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LEBANON: IDENTIFICATION OF POLICY OPTIONS

FOR THE MINISTRY OF THE ENVIRONMENT

DRAFT FINAL REPORT

June 1995

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For and on behalf of
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ERM

International Organisations

ERM	Environmental Resources Management
EU	European Union
FAO	Food and Agriculture Organisation
GEF	Global Environment Facility
IFC	International Finance Corporation
IMO	International Maritime Organisation
IUCN	The World Conservation Union
OECD	Organisation for the Economic Cooperation and Development
UNESCO	United Nations Education, Scientific and Cultural Organisation
UNICEF	United Nations Children Fund
UNDP	United Nations Development Programme
WHO	World Health Organisation

Lebanese Organisations

Ministries

MHER	Ministry of Hydraulic and Electric Resources
MoAg	Ministry of Agriculture
MoE	Ministry of Environment
MoF	Ministry of Finances
MoH	Ministry of Housing and Cooperatives
MoIP	Ministry of Industry and Petroleum
MoPH	Ministry of Public Health
MoPW	Ministry of Public Works
MoT	Ministry of Transport

MURA	Ministry of Urban and Rural Affairs

Other Organisations

ALME	Association Libanaise Pour la Maîtrise de l'Energie
AUB	American University of Beirut
CDM	Camp Dresser Mckee
CDR	Council for Development and Reconstruction
CNRS	Marine Scientific Research Centre
CNT	Conseil Nationale du Tourisme
EDL	Electricté du Liban
IFAPO	Institut Français d'Archéologie du Proche Orient
LAI	Lebanese Association of Industrialists
LCSR	Lebanese Council for Scientific Research
LIBNOR	Lebanese Institute for Normalisation
NGO	Non Governmental Organisation
RPTA	Railways and Public Transport Authority
SPNL	Society for the Protection of Nature in Lebanon
VRO	Vehicle Registration Office

Units

LL	Lebanese pound
US$	US Dollar
mm	millimetre
m	metre
m^2	square metre
Mm^2	million square metres
km	kilometre

km^2	square kilometres
m^3	cubic metre
Mm^3	million cubic metre
ha	hectare
hp	horse power
t	tonne
Mt	million tonne
l	litre
Ml	Million litre
mg/l	milligram per litre ($x10^{-3}$)
kg	kilogram ($x10^3$)
gal	gallon
°C	degrees centigrade
Kv	kilo volt ($x10^3$)
MW	megawatt ($x10^6$)
KWh	kilowatt hour ($x10^3$)
GWh	gigawatt hour ($x10^9$)
BPD	barrels per day
ppm	parts per million
g/s	gram per second
$\mu g/m^3$	microgram per cubic metre ($x10^{-6}$)
toe	tonne of oil equivalent
Ktoe	kilotoe ($x10^3$)
Mtoe	megatoe ($x10^6$)
Gtoe	gigatoe ($x10^9$)
Gj	gigajoules ($x10^9$)

PM_{10}	concentrations of particles <10 μm in diameter
IRR	Internal Rates of Return
CFu	coliform unit

Chemical Compounds

BOD	Biochemical Oxygen Demand
$CaCO_3$	Calcium carbonate
CFCs	Chlorfluorocarbons
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
HF	Hydrogen fluoride
H_2O	Water
NMVOCs	Non-methane hydrocarbons
NO	Nitrogen dioxide
NO_2	Nitrogen oxides
NO_x	Nitrogen oxide
N_2O	Nitrous oxide
O_3	Ozone
PAN	Peroxyacetyl nitrate
SiF_4	Silicon tetrafluoride
SO_2	Sulphur dioxide
SO_3	Sulphur trioxide
SPM	Suspended particulate matter
SS	Suspended Solids
TEL	Tetraethyl lead
TPM	Total particulate matter

