



UNITED NATIONS ENVIRONMENT PROGRAMME
REGIONAL OFFICE FOR ASIA AND THE PACIFIC



**ENVIRONMENTAL AND RELATED ISSUES
IN THE ASIA-PACIFIC REGION**
**IMPLICATIONS FOR TERTIARY-LEVEL ENVIRONMENTAL
TRAINING**

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NETWORK FOR ENVIRONMENTAL TRAINING
AT TERTIARY LEVEL IN ASIA AND THE PACIFIC
(NETTLAP)

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ABSTRACT

Enhancing the environmental expertise of staff in tertiary institutions in the Asia-Pacific region will facilitate the transition to a more sustainable world. It is a strategically important part of the overall task of capacity building through human resources development in order to This report, the first of a series of three, focuses on the identification and elaboration of environmental issues of significance to the Asia-Pacific region and highlights the present shortcomings and anticipated needs in both human expertise and understanding. In subsequent reports these findings will be combined with assessments of current and required capacities for tertiary level environmental education in the region, leading to the identification of the specific needs for additional human resources development in tertiary institutions.

Most attention is given to three themes - coastal zone management, environmental economics and toxic chemicals and hazardous wastes - but in less detail a wider environmental view is also adopted. This provides a broader context for the three themes and also indicates environmental issues which might be the focus of training activities in the near future. These include such global issues as climate change, ozone depletion, marine pollution and international movement and dumping of unprofitable or environmentally unsound materials, technologies and processes. Other regional issues that are examined include urbanization, landlessness, human health and welfare, deforestation and loss of biodiversity, water quality and supply, environmental hazards and disasters and energy production and use.

Each of the themes is examined initially from an environmental perspective and subsequently from a more holistic viewpoint. General prevention and remediation response strategies are then identified and used to indicate the consequential requirements for human resources development and specifically the associated training requirements for staff in tertiary institutions.

Finally a number of common themes and linkages are identified with respect to the approaches being taken with regard to environmental protection, resource conservation, social progress and economic development, both individually and as integral objectives of the overall goal of sustainable development. These lead to a series of broad recommendations regarding training programmes for environmental educators in tertiary institutions, suggestions that will be explored and developed in the subsequent companion reports.

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ENVIRONMENTAL AND RELATED ISSUES IN THE ASIA-PACIFIC REGION:

IMPLICATIONS FOR TERTIARY LEVEL ENVIRONMENTAL TRAINING

1. INTRODUCTION

1.1 PURPOSE OF STUDY

Enhancing the environmental expertise of staff in tertiary (i.e. post secondary) education and training institutions is a strategically important part of the overall task of capacity building through human resources development. Both the UN Conference on Environment and Development held in Rio de Janeiro, Brazil in 1992, and its formal outcome - Agenda 21 - acknowledge that job-specific training is one of the major strategies to develop human resources and in turn facilitate the transition to a more sustainable world. This report, the first of a series of three, provides background information fundamental to the implementation of a UNEP administered project designed to enhance the environmental and related expertise and skills of tertiary level educators in the Asia-Pacific region.

This first report focuses on the identification of environmental issues of significance to the region and indicates the areas where there is an urgent need to increase human resource capacities. The present shortcomings and anticipated needs in both expertise and understanding are highlighted. Most attention is given to three themes - coastal zone management, toxic chemicals and hazardous waste management and to environmental economics - but with less detail a wider environmental perspective is also adopted. Many of the implications for training programmes directed towards tertiary educators are identified in this first report. However, more specific attention will be given to existing human and institutional capacities and to additional training requirements and related needs in the second and third reports, respectively.

1.2 CONTEXTS OF STUDY

1.2.1 Capacity Building Context

In the early 1970s the world at large was literally shocked into action by the recognition of a profusion of environmental issues and problems attributable to human abuse of environmental systems and over-zealous exploitation of natural resources. One response was recognition of the need for preventive action, including the education of tomorrow's decision makers and the guardians of the world's environmental heritage. In many cases the resulting environmental education and training programmes had their routes in, and were not

greatly differentiated from the more traditional conservation education, outdoor education, nature study and interpretation and outdoor education that had preceded them. The identity, goals and content of environmental education and training were poorly defined and as numerous as the distinctive groups practicing it. As the amount to be learned in each discipline increased, and people specialized more and more, few were capable of putting together all the disciplines for a total view of an environmental, much less developing an understanding of the interactions, including those with human culture and economic systems.

But the status quo was about to change. In 1975 UNEP and UNESCO organized the Belgrade Workshop and launched the joint International Environmental Education Programme (IEEP). A UNEP-UNESCO study (UNESCO, 1977) undertaken in preparation for the 1977 Tbilisi Intergovernmental Conference on Environmental Education, identified the following characteristics at the global level:

- environmental education and training programmes were insufficient in number and deficient conceptually and in terms of scope, particularly in developing countries;
- a lack of effective interdisciplinary approaches in environmental education and training, with emphasis on the natural environment (pollution, conservation of natural resources etc.) and attempts to be interdisciplinary have tended to remain within the natural or social sciences, with no meaningful interaction among them when analysing or interpreting environmental problems;
- a general absence of concrete problem-solving approaches, due largely to a preoccupation with abstract content and the acquisition of facts, isolated environmental education and training programmes, and the participants, from meaningful interaction with the wider community, resulting in little practical application of the learning experience; and
- the reduction of environmental education and training to consider only the natural environmental components to the exclusion of social, economic and cultural perspectives makes it exceedingly difficult to comprehend complex phenomena and problems.

In response, the IEEP activities concentrated initially on creating widespread awareness of the need for environmental education, but they soon moved on to the formulation of concepts and the development of methodological approaches in environmental education. Eventually efforts focused on applying these earlier findings and also on assisting countries to incorporate an environmental dimension in their education programmes.

The growing awareness of the need for, and benefits of, environmental education and training inspired the delegates to the first Intergovernmental Conference on Environmental Education (Tbilisi, 1977) to unanimously support the Tbilisi Declaration and 41 recommendations. These collectively form a major landmark in the evolution of environmental education and training. Fundamentally the conference statements recognise the need to empower citizens to take responsibility for, and engage in, environmental problem solving.

Agenda 21 (UNCED, 1992), drawing on the Declaration and Recommendations of the Tbilisi Conference and on the recommendations of the World Conference on Education for All (Jomtein, Thailand, 1990), recognizes the need to support university and other tertiary institutions and networks involved in education and training related to society, environment and development. Their activities can be used to enhance the abilities of people to assess and address the diverse concerns related to sustainable development, environmental quality and the quality of life. Some of the specific training initiatives identified in Agenda 21 are:

- i) implementation of sustainable development at all points of policy- and decision-making;
- ii) integrate environmental and development issues;
- iii) increase skills related to environmental management in all relevant training programmes;
- iv) develop new training programmes for existing environmentally sound practices;
- v) respond to structural adjustments which impact on employment and skill requirements;
- vi) respond to the training needs of minority, isolated and marginalized people to assist them to participate more fully in developing sustainable work practices and lifestyles;
- vii) enhance the understanding of the relationships between good environmental and good business practices;
- viii) achieve universal access to technical services supporting sound environmental management practices; and
- ix) enhance the ability to access, analyze and effectively use information and knowledge on environment and development.

Environmental education and training specialists from the Asia-Pacific region anticipated such needs and responses when they met in Bangkok in 1985 (UNEP, 1986) and proposed a programme of action for environmental education and training in the region. They identified an urgent need to develop curricula for tertiary level environmental education and training, placing a high priority on those specific issues which would a) provide a better understanding of the holistic nature of environmental problems; b) were of immediate concern to most countries in the region; and c) would be gaining considerable urgency in the near future. The specialists also proposed that the need for greater collaboration and interaction in environmental education and training in Asia and the Pacific be addressed by the establishment of a regional network of institutions and individuals active in environmental education and training.

It is within this context that the predecessor to UNEP's *Network for Environmental Training at Tertiary Level in Asia and the Pacific (NETTLAP)* was established, with the

project's activities emphasizing the need for networking the development of curriculum materials and the implementation of training programmes related, at least initially, to environmental economics, toxic chemicals and hazardous wastes and to coastal zone management. These were three of the priority areas identified by the experts at the 1985 meeting in Bangkok.

The present report explores the environmental and related issues pertaining to these three themes and to the wider concerns associated with environment and development in the Asia-Pacific region. The priorities, needs, shortcomings and opportunities identified in this report will be combined with those arising from a subsequent assessment of current and required capacities for tertiary level environmental training in the region. This information will help guide the capacity building activities of the Network and other regional projects in the coming years.

1.2.2 Regional Context

The Asia-Pacific region covers 23 percent of the world's land area, extending from the Islamic Republic of Iran in the west to the Cook Islands in the east, and from the Russian Federation in the north to New Zealand in the south. It also includes a vast oceanic area, including the world's largest ocean, the Pacific, as well as the Indian Ocean and numerous important seas (Figure 1.1). In part of the region the vast land areas of China and India dominate; in the expanse of the Pacific the land areas often pale to relative insignificance. But in all areas it is the interactions between environmental components and systems on all scales which contribute to the complexity of environmental problems and the failure of overly simplistic "solutions"

Over 55 percent (3.17 billion) of the world's inhabitants live in the region. Three of the five most populous countries are in the region (China with 1.19 billion, India with 880 million and Indonesia with 185 million), but there are also states with populations of less than 20,000 people. While some 70 percent of the region's inhabitants live in rural areas, the annual population growth rate of 3.7 percent for urban areas as opposed to 1.5 percent for rural areas highlights the fact that the region is undergoing rapid urbanization. Mega-cities are now a feature of Asia - of the 21 most populous cities in the world, 13 are located in the Asia-Pacific region.

The region is characterized by its diversity: environmentally, economically, culturally, socially, and politically. Such diversity gives the region its identity and much of its global significance, but it also presents an enormous challenge to those who are required to characterize the region or attempt to find commonalities for regionally-based cooperative initiatives. The difficulties are exemplified in the present study, which attempts to identify the environmental and related issues facing the region as a whole, and especially those related to coastal zone management, environmental economics and toxic chemicals and hazardous wastes and to assess training requirements for tertiary staff who are offering educational and training programmes related to these issues.

The Asia-Pacific region does share at least one common characteristic - an unfortunate attribute of escalating environmental degradation. Table 1.1 indicates that virtually all indicators of environmental quality are revealing deteriorating conditions, consistent across

Table 1

**Trends of Selected Environmental Indicators for the Asia-Pacific Region
for the Period 1960 to 2000 (from ESCAP, 1992)**

	South Asia		East and South-East Asia		Pacific	
	1960-1980	1980-2000	1960-1980	1980-2000	1960-1980	1980-2000
Terrestrial ecosystem						
<i>Forest Lands</i>						
Forest cover	↓	↓	↓	↓	↓	↓
Extinction of species	↑	↑	↑	↑	↑	↑
Flooding and droughts	↑	↑	↑	↑	↑	↑
<i>Crop Lands</i>						
Soil erosion	↑	↑	↑	↑	↑	↑
Waterlogging and salinity	↑	↑	↑	↑	↑	↑
<i>Grazing Lands</i>						
Desertification	↑	↑	↑	↑	↑	↑
Aquatic ecosystems						
<i>Fisheries</i>						
Water pollution	↑	↑	↑	↑	↓	↓
Fish yield ^{1/}	↓	↓	↓	↓	↑	↑
<i>Mangrove forests</i>						
Disappearance	↑	↑	↑	↑	↑	↑
<i>Coral reefs</i>						
Destruction	↑	↑	↑	↑	↑	↑
Environmental health						
<i>Water supply and sanitation services</i>						
Urban deterioration	↑	↑	↑	↑	↑	↑
Rural drinking water	↑	↑	↑	↑	↑	↑
Urban sanitation	↓	↓	↓	↓	↑	↑
<i>Urban deterioration</i>						
Air pollution	↑	↑	↑	↑	↓	↓
Water pollution	↓	↑	↑	↑	↓	↓
Solid waste	↑	↑	↑	↑	↑	↑
Noise pollution	↑	↑	↑	↑	↑	↑
<i>Rural deterioration</i>						
Pesticide morbidity and mortality	↑	↑	↑	↑	↑	↑
Malaria incidence	↑	↑	↑	↑		
Schistosomiasis	↑	↑	↑	↑		

Note: Increase ↑ Significant increase ↑↑ Decrease ↓ Significant decrease ↓↓

all three subregions considered in the analysis. Faced with a rapidly growing population seeking a higher standard of living and rapid economic growth (the region averaged 6.8 percent in the 1980s, over twice the world average of 3 percent), the region must move quickly to harmonize the potentially and often potentially, if not in reality, conflicting goals of environmental protection, resource conservation, economic development and social progress.

Jointly with other national, regional and global efforts, the *Network for Environmental Training at Tertiary Level in Asia and the Pacific (NETTLAP)* works to increase the capacity of the region to arrest undesirable changes while at the same time achieving the desired environmental and socio-economic outcomes. Targeted training is a key to fulfilling these objectives - increased quality and relevance of the educational and training roles performed by tertiary level educators and trainers will not only result in more skilled and knowledgeable students graduating from these institutions, but decision makers and policy formulators from both the public and private sectors will also benefit significantly from formal and informal interactions with tertiary staff.

Enhancing the environmental knowledge and skills of a tertiary educator or trainer has the benefit of a large multiplier effect. The environmental training of tertiary staff is very cost effective and efficient, for one environmental educator or trainer in a tertiary institution can upgrade the environmental skills and awareness of hundreds of students. Upon graduation many of these will move into positions of responsibility where they apply this environmental expertise in the public and private sectors and in the communities within which they live. In addition, through informal education and training programmes, such as short courses or public lectures, this same staff member is also able to enhance the skills and awareness of key individuals in government, the private sector and the community at large. The effectiveness of this transfer process is even greater if the staff member passes on some of his/her expertise to colleagues in his/her own institution, or elsewhere.

NETTLAP has pioneered the Resources Development Workshop (RDW) as one effective way to support environmental education and training activities - the approach also has the benefit of a large multiplier effect. Selected environmental educators and trainers work with those who have specialist expertise in such areas as training methods, instructional design, training technologies and preparation of training materials to develop three products - curriculum guidelines, instructional materials and instructional aids. These can then be packaged in resources volumes and kits for widespread dissemination to tertiary institutions throughout the region. The full involvement of experienced educators, trainers and practitioners in this process ensures that the resulting outputs are consistent with regional and even more local requirements and capacities. They also address the impediments to widespread acceptance and application.

1.3 METHODOLOGY AND APPROACH

This study seeks to characterize the environmental and related issues of significance to the Asia-Pacific region and to identify the implications for the development of training programmes targeted at tertiary level educators and trainers in the region. Wherever possible, information and assessments provided by Network members, and especially the

Network's National Focal Points and Specialist Focal Points, have been used. The survey and analysis has also relied on country and regional reports on the state of the environment, many of these having been prepared for the 1992 UN Conference on Environment and Development. The task has been made much easier, and the study more comprehensive, as a result of the availability of such material. In addition, the study has drawn on published papers and reports. These have often provided insight to specific problems or issues.

As already noted, and for the reasons given above, this study focuses on coastal zone management, environmental economics and toxic chemicals and hazardous waste management. This has enabled the treatment to be more focused and in-depth. It is anticipated that, in addition to the other areas identified at the Bangkok meeting and as other themes are identified for special emphasis in the Network's activities, there will be a need for further theme specific reviews and assessments. An indication of possible future themes is provided in Sections 5 through 7. These sections survey a wider spectrum of environmental and related issues facing the region, but in less detail.

1.4 OUTLINE OF CONTENTS OF REPORT

In Sections 2 through 4, each of the environmental themes, coastal zone management, environmental economics and toxic chemicals and hazardous waste management, is examined in turn. Initially this is done from environmental and more holistic perspectives. General prevention and solution response strategies are then indicated. These will to a large extent determine the consequential requirements for human resources development, and specifically the associated training requirements.

Section 5 presents a similar but far less detailed assessment covering global issues of regional significance. In a similar manner, Section 6 covers important regional issues in addition to the three themes identified above, while Section 7 reviews national issues of regional importance.

The final two sections, 8 and 9, integrate the earlier findings by identifying common themes and linkages and formulating conclusions and recommendations related to environmental training programmes aimed at tertiary level environmental educators and trainers.

2. ISSUES IN COASTAL ZONE MANAGEMENT

2.1 INTRODUCTION

Over half of the world's population live in the Asia-Pacific region. Moreover, it is estimated that some 70 per cent of these people live in coastal areas. But such region-wide statistics obscure the considerable intra-regional variability. Apart from the interiors of the larger Melanesian islands, the Pacific islands are entirely coastal in nature. On the other hand, countries such as Nepal have no coastal areas.

