities such as water and energy. However, even natural resources, such as air or water are not necessarily free: their use may impose costs on the use of other resources in the ecosystem. These externalities are the social costs of production and are not generally accounted for in the market place.

The two traditions of environmental economic thought that frequently emerge to address this issue are those of Pigou and Coase. Pigou's work makes extensive use of the metaphor of external cost, wherein the price mechanism cannot assure the efficient use of natural resources due to the distorted price signals perceived by individuals, and can in fact exacerbate the degradation of the ecosystem—a situation referred to as market failure. On a political level, this approach leads to state intervention, with the efficient use of resources to be ensured by the imposition of appropriate regulations. The approach of Coase, refutes the idea of market failure and instead emphasises the significance of property rights. Inefficient use of resources is interpreted as a consequence of unspecified property rights. The most important aspect of this for the environment lies at the institutional level, whereby many ecological problems are solved through moderate state intervention, i.e. via specification of rights and liabilities.

There is however, the additional problem that investment returns for many natural resource based industries or environmental protection schemes are likely to be much less than could be obtained from a standard form of financial investment. The individual could thus be justified in market terms in depleting or ruining the resource completely. Discounting the future simply adds to the problem, because most environmental resources would have almost no monetary value for a rational decision-maker assuming a high discount rate. If one assumes a very low discount rate, then the resource is essentially removed from the market. A better solution would be to set a high value in the present, so that a non-trivial future rate is obtained and the correct message about the environment expressed. However, these approaches, which are gaining favour within many of today's institutions, assume objective efficiency as an external perspective. It implies that there is sufficient understanding of the markets so as to be able to determine it externally through fixed goals.

But even if external costs and property rights have been accurately interpreted, there still remains the problem of determining costs and liabilities. A different perspective would be to presume that market failure cannot be determined independently of the subjective opinions that individuals have about the magnitude of external costs. This phenomenon is observed in many farming communities, where there is a distinct tenacity to hold onto the resource base as a means of existence despite economic inefficiencies. Such an internal perspective, generated by both public and political processes, implies that straightforward economic models, involving the calculation of maximum economic yield are likely to be inappropriate, as there will be a difference between that defined for the industry and that defined for the community.

Most actions taken within any industry are influenced by decisions of investment, profit and the participation of others. Rational decisions, as implied by the models above, are unlikely to be possible, implying that much of environmental management is premised on an erroneous assumption of human behaviour. Instead we need to introduce a model which does not simply assume that individuals have preferences which can be ordered, thereby determining a type of utility function i.e. an instrumental sense of rationality, but one in which actions can be concerned with deciding on, creating or exploring the ends pursued to achieve quality of life. People in this model are less certain about their objectives and the environment in which they operate, less autonomous but more active and enquiring.

This more elusive idea of the individual is of course much less mathematically tractable than the rational choice version of standard resource economics, so consequently there are fewer theorems and elegant proofs. Nevertheless it is possible to use these ideas to distinguish two types of action—the procedural role (or rule-bound) and the expressive (or existential or autonomous). In the former, people use rules of thumb to avoid the costs of acquiring information which would better enable them to take a course of action; the use of rules constitutes a significant shift away from the instrumental model, and when shared, as in norms, they become a source of reason in their own right. In a wider sense, rule following marks the irreducible social and historical location of individual action, because, when shared, they form the building blocks of a society's culture.

Anthropologists are quick to remind us that shared beliefs are to some degree arbitrary when they act as a system for communication; this is because individual choices cannot always be understood solely in terms of individuals acting to satisfy their own ends. This has a direct bearing on any analysis of industry because it implies that we need to understand not only prices and cost/profit structures of local markets but also the behaviours involving such things as imputed shadow prices, repeated or infrequent decisions, emotional and mechanical ends, individual levels of wealth and poverty, status and age. This implies that understanding how communities will react to differing levels of pollutants in the environment is unlikely to be open to precise economic study. Instead analyses of social networks, which can help to disclose the reciprocity arrangements that exist, need to be undertaken. The specific relationship between reciprocity arrangements and modern economic transactions is especially important in establishing environmental management regimes, because in many communities the significance of balanced and generalized reciprocities appears to resist erosion in an otherwise "economic society" promoting self-interest.

Another approach to the problem of dealing with human activity in a world based on fluctuating and vulnerable resources is to take a property rights view and introduce usufructory rights. This corresponds to a quite different understanding of social practice and may have a high potential for eliminating the problem of private rates of discounting that from a sustainable environment and materials management perspective are too high. But even the introduction of such rights is not enough to address all the problems; for example solutions based on property rights, permits and other similar instruments are often difficult to reconcile with community-based management.