TSP	Total suspended particulates
VOCs	Volatile organic compounds

Others

BUAP	Beirut Urban Archaeology Programme
DGA	Directorate General of Antiquities
DGCA	Directorate General of Civial Aviation
DGLMT	Directorate General of Land and Maritime Transport
GBA	Greater Beirut Area
GDP	Gross Domestic Product
GNP	Gross National Product
LPG	Liquid petroleum gas
MAP	Mediterranean Action Plan
METAP	Mediterranean Environmental Technical Assistance Programme
POS	Plan de Détail d'Occupation des Sols
IRR	Internal Rates of Return
NWMP	National Waste Management Plan
NERP	National Emergency Recovery Programme
ODP	Ozone depleting potential
ODS	Ozone depleting substances
O&M	Operations and Maintenance
SDAU	Schema Directeur d'Aménagement et d'Urbanisme
SDN	Sustainable Development Network

General Definitions

Coastal Zone: Defined as including the shoreline, the coastal plain (and lower plateau of Akkar till 500 m) and the foothills of Mount Lebanon (up to 250 m).

Bechtel Reports: For the purposes of this Report, we have abbreviated the "*Recovery Planning for the Reconstruction & Development of Lebanon*" Reports carried out by International Bechtel Inc. and Dar Al-Handasah Consultants (Shair & Partners) as *Bechtel WPNo, Date* (eg WP36, 1992).

Population Growth: Overall population in Lebanon is expected to grow at about 20% per year.

Spelling of words: We have tried to adopt a consistent translation of Arabic words, but in some cases, where for example we quote directly from physical texts, other spelling may have been retained. In discussion of archaeological heritage we have retained the archaic spellings for place names.

Technical Terms

Alluvions: Material that has been deposited by flood.

Batha: Agricultural land that has been abandoned for extended periods of time, and has reverted to a porly productive natural state (mainly dwarf shrub and grass communities).

Edaphic: Produced or influenced by the soil.

Guarrigue: Degraded shrub.

Littoral: Of or on the shore/region lying along the shore.

Maquis: Brushwood.

Marl: Soil consisting of clay and lime (ie a valuable fertiliser).

Rendzina: Soils that contain appreciable amounts of organic matter, are highly calcareous and prone to erosion.

Steppe: Level grassy plain devoid of forest species.

Terra Rossa: Soils with a high stone/clay content (up to 90%) with low calcium carbonate.

Wadi: Rocky watercourse which is dry except in the rainy season.

Xerophyte: Plant able to grow in very dry conditions.

CONTENTS

1.1 OBJECTIVES

In the *Draft State of the Environment Report (DSOER) (May 1995)* ERM identified the main environmental issues which need to be addressed in Lebanon, and focused on five priority areas for action. The *DSOER* examined current economic and human activities, and, in the absence of direct data on the state of the environment, drew conclusions as to the likely types and severity of environmental stresses in Lebanon. The purpose of this *Policy Options Report* is to provide a review of possible policy options which could be developed by the Ministry of the Environment (MoE) in Lebanon to address the key environmental issues, within the framework of an overall Environmental Management Strategy. The emphasis in our approach is on finding policy options which could, realistically, be effective in Lebanon.

The Report is structured as follows:

- In *Section 1.2* we summarise the findings of the DSOER by presenting the priority areas for environmental management together with the criteria used to establish these priorities. *Section 1.3* discusses the broad types of policy approaches which could be brought to bear to address specific problems, also noting the role of cross sectoral or national scale policy options. *Section 1.4* discusses a set of criteria against which policy options can be evaluated.

- *Chapter 2* discusses cross sectoral or national level policy measures which would help to establish a framework for environmental management. These cross-cutting measures include the tools for environmental management (measurement, EIA, regulation), institutional structure, the effects of economic and fiscal policies and financial sustainability.

- *Chapter 3* examines the most appropriate policy options for each of the main priority areas; these concepts are developed further in Policy Evaluation Notes for each policy option, presented in *Annexes A* to *E*.

- In *Chapter 4* we present a series of tables evaluating possible policy measures for the other 'secondary' environmental issues, against the criteria which we have discussed. We also briefly draw together the main themes, highlighting the role of cross sectoral policies as well as noting specific policy options.