Nevertheless, the already substantial and rapidly growing population living in coastal areas of the region focus the demand for natural resources and place enormous stress on a particularly sensitive and hence vulnerable environment. Impacts are profound as a consequence of the rapid depletion of non-renewable resources, the non-sustainable rates of harvesting renewable resources and the release of large volumes and often high concentrations of solid, liquid and gaseous wastes. Being at the interface of the land and the sea means that the coastal environment is subject to pressures from both land-based and oceanic sources.

Many countries in the region are characterized by long lengths of coastline, either absolutely as in the case of China's 14,500 km, or relative to overall area of land and Exclusive Economic Zone, as in the case of Kiribati's 1,143 km. High numbers and concentration of people living in and receiving sustenance from coastal areas are also indicative of both the need for, and the difficulties of, providing effective coastal zone management in the region.

The region's coastal environments are among the most diverse and productive of the world. There are extensive areas of specialized ecosystems such as mangroves, coral reefs and seagrasses. Over two-thirds of the world's coral reefs and one-third of the world's mangrove forests are located in the Asia-Pacific region. Such rich and diverse ecosystems provide a large portion of the food intake and support a variety of economic and other human activities such as tourism, recreation and transportation.

As Crawford (1991) notes, the coastal zone is managed in order to "guide and modify human behaviour to either maximize benefits to humanity, to protect lives and preserve livelihoods, or to protect the resources from the consequences of human activity and mitigate resulting impacts". He goes on to state that the challenges of coastal zone management include the fact that one is "dealing with some of the most dynamic and complex ecosystems, that it requires coordination among several levels of government with overlapping and often conflicting jurisdictions and involves numerous user and interest groups".

The training of coastal zone managers and the familiarization of other professionals with the fundamentals of coastal zone management therefore present an immense challenge - to give due attention to the breadth of the subject and to the interactions with other disciplines and specializations without being so superficial that the trainees have little or no professional ability or credibility in the workplace.

Significant publications on the topics to be covered in this section include UNEP (1992a, 1992c), GESAMP (1990), Brodie et al., 1990, Gomez et al., 1990, Gupta et al., 1990, Norse (1993), Tolba et al. (1992), Chou et al. (1991), Hay and Chou (1993), Chua (1991), Brandon and Ramankutty (1993), McLean and Mimura (1993) and UNEP/IUCN (1988).

2.2 ENVIRONMENTAL PERSPECTIVE

The serious environmental problems that exist in the coastal zone, and the consequent socio-economic ramifications, are no better exemplified than in the Pacific island developing countries. They have identified the primary causes of their coastal problems as:

- improper disposal of sewage and domestic solid waste;
- mismanagement of non-domestic waste;
- increased sedimentation due to construction, hillside gardens, mining and other changes in land use;
- coastal development activities; and
- natural disasters.

The consequences for these countries, and for the Pacific subregion as a whole, are profound - "it is impossible to understate the importance of coastal areas (coastal lands and near-shore waters) to the Pacific island peoples, cultures and economies. The coastal areas of all islands in the Pacific are the location of the vast majority of human habitation, the focus of subsistence and commercial agricultural and fisheries activity and the target of most economic development. This combination of factors is increasingly resulting in coastal habitats being destroyed or degraded, natural resources being over exploited and growing conflicts in coastal resource use, especially around the rapidly growing urban centres of the Pacific" (SPREP, 1993).

With respect to environmental issues of relevance to coastal zone management, the small islands of the Pacific are in some ways a microcosm of problems besetting the remainder of region. But in these other areas there are the exacerbating effects of larger and more densely occupied and significantly modified catchments for land-based sources of coastal pollution, significantly more industrial activity and a longer history of human occupancy and modification. Environmental damage does not only arise from land-based and domestic sources. Environmental degradation and its socio-economic consequences may also be traced to activities taking place within the Exclusive Economic Zone and in international waters. Drift net fishing and pollution from passing oil tankers are just two of many examples. Such problems of a transboundary nature are notoriously difficult to resolve, partly because they require the willing cooperation of numerous parties.

The majority of the coastal environment in the Asia-Pacific region is characterized by over-use or over-exploitation, leading to rapid and in many cases irreversible degradation of the environment and depletion of resources. Over-use may be sub-divided into over-use of the assimilative capacity of the coastal environment and over-use of the productive capacity of the coastal environment, especially its natural resources.

2.2.1 Problems Associated with Exceeding the Assimilative Capacity

By and large coastal and small island ecosystems have limited capacity to absorb and recycle wastes and tolerate disturbances. The sources and forms of environmental pressure are numerous, as are the consequential effects. The following list highlights the major problems that are to a greater or lesser extent found and remain unresolved throughout the coastal areas of the region:

- pollution of coastal waters from domestic sewage and industrial effluent which are often discharged directly into coastal ecosystems, as well as from agricultural and surface run-off, often leading to eutrophication of estuarine and other coastal waters;
- degradation or loss of ecosystems due to discharge of wastes, thermal discharge, petroleum product spills, bottom trawling and dredge and fill operations;
- destruction of sensitive coastal ecosystems such as mangroves and coral reefs, through cutting, reclamation, conversion, exploitation and pollution; the decline in mangrove area and health may be directly due to clearing but also to excessive siltation, salinity change, surface water impoundment and oil pollution;
- clearing of mangroves and other significant habitats to make ponds for cultivation of fish and prawns and into rice fields and as a consequence of tin mining;
- damage to mangroves through improper design of causeways, bund walls and seawalls;
- coastal development, land reclamation and the related destruction of habitats, including expansion of human settlement into mangrove areas, the draining of mangrove areas for agriculture, aquaculture and other uses and landfilling and coastal reclamation for building sites;
- microbial and chemical contamination of sea food and beaches;
- progressive build-up of chlorinated hydrocarbons and the accumulation of tar on beaches;
- sedimentation of coastal habitats as a consequence of unsustainable agriculture and the expansion of gardening activity on steep and frequently marginal soils, construction and earthworks associated with public infrastructure development, deforestation, mineral prospecting and mining;
- beach mining, which is particularly damaging in the low coralline islands or atolls and where there are few alternatives to alleviate a critical shortage of suitable construction grade sand and aggregate for infrastructure development;
- dredging of lagoon sands causing, for example, a loss of sea grass habitat, adverse impacts on filter feeding organisms and the prevention of coral colonizing new habitats;
- destruction of heritage areas, both natural and human;
- chemical contamination of foreshore waters by leachate from coastal landfills and seepage of contaminated groundwater;
- saltwater intrusion into potable groundwater;
- artificial radioactivity "hotspots";
- ciguatera fish poisoning and crown of thorns - both may be a consequence of physical disturbance of coral reefs;
- coastal engineering structures, which tend to alter wave patterns and currents;
- offshore exploration and drilling for minerals;
- international movement and disposal of wastes in marine areas, with adverse effects on coastal systems;
- extreme natural events (natural hazards), including insufficient resilience to withstand destructive wave action and strong currents during tropical cyclones, landslides,

- earthquakes, volcanic eruptions, tectonic uplift and subsidence; and
- long-term environmental changes associated with both natural and human related factors as climate and sea level variations and changes.

The significance of this extensive list of issues is profound, not least of all regarding the implications for human resources development are considered. Training programmes which increase fundamental knowledge, develop abilities to avoid, remedy and mitigate the specific problems, strengthen technical skills in such areas as monitoring, modelling, assessment and evaluation and enhance policy formulation and decision-making abilities are but a few of the resulting needs.

2.2.2 Problems Associated with Exceeding the Productive Capacity

Despite the fact that most countries in the region are currently experiencing increased returns from their inshore fisheries, the FAO (1987) considers that the "time of spectacular and sustained increases in catch is over - reef stocks and those of estuaries and littoral zones are under threat from illegal fishing and environmental pollution". Thus marine and aquatic yields, although currently very high, are threatened in many parts of the region. As a consequence of declining yields, in some areas the overlap between artesanal and commercial fishing is increasing as local fishermen go further and deeper to ensure an adequate catch. Over-fishing has accelerated the depletion of inshore stocks which were already under stress from habitat destruction, pollution and indiscriminate damage due to the use of explosives and chemicals in harvesting.

Over-fishing has become a particularly serious problem near most of the larger urban centres, especially where the lagoon or other shallow waters are heavily fished and families scour the intertidal flats daily for anything edible and of almost any size. They also seek shells and other materials for handicraft manufacture. For many coastal people fish from reefs and lagoons are the primary source of subsistence protein. It is therefore not surprising to find that, as an example, the Pacific island subregion has the world's highest proportion of endangered species per inhabitant or per unit of land area.

Given the pressures on marine food sources and given that most of the naturally available freshwater fishstocks are fully exploited or damaged by pollution, aquaculture in controlled water bodies is increasingly viewed as a way to help meet future needs. Although yields from aquaculture have almost doubled in the Asia-Pacific region during the last decade and currently represent over 20 percent of the region's production of fisheries, this expansion has itself not been without significant cost to the environment through the damaging of sensitive ecosystems like mangroves, corals and wetlands and the loss of significant habitats and biodiversity. As always, it is important to consider the balance of benefits and costs, and not only to environment.

Less conventional (at least to some) marine food sources are being developed further. For example, not only is seaweed an important biological resource as part of the "food web" of marine life, but it is also used for direct human consumption and for pharmaceuticals, animal feed, fertilizers and industrial raw materials. Almost all the world's production is from the Asia-Pacific region. Market demand has far exceeded supply in recent years despite natural supplies being increasingly augmented by cultivated species.

Other extractive uses of coastal resources where consumption often exceeds production, with adverse impacts on the remaining supplies of the resource, as well as other environmental components, include:

- extraction of salt from sea water, usually involving large areas of ponds, often gained by reclaiming mangrove habitat;
- mangrove forests which are harvested for fodder, timber, firewood, for production of charcoal and for construction materials such as poles and posts;
- extraction of sand and coral rock for construction etc, leading to coastal erosion;
- removal of corals and aquatic life for ornamental purposes and the souveniring of corals and shells by tourists or their sale to tourists as well as tourists trampling across reefs;
- deliberate destruction of coral to drive fish out after encirclement with nets;
- aquarium fish exports;
- unsustainable use of potable groundwater supplies;
- capture of endangered and threatened species for food or for trade, leading to a further decline in numbers due to this direct exploitation, aggravated by habitat loss, pollution and by catches in fishing; and
- narrowly focussed commercial fisheries (mono aquaculture?) which in some areas exert pressure causing over exploitation of stocks needed for the subsistence of those not engaged in the commercial fishing.

In many cases the challenge of sustaining multiple use of a limited resource is complicated by uncertainties in populations, replacement rates and harvesting effort. In light of such uncertainties, adaptive management strategies coupled with conflict resolution form a core area of training requirements for resource and environmental managers working in coastal areas.

2.3 INTEGRATED PERSPECTIVE

Degradation of the coastal environment and depletion of its resources are due not only to the aforementioned pressures, but are also a consequence of the failure to recognize the wider interactions within and between activities and conditions of other natural and managed systems. Hence the need for an integrated approach to management of the coastal environment and resources.

As noted previously, the coastal zone is at the interface between land and sea, and therefore susceptible to pressures from both. Moreover, a unisectoral overuse of some resources is creating serious consequences for the coastal environment. For example, logging or mining in the upland interiors may well be of great short term economic benefit but it can also lead to enhanced erosion and sediment yield. This may well destroy or degrade significant parts of coastal ecosystems and impair the quality of human life, eventually more than offsetting any short term economic gains from either the logging or the mining.

These pressures are compounded by the expansion of economic activity in response to the legitimate desire of coastal people to enhance their standard of living and quality of

life. Policy makers, planners and managers should therefore be seeking not only the sustainable management of the environment and of natural resources, but also sustainable socio-economic development. These must not be seen as separate and competing objectives, but rather as complementary goals which are approached using a common and integrated strategy.

2.4 PREVENTION AND REMEDIAL STRATEGIES

The development of policies and management programmes for the coastal zone cannot be limited to responses to the degradation of coastal environments or ecosystems or non-sustainable depletion of resources. Neither can it be limited to consideration of the diverse biophysical, socio-economic and cultural systems within the coastal zone. Rather, the linkages with, and the influences of, the adjoining regions must also be reflected and accommodated in policy responses and management strategies.

Thus coastal zone management is a comprehensive, multisectoral and integrated approach to the planning, management and use of coastal areas. This requires acknowledgement of the goals of sustainable development or management, multiple use and conservation of coastal areas, resources and ecosystems. Natural hazard preparedness and response planning are also integral components of coastal zone management.

Agenda 21 identifies a number of objectives related to the integrated management and sustainable development of coastal areas. While generally applicable to sound environmental planning and management, their application to the coastal zone is of highest priority but also presents the greatest challenge. The objectives include the instigation of an integrated policy and decision-making process, that involves all sectors and strives to harmonize the various uses and users of the coastal zone. In light of uncertainties, sensitivities and the complexities of coastal systems there is a need to adopt and apply precautionary and preventive approaches in project planning and implementation. Prior assessment and systematic monitoring of system and component responses are fundamental to an effective implementation of sustainable management policies. The enhancement of public awareness and the development of public participation through the provision of relevant information and involvement in planning, decision-making and evaluation activities are also priorities for effective coastal management.

Various actions consistent with these objectives are also identified in Agenda 21. These include:

- preparation of coastal profiles identifying critical areas, including eroded zones, physical processes, development patterns, user and use conflicts and specific priorities for management;
- integration of programmes on sustainable development developed by sectors affecting the coastal zone, including those related to agriculture, tourism, human settlements, fishing, coastal infrastructure and industry;
- pre-activity environmental impact assessments and systematic monitoring to provide baseline and post-activity data, with procedures which ensure that relevant

information is incorporated in decision-making;

- contingency planning for human induced and natural environmental change, including extreme events and accidents;
- improvement of coastal settlements, especially with respect to housing quality, access to drinking water, treatment and disposal of sewage, solid wastes and industrial discharges;
- conservation and restoration of modified critical habitats;
- promotion of environmentally sound technology and sustainable practices; and
- human resource and development training.

These and the numerous other responses that can be identified require structural and institutional changes in order to realize effective integrated and sustainable management practices. Legislation must overcome the jurisdictional complexities typical of the coastal zone and support the diverse economic, regulatory and voluntary mechanisms for implementing coastal policies and achieving the management objectives.

Restructuring and realigning the institutions managing the coastal zone leads to the need to retool the personnel who must take on new responsibilities, functions and tasks. Coastal area management methods and technologies must be reformed and strengthened to reflect the new demands and requirements. Accessible information and powerful analytical tools are fundamental to effective coastal zone management. Wherever possible and practicable such tools as geographic information systems, remote sensing and computer aided decision support systems should be made integral components of the policy development, planning and management activities.

2.5 EDUCATION AND TRAINING IMPLICATIONS

Achievement of the coastal zone management goals of sustainable development or management, complimentary multiple use and conservation of coastal areas, resources and ecosystems and the incorporation of natural hazard preparedness and response planning represents a significant challenge, not only in the immediate sense for the practitioner, but also in the longer term for those who carry the responsibility for educating and training such individuals.

At the broader level the issues to be addressed include those identified by Crawford (1991), namely:

- water quality management;
- habitat regulation, protection and restoration, with emphasis on coral reefs and mangroves;
- mitigation and, where possible, prevention of human and natural hazards, including tropical cyclones, tsunamis, oil spills, erosion and sea level change (emergency response strategies);
- administrative reforms required to overcome policy and market failures and properly manage coastal resources and environments;
- policy, management and regulatory tools and techniques; (implementation and enforcement) (international and regional protocols);

- the role of public education and participation; and
- balance of local versus national and national versus international authority and priorities.

An integrated treatment of such a diverse list of topics suggests that an holistic interdisciplinary ecosystems-based approach is required. This indicates the need for a reorientation of many existing educational and training programmes which tend to be disciplinary or sector based. It also highlights the need to incorporate a significant land-based component in any educational or training activity, thereby including water resources, catchment management, and land use, urban and regional planning.

Other topics which should be included in a broad-based training programme include:

- identifying and applying the basic concepts and tools of integrated coastal zone management;
- incorporating social, cultural, political, economic, legal dimensions and imperatives in integrated coastal management ;
- minimizing the adverse effects of engineered structures and other human features on natural coastal processes ;
- mainstreaming environmental impact assessment, ongoing state of the environment evaluations and environmental enhancement procedures;
- optimizing institutional support and minimizing structural constraints;
- infrastructure planning and development;
- minimizing loss of biological diversity;
- applying practical tools and techniques for enhancing the basic understanding of coastal systems;
- harmonizing and strengthening information gathering, exchange and processing systems and procedures;
- developing and applying the techniques and technologies of coastal monitoring;
- strengthening decision-making, applying conflict resolution, and operationalizing techniques of goal setting and establishing priorities; and
- incorporating innovative engineering designs to avoid, remedy and mitigate coastal pollution and degradation.