To create any conformity between environmental and economic sustainability management, institutions will have to be organizationally flexible. Such flexibility relies on responsiveness and innovation. On the industrial side it mainly requires firms with intensive links to the local and regional environment, and on the management side it relies on good lines of communication and implementation. This is especially true where conservation and protection is not an attribute of single units of production, but rather the outcome of a symbiosis and cooperation between produces, suppliers and producer services and local authorities in a region.

6 Conclusions

6.1 Social exclusion from environmental health

One of the most frequently heard environmental arguments is that environmental degradation affects everyone equally. Pollution is certainly no respecter of class or income. The universalist claim—i.e. we all breathe the same air—has had a powerful effect in galvanizing public concern. But in fact it is only partially true. Poorer people almost always experience worse environments. Air pollution and traffic congestion are worse in inner city areas and often poorer people cannot afford to move away from areas of poorly regulated industries. Similarly, many industrial sites are located in rural areas, where lack of any alternative employment keeps people close to potential sources of pollution. They therefore often suffer more from respiratory diseases and general poor health. Within neighbourhoods, most environmental goods are public goods, meaning that they are collectively rather than individually consumed. However, wealthier people have the option to buy their way into cleaner environments. The argument here, then is that environmental issues are not only bound up with industrial development, but also with the central trends in contemporary society.

The environmental impacts of these trends are complex. Globalization simultaneously embodies forces tending towards environmental degradation and away from it. A highly developed consumer society, as in the Europe Union, heightens environmental impacts; but it also increases the demand for environmental protection. Rapid technological development is expanding the scope and character of environmental risks; but the trend towards individualism helps force those risks onto the business and political agendas. Increasing inequality in society is manifested in environmental inequality; but the widely perceived "universality" of environmental degradation encourages a collectivist politics potentially capable of tackling this. The new modernity cannot be wished away, but it does need to be shaped as far as possible to reduce environmental impacts.

6.2 The regulatory ladder and industrial policy

One key objective in the environmental agenda is to raise environmental productivity: to get more out of the economy from less. Such trends already exist in the global economy, but they need to be accelerated. To move in this way requires greater emphasis on the development of environmental technologies and industries. One way of encouraging the uptake of such technologies is to introduce economic incentives, such as an accelerated depreciation allowance enabling firms to depreciate selected investments in innovative technologies faster than normal. Second, support needs to be provided to firms to enable them to improve their environmental efficiency, not just through highly innovative technologies, but in more basic ways through training and transfer of knowledge. Third, there should be sectoral strategies that enable key industries to modernise and accelerate their environmental performance. Fourthly, these measures need to be backed up by regulatory regimes which ensure that environmental inefficiency is not an attractive option. This can be achieved through environmental taxation or fines. To be most effective, the revenues from such taxation schemes should be hypothecated for environmental spending.

Thus a regulatory ladder needs to be put in place to underpin environmentally-aware industrial development. This would include the formal regulatory regimes of international conventions and their national and local analogues, "naming and shaming" persistent polluters, taxation and market-share.

6.3 The role of international organizations

Throughout this paper, it is clear that the transboundary nature of so many environmental problems demands a regional and/or international stance. In the case of the European Union, the legal and socio-economic frameworks for such a stance already exist. But with discussions of enlargement high-up on the political agenda, it is likely that shortly we shall see the accession of a number of new States from Central and South-eastern Europe. Given that issues of water pollution and liabilities for transboudary pollution events will still exist in the region, the role for international organizations, such as UNIDO, will be even more critical, especially as new member states will have to harmonise their environmental regulations with those of the EU.

UNIDO has experience in areas of sound management of natural resources, POPs and PTs, the transfer of environmentally sound technologies, the reduction, use and recycling of waste, investment in clean technologies and new environmental monitoring and diagnostics, and special expertise in transboundary effects. Several programmes are particularly relevant to the discussions above: the project for the "Transfer of Environmentally Sound Technology to Reduce Transboundary Pollution (TEST) in the Danube River Basin", and the "Tisza River Environmental Management and Pollution Control" are but two. What is important in this instance is UNIDO's ability to work at a regional level, with a high level of technical competence in the field.

Given the complex nature of the environmental and industrial issues raised in this paper, it is worth considering that international organizations themselves must also adapt to the new global order. They must be able to understand not only the technical aspects, but also the socio-economic issues outlined above. They must in short recognize that whilst they can understand that "one and one make two", they must also understand the word "AND"—a challenge that the international community must meet in order to deliver a safe and healthy environment.