1.2 ENVIRONMENTAL ISSUES

1.2.1 *Green and Brown Issues*

Environment, as defined in this study covers both *brown* and *green* issues. *Brown* issues include clean up of wastes, minimisation of waste generation, and the sustainability of waste management or control systems. *Green* issues are more diffuse, and are concerned with the protection of the natural resource base, as well as Lebanon's cultural and natural heritage.

The distinction has implications for policy approaches. Pollution control ('*brown*' environment), where human health is at risk, requires direct action and investment in measures to control or reduce the sources of pollution. Conservation and sustainable use of environmental resources ('*green*' environment) requires a more subtle blend of direct and indirect action, including identification of those resources worth protecting and the setting up of clear conditions for use or exploitation.

To date, Lebanon has focused her attention on the (often urgent) brown issues, and is making headway in pollution control and waste management. However, green issues have not yet received comparable attention, even though the effects on the environment may be equally profound.

1.2.2 *Criteria for Identifying Priorities for Action*

Lebanon faces considerable constraints in terms of financial, management and institutional resources. Efforts should therefore be focused on priority areas. While it has not been possible to rank issues in a highly quantitative manner, the *DSOER* adopted the following set of criteria which reflects the concerns of Lebanese people, and provides a subjective but nonetheless useful tool for assessing the importance of each environmental issue.

- *Urgency*; a subjective assessment, implying that unless action is taken urgently either the situation will deteriorate rapidly, or a large number of people or resources will become, or continue to be, seriously at risk.

- *Irreversibility*; where damage or loss of a resource is irreversible, then it becomes more important to address the source of impact than if the effect is reversible. Irreversibility is also an indicator of the *environmental damage* inflicted, and enables us to draw a distinction between, for example, the effects of toxic waste disposal which could impair environmental quality in perpetuity with say urban air pollution from vehicles which will not leave a lasting legacy, once the source of pollution is controlled.

- *Health*; the criterion of human health is clearly of the utmost importance.

- *Loss of amenity*; this criterion refers to issues where the quality of life is affected in an abstract or non quantifiable way, such as through loss of landscape quality, or loss of access to clean beaches and rivers for recreation and fishing.

- *Number of people affected;* this criterion provides a measure of how widespread the impact is in terms of health, amenity and quality of life. For example, contamination which affects one million people is more important that contamination which affects a few thousand. For the purposes of this evaluation, we have adopted a cut off of one million to weight this consideration.

Further, we have afforded higher priority to issues which are of concern on several of the above criteria, but for which no action is at present being taken in Lebanon. For this reason, some important *'brown'* issues (such as municipal waste management, sewerage and waste water management) are not identified as priorities in this Report, as Lebanon is already taking action to address these issues.

Although not actually a criterion for selecting priority areas for action, a further important concern is the *financial sustainability* of management and mitigation measures. We have therefore noted in the evaluation framework presented in the DSOER whether, in principle, financial resources can be found and maintained.

1.2.3 *Priority Issues*

On the basis of these criteria, the five priority areas shown in *Box 1.2a* were identified.

Box 1.2a **Key Priority Areas for Environmental Action**

Green Environment

- *Development of land use planning,* focusing on the coastal zone.
- *Water resource management,* focusing on improving knowledge of the quality and quantity of ground water resources, and on reducing excessive use of water, particularly for irrigation.
- Control of *soil erosion,* focusing on the rehabilitation of degraded terraces and rangelands, and the prevention of further degradation.

Brown Environment

- Management of *hazardous and toxic wastes* focusing specifically on toxic industrial wastes and clinical wastes.
- Management of *urban air quality,* focusing on vehicular pollution. This is the only serious area of pollution which has not yet been tackled explicitly by the Government of Lebanon.

Land Use Planning

The absence of effective land use planning underlies many areas of environmental stress, particularly in the coastal zone. Effective land use planning will, directly or indirectly:

- help alleviate pressures on the beaches and improve coastal water quality;
- reduce pressures on natural resources in the Mount Lebanon area, particularly if *ad hoc* real estate development in the fragile ecosystems of the mountains can be contained;
- help reduce pressures on ground water resources through regulation and control over sinking of wells;
- enable land use zoning in support of controls on industrial activity (such as the establishment of industrial estates);
- slow down the pressures for conversion of agricultural land to urban or low density sprawl, through zoning and suitable policy instruments;
- support moves for the conservation of city and village areas of high cultural and architectural value; and
- provide a framework within which other policy measures can be effectively implemented.