An earlier study (ESCAP, 1985) characterized the state of coastal zone research and training capacities in the Asia-Pacific region. Many of its observations are of relevance today given that the region still has the following:

- limited availability of scientifically trained personnel, particularly in marine and coastal ecology, environmental impact assessment, monitoring, prevention and control of pollution, and a lack of appropriate support facilities;
- many coastal zone management courses in tertiary institutions being taught from a traditional discipline base rather than in an interdisciplinary environment;
- few programmes on environmental impact assessment and monitoring that qualify graduates in the use of modern tools and technologies such as remote sensing and geographic information systems;
- lack of regionally compatible and integrated monitoring programmes that support a comprehensive approach to state of the environment reporting; and
- few mechanisms for disseminating the results of investigations of coastal systems and

components to either policy and decision makers or the general public and for ensuring effective public participation in determining the content of policies, management strategies or strategic and background studies.

That same study sought to address these and other shortcomings and needs by proposing that 19 themes be targeted for training and the provision of fellowships. These were:

- general oceanography;
- meteorology and ocean phenomena;
- marine biology and ecology;
- marine ecosystems: planning and management;
- mangrove ecosystem management;
- coral ecosystem management;
- living resources: planning and management;
- non-living resources: planning and management;
- marine pollution: monitoring and control;
- oil pollution;
- industrial pollution;
- domestic pollution;
- sedimentation: survey and control;
- integrated coastal zone management;
- environmental impact assessment;
- ocean engineering;
- environmental legislation; and
- environmental education and training support.

The earlier analysis indicates that, almost ten years later, most of these topics continue to justify a high priority. But recent changes in approach and emphasis suggest that training programmes should today focus less on quantification of the problem and more on identifying and implementing solutions, focus less on control strategies and more on prevention, balance a biophysical focus and technical orientation with consideration of social, economic, cultural, political and legal concerns, give more attention to technologies, tools and development of human capacities for coastal management and emphasize the need for integrated, multidisciplinary, multisectoral, long-term and sustainable management practices.

These new, revised or expanded themes are reflected in the postgraduate coastal area management curriculum developed at a workshop in 1990 (Chua, 1991). The basic components of the programme are:

- coastal oceanography and coastal processes;
- tropical coastal pollution;
- coastal ecosystems: structure and function;
- coastal resources and management;
- economics of coastal resources and activities;
- social aspects of coastal development;
- institutional arrangements in coastal management;
- remote sensing and geographic information systems;

- resource surveys and environmental information systems;
- coastal area planning and management;
- analysis of coastal development alternatives;
- marine legal regime; and
- case studies in coastal area management.

But as Hay (1993) comments, the proposed content indicates that all components suggest an emphasis on problem identification and quantification and the development of generalized approaches. There is little to suggest a maturation of training activities to the extent that the focus is now on solution-oriented approaches. There is an urgent need for this to become the core of future training activities in the region.

Other gaps in training activities, training materials and training support related to coastal zone management have been identified recently by DGIP/DOALOS, 1993. These include:

- absence or inadequate attention to policy-making, policy analysis and policy implementation issues;
- absence of training courses geared to sectoral interests and the integration and/or adaptation of sectoral courses into the broader context of coastal management;
- weak linkages between training and implementation;
- absence of training programmes geared to the particular needs of users/implementors/operators;
- lack of consistency in terminology in current training materials;
- the majority of courses lacking structured materials (e.g. training packages, modules, case studies);
- no formal or institutional context for research relating to appropriate curriculum areas, delivery methods etc.;
- lack of linkages between training and research
- lack of research in the field of training/education in integrated coastal zone management; and
- limited research dealing with priority areas in the field of training for coastal zone management.

In a review of possible future directions for integrated coastal zone management, Hay and Kay (1993) conclude that the overriding purpose of future work programmes must be to increase capacities within and between the local, national, regional and international levels of governance and management. This capacity building would address:

- monitoring and assessment in the coastal zone;
- policy and response strategy formulation;
- decision-making; and
- policy implementation.

They argue that at the regional level there is typically sufficient potential capacity to accomplish these tasks. But this potential needs converting into productive capacity through training programmes and institutional strengthening, amongst others. More mature and comprehensive training programmes might therefore include:

- resolution of geopolitical issues and solutions;
- application of conflict resolution strategies;
- methods for enhanced information management;
- application of performance indicators;
- application of decision support systems;
- use of traditionally-based and innovative solutions to coastal zone management problems;
- application of non-market valuation methods;
- use of special area management planning approaches;
- methods for avoiding and mitigating cumulative and secondary impacts;
- procedures for public consultation and participation;
- use of environmental and social risk assessments;
- approaches to achieve economic main-streaming of integrated coastal zone management;
- methods for identifying and implementing governance systems supportive of integrated coastal zone management;
- applications of environmental, social and natural resource accounting;
- methods for optimizing allocation of integrated coastal zone management responsibilities in public and private sectors;
- methods for enhancing cooperation at regional and international levels;
- application of policy, planning and management instruments to support sustainable development;
- use of institutional, financial and legal measures for supporting sustainable development of coastal areas; and
- methods for predicting boundary conditions, environmental changes and responses.

The preceding list highlights the need for training programmes that provide participants with interdisciplinary skills in identifying and implementing appropriate solutions to coastal zone management problems and in the adoption of preventative and mitigative strategies, rather than programmes which are multidisciplinary or founded on the single disciplines on which coastal zone management is based.

DGIP/DOALOS (1993) suggests that the following types of training programmes be implemented in order to address the gaps identified in current activities relative to existing and anticipated needs:

- policy oriented training to sensitize top policy makers to the underlying principles of integrated coastal zone management;
- training to sensitize sector specialists in integrated coastal zone management, aimed at senior decision-makers at the sectoral level; and
- specialized training to meet the specific technical, legal and managerial requirements of users, implementors and operators (e.g. technology transfer issues, development and application of regulations concerning new uses of coastal areas; identification and resolution of cross-sectoral conflicts).

The work of Robinson (1988) also contains much of relevance to identification of priority training approaches related to coastal zone management. Robinson has a similar opinion regarding the target groups for training. He identifies three:

- upper level administrators and policy-makers requiring a basic understanding of the relevant biophysical systems and their relevance to humans, an appreciation of the economic

- value of coastal systems, and awareness of the consequences of degrading such systems and some knowledge of management and operational strategies;
- middle level managers and planners who need to receive more training that is more detailed in content, but which addresses much the same topics as those listed above; and
 - field staff level, with training being in one or more of the following areas: basic knowledge of coastal systems, knowledge of regulations and procedures for enforcement etc, techniques for equipment handling, first aid etc, techniques for survey, monitoring and collection of statistics, interpretation skills for visitors, commercial and recreational users and basic knowledge of accounting and marketing.

Kenchington (1993) builds on the above listing of Robinson, notably by adding community and coastal stakeholders including users, owners or custodians of coastal resources, religious and other community leaders and school and college teachers. He also makes useful observations and suggestions regarding delivery systems, packages, centres and networks.

It is apparent that training in coastal zone management has proceeded over the last few decades from a narrow, traditional, discipline-based and issues-oriented approach to one which is more interdisciplinary and based on prevention and mitigation, as opposed to control. As training programmes mature still further they will give full recognition to the multidisciplinary form of coastal zone management, including greater emphasis on social and cultural imperatives, and to the need for solutions rather than issues oriented approaches. The key to the sustainable development and use of coastal resources and environments lies in research and teaching directed towards:

- technical solutions to technical problems;
- social research which provides a basis for public awareness and education;
- development of alternative engineering practices; and
- adoption of alternative land use practices.

In the Asia-Pacific region, perhaps more so than elsewhere in the world, tertiary institutions will take a leading role in progressing coastal zone management training in the directions indicated above. Staff from such institutions are intimately involved in coastal zone management in general and in coastal zone management training in particular. There are a number of reasons: i) tertiary institutions are the primary forum for such training, often being contracted by the government and private sector to develop and implement training courses and programmes; ii) graduates courses offered by tertiary institutions in the region soon gain positions of responsibility in government and industry due to the current shortage of qualified personnel; and iii) staff of tertiary institutions often serve on government and non-government organizations where their advice may be highly influential.

In conclusion, the preceding assessments provide a preliminary outline of the themes, focus and priorities for tertiary level educational programmes related to the sustainable management of coastal areas in the Asia-Pacific region. More detailed appraisals will follow in the companion reports which assess present day educational capacities and current and future training requirements. The ultimate objective of these studies is to identify the specific requirements of tertiary educators with respect to enhancing their ability to provide quality instruction in coastal area management, particularly through the provision of targeted training and increased access to resource materials and educational technology.

3. ISSUES IN ENVIRONMENTAL ECONOMICS

3.1 INTRODUCTION

There are three broad dimensions to environmental economics. One focus is on uses of environmental assets as a source of materials for economic growth. Commercial harvesting activities, such as forestry and fishing, can have a direct impact on the stock of natural resources available now and in the future. Future opportunities for profit are therefore contingent upon current harvesting decisions. High quality environmental assets constitute a stock with few close substitutes and over-depletion can lead to a divergence between private and social returns. Technology often has an asymmetrical impact on the relative price of natural resource commodities. For example, technology can lower the supply price of manufactured goods but have little impact on the supply price of amenities flowing from the natural environment.

Because of their relative scarcity and the worth assigned to many environmental assets, their value is likely to increase over time. Concern arising out of the need to measure the flow of benefits associated with natural environments led to significant advances in the development of consumer valuation theory and analytical methods for measuring these values. There is a range of techniques for valuing non-market services, allowing the opportunity cost of development to be explicitly incorporated into cost-benefit analysis. Research in this area continues to refine existing, and develop new approaches to valuation.

Use of the environment's assimilative capacity is a second major focus. By incorporating the laws of physics into their models, economists are able to show that residuals are an inevitable consequence of production and consumption.

The third major focus is concerned with alternative institutional and policy responses to environmental problems. For example, it is widely recognized that the assimilative capacity of the natural environment will be depleted if managed under an open-access arrangement. Increasing attention is being given to the role of property rights in allocating environmental resources and the use of economic incentives, such as taxes and tradeable rights, in environmental policy.

In addition, it is useful to distinguish between economic policies which inadvertently have an adverse effect on environmental outcomes, and economic policies which are designed intentionally to have a positive effect on environmental outcomes. Until recently economic policies have focused on development, and national income accounting made no allowance for the net depletion of natural resources or for degradation of the environment. Under such an accounting system a country could clear its indigenous forests, degrade its cultivable soils, exterminate its wildlife and living marine resources and exhaust its mineral resources without the nation's spending, income and output being discounted in any way to reveal the loss of such important national assets. This is in stark contrast to the way the depreciation of capital equipment is incorporated in national income calculations. The failure to include resource depletion and environmental degradation in the national income accounts is especially serious for those developing countries which retain a high dependency on natural resources for employment, revenues and foreign exchange earnings.

For example, in the case of Indonesia, Repetto et al (1989) show that between 1971 and 1984 the gross domestic product increased at an average annual rate of 7.1 per cent, but if resource depletion was taken into account the average annual increase would be only 4 per cent, with negative values in 1979 and 1980.

A system of national accounting that measures resource depletion and environmental degradation as well as the depreciation of manufactured capital goods is a useful aid to implementing and evaluating national policies for sustainable development. While the principle has been established, the accounting procedures to be used are still subject to considerable debate and the mechanisms for implementation present innumerable challenges. Thus environmental economists and policy analysts have a pivotal role in continuing with the development of resource accounting techniques and their application in the form of sustainable development policies.

3.2 ENVIRONMENTAL PERSPECTIVE

Until recently little attention had been paid to the price associated with the use of services flowing from environmental assets. A zero market price, given scarcity, produces an incentive to over use significant, and perhaps irreplaceable life-support systems and creates few or no incentives for their preservation or replacement. The quality and quantity of environmental assets are largely taken for granted in present approaches to economic growth. There is no attempt to take into account the costs to resources and the environment in general. Such a situation will persist so long as there are few or no incentives for the conservation of resources, the use of substitutes and for the preservation of the environment.

Perhaps an even more unsatisfactory situation arises when an environmental disaster contributes to economic growth, even if only in the short term. The Exxon Valdez incident is a good example of how accounting systems often distort the real costs and benefits. That disaster has "contributed" more than US\$2 billion to Alaska's economy by creating employment in clean-up operations and by increasing demand for accommodation and other visitor services, through the procurement and transportation of equipment and through increased use of air transport.

But ecological damage can also arise from the influence of social factors. These in turn may be due to poor economic performance and/or inequitable distribution and participation. For example, while the poor use fewer resources, create less waste and do less harm to the environment than do the affluent members of society, there is a threshold poverty below which the poor become disproportionately destructive, destroying in the short term the very resources that are the means of their survival in the longer term - sacrificing sustainability to the immediate need to survive. Thus poor economic performance and/or inequitable distribution and participation are also a route to environmental degradation.

At the core of the problem is the fact that people tend to waste that which they do not value while prizing and using wisely and efficiently those things which are considered to be scarce and precious. The solution is to include the environment and resources, which have typically been regarded as "free", in the array of assets which are valued and therefore

managed in a much more responsible and efficient manner.

There are enormous impediments to instigating such a comprehensive and fundamental change in the way these environmental and resource assets are viewed. For example, what price should be placed on the tropical forests or mangrove ecosystems in order to conserve them through sustainable management programmes? What prices are people willing to pay for clean air and pure drinking water?

Recent experience with environmental and resource accounting in New Zealand highlights some of the practical difficulties in this valuation problem. The entire conservation estate of New Zealand (national parks, reserves, sanctuaries etc) was valued at NZ\$315 million. This figure was arrived at via land sales in the immediate vicinity, but with values then being adjusted downwards to reflect such factors as the restrictions on land acquisition and use in national parks, and the smaller land areas involved in the private sales used as bench marks. In contrast, the National Archives were valued at NZ\$826 million, the National Library collection at NZ\$502 million and the state highway system at nearly NZ\$6.4 billion.

This comparison highlights the inherent problems which arise when attempting to place monetary values on non-market assets and services. Perhaps a quite different value would have been placed on New Zealand's conservation lands had the following been taken into account - more than 50 percent of the \$4.9 billion contributed by tourism to New Zealand's gross domestic product in 1990 can be directly attributed to the conservation estate. But valuation will be an even greater challenge in other situations. How does one value New Zealand's biodiversity that includes over 50,000 native plants and animal species that are found only in that country?

3.3 INTEGRATED PERSPECTIVE

The key to sustainable development is the integration of economic and ecological goals, with due recognition also being given to social goals. Thus medium- and long-term sustainable development plans need to take into account the importance of integrating environmental, social and economic factors in maintaining cultural and biological diversity and conserving endangered species and critical habitats on both land and sea. Environmental preservation should be integrated with economic and social development policies and planning.

The Asian Development Bank (1990) presents a number of questions which relate to the implementation of sustainable management policies. The points raised in these questions reflect the diversity of issues which should be addressed explicitly in all future project and policy discussions if the goal of sustainability is to be achieved. The questions are:

- how will the proposed action affect the environment and the country's ability to maintain the pace of development for the benefit of future generations?
- can detrimental effects be reduced or eliminated, and if so, at what cost?
- are negative effects fully compensated for by increments to national capital resulting from the proposed action?

- what alternative actions will yield similar "economic" returns but with enhanced sustainability?
- what arrangements are in place to monitor results of the policy, project or programme from the point of view of sustainability, so that threats to the environment, both foreseen and unforeseen, are detected?

An ability to provide comprehensive and credible answers to these questions highlights the requirement for competent and experienced environmental and resource economists if sustainability issues are to be given appropriate recognition in future policy development and management decisions.

But sustainability cannot be an incontrovertible goal for, in the short term, exploiting renewable resources at rates which are unsustainable might be justified in that it provides the basis for economic activities which achieve sustainable development in the longer term. However, there is also a finite level of exploitation beyond which there is a risk that the resource will not recover (i.e. use exceeds the so-called "bottom line"), leading to undesirable environmental, economic and social outcomes. Many countries in the Asia-Pacific region are already experiencing the adverse effects of previous over exploitation and in many cases are finding workable solutions difficult to identify.

The challenges of harmonizing environmental, resource and economic management goals are no where better demonstrated than in countries of the Asia-Pacific region that have experienced little or no economic growth in the recent past. ESCAP (1993b) and other sources provide an insight to the interactions between environmental and socio-economic conditions and the attendant costs. These include:

- low economic growth has a negative impact on the process of social participation, the development of human resources and the preservation of ecosystems;
- pressure on the environment is enhanced when limited economic growth combines with certain demographic characteristics, resulting in widespread misalignments between labour availability and demand, in excess out-migration in combination with an aging rural population and relatively high youth dependency ratios, and in insufficient coverage and often poor quality of essential services such as health, education and vocational training, and housing facilities;
- an unfavourable pattern of economic growth also contributes to considerable ecological problems and damage across many sectoral areas, including, for example, over-fishing and pollution of inshore areas, loss of biodiversity; inadequate land use controls; and poor management and disposal of urban and other wastes;
- the need for complex tradeoffs in public sector priorities e.g promotion of greater economic growth with equitable social development and limited environmental degradation; and
- shortcomings in policy and institutions hampers the incorporation of social and environmental concerns into development policies.

In many developing countries of the Pacific subregion the growth in GDP has not been able to satisfy the requirements of growing populations with rising aspirations. This is in contrast to the increases in real income achieved by most least developed countries in Asia. For most Pacific island countries per capita income has declined in real terms and therefore so too has the standard of living in a large part of the Pacific island subregion. As

noted earlier, there are strong links between increasing poverty and growing pressures on the environment.

3.4 SUSTAINABLE DEVELOPMENT: A PREVENTION AND SOLUTION STRATEGY

Efforts directed towards environmental preservation should go hand-in-hand with the implementation of economic and social development policy and planning. There is a need to integrate environmental, social and economic factors in maintaining cultural and biological diversity and conserving endangered species and critical habitats on both land and sea when forming sustainable development plans.

The way forward is to integrate environment and development while at the same time decoupling economic growth from environmental impact (see Fig. 3.1). In the past progress towards achieving the goal of economic development, social progress and environmental protection has often been impeded by the lack of integration and coordination of policies and management programmes. Achievement of these goals requires close coordination of macroeconomic as well as sectoral policies and their realization. The complex trade-offs among policy and management priorities must also be handled in a integrated manner that acknowledges the overriding objective of long-term sustainability. Sustainable management of natural resources, and the environment at large, necessitates, among other things, a conscious recognition and acceptance of the fragile balance intrinsic to all life-support systems (e.g., air, soil, water) as well as in natural communal assets. Examples of the latter are rain forests, mangroves, coral reefs, lagoons and deep-sea resources. Technological change, especially increased use of environmentally sound technology, substituting resources and ensuring that the full costs of environmental degradation and resource use are reflected in prices, are steps towards sustainable development.

Integration of sustainability into economic management therefore requires specific recognition of the environment as a source of natural capital and as a sink for by-products generated during the production of managed capital and other human activities. Given the coexistence of social, economic and environmental considerations in sustainable development, national, local and corporate accounting procedures should not be limited to commonly enumerated goods and services. The contributions made by all sectors and activities of society, that are not included in conventional accounts should be included, either in an integrated or complementary manner.

Agenda 21 of UNCED (1992) recommends the following objectives:

- (a) To incorporate environmental costs in the decisions of producers and consumers, to reverse the tendency to treat the environment as a "free good" and to pass these costs on to other parts of society, other countries, or to future generations;
- (b) To move more fully towards integration of social and environmental costs into economic activities, so that prices will appropriately reflect the relative scarcity and total value of resources and contribute towards the prevention of environmental degradation;

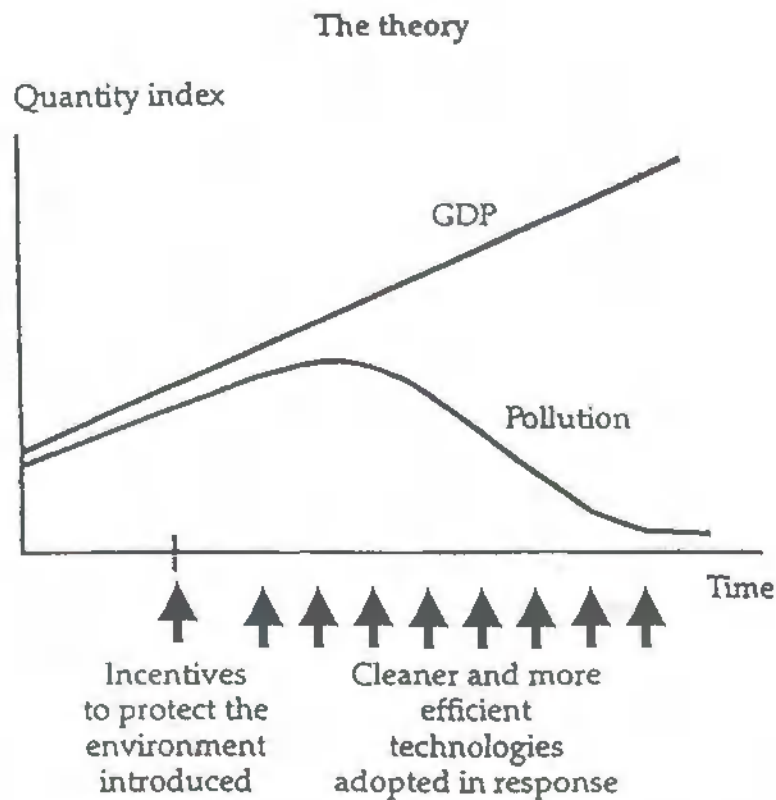


Fig. 3.1 Breaking the link between growth in gross domestic product and pollution (from Ohta, 1993).

(c) To include, wherever appropriate, the use of market principles in the framing of economic instruments and policies to pursue sustainable development.

As noted in Agenda 21, these objectives can best be achieved by:

- (1) Establishing effective combinations of economic, regulatory and voluntary (self-regulatory) approaches;
- (2) Removing or reducing those subsidies that do not conform with sustainable development objectives;
- (3) Reforming or recasting existing structures of economic and fiscal incentives to meet environment and development objectives;
- (4) Establishing a policy framework that encourages the creation of new markets in pollution control and environmentally sounder resource management; and
- (5) Moving towards pricing consistent with sustainable development objectives.

Changes are therefore needed in the basic economic assumptions and in the tools and indicators that are used. Many can be integrated into a system of environmental accounting, applicable at both the national, regional, local and business enterprise levels.

There are four main approaches:

i) the adjustment of national accounts: existing methods for determining the gross domestic product or other relevant measures of performance are modified to take into account both resource depletion and environmental degradation.

ii) satellite accounts: these are accounting systems that run in parallel to and complement the conventional accounting systems by incorporating environmental and natural resource status and change. Discount rates are adjusted so that the needs of future generations are recognized and depreciation rates for environmental assets and natural resources are also included.

iii) natural resource accounts: these accounts describe in physical rather than economic terms the stocks of resources by considering both quality and quantity, the flows between the environment and economy, and the flows within the economy.

iv) integrated environmental, economic and social accounting: in addition to the environmental, resource and economic indicators used in the above accounting systems, this approach incorporates indicators for various social measures including the distribution of wealth and the quality of life.

Further details on these approaches may be found in United Nations (1993) and Abaza (1992b). Successful implementation of any of these approaches requires access to databases holding comprehensive environmental statistics and regular state of the environment reporting. It also requires the development of human resources and the promotion of access to environmentally sound technology for sustainable development.

In a number of countries in the region significant advances have already been made with respect to such changes. Greater economic liberalization and deregulation have resulted in increased compatibility between public and private sector activities. Implementation of sustainable development policies is aided by this synergism between the public and private sectors and will enhance the ability to resolve perceived or real conflicts between social, economic and environmental goals.

As Abaza (1992a) notes, an essential step towards achieving sustainable development is the sound and efficient management of natural resources. One way to accomplish that goal is by accounting for the depletion and degradation of natural resources. Based on a review of the various approaches to environmental and resource accounting and the experience countries have had in its introduction, Abaza recommends the use of environment and resource accounting as a useful instrument for assisting countries to achieve sustainable development. He goes on to recommend:

- i) development of a methodology for determining and prioritizing the information needs of environmental and resource accounting;

- ii) as a standard approach, serious consideration be given to adoption of the UN Statistical Office's System for Integrated Environmental and Economic Accounting (United Nations, 1993);
- iii) the development of guidelines for the implementation of environmental and resource accounting;
- iv) further development of physical resource accounting and valuation techniques; and
- v) establishment of a central focal point for information on environment and resource accounting.

ESCAP (1993b) proposes a number of approaches that will facilitate the process of harmonization of public and private sector policies and activities, including:

- tax and incentive systems designed to encourage resource conservation and minimize ecological degradation through more rational exploitation and utilization and to promote continuous replacement in the case of renewable resources;
- inclusion of specific guidelines in legislation and investment programmes to ensure greater consistency with local environmental imperatives e.g. mandatory requirement for ecological and social impact assessments for investment projects over a certain size or in sensitive areas;
- greater public participation in decision making regarding the use of local resources; and
- a compensation fund for those who forgo future income in order to preserve or create new communal assets (e.g. forest reserves or water-catchment lakes). This approach could also be used for actions to stop erosion and repair damage and to ensure continuous renewal of depleted stocks.

Ecological concerns add another complexity to development policy design and management. The effectiveness of policy measures is dependent on such requirements such as:

- skilled human resources;
- financial resources;
- institutional and organizational bases; and
- scientific data and information on resource inventories and local environmental status.

However, such assets and resources are in short supply in most countries of the region. Frequently wide ranging weaknesses in policy and institutions have severely constrained a more effective integration of socio-environmental concerns into the development process. Such inadequacies are quite pervasive. Moreover, the occurrence of frequent and highly disruptive natural disasters also presents a significant impediment to sustainable development in many economies. For example, the economic consequences of the multiple tropical cyclones that passed through Fiji, Samoa, Solomon Islands, Tonga and Vanuatu in recent years have been estimated (ESCAP, 1993b) to be equivalent to several percentage points of gross domestic product. Combined with these obvious physical, social and economic impacts are the more subtle effects of the possible or even probable scenarios for global warming. These have imposed another costly externality on many Asia-Pacific

countries which are already disadvantaged and hard-pressed, economically and socially.

Nevertheless, in the region there is a substantial commitment to sustainable development. At the UN Conference on Environment and Development, or subsequently, most countries have affirmed that development must be both economically and ecologically sound. Frequently mentioned impediments to achieving this goal include:

- the limited extent to which environmental considerations have been integrated into macroeconomic and sectoral policies and plans;
- the difficulty in identifying strategies for making compromises between the need for growth, social equity and environmental protection; and
- the lack of practical guidelines and check-lists for incorporating such procedures as environmental and social impact analyses and assessments at the sectoral and project levels in policies for sustainable development.

For many of the smaller Pacific island and some Asian countries an important additional issue is the extent to which economic instruments such as those identified above are workable in their predominantly subsistence economies. Furthermore, the desire to offset the large import surpluses experienced of such developing countries has often resulted in the rapid depletion of readily tradeable natural resources. As ESCAP (1993a) states: "all island economies have long suffered from an acute lack of critical mass necessary for reaping economies of scale and scope in their economic activities. Also great insularity and the archipelagic nature of most Pacific island economies exacerbate many of the difficult problems of domestic resource development and economic management: a narrow range of exports; largely unprocessed or semi-processed primary goods, and tourism services".

Reflecting the global situation, UNEP has five major concerns in the area of environment and economics (Abaza, 1992c). These are:

- the financial implications of implementing international environmental agreement - these have been one of the major bottlenecks in negotiating such conventions;
- the additional financial resources required for funding international environmental agreements and programmes - there may be a need to restructure and rechannel existing financial resources;
- development and implementation of methods for valuing environmental goods and services;
- use of various economic instruments, such as taxes, subsidies and charges for environmental management; and
- impact of international environmental relations on environmental planning and management, including the relief and structuring of external debt of developing countries, structural adjustment programmes, commodity terms of trade, non-tariff trade barriers and conditionality of aid.

These foci are also elaborated by Abaza (1993), who goes on to emphasise that the environmental problems currently facing the world are caused mainly by misguided development, which in turn hinders further development. To avoid and remedy these problems development priorities in both developed and developing countries have to be adjusted to reflect sustainable development patterns, incorporating environmentally sound and sustainable economic development models.

Sharp (1993) provides a concise summary of the issues and solutions that arise for the Asia-Pacific region as a result of the reciprocal relationship between environmental economics and environmental policy. He argues that, while the countries within the region recognize the common sense of sustainable development, to date there has been little analysis of alternative policies aimed at achieving sustainable outcomes. In particular, there is a need to consider alternative instruments and mechanisms for achieving a balance between policies focused on growth, social equity and environmental protection. The need to recognize the impact of environmental degradation also gives rise to an urgent requirement to measure the net impact of environmental degradation and incorporate the information into policy analysis and implementation.

Sharp goes on to note that many countries within the Asia-Pacific region are export oriented and contribute to a large share of international trade. However, the environmental costs of export led growth and the environment-trade nexus have not been fully considered. Furthermore, pressure to offset the large import surpluses experienced by many countries has resulted in, amongst other things, the exploitation of readily tradeable natural resources which has often not resulted in judicious conservation in many island economies. Specific consequences of the prevailing social and economic conditions are a narrow range of exports, largely unprocessed or semi-processed primary goods and disproportionate reliance on earnings from tourism services.

The preceding discussion has identified a number of objectives and activities consistent with the need for greater integration and harmonizing of environmental, social and economic development concerns. This clarification of priorities will be instrumental in enabling people to fulfill their basic needs, improving the quality of life of the economically and socially disadvantaged, protecting valued ecosystems, conserving resources, enhancing environmental quality and in ensuring a safer and more prosperous future for all.

An ability to pursue these initiatives is contingent upon the availability of qualified and experienced human resources. The need for institutions of higher learning to strengthen educational programmes in sustainable development economics is therefore a matter of urgency. This will be explored further in the following section.

3.5 EDUCATION AND TRAINING IMPLICATIONS

Environmental and natural resource accounting are key tools in operationalising sustainable development, but their recent introduction, still largely on a trial and exploratory basis, means that few people are familiar let alone competent in their use. This one example demonstrates the need to assign a high priority to ensuring the availability of the human expertise needed to undertake the integration of environment and development at various stages of the decision-making and implementation process. The requirement for such expertise is best met by interdisciplinary education and skills training in technical, vocational, university and other curricula. Initially government personnel, planners and managers need to be informed of the fundamental principles of sustainable development and its application in their areas of responsibility, and subsequently given ongoing training on a regular basis. The focus should be the requisite integrative approaches and planning and management

techniques that are suited to country-specific conditions.

In this respect, Agenda 21 (UNCED, 1992) calls for:

(a) Institutions of higher learning to review their curricula and strengthen studies in sustainable development economics;

(b) Regional and international economic organizations and non-governmental research institutes with expertise in this area to provide training sessions and seminars for government officials;

(c) Business and industry, including large industrial enterprises and transnational corporations with expertise in environmental matters, to organize training programmes for the private sector and other groups.

Training of national accountants, environmental statisticians and national technical staff should focus on the establishment, adaptation and development of integrated environmental and economic accounting systems. Specific themes include collection and analysis of environmental data and information and its integration with economic data, the valuation of non-marketed natural resources and standardization in data collection, development of physical environmental accounts and methods of decision making based on the use of such information.

Sharp (1993) outlines a syllabus in environmental economics based on the assumption that a student has already completed the prerequisite papers in economics. He suggests the following topics:

- macroeconomic aspects of economic growth and environment, especially the cumulative impacts of accelerated growth on the environment;
- application of environmental accounting at the macro-level; the utility, at the project level, of cost-benefit analysis and other analytical tools for evaluating development policy options. Environmental accounting at the enterprise level. Environmental accounting as a tool in environmental audits in the private sector; incorporating environmental policy into decision making;
- economic tools and instruments for environmental management and environmental impact assessment. The theory and principles underlying economic instruments, including polluter pays charges, tradeable rights and liability; possible roles for government; international agreements such as debt swaps;
- market and non-market valuation methods for environmental goods and services. Survey of the range of techniques for evaluating changes in environmental quality and value; information requirements; incorporating non-market valuation information into decision making;
- economic analysis of the environmental management institutions. Economic approaches to analyzing legal systems of governance; role of legislation in providing basis for economic instruments; regional and international agreements;
- trade and the environment. Impact of environmental policy on a country's competitive advantage, relative merits of unilateral, bilateral and multilateral initiatives; environmental consequences of international trade agreements; and

- basics of investment analysis, consideration of incentives to adopt new, less polluting or less destructive technology.

Sharp also advocates that education programmes in tertiary institutions should recognize the need for training that exists in public agencies, international organizations and research organizations. He believes that it is important that environmental economists and managers sustain an ongoing awareness of the developments in the environmental economics literature and the outcomes of environmental policy - this flow of information is essential if theoretically based prescriptions are to be exposed to critical testing in the policy arena.