Water Resource Management

Water resources are a scarce and highly charged political issue in the Middle East, and effective water resource management is therefore key in order to:

- maintain long-term year-round security of supply for all uses;
- reverse saline intrusion and the loss of groundwater resources;
- halt current patterns of increasing salinity of soils from over use of water for irrigation.

Soil Erosion

Soil erosion is one of the most serious and intractable long-term environmental problems facing Lebanon. So far, no coherent action has been taken to address soil erosion in the country although the necessary institutional structure does exist within the MoAg and the Green Plan.

The costs of rehabilitation of degraded lands, particularly terraces, are potentially very high, yielding social and economic benefits over a long time frame. Serious efforts must be made to:

- quantify the extent and location of soil erosion problems;
- establish priorities for remediation (eg afforestation and rehabilitation of terraces); and
- prevent or reduce further soil erosion through improved agricultural practices (such as rangeland management and agroforestry programmes)

Hazardous and Toxic Waste Management

The World Bank is considering funding a project to trace, treat and dispose of the toxic waste that has been dumped around the country. However, this does not address the problems of 'routine' hazardous wastes, including toxic industrial wastes and clinical wastes, which are currently dumped alongside municipal wastes.

Urban Air Quality and Vehicle Related Pollution

Although there are no direct measurements of urban air quality in Lebanon, the poor air quality in Beirut is self-evident and may be imposing direct health damage on the population. Transport is the major contributor to poor air quality in urban areas, and measures to reduce vehicular emissions offer positive gains in several areas. For example, in addition to improving the health of the urban population, measures to address air pollution from vehicles could help to ease traffic congestion (a barrier to development), encourage more efficient use of imported gasoline, and help promote the modernisation of the car fleet.

Vehicular emissions in major urban centres are also likely to generate concentrations of ozone along much of the coastal zone.

1.3 POLICY OPTIONS FOR ENVIRONMENTAL MANAGEMENT

1.3.1 *Cross Sectoral vs Specific Issues*

Policies for environmental management can operate in a number of ways.

- Macro policies (economic or institutional) can have widespread impacts on environmental quality or management, across a number of economic and environmental sectors. These include fiscal and pricing policies, and the legal and institutional framework for policy implementation.

- Tools which operate at a project or programme level, but which can be applied across a wide range of issues. These include the use of environmental impact assessment, environmental monitoring and measurement; and environmental quality and emissions standards.

- Issue specific policies and actions which tackle a particular problem, such as for example, setting up controls for hazardous waste management or the import, distribution and application of pesticides.

The first two are 'cross-cutting' issues, setting the macro environment for environmental management, and are discussed in *Chapter* 2. If these macro issues are inconsistent, then the effectiveness of more specific policy options is likely to be much diminished. For example, policy tools to target vehicle emissions through the introduction of pollution control technology (three way catalytic converters) will be less effective when the structure of excise duties is a major barrier to the import of new, more efficient cars. Thus it is

important that the underlying policy context works to reinforce specific policy measures.

1.3.2 *The Four Is*

More specific policies for environmental management can be grouped under the following four broad headings, known as the *'Four Is'*.

- *Investment.*
- *Instruments.*
- *Information.*
- *Institutions.*

Investment

Investment is the policy approach which is furthest developed in Lebanon at present and covers investment in physical infrastructure, equipment and other resources required for environmental management.

Plans and programmes are in place for domestic sewerage including long sea outfalls; for landfill sites and composting plants; and for restoration of the country's irrigation networks. Investment in environmental infrastructure committed in the CDR's Horizon 2000 programme totalled US$ 1,300 million, covering water supply, waste water and solid waste management. A further US$ 35 million are proposed for the establishment of the Ministry of the Environment, including the setting up of environmental monitoring units, equipping a central laboratory, and establishment of nature reserves.