In the Asia-Pacific region emphasis might well be placed on subsistence dominated economies and on economies in transition. Both categories face particular challenges associated with a shortage of trained personnel and a lack of understanding of the implications of such outcomes as price distortion, loss of competitive advantage and imbalances in economic, regulatory and voluntary management approaches.

Sharp (1993) suggests that education and training curricula should also:

- take advantage of more accessible and comprehensive data bases and technologies for presentation and interpretation of information;
- use information processing systems and sophisticated physical models capable of realistic representations of the form and functions of complex systems;
- embrace education technologies such as interactive learning systems, self-learning packages and simulation packages and computer aided instruction; and
- utilize delivery systems for distance learning, such as satellite communication allowing interactive video.

He notes that, in the Asia-Pacific region, demand for education and training in environmental economics exceeds supply. Balancing supply with demand will not be achieved unless it is first recognized as a problem and long-term strategies are implemented. It is important that progress is based on conceptually sound economics. From this basis it is possible to adjust the mix of topics and move in a direction that suits the individual country's economic, social and cultural conditions. University staff and other similar tertiary level institutions have a comparative advantage in economic theory and environmental economics. Partnerships and cooperative programmes with industry, government agencies and international agencies, such as UNEP, can incorporate contemporary issues and provide the practical insights into environmental policy. Improving the quality of education will involve greater effort in targeting groups and using programmes that are appropriate for each group. Clearly the technology for delivering education services to university students will differ from that used to train analysts in government, consulting firms and industry.

It was in this context that the *Network for Environmental Training at Tertiary Level in Asia and the Pacific* convened a Resources Development Workshop (Hay, 1993b) to prepare curriculum guidelines, resource materials and instructional aids for teaching environmental economics at tertiary level in the Asia-Pacific region. The resulting resources volume (Hay and Sharp, 1993), provides a range of materials to support the development and implementation of an education and training programme that goes some way towards meeting the requirements identified above.

In conclusion, sustainable development economics, and the broader field of environmental economics, are still in their infancy. This leads to some particular challenges as tertiary institutions strive to meet the growing demand for such expertise. Forthcoming reports will assess the existing capacities of institutions in the region to meet this demand and identify the training and related programmes that must be implemented in order to help redress any shortfalls.

4. ISSUES IN TOXIC CHEMICALS AND HAZARDOUS WASTE MANAGEMENT

4.1 INTRODUCTION

Chemicals arise naturally, or are synthesized as a result of human activities. Natural chemical materials are a normal part of the environment and, as such, have been used by humans since the beginning of civilization. Those produced by humans, particularly as the result of industrial chemical manufacturing, have generally contributed substantially to modern life. Examples of benefits arising from such chemical manufacturing include the production of cleaner burning and higher energy fuels, a range of beneficial pharmaceuticals including contraceptives, and modern insecticides which do not exhibit adverse public health or environmental effects. Unfortunately some chemicals do exhibit toxic and other hazardous characteristics and it is these that require identification and a "cradle to the grave" approach to their management.

Currently there is no universally accepted definition for terms such as "toxic substances" or "hazardous waste" but such terminology implies a general acceptance that materials of these types can pose a potential threat to human health and/or the environment. On the other hand, with regard to such materials there is an area of common concern relating to the need for identification, classification, regulation and management of potentially toxic chemicals and potentially hazardous wastes.

According to the International Register of Potentially Toxic Chemicals (IRPTC) there are more than 8 million known chemicals, with about 70,000 in common use. Each year between 1,000 and 2,000 new chemicals are released onto the market (UNEP, 1992c). This range of chemicals produces between 300 and 400 million tons of hazardous wastes annually, the precise amount being very difficult to determine (UNEP, 1992c).

Specific data for the Asia-Pacific region are equally hard to obtain. A survey on hazardous waste carried out by ESCAP in 1989 produced little information due to a poor response rate and, for many of the countries surveyed, a lack of qualified personnel to undertake the necessary national assessments (Fretheim, 1991). Hence comprehensive regional data on the amounts and characteristics of hazardous wastes are not available. Additionally there is wide variation as to what substances each country classifies as toxic or hazardous wastes, though the most important components tend to be compounds of heavy metals, cyanides, phenols and phosphorous compounds.

To overcome the problem of classification and inventory and arrive at both national and regional evaluations, Hernandez (1993) estimated annual production of hazardous wastes using population data and coefficients that reflect the degree of industrialization, the complexity of the economy and the status of development. The coefficients range from 4 to 9 kilograms per capita per year for mature industrial countries and for those countries that have experienced little or no industrialization. Coefficients for countries with newly developed industrial economies range from 15 to 20 kilograms of hazardous waste produced per capita per year. Hernandez considered it unwarranted to use such an approach for the smaller Pacific island countries. Table 4.1 presents the results of these estimations and indicates that the region as a whole produces around 50 million tons of hazardous waste

annually. Some consolation might come from the observation that this is "only" some 20 percent of global production for a region that has over 55 percent of the world's population. But the figures are also indicative of an escalating waste management and environmental problem as the region undergoes rapid industrial and agricultural development.

Table 4.1

Reported or Estimated* Annual Production Rates for Hazardous Waste Production in the Asia-Pacific Region (from Hernandez, 1993)

Country	1993 Population in Millions	Reported or Estimated Hazardous Waste Production (1000 tons per year)	Country	1993 Population in Millions	Reported or Estimated Hazardous Waste Production (1000 tons per year)
Australia	17.3	109	Malaysia	18.3	377
Japan	124.7	82	Fiji	0.8	NA
New Zealand	3.4	22	Thailand	58.1	882
Singapore	3.1	28	P.N. Guinea	3.9	15 - 35*
South Korea	43.8	269	Philippines	63.4	80 - 150
Indonesia	186.4	5000	Sri Lanka	17.6	70 - 158*
India	873.0	39000	Pakistan	121.0	484 - 1089*
Bhutan	0.6	3 - 5*	China	1176.9	50,000
Laos	4.3	17 - 39*	Burma	44.0	176 - 396*
Bangladesh	119.3	475 - 1000*	Nepal	20.1	80 - 180*
Taiwan	20.9	300	Cambodia	8.7	35 - 78*
Mongolia	2.2	9 - 20*	Brunei	0.3	1 - 2*
Vietnam	70.8	280 - 640*	Hong Kong	5.8	35

* The data in this table are estimates derived from various sources, with some as current as 1992 and others pertaining to the early 1980s. As the same definition of "hazardous waste" has not been employed in all cases, the information is not comparable between countries and should be used only as a very crude estimate. For those countries where no information is available, an * is used to indicate the values are based on calculations using a coefficient for hazardous waste generation. This was varied between 4 and 20 kilograms per capita per year, depending on the country.

Countries in Asia-Pacific which are in the relatively early stages of agricultural development tend to use small quantities of traditional and relatively inexpensive chemical products. In the more developed countries of the region a greater range and amount of pesticides and other potentially toxic chemicals are used and hazardous wastes generated. Therefore there is a high potential for increased environmental and health impacts in the region unless toxic chemicals and hazardous wastes are managed appropriately.

Significant publications on the subject of toxic chemicals and hazardous wastes, some with reference to the Asia-Pacific region, include Asian Development Bank (1987), Chua and Garces (1992), Carpenter and Cirillo (1990), UNEP(1990, 1992b, 1992c), ESCAP (1992a), Fretheim (1991), Hernandez (1993), Batsone et al. (1989), Hay and Thom (1993) and Tolba et al. (1992).

The following sections provide more detailed information on toxic chemical use and hazardous waste generation in selected countries and discuss the environmental and wider consequences. The discussion concludes with an assessment of the implications for education and training.

4.2 ENVIRONMENTAL PERSPECTIVE

The impact of a specific pesticide on an ecosystems varies considerably due to differences in soil, water and plant conditions and responses. In some situations pesticides will disperse widely at relatively low concentrations while in other instances hot spots of high concentration will occur.

Of the major types of pesticides, insecticides generally pose the greatest threat to the environment due to their acute and chronic toxicity to living organisms, their general persistence and their cumulative properties.

In addition to direct effects on flora and fauna, many such chemicals enter the human food chain and present a long-term potential health risk, especially due to chemical carcinogenicity and an ability to cause congenital defects. As well as the population at large, worker exposure to these chemical contaminants at the workplace may be of particular concern. This is especially the case in the small-scale industries which dominate in the developing countries of the Asia-Pacific region. In such cases ignorance of the hazards of toxic chemicals and the absence of adequate protective measures combine to increase the incidence of occupational diseases to alarming rates.

Despite their general lack of industrial development, Pacific island countries are highly vulnerable to contamination by toxic chemicals, hazardous wastes, and radioactive materials. Their biophysical characteristics, their isolation and oceanic location and their dependence on a marine and limited terrestrial resource base make them susceptible to environmental degradation through inappropriate use of agro- and other chemicals and the inadequate management of hazardous wastes. Island countries in the Pacific subregion currently import only small quantities of chemicals, though amounts are increasing. Of

particular concern is the quantity of pesticides available which are banned or severely restricted in other parts of the world.

All developing countries in the region are faced with the problem of safe disposal of solid and liquid wastes, including those from domestic sources. Point source pollution from industrial wastes, inappropriately sited and poorly managed garbage dumps, and disposal of toxic chemicals are significant contributors to land contamination and water pollution and overall environmental degradation in the region. There is also growing concern that hazardous wastes are being brought into developing countries from developed countries outside the region.

More explicit examples information on toxic chemicals and hazardous wastes in the region is best presented in the form of a series of five country case studies. Additional case studies for the Asia-Pacific region can be found in Hay and Thom (1993).

The Philippines

Sources: Tolentino et al. (1990) and ESCAP (1992a)

- there are about 85,000 industrial manufacturing plants of which 18 per cent are located in the Metropolitan Manila Region;
- industries producing hazardous wastes include those involved in the manufacture of textiles, leather, wood products, plastics, industrial chemicals and other chemical products, iron and steel, and nonferrous metals;
- estimates of generation of hazardous wastes in the Philippines range from 80,000 to 150,000 cubic metres per annum;
- wastes could be classified as:
 - > intractables, including persistent and highly toxic materials such as polychlorinated biphenyls (PCBs), DDT and other chlorinated hydrocarbons, and wastes containing high concentrations of mercury and arsenic;
 - > toxic materials, including high-strength chemically active materials such as acids, alkalis, heavy metals, and oxidizing and reducing agents;
 - > hazardous wastes in the form of stabilized chemical sludges, asbestos, oil and grease, emulsions, skimmings and concentrates from wastewater treatment plants;
- most of the hazardous wastes, heavy metals, oils and pesticides are common to all industrialized areas;
- special attention is drawn to wastes that may have been eliminated in more developed countries i.e. mercury from chloralkali plants using electrolytic cells and from small scale gold mining;
- other wastes of special interest are: organic chemical wastes from the manufacture of aldehydes from ethylene, arsenic and oxides of sulfur and other heavy metals from copper roasting or smelting processes; gaseous acidic wastes from inorganic acid plants; asbestos dusts in the manufacture of products using asbestos as raw materials;
- present methods of disposal are:
 - > direct discharge of dilute washwaters from the drains of industries to watercourses;
 - > storage and/or burial on the industry site or other land owned or leased by

industry;

- > collection by tanker and discharge to a solid waste dumping site;
- > collection by tanker and discharge to open land, often farm lands;
- > collection by tanker and illegal discharge to sewer or drain;
- > recycling;
- > incineration;
- there is large ignorance of the nature and associated hazards of the wastes;
- the lack of a sewerage system for most of Metro Manila aggravates the wastewater and hazardous waste disposal problem because wastes are directly discharged to inland waterways;
- ocean dumping of specific wastes is still practiced, and is under the control of the Philippine Coast Guard.

Responses include:

- government programmes advocating further utilization of wastes;
- reduction, reuse, recycling and recovery are practiced increasingly;
- Toxic Substances Control Act (1990) empowers government to control, supervise and regulate activities relating to toxic chemicals and hazardous wastes;
- under the Act rules and regulations have been formulated, but there are practical limitations on effective implementation and enforcement;
- the 1990 Act also prohibits the entry (even in transit) of hazardous wastes and their disposal in the Philippines, but problems arise when people are unable to ignore potential revenue or other benefits. Thus hazardous wastes are entering the country for recycling and reuse;
- increased vigilance regarding the disposal of hazardous wastes by reducing their direct discharge to water bodies, but the lack of identified hazardous waste disposal sites still results in much industrial waste being dumped in open dumps and solid waste landfills;
- importing of hazardous waste is prohibited without prior notification to government.

Future requirements:

- more work is required on the development of standards, on environmental monitoring and on the regulation of hazardous waste disposal;
- more regulated and controlled disposal sites and treatment plants are needed;
- technical staff need training;
- industries need to focus on limitation of and better management of waste production, in addition to paying attention to disposal;
- a critical need is for assistance in the proper and effective implementation of the legislation on hazardous wastes;
- public awareness programmes, development of computerized database systems, laboratory facilities and equipment; and
- development of cadres of trained and qualified personnel, including experts on new technologies for waste disposal.

Niue

Source: ESCAP (1992a)

- agricultural chemicals are a major environmental and human health threat;
- as yet there is no official record of any contamination of domestic water supplies by pesticides or fertilizers;
- a stock of mercury-based dental amalgam is also creating disposal problems;
- the Department of Agriculture, Forests and Fisheries has an unwanted supply of out-of-date and unlabelled agricultural chemicals which it is storing until there is some safe method of disposal;
- two of the five diesel generators at the power station operate continuously and waste oil is accumulating and may soon have to be burnt unless a safer and more environmentally appropriate method of disposal can be found;
- disposal of hospital waste also poses a threat to the environment and to human health;
- the Health Department has neither the means of disposing of hazardous substances (such as mercury and expired medication) nor the appropriate facilities to incinerate its solid waste (including surgical waste, infected dressings and swabs, needles and scalpels);
- disposal of solid waste from the 13 villages is by continual burning of rubbish at dump sites. In addition to general air pollution there is a concern about carcinogens from the burning of plastics;
- cases of fish (ciguatera) poisoning have been reported in Niue and there is a belief that this such occurrences are related to marine pollution from rubbish dumps as many are located within 500 m of the coastline;
- the need to address these issues has been acknowledged and discussed, but nothing has been done because there is a lack of people with appropriate tertiary training and a shortage of funds prevents the recruiting of such a person from overseas; and
- relevant regional organizations are providing assistance and donor agencies have also provided personnel with the required environmental and technical expertise

Tonga

Source: ESCAP (1992a)

- generally national policy and legislation related to hazardous wastes is lacking;
- hazardous wastes generated in Tonga are principally agro-based or from small industries such as producers of paints, from service stations, electric power generation, from hospitals and from domestic sources;
- waste management is mainly the responsibility of the producer;
- little work has been done in the field of hazardous waste management and consequently no information is available on the quantity and types of wastes generated;
- waste management methods differ substantially in different sectors and range from nothing being done (open dumping, pouring onto the ground, into swampy areas or dumping into the sea) to storage in sealed containers, burning, or letting it run into the sewerage system; and
- quantities of DDT have been sent back to the overseas manufacturer.

Responses:

- in 1985 the Government decided that all new industrial developments would require an environmental impact assessment;
- a lack of trained personnel and conflicts of interest have lead to the decision being bypassed; and
- a Privy Council Order prohibits the import of hazardous wastes.

Needs:

- to be able to manage its hazardous wastes and have technical manpower to engage in dialogue at the highest level possible in any hazardous waste trade proposal, Tonga requires assistance in the following areas:
 - > human resource development in technical, legal and administrative aspects of the management of hazardous wastes;
 - > technical assistance in carrying out an inventory of the hazardous wastes being generated;
 - > establishment of and providing proper facilities for waste analysis;
 - > formulation of appropriate policies and legislation plus proper enforcement of the latter; and
 - > awareness programmes on the dangers posed by hazardous wastes and the management of such wastes.

Malaysia

Sources: Goh (1990) and ESCAP (1992a)

- in 1987 Malaysian industry produced nearly 400,000 m³ of hazardous waste, with more than half coming from the states of Selangor and Penang;
- major generators of the wastes were metal finishing industries (29 per cent), textiles (14.5), industrial gas processing (14.2), foundry and metal works (10) and asbestos (8 per cent);
- the main types of hazardous wastes generated were acids and alkalis (probably containing heavy metals), toxic sludges, asbestos, paint wastes, oils, hydrocarbon and spent solvents;
- there are currently no comprehensive hazardous waste treatment and disposal facilities in Malaysia;
- there are many refuse sites all over the country which also cater for industrial waste disposal. However, practically all of these are found to be unsuitable for the disposal of toxic and hazardous waste;
- as of March 1989 there was no legislation relating to the management of hazardous waste. This situation meant that hazardous waste generators, particularly the small and medium ones, would neither treat their waste nor improve on their manufacturing process in order to reduce the quantity of waste generated;
- due to an absence of disposal facilities, many industries are storing their waste both partially treated or fully treated, at the factory compound, in warehouses or temporary storage sites;

- many operations are running out of space and there is pressure to establish a secure landfill site;
- many of the wastes generated by Malaysian industry cannot be disposed safely, even in secure landfills, but must receive some form of advanced treatment before disposal;
- problems in management of hazardous wastes include:
 - > general lack of technical expertise in industry regarding management of hazardous waste;
 - > lack of knowledge of regulations on the part of industry;
 - > lack of proper facilities;
 - > difficulty in compilation of data;
 - > lack of enforcement of regulations;
 - > general lack of expertise in toxic waste management in industry;
 - > lack of personnel to enforce the regulations fully;
 - > illegal dumping;
- economically most of the industries, particularly the medium to large ones, should be able to pay for the cost of waste treatment and disposal;
- smaller industries and workshops may find it difficult to absorb the cost of treatment and disposal;
- illegal traffic of hazardous wastes into Malaysia is minimal;
- some wastes are exported to other countries for treatment and recovery, but this is strictly controlled; and
- steps are being taken to sign the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.

Responses:

- strategies being used for hazardous waste management include legislative control, treatment and disposal facilities, and supporting services;
- these give rise to programmes such as enforcement of hazardous waste regulations and guidelines, development of treatment and disposal facilities and implementation of various supporting activities such as data collection and research, educating the public and industries, advisory services, waste reduction at source/waste exchange and training personnel;
- regulations for dealing with hazardous wastes including storage, transportation and disposal were gazetted in 1989;
- waste generators are required to keep an up-to-date inventory of scheduled waste generated, treated and disposed of and transporting of waste should be monitored in an approved fashion until it reaches its approved destination;
- scheduled waste can be stored, recovered and treated within the premises of a waste generator, without a license being required;
- land farming, incineration, disposal and offsite recovery, storage and treatment must be carried out at licensed premises;
- recovery facilities for solvent wastes, lead-acid batteries, solder dross and waste oils are available;
- toxic and hazardous waste treatment and disposal facilities will be operated on a private investment basis;
- viable options for the treatment and disposal of hazardous waste include a centralized treatment and disposal system including an incineration facility, a physico-chemical

- treatment facility, a stabilization facility and a secure landfill;
- implementation of the central treatment and disposal facilities has been delayed because finding a suitable secure landfill site that satisfied the environmental and hydrogeological requirements was difficult;
- adoption by the public of a "not in my back yard" (NIMBY) attitude has also caused delays in implementing the plans for a central facility; and
- a proposed facility is expected to be operational in 1995.

Needs:

- advisory services for industry require skilled and experienced personnel;
- personnel should be trained in pollution control and waste treatment and have a good basic foundation in chemistry, chemical technology or chemical engineering; and
- the best way to educate the industries and the public is through a set of regulations or guidelines. This would illustrate the commitment and seriousness of the Government to address the hazardous waste management problems.

Mongolia

Source: Ts. Adyasuren (pers. comm., 1994)

The current lack of appropriate policies and procedures for the environmentally sound management of wastes (including hazardous wastes) and toxic chemicals is an urgent environmental problem in Mongolia. Significant amounts of toxic chemicals are imported and used in industry and agriculture without specific standards of care or safeguards, and the wastes generated each year in Mongolia are managed by simple deposition on the ground surface in designated areas. This situation results in the release and migration of polluting and dangerous substances to the ambient environment, and has the potential to cause severe adverse environmental and human health impacts.

An additional cause for concern is the fact that neither the specific media and areas affected, nor the degree of the impacts on human health and the environment associated with the problem, are clearly defined. Monitoring focussing on releases from waste areas or from processes involving toxic chemicals has not been conducted. Epidemiological or ecological data focussing on the impacts of current waste and toxic chemical management practices are likewise unavailable. Current understanding of the probable extent of the associated impact is based on observation, assumptions drawn from the amount and types of waste and toxic chemicals present, basic environmental impact assessment principles, and the experiences of other countries.

a) Solid and Hazardous Waste Management

The probable contributions of current waste (including hazardous waste) management practices to the degradation of air, water, groundwater, and soil resources and quality have been identified. Domestic wastes are collected by a relatively effective waste collection system in Ulaanbaatar and other large cities. These and all other wastes are transported to designated waste dumping sites on the outskirts of the cities. In Ulaanbaatar there are three

such sites situated in hilly terrain roughly 10 km from the center of the city.

These designated waste dumping sites are unregulated - any vehicle transporting any substance may enter freely. No measures are in place to screen wastes entering the sites, or to manage different types of wastes separately. Hence, these sites receive domestic wastes, construction wastes, sewage treatment sludge, boiler ash, industrial wastes, and hospital wastes. These are dumped indiscriminately within the site. A portion of these wastes, particularly in the last two categories, is believed to consist of toxic and hazardous wastes. The volumes, types and specific hazards of these toxic and hazardous wastes are not quantified.

Wastes are simply deposited on the open soil surface. No measures are in place to isolate these wastes elements, to isolate mutually incompatible materials, or to prevent the migration of mobile waste substances or degradation products from the site. Wastes are not covered in any way, and water run-on and run-off are not controlled. Much of the waste, particularly boiler ash, is burning and emitting smoke when deposited. Access to these sites is completely open. Many people, including groups of children, scavenge among the waste, and herd animals are allowed to forage in the wastes for edible materials.

An additional problem is that wastes are often deposited indiscriminately outside of the designated sites, particularly along the roads leading to these sites. These roads (e.g., the road leading to the large Daryekhiin Ovo site near Ulaanbaatar) often pass through heavily populated settlement areas. Because vehicles used to transport wastes are generally not purpose-designed (uncovered dump trucks are most commonly used), waste release during transport is common, providing an additional source of exposure to communities along waste transport routes.

Measures required to reverse the environmental degradation and (assumed but unsubstantiated) adverse human health impacts associated with current waste management practices effectively constitute a comprehensive waste management program, and include:

- a survey of waste arisings (volumes, types, and regional patterns;
- assessment and development of the required collection and transport capacities, and the required disposal capacities, for inert solid wastes, including development of controlled sanitary landfill facilities;
- assessment and development of the management/treatment processes and capacities required for toxic and hazardous wastes;
- institutions of measures (policies, programs, and physical facilities) to separate different categories of wastes, and channel these to appropriate management streams;
- identification of recyclable or reusable waste materials, and assessment and development of the appropriate recycling/reuse processes; and
- development of the policies and institutions required to implement the above measures.

b) Toxic Chemicals Management

The issue of toxic chemicals management is related to that of waste management in Mongolia in that the need for environmentally sound toxic chemical waste management practices is a part of the overall waste management issue. Under current waste management practices solid toxic chemical wastes are codisposed along with other waste types in the manner described above, a practice that does not isolate these toxic chemical waste from the environment or from human exposure and potentially poses a significant risk to the ecology and human health.

It is estimated that several thousand tons of more than 2800 chemicals are imported from 10 countries each year for industrial use. Among these are at least 20 toxic chemicals. These chemicals are used in a wide range of industrial applications. They are considered essential for the industrial and economic development, and production of goods deemed important in raising the general standard of living. It is projected that the amount of chemicals, including toxic chemicals, imported each year will increase.

In addition to these toxic chemicals used in industry, a wide range of pesticides are imported, and approximately 1000 tons are applied every year.

In concluding this section it should be pointed out that a comprehensive understanding of the environmental and human health effects of toxic chemicals and hazardous wastes comes only after extensive testing to define such properties as human and ecotoxicity, mutagenicity, carcinogenicity, ability to biodegrade and to bioaccumulate. This is an expensive and time-consuming exercise. Considerable effort is being directed towards making the results of such testing readily accessible in international or national databases such as those maintained and being promoted by UNEP's International Register of Potentially Toxic Chemicals (IRPTC) (UNEP, 1990).

4.3 INTEGRATED PERSPECTIVE

Given the expected population increase, the inevitable expansion of agriculture and industry and the probable increase in the standard of living the use of toxic substances and the generation of hazardous waste are likely to increase despite a substantially increased emphasis on environmental protection measures. The Thailand Development Research Institute has predicted that for that country hazardous discharges by industries will increase threefold in the next 10 years due to industrial expansion. Arresting this type of change will require considerable effort and financial resources.

The ESCAP Consultative Meeting on Problem Assessment of Hazardous Waste Management in the Asia Pacific Region (Bangkok, 1992) considered both country reports and a regional assessment when identifying the following specific problems and constraints related to hazardous waste management in the region:

- lack of sufficient technical know-how to deal with the problems of prevention, treatment and disposal of hazardous wastes;
- the widespread lack of waste exchange programmes;
- the need to update and increase the effectiveness of regulations for waste management;
- urgent need for technological and human resources development, especially in the Pacific island countries;
- the lack of facilities in most countries for training of middle-level personnel for monitoring and other associated activities;
- the failure to disseminate information;
- inadequate public awareness; and
- more monitoring and vigilance was needed to control illegal movement of hazardous wastes between countries.

An assessment by ESCAP of environmental legislation in its member countries indicated that only 3 or 4 have extensive hazardous waste legislation, approximately 10 have some legislation, while the remaining countries have minimal or no legislation.

Of particular relevance to the present study is the observation that expertise in hazardous waste management is scarce in most countries. There is also considerable opportunity for the transfer of technology related to environmentally sound processes, technologies and products avoiding or reducing waste generation, recycling wastes, or producing environmentally safe products.

4.4 PREVENTION AND REMEDIATION STRATEGIES

Over time, a hierarchy for hazardous waste management has developed. If waste is eliminated at source, disposal is not required. Volume or weight reduction and the attenuation in hazardous characteristics of any waste that is produced is also highly beneficial. Recycle, reuse and recovery conserve raw materials, improve the economics of the overall process and allow for the potential marketing of by-products and energy. Treatment and subsequent disposal are less desirable because of cost and the almost inevitable occurrence of some residual which creates a long-term liability.

While some industries have modified their processes and technology to minimize wastes others have replaced hazardous chemicals with more easily treatable chemicals, or introduced alternative technologies which do not require the use of chemicals. In all cases more emphasis should be given to the maintenance and operation of plant and equipment for containing pollution and reducing risks to human health.

For disposal of hazardous wastes use should be made of the best demonstrated available treatment (BDAT). Liquid hazardous wastes should be banned from landfilling - pretreatment should be required before disposal. Recovery and recycling of waste materials should be emphasized. Source reduction and recycling to reduce the amount and toxicity of contaminants and thus the need for pollution control should be a priority.

Wider use should be made of the International Cleaner Production Clearinghouse (ICPIC) which provides a computer-based information exchange system, providing material

on clean technology and processes - i.e. ones that produce significantly less waste while at the same time maximizing efficiency and safety.

The International Programme on Chemical Safety (IPCS), an initiative of UNEP, the World Health Organization and the International Labour Organization, complements the activities of IRPTC by publishing evaluations of health and environmental risk associated with selected chemicals. It also offers advice on control and exposure levels. This information is made available through the data profiles provided by IRPTC. A collaborative programme involving UNEP, FAO, UNDP and others is exploring strategies for integrated pest management, combining judicious use of pesticides with biological control methods that use the pests' natural enemies, pest resistant crop varieties, crop rotation and traditional means of control. In another programme, integrated crop production is being evaluated as a means of achieving sustainable agriculture, thereby avoiding the use of chemicals, amongst other advantages.

Most countries in the region have introduced chemical registration schemes for controlling imports, distribution, sale and use of pesticides using formal lists of banned and restricted products. Other efforts focus on quality control to detect adulteration and inferior quality of formulations. Both are common problems in the region, but remedying them is hampered by a lack of trained analysts and the high cost, insufficient supply of chemicals, analytical standards and reagents, inadequate equipment and deficient maintenance programmes for existing equipment and a lack of standard specifications and methods of analysis.

Residue monitoring is also a critical task in ensuring that contamination does not occur in either domestic or export foods. However, many countries have neither the expertise nor the equipment to conduct such programmes. While in many of these cases food is produced only for local consumption, there is still the responsibility to ensure that contamination is avoided.

In the workplace four principles should be applied to reduce exposure to toxic chemicals and to hazardous processes. These are:

- eliminate the hazard;
- put distance or shielding between the substance or the potential hazard and the worker;
- provide adequate ventilation and other services to reduce the potential for contamination or exposure to other hazards; and
- protect the worker by providing personal protection.

As a summary, it is useful to draw on the analysis of Thom (1993) who describes how the control of hazardous substances has evolved in a common manner in many countries. In specific cases controls may vary in comprehensiveness and may be still evolving.

Initially there is a focus on the management of those substances which clearly exhibit direct harmfulness to human health. Typically this gives rise to control measures for poisons and explosives, and the coverage extends into food additives, pharmaceuticals and pesticides.

This is followed by the management of substances which are regarded as having the

potential to give rise to adverse environmental effects or otherwise indirectly affect public health. Such concerns have given rise to pollution control and occupational health and safety measures. Normally associated with these are emission limits and exposure values.

As communities develop, concerns relating to the potential for emergencies such as chemical incidents and the associated risk of direct and indirect health and environmental effects are often expressed. These concerns may be addressed by restrictions on the location or zoning of facilities associated with hazardous substances, such as in manufacturing, use, storage or disposal. Many communities prepare for such incidents by establishing a coordinating group consisting of emergency services, local authorities and other specialists. Emergency incident response planning thus is facilitated, rehearsed and updated.

A further stage is when consideration is given to the effectiveness of previous control measures and the environmental contamination that may have resulted from hazardous substances previously used. This gives rise to specific chemical product control reviews which may, for example, cover pesticides, food additives and pharmaceuticals, the use of which was previously regarded as acceptable. It also allows for evaluation and management of sites that may have become contaminated by previous activities.

Many countries are recognizing the need for controlling the use of substances that may result in global environmental damage. A prime example would be the use of substances such as chlorofluorocarbons which result in the depletion of stratospheric ozone.

Finally there is the recognition that effective management of hazardous substances requires a life cycle or "cradle to grave" approach in that the environmental implications of that substance during all stages through raw materials, manufacture, use and final disposal are considered. Emphasis is less on the safe use of hazardous substances and processes, and more on questioning the need to use such substances and the use of safe substances in processes which have minimal environmental impact.

Training opportunities exist at all stages during the evolution of such control measures.

4.5 EDUCATION AND TRAINING IMPLICATIONS

Sound management of toxic chemicals and hazardous wastes and reduction in the risk associated with hazardous processes requires, amongst other actions, an investment in training and education. With increasing industrial development and with reports of serious accidents such as Bhopal, effective management of hazardous wastes and processes and of potentially toxic chemicals has become a major objective in most countries of the region. A factor which is hindering the introduction and maintenance of appropriate management practices in all developing countries of the region is a shortage of trained, experienced and qualified personnel. Only with adequate expertise is it possible to reduce the risks to human and environmental health as a consequence of the use of toxic chemicals, the operation of hazardous processes and the production of hazardous wastes.

Training programmes on the safe and efficient management of chemicals and

hazardous wastes are required throughout the region. Countries require trained and qualified personnel before they can embark on the necessary steps to enhance their ability to monitor chemical residues in food and in the natural environment, and to regularly check the effects of chemical use on the health of industrial workers.

A situation characteristic of many countries in the region is the lack of manpower in the environmental management sector. In the present context this relates to lack of personnel trained in the various aspects of chemical management including the assessment of chemical hazards, implementation of regulations and the related inspections and the identification, testing and analyses of chemicals. In the developing countries of the region there is a particular serious lack of trained legal and technical enforcement personnel, especially inspectors (Tolentino, 1992). Even in the pesticide sector there is a lack of people who can take responsibility for licensing and registration and for laboratory work.

While technical design can reduce the risk associated with potentially hazardous industrial processes, no plant can be designed so that it will operate without human intervention. The contribution that workers make to the safe operation of a plant can be enhanced by appropriate training. This should stress:

- the hazards of the process and/or the substances used;
- possible operating conditions, including start up and shut down procedures;
- actions in the case of malfunctions or accidents; and
- experience in similar plants elsewhere, including accidents and near accidents.

Tertiary education and training should emphasize hazardous waste reduction and the overall concept of cleaner production rather than treatment and disposal procedures. This would be more consistent with the waste management hierarchy outlined in Section 4.4.