For the future, other types of investment may be required, such as investment in pollution control equipment by industry, investment in afforestation or rehabilitation of terraces to arrest soil erosion; or clean up and containment of areas of contaminated land. Investment may also be needed in order to implement some of the other policy instruments discussed below, to collect and disseminate information or to achieve adequate institutional capabilities.

Instruments

Investment can be complemented by the use of *instruments*, which include a wide range of tools and mechanisms designed to control or change people's behaviour in order to protect or manage the environment. Policy instruments include *regulations* (also known as 'command and control') which set standards and controls on behaviour, and *economic* or *market based instruments (MBIs)* which take the form of charges levied for use of environmental resources, or subsidies which can offset some of the private costs of investment or changes in practice.

Lebanon is well equipped with *regulations and laws* covering many aspects o environmental management, but enforcement is extremely low, and in many cases there are conflicts and overlaps between the agencies charged with enforcement of regulations. Weak enforcement runs through all the priorit

areas identified in *Section 1.2* above; for example, there are requirements for private cars to undergo annual inspections for roadworthiness, for which car owners must obtain a certificate from a designated garage. In practice, certificates are issued without the vehicle ever visiting a garage. Similarly, there are regulations covering the drilling of wells for ground water, for which permits are required, nevertheless most of the wells attached to new developments in the coastal zone have been drilled illegally.

The Capacity 21 programme is preparing a basic environmental law for Lebanon, but the weak enforcement capacity must be borne in mind when proposing regulatory controls. Some approaches are discussed in *Section 2.2*.

Economic instruments are policy instruments that can be used to ensure that those who 'use' environmental resources pay the costs of doing so. Many environmental resources are not priced in markets, and are therefore overused or abused. When industry discharges wastes to surface waters, it does so because the use of the river as a disposal route is 'free', regardless of the fact that the pollution so caused imposes a cost to society. The broader costs to society are 'external' to the industrialist (or other polluters) and are known as *externalities*. Economic instruments can be used to correct for this, when the polluter (or user of environmental resources) is required to pay a charge reflecting the damage to the environment imposed by their actions.

When individuals are required to face both direct costs and the costs of 'externalities' they face an incentive to use the resource more efficiently. Types of economic instruments and the ways in which they can operate are summarised in *Box 1.3a*.

At the simplest level, it is appropriate that where the use of resources imposes a cost to society, such as excessive use of irrigation water, or use of gasoline which impairs air quality, then the use of these resources should not be subsidised but be paid for at the full long run marginal cost.

Fundamentally, people should face the costs of management of the wastes which they produce, and this can be embodied in cost recovery charges. Ideally, these should cover the externalities as well, although the value of these may be hard to determine, and such charges may be harder to introduce than charges which are levied in return for a service.

Information

Information has two key roles to play in environmental management.

- Collection: information is needed for measuring the state of the environment and monitoring the impact of environmental policies. While policy actions can be taken to ameliorate some of the more obvious problems in Lebanon, the absence of measured information about the condition of the environment makes it difficult to prioritise sensibly and develop a strategic view.

Box 1.3a *Types of Economic Instruments*

Economic instruments can operate in a number of ways:

- through *'internalising the externalities'* imposed on the environment, the 'polluters' face the full costs of their actions, and will be encouraged to change their behaviour;
- economic instruments can provide *incentives* to polluters to change their behaviour;
- economic instruments can be used to *raise revenues* which can be used for environmental projects; and
- they can be used to *compensate* individuals for the loss of economic benefits arising from compensation and contribution to the public good.

Possible Economic Instruments for Environmental Management include:

- cost recovery charges for environmental services;
- pollution charges on emissions from industry;
- subsidies and compensation;
- tradeable permits, transferable development rights;
- product charges;
- tax allowances and other incentives; and
- changes in property rights (eg producers responsibility for wastes).

- *Dissemination:* information dissemination to the general public, as well as more targeted information to polluters or major resource users, is necessary to foster an understanding of their role in environmental protection. Also information is a strong *tool for stimulating compliance* with regulations and environmental controls. In the USA for example, the Toxic Release Inventory whereby all companies have to register, publicly, the emissions of hazardous materials they produce, has been highly effective in encouraging industry to manage their environmental processes better.

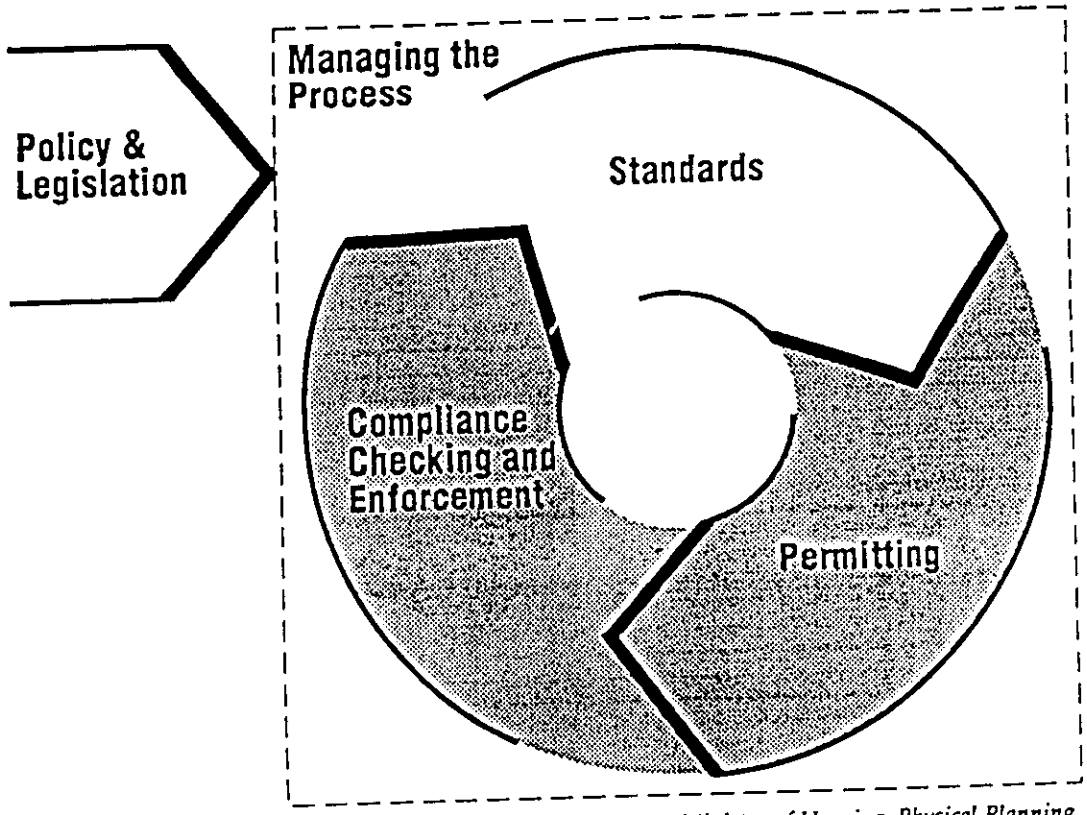
Institutions

Institutions are the organisations through which environmental policies are implemented, and include the Ministry of the Environment, line Ministries, NGOs and the private sector.

The institutional process for the regulation of pollution control from indust and other sources is set out diagrammatically in *Figure 1.3a*. The objective environmental management is to protect the environment through raising the standards of behaviour which impact on the environment. The figure shows schematically the steps in this process:

- *policy formulation* and *legislation* - which sets out the policy objectives an the legislative tools for its implementation. The key components of this step are:

Figure 1.3a *The Process of Environmental Management*



Adaptation from the Regualtory Chain, Ministry of Housing, Physical Planning & Environment, Netherlands

- identification of policy objectives and priorities and policy instruments;
- ensuring enforceability of measures - legislation must be drafted in such as way to be unambiguously interpreted and enforceable. In Lebanon, this process is being managed through the UNDP Capacity 21 programme which is preparing an *Environmental Code* for Lebanon; and

- *managing the process* - setting *standards*, *permitting* commercial and industrial organisations which have the potential to pollute the environment (industry, waste water treatment bodies, landfill sites and solid waste management, quarries, agricultural