Priority areas for human resource development that impinge on the teaching and educational activities of tertiary institutions include the following areas, many of which are identified in Agenda 21:

- enhance capacity to contribute to and make use of national and international assessments of chemical risks;
- develop and use mechanisms for the risk management of chemicals;
- increased understanding and use of a new harmonized classification and compatible labelling system for chemicals;
- develop greater understanding and use of databases and other information systems on toxic chemicals;
- develop and use mechanisms for the safe production, management and use of dangerous materials, formulating programmes to substitute them with safer alternatives;
- promote and adopt interdisciplinary approaches to chemical safety problems;
- encourage investigations into and promote the use of cost-effective alternatives for processes and substances that currently result in the generation of hazardous wastes;
- seek and adopt economically attractive mechanisms leading to the ultimate phase out of those substances that present an unmanageable risk and are toxic, persistent and bio-accumulative;
- explore and implement strategies that lead industry to adopt cleaner production methods,

- to invest in preventative and/or recycling technologies and to pursue hazardous waste minimization and management programmes which are environmentally sound;
- promote the development and implementation of environmentally sound technologies;
- develop methods for tracking the generation, movement, storage and disposal of hazardous wastes and for the identification of contaminated sites;
- assist in the identification and application of methods for the environmentally sound disposal of hazardous wastes and for the rehabilitation of contaminated sites; and
- encourage the development and implementation of procedures and programmes for hazardous waste audits and for regulation of hazardous processes, activities and materials generation.

Thom (1993) identifies three levels of opportunity for training related to toxic chemicals and hazardous waste management:

- development of awareness, especially in current and potential future decision makers, of the issues involved and the options available to address them;
- training of local specialists, empowering them with the capacity to develop and support management and control programmes; and
- ongoing training to provide the linkage between managers and the supporting technologists administering current control programmes on the one hand and, on the other, the providers of the research and development which extend the knowledge base on hazardous characteristics and management technologies.

A variety of uses have been identified for the UNEP (1991a) Training Manual related to Hazardous Waste Policies and Strategies. Professional trainers and educators could be used the manual in its entirety or adapt parts for use in short courses on specific subjects. Environmental and waste control administrators might wish to build in-house training sessions around the simulation exercises in the manual. National administrators will find advice on waste situation reports and information on the location of relevant information in their countries. Individuals can make use of the manual to obtain a more detailed appreciation as to how hazardous waste management is carried out at the national level. The manual will provide guidance on waste management procedures to technical personnel while consultants will find the waste survey exercises and annex useful in their work with national authorities. Finally, the manual will provide all users with important background information, tabulated data and key information on management options. Such are the diverse uses to which training materials can be put - all can be facilitated by tertiary level educators and trainers in formal and informal programmes.

Examples of these activities in the Asia-Pacific context are provided in Hay and Thom (1993), a volume arising from a NETTLAP Resources Development Workshop in training related to the management of toxic chemicals and hazardous wastes. Training activities should, wherever appropriate, draw on the results and expertise of international programmes related to the management of hazardous substances, including:

- International Register of Potentially Toxic Chemicals (IRPTC);
- London Guidelines for the Exchange of Information on Chemicals in International Trade (London Guidelines);

- The Prior Informed Consent Principles, an addition to the London Guidelines;
- International Code of Conduct on the Distribution and Use of Pesticides;
- The Basel Convention on the Transboundary Movements of Hazardous Wastes and their Control;
- The International Programme on Chemical Safety (IPCS); and
- The International Cleaner Production Programme.

There are training opportunities both in developing awareness of these activities and in the provision of support staff at international, regional and local levels.

Through research, tertiary institutions have already contributed extensively to the ability to manage toxic chemicals and hazardous wastes in ways which are environmentally sound and to the development of alternative approaches that avoid the use of toxic chemicals or the generation of hazardous wastes. Through technology transfer and training and educational programmes for both students and members of the public and private sectors these environmentally sound approaches have gained widespread use and acceptance. But the process is far from complete, and tertiary institutions still have a critical role to play. The ability of those institutions to meet this challenge within their existing programmes and with current resources and the capacity enhancement required to meet any shortfall will be assessed in forthcoming reports.

5. GLOBAL ISSUES OF REGIONAL SIGNIFICANCE

5.1 INTRODUCTION

The issues to be considered in this section are those where undesirable environmental and related changes are a consequence of external actions or inactions, where the impacts transcend national boundaries and where the primary internal responses of countries are adaption to, or mitigation of, the changes rather than the implementation of prevention strategies. The objective of this review is merely to ensure that the three themes already examined are placed in a broader context of the plethora of environmental issues facing the countries and inhabitants of the Asia-Pacific region. Consequently the assessments in this and the following two sections will be somewhat perfunctory. More exhaustive analyses are provided in such sources as UNEP (1993a), Brandon and Ramankutty (1993), Tolba et al. (1992), ESCAP/UNDP (1993), ESCAP (1992b, 1993c) and SPREP (1992), on which much of the following material is based.

5.2 THE ISSUES

The most pervasive environmental changes are those associated with inadvertent modification of the composition of the Earth's atmosphere. The radiative properties of the atmosphere are being changed by the addition of gases such as carbon dioxide and methane and particulate matter resulting from the burning of fossil fuels and the disturbance of land cover and the underlying soil. The overall effect of these changes is the warming of the Earth's atmosphere, though there is still some uncertainty as to the rate at which this will occur, both globally and, more importantly, regionally. Even greater uncertainty surrounds the consequential effects such as the changes in weather patterns (e.g. precipitation, cloud cover, wind, tropical cyclone frequency and intensity) and in sea levels, both globally and regionally. These changes will in turn influence various natural processes and human activities including coastal erosion and flooding, fisheries and agriculture. Unfortunately, in these cases the consequences of global warming are even less certain. Hence its significance for the Asia-Pacific countries and the region as a whole is not clear cut, and neither are the response strategies which should be implemented, except to instigate whatever preventive measures are available nationally and encourage other countries, through conventions and other instruments, to make an equitable contribution to limiting greenhouse gas emissions.

Human induced changes in the chemical composition of the atmosphere are also upsetting the natural balance in the creation and depletion of stratospheric ozone. In this case the primary causes are the release of synthetic chemicals such as the chlorofluorocarbons and bromofluorocarbons which have a long residence time in the atmosphere. In the presence of ultraviolet radiation in the stratosphere these normally inert chemicals are broken down. The chlorine and bromine ions then act as catalysts and accelerate the ozone destruction process. Although the major releases of ozone depleting substances are in the Northern Hemisphere, the direct consequences are manifestly greatest in the Antarctic in winter, when the strong zonal circulation pattern prevents the natural replenishment of ozone from lower latitude sources. Surfaces of ice crystals formed as a consequence of the naturally low

stratospheric temperatures also help accelerate the destruction process. But reduced stratospheric ozone levels are now observed worldwide, with consequential increases in the intensity of ultraviolet (including UV-B) radiation reaching the Earth's surface. This radiation is known to have a number of damaging effects on humans, plants, animals and materials. Since this includes aquatic organisms such as phytoplankton, zooplankton, larval crabs, shrimp and juvenile fish, many of which form the base of the marine food web, increased UV-B may have an adverse effect on the productivity of fisheries. Other less certain but no less significant repercussions relate to changes in global weather and climate, as changes in the vertical distribution of ozone may warm the lower atmosphere, reinforcing the greenhouse effect.

Marine pollution is also a global problem with serious manifestations in the Asia-Pacific region (UNEP, 1992c). Rivers and the atmosphere are the dominant pathways for pollutants entering the marine environment. More than 90 percent of the lead, cadmium, copper, iron, zinc, arsenic, nickel, PCBs, DDT and HCH found in the open ocean come via the atmosphere (GESAMP, 1990; 1993). For other chemical contaminants river inputs are generally even more important, especially in coastal areas, introducing to the oceans much of the liquid waste and a growing proportion of the solid wastes produced by humans, high loadings of particulate matter and chemically and biologically contaminated runoff from agricultural, urban and industrial areas. Much of the solid waste entering the oceans is now much more durable, travelling long distances to eventually accumulate on beaches. Both sewage and agricultural runoff introduce large quantities of nutrients into coastal waters, nourishing algae and often causing explosive growth and encouraging toxic algal blooms. In many cases aquatic organisms become contaminated creating one of the principal problems for human health on a world scale. The discharge of pathogenic organisms into coastal waters and subsequent contact with humans through bathing and other activities or the eating of contaminated seafood can lead to widespread and, in many cases, serious illness.

Sightings of oil at sea are now common, especially along the major shipping lanes (Fig. 5.1), the consequence of both accidental and deliberate (e.g. deballasting) events. Much of this oil eventually ends up on beaches in the form of deposits of tar-like residues (tar balls), decreasing the attractiveness of the environment and causing mortality among flora and fauna and the tainting of edible shellfish.

For the Asia-Pacific region international dumping is a significant environmental problem that has several global dimensions. Items being dumped are diverse, but they can generally be described as being unprofitable or environmentally unsound in the country of origin, often to the extent that there are no legal means of disposal in the source country while legal or illegal disposal in the receiving country is relatively inexpensive. Examples are wastes, chemicals, technologies and manufacturing plants. Countries that receive these generally have weak legislation and inadequate, surveillance, monitoring and enforcement mechanisms. Growing concern over the international movement of toxic chemicals and hazardous wastes has led to the adoption of prior informed consent procedures, applicable to transfrontier movement of chemicals that are banned or severely restricted in five or more countries and of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.

5.3 EDUCATION AND TRAINING IMPLICATIONS

In addition to the general thrusts of environmental educational and training, global issues such as those discussed above give rise to some special requirements, including:

- increasing the capacity to participate in negotiation and implementation of global and regional conventions and other agreements designed to limit environmental degradation;
- increasing the capacity to work cooperatively with representatives of other countries and with international and regional governmental and non-governmental organizations to ensure that they are aware of the national and regional repercussions of global environmental change;
- increasing the capacity to make use of and contribute to regional and international data bases that provide information on threats to the environment; and
- increasing the capacity to develop and implement adaptive response strategies, including use of alternative technologies and institutional changes.

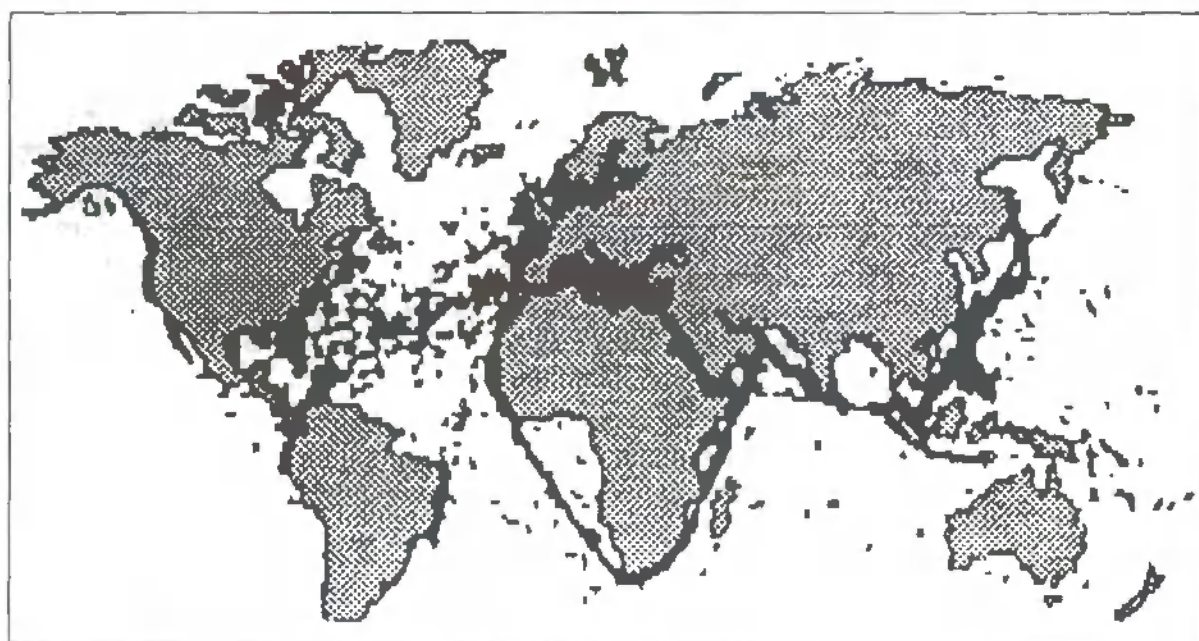


Fig 5.1 Oil slicks in seas during the 1980s (from ESCAP, 1992b and based on the work of IOC)

6. OTHER REGIONAL ISSUES

6.1 INTRODUCTION

This section introduces some of the many occurrences of environmental degradation that are characteristic of the region as a whole and which call on responses that are regionally as opposed to truly internationally or nationally based. The former have been discussed in Section 5 and an example of the latter will be considered in Section 7. Issues related specifically to coastal zone management, environmental economics, toxic chemicals and hazardous processes and wastes have been discussed in previous sections. Many of the issues considered in the present section are reviewed in ESCAP (1992b), Brandon and Ramankutty (1993) and in SPREP (1992).

6.2 THE ISSUES

As noted previously, the Asia-Pacific region has only 23 percent of the world's land area, but it has 55 percent of the world's human population. Overall population growth rate is 1.8 percent, though some countries are experiencing growth rates in excess of 3 percent. While around 70 percent of the people in the region still live in rural areas, there is an increasing shift of population towards the cities, and especially the mega-cities of the region. This growing and urbanizing population is exceeding the capacity of the infrastructure and services, resulting in more urban congestion and pollution, the proliferation of slums and squatters settlements and substantial and generally irreversible impacts on the areas surrounding the urban lands (ESCAP, 1993c). Growing populations with little or no increase of agricultural land are also resulting in increasing rural landlessness, either through the loss of ownership or through loss of tenancy. Some 25 percent of the population of the region, in both urban and rural areas, are therefore not benefitting from the economic development of the region and are consequently living in extreme poverty, with deteriorating health and increasing social problems. It will take a concerted effort to redress the present inequitable status of economically and socially disadvantaged groups in the region. Increased equality, choice, access and participation are an integral part and provide a foundation for sustainable development.

According to ESCAP (1992b) and Brandon and Ramankutty (1993), deforestation is possibly the most serious and widespread environmental problem facing the Asia-Pacific region, with the area most affected being insular Southeast Asia where more than 2 million hectares are being deforested each year. The majority of developing countries in the Asia-Pacific region are experiencing land degradation as evident in the reduction of soil depth or quality and in the quality and quantity of vegetation the land supports. Desertification, or land degradation in drylands resulting mainly from adverse human impacts, has been underway in some parts of the region for thousands of years. However, during this century, and particularly since the 1950s, the rate and extent of desertification has increased markedly. This is largely due to population growth, the expansion of economic activity, the mechanization of agriculture and industrialization. While desertification may also be a natural phenomenon, the preceding human pressures bring about a rapid acceleration of the process.

The Asia-Pacific region is renowned for its biological diversity and for its endemism, both terrestrial and marine (UNEP, 1993b). The full extent of this species diversity is unknown as estimates indicate that only 10 percent of tropical species have been described. Island biodiversity in the Pacific subregion is among the most critically threatened in the world. Again it is estimated that about 75 percent of the mammals and birds that have become extinct in recent history were island-dwelling species. The relict wet forests in Sri Lanka, the monsoon forests of the Himalaya, northwestern Borneo and parts of the lowlands of the Philippines and Australia are also unusually rich in biodiversity. Biodiversity provides for a significant portion of the human diet and other materials which help sustain life, but diverse species are now also being seen as a new genetic resource which can contribute to the improvement of breeds and the development of biotechnology. Pressures resulting in reduction in biodiversity in the region are high. They include habitat destruction due to urban and agricultural expansion and trade in species and materials as countries strive to offset expensive imports and large foreign debt.

Water quality and supply are also key issues for the region, often with transboundary implications (UNEP, 1991b; 1992c). Water is essential for agriculture, industry, human settlements and energy production and is often vital to transportation. It is estimated that clean water is available to only 60 percent of the people inhabiting the Asia-Pacific region. Increasing demand and poor management of wastes has often resulted deterioration of both the quality and quantity of available freshwater resources. Pressures are not only being felt strongest in the more arid parts of the region but also in the rapidly industrializing countries such as Singapore, the Republic of Korea and Hong Kong and where population growth is rapid, as in India. Groundwater and surface water development and utilization often leads to land subsidence, salt-water intrusion, sedimentation and inundation. Threats to wetlands, which form the most productive ecosystems of inland waters, have increased as a consequence of reclamation, pollution, over-exploitation, and the degradation of watersheds.

The Asia-Pacific region is very prone to environmental hazards and disasters, of either natural or human origin (UNEP, 1992c). This regional vulnerability and that of many individual countries is in part due to the impaired state of the environment and the rapid pace of environmental degradation due to, for example, severe deforestation, erosion, over-cultivation and over-grazing. For the region as a whole, droughts, floods, tropical cyclones and earthquakes are responsible for more than 90 percent of all loss of life and damage to the environment resulting from natural disasters. The remainder is associated with such hazards as volcanic activity, landslides, tornadoes, avalanche, fires, hailstorms and extremes of temperature. Major industrial, transportation and other human-induced accidents are not uncommon in the region and they typically have environmental repercussions in addition to the fatal and serious injuries to humans. Human vulnerability, particularly to natural disasters, is increased by the degradation of the resilience of natural systems, as the following example shows. Between 1960 and 1981 the Philippines and Bangladesh experienced a similar number of violent storms, but the death toll in the former country was less than 6,000 while in Bangladesh over 380,000 people perished. Deforestation of the flood plains, destruction of much of the protective fringe of coastal mangroves and the accumulation of soil eroded from the Himalayas has created a smooth pathway for floods to move down and storm surges to inundate the country.

Energy consumption has escalated along with economic growth in the region (Brandon and Ramankutty, 1993). Only Japan has been able to increase its capital stocks while maintaining a constant level of per capita energy consumption. This performance, which might serve as a useful guide to methods for minimizing the depletion of resources while sustaining economic growth, was assisted by ready access to the most recent and efficient technologies and by a low emphasis on the processing of raw materials. The use of energy is often regarded as production while depletion of reserves does not enter the national accounts as a cost. In the same way, the currently externalized costs associated with pollution generated by energy consumption should also be internalized. The Asia-Pacific region has only a small proportion of the world's proven energy reserves for gas and oil. Commercial energy consumption continues to be dominated by solid fuels, such as coal. The projected increased consumption of coal will be partly influenced by public willingness to accept the associated negative effects on air quality and likely contributions to greenhouse warming. Fuelwood is also an important source of energy for the region, contributing around 40 percent in 1980. Fuelwood extraction accounts for almost 80 percent of the total wood extracted by developing countries in the region, adding to deforestation and the loss of biodiversity. This highlights the need for ecosystems to be managed on a sustainable basis, though even present harvesting rates leave some 832 million people in Asia adversely affected by a fuelwood deficit.

6.3 EDUCATION AND TRAINING IMPLICATIONS

The complex character of the problems introduced in the previous section and the often elusive nature of the solutions means that it is of fundamental importance to ensure that the public at large as well as those with specific decision-making, planning and management responsibilities are equipped with the necessary knowledge, values and skills. An informed public will pressure those causing environmental degradation and those responsible for environmental enhancement and protection to help ensure that adverse impacts are avoided, remedied or mitigated. At the same time, such people will be more prepared to meet the economic, social and other costs associated with sustainable development policies and programmes. It is also important to inform people of the resulting benefits, not all of which might be immediately obvious to a poorly informed public, in order to encourage such support.

While also members of the general public, individuals charged with professional or technical responsibilities require additional education and advanced training in order to be appropriately equipped to fulfil their diverse responsibilities and roles.

Tertiary institutions in the region can contribute to addressing both these needs. On the one hand this would be by offering interdisciplinary undergraduate courses in environmental studies, thereby giving students an opportunity to develop skills which will enable them to think critically about, and act effectively for the environment, to develop an environmental ethos based on the values of social justice, economic equity and ecological sustainability, and to enhance their environmental knowledge by addressing such concepts as environmentally sound and sustainable development, human ecology and the resilience and vulnerability of natural and managed systems.

On the other hand, the more advanced professional and technical needs can be addressed through graduate programmes that are multidisciplinary and empower professions with the knowledge and skills related to environmental policy formulation, environmental planning, environmental management and environmental assessment. Additionally, other discipline-based courses would have a strong environmental emphasis. Examples of the latter are environmental engineering, environmental science, environmental law, environmental ethics and environmental health. Another important vehicle for meeting the educational and training needs of decision makers and policy formulators, from within both the public and private sectors, is for tertiary institutions to use both their staff and their facilities for targeted short courses directed at decision makers and opinion leaders.

In these ways, tertiary institutions can make a very effective and rapid contribution to developing the human resources required for effective environmental management and for achieving sustainable development.

7. NATIONAL ISSUES OF REGIONAL IMPORTANCE

7.1 THE ISSUES

As it forms part of a regionally oriented activity, this report does not focus on environmental problems that are specific to a given state, or smaller political unit. Nevertheless, some of the environmental issues that are preoccupying national authorities are still of relevance at the regional level. There are various reasons for this: some national issues result in transboundary costs; some issues that have a national dimension today may well become regional issues in the near future - the precautionary approach encourages the early recognition and avoidance of such possibilities; many countries rely on regional institutions and organizations to assist them with resolving their more local environmental and related problems - regional cooperation at all levels enhances the chances that problems will be resolved with minimal cost; and awareness of the problems facing a neighbouring country and of the responses they are adopting may well suggest strategies and develop technologies that nations and individuals can adopt to solve their own particular problems.

These points are illustrated by the environmental problem of acid rain (UNEP, 1992c). While acid rain is unlikely to be an issue for most countries in the Asia-Pacific region, some heavily industrialized areas, especially in China and Korea are already experiencing the phenomenon and its effects. The major source is the sulphur dioxide emissions from coal combustion. Observed concentrations of sulphur dioxide are reportedly high throughout the country, but the patterns of acidity of the rain are more complex. Some cities experience acid rain but have relatively low concentrations of sulphur dioxide, while others have high SO₂ levels and no acid rain. The explanation for such apparent contradictions lies in recognizing that acid rain typically involves medium and long range transport of pollutants and may also be alleviated by the buffering capacity of the environment. In parts of China the latter appears to be related to large amounts of ammonia combining with airborne alkaline particles to buffer the acids.

Research into acid rain in China has benefitted from international collaboration. Acid rain may well be a problem facing only a few nations today, but already parts of the Asia-Pacific region are experiencing regional air quality problems, and long-range transport is an inherent part of the acid rain problem. The experiences of countries such as China and Korea should alert other nations in the region to the potential disadvantages of basing future growth of the energy sector and the economy as a whole on coal; other energy sources should be considered along with the adoption of processes, technologies and substitute materials which will reduce emissions of sulphur and nitrogen oxides.

7.2 EDUCATION AND TRAINING IMPLICATIONS

Many national environmental problems have a regional dimension, today and even more so if the future is considered. Higher education is often conducted through regional as well as national institutions. Case studies which draw on the experiences of other political, cultural, social and economic groups will broaden the experience of both the educators and their students, opening up more options for prevention and remediation.

Regional collaboration will reduce the likelihood of conflict between neighbouring countries, for they will see mutual benefit in sharing expertise and knowledge and in developing compatible strategies for environmentally sound and sustainable development.

8. COMMON THEMES AND LINKAGES

There is widespread recognition, within the public and private sectors and in the community at large, that degradation of environmental quality must be arrested, that natural resources are being depleted at an unsustainable rate and that legitimate demands for an improved quality of life and enhanced environmental quality must be answered. In the preceding sections numerous other important factors have also been identified. These are shaping the approaches being taken with regard to environmental protection, resource conservation, social progress and economic development. These are not to be treated as separate and conflicting goals, but as integral objectives of the overall goal of sustainable development.

A number of common themes and linkages that should influence tertiary level education and training programmes can be extracted from the previous issue focussed discussion. These are:

- there is a growing movement towards the sustainable use of resources and management of the environment, with a symbiotic relationship between environment and development;
- we are witnessing a greater awareness of the complexity of human-environment interactions and of the resulting uncertainties, leading to a precautionary approach in environmental technology and management;
- there is greater awareness of the intrinsic linkages in natural and managed systems, leading to the need for multidisciplinary and integrated approaches to both environmental and resource management and related problem solving;
- there is increasing recognition that the traditional approaches to economic development and social progress practiced by western countries may not be appropriate for developing countries in the Asia-Pacific region;
- more and more people are acknowledging that the industrial technologies and processes currently favoured by developed countries may not be optimal for developing countries in the Asia-Pacific region;
- environmental management and the associated legislation is now giving more attention to avoiding, remedying or mitigating adverse environmental effects rather than adopting environmental protection strategies and regulations which simply apply available pollution control technologies;
- there is now less reliance on complex technological solutions and a preference for management and remedial strategies that build on the inherent resilience and restorative capacity of natural environmental systems and for the use of traditional practices and endogenous technologies;
- effort is being directed towards complementing activities in pollution control and emergency response with attention to pollution prevention and hazard avoidance,

using cleaner production, process efficiency and other prudent strategies;.

- over recent years there has been an increase in the ability to monitor and assess the state of the environment and the nature and rate of environmental change and a growing commitment to make use of these capacities;
- for many environmental systems, recent technical and scientific developments have enhanced the ability to predict the nature and magnitude of natural and anthropogenic changes using numerical and physical models;
- there is a rapidly growing movement towards developing and implementing integrated and comprehensive approaches to environmental, economic and social accounting;
- consistent with the previous development, there is greater internalizing of costs, especially those related to environmental effects;
- it must be recognized that an emerging global economy brings with it such undesirable outcomes as transboundary movement of hazardous wastes, trading in endangered species and transfer of technologies and products banned in some countries; and
- significant changes are occurring in population demographics, socio-economic values, aspirations, access, choice, equity and goals, personal career profiles, employment opportunities, job security and mobility in the labour force.

While environmental education and training programmes are being faced with diverse and complex demands they are also being supported by such recent developments as:

- more accessible and comprehensive data bases and technologies for presentation and interpretation of information;
- increased accessibility to information processing systems and sophisticated physical models capable of realistic representations of the form and functions of complex systems;
- rapid development of personal and mass communication technologies;
- growth of education technologies such as interactive learning systems, distance education and simulation packages and computer aided instruction;
- increased availability and use of self learning packages; and
- new delivery systems for distance learning, such as voice mail and satellite communication allowing interactive video

It is also important to recognize that environmental educators in tertiary institutions are now serving at least five "client" groups: students in degree and diploma programmes, research sponsors, consulting firms, community and NGO members and short course participants who may be from the private or government sectors. This multiplicity of applications and responsibilities means that the training systems must be adaptive, but not excessively disruptive and demanding in terms of time required and location of training.

9. CONCLUSIONS AND RECOMMENDATIONS

The foregoing observations suggest that training programmes for tertiary level environmental educators should be based around:

- the priorities of environmental protection, resource conservation, social progress and economic development, with these being treated not as separate and conflicting objectives, but as integral objectives of the overall goal of sustainable development;
- the use of flexible learning systems that are modular in construction and both user focused and friendly;
- the use of self learning and distance learning delivery systems, with short periods of intensive group learning;
- the adoption of existing educational and training packages, wherever possible, with adaptation to local conditions (e.g language, case studies, regulations, cultural values) where necessary or desirable; and
- partnerships between tertiary educators, industry and commerce to benefit not only from a better understanding of "client" needs and of industrial processes and commercial practices but also from a transfer of training technologies and methods since these are often pioneered by the private sector.

Capacity building to support the transition to a more sustainable world is one of the fundamental objectives proposed in Agenda 21 and subsequently adopted by the UN System and other international organizations. A major requirement in capacity building is the development of human resources through training and education.

Agenda 21 also includes a number of other recommendations which are relevant to the present study:

- *environmental management training capacities should be strengthened;*
- *new training approaches for existing environmentally sound practices should be developed;*
- *training ... should have a job-specific focus, aimed at filling gaps in knowledge and skill;*
- *the United Nations system, as appropriate, should extend its training programmes, particularly in environmental training and support activities for employers' and workers' organizations;*
- *aid agencies should strengthen the training component in all development projects, emphasizing a multidisciplinary approach; and*
- *countries and educational institutions should integrate environmental and developmental*

issues into existing training curricula and promote the exchange of their methodologies and evaluations.

Agenda 21 also urged that there be increased *support (of) university and other tertiary activities and networks for environmental and development education* and stressed that *there is a need to strengthen, within five years, information exchange by enhancing technologies and capacities necessary to promote environment and development education and public awareness.*

The foregoing sections have shown that such capacity building is a particularly urgent priority in the Asia-Pacific region, for the stresses on environmental systems are currently extreme, and growing at an alarming rate. Enhancing the environmental knowledge and skills of a tertiary educator or trainer has the benefit of a large multiplier effect. The environmental training of tertiary staff is very cost effective and efficient, for one environmental educator or trainer in a tertiary institution can upgrade the environmental skills and awareness of hundreds of students. Upon graduation many of these will move into positions of responsibility where they apply this environmental expertise in the public and private sectors and in the communities within which they live. In addition, through informal education and training programmes, such as short courses or public lectures, this same staff member is also able to enhance the skills and awareness of key individuals in government, the private sector and the community at large. The effectiveness of this transfer process is even greater if the staff member passes on some of his/her expertise to colleagues in his/her own institution, or elsewhere.

But for a region as large and diverse as Asia and the Pacific, how is it possible to have a significant impact on the quality and relevance of environmental training in the region's tertiary institutions, including universities, technical institutes and teacher training colleges? A critical factor is identification of key tertiary educators who will incorporate the information and techniques into both their formal and informal teaching and training activities. A major challenge relates to the inability to involve even these important people in intensive, personalized training programmes by which the knowledge and skills are transferred - there are simply too many and the required resources too few to adopt such a direct approach. Again there is a solution, which fortunately also has a large multiplier effect.

The key is the Resources Development Workshop (RDW), pioneered by UNEP's *Network for Environmental Training at Tertiary Level in Asia and the Pacific (NETTLAP)*. In an RDW selected environmental educators and trainers work with those who have specialist expertise in such areas as training methods, instructional design, training technologies and preparation of training materials to develop three products - curriculum guidelines, instructional materials and instructional aids. These can then be packaged for widespread dissemination to tertiary institutions throughout the region. The full involvement of experienced educators, trainers and practitioners in this process ensures that the resulting outputs are consistent with regional and even more local requirements and capacities. They also address the impediments to widespread acceptance and application.

Over the past 18 months NETTLAP has developed, implemented and evaluated these

approaches, while at the same time building up a network of experts and practitioners in environmental education and training in tertiary institutions throughout the Asia-Pacific region. In NETTLAP the multiplier effect is realized initially through Resources Development Workshops (RDWs). These bring together resource persons and participants who are recognized for their expertise and experience, not only in the thematic focus of the workshop (current themes in NETTLAP are toxic chemicals and hazardous waste management, environmental economics, and coastal zone management), but also in the learning systems which can be used for education and training. Individually and jointly these people apply their knowledge and skills to the development of a number of resources - hence the concept of the RDW, as opposed to conventional training workshops. The resources that are developed during and as a direct result of the RDW include:

- development of the knowledge and skills of the workshop participants;
- development of curriculum guidelines for education and training activities;
- development of instructional resource materials to support the education and training activities in tertiary institutions;
- development of instructional aids (e.g. computer assisted learning software) to support the education and training activities in tertiary institutions; and
- development of a self-sustaining network for the promotion and dissemination of the above products.

The products of the RDWs are distributed widely, in the Asia-Pacific region and beyond. NETTLAP's extensive network of institutions and individuals active in tertiary level environmental training and educations in the Asia-Pacific region (Hay and Pradhan, 1993) is used for this purpose. Currently the network has over 150 Institutional Members and more than 1300 Individual Members, in 33 countries in the region.

Thus the activities based around the RDWs lead directly to institutional strengthening and human resources development - the latter in both the tertiary institutions and ultimately, through the graduates and short courses, in government, the private sector and the community.

While the development of NETTLAP was catalyzed by UNEP, the effectiveness of environmental training of staff in tertiary institutions will be reinforced if other governmental and non-governmental organizations use NETTLAP to increase access to and the use of the outputs of their programmes. If more targeted programmes are required these can be facilitated by adding additional thematic networks. In this way the interests of governmental and non-governmental organizations could be well served.

Tertiary institutions in the region are striving to meet the need to increase environmental awareness in the wider population and at the same time provide a segment of the population with more advanced environmental knowledge and skills. Implementation of institutional strengthening and human resources development programmes, such as those described above, are critical to meeting this demand.

It is hoped that assessments of the state of the Asia-Pacific environment undertaken early in the next millennium will show measurable improvements in environmental quality and a tangible decrease in the rate of environmental degradation. Furthermore, the

motivation for those involved in NETTLAP, and in tertiary level environmental training generally, is that some of the successes can be attributed to the investment currently being made to enhance the knowledge and skills of people who are being, or are about to be, trained and educated in the tertiary institutions of the region and who have benefitted from the activities of NETTLAP and similar initiatives.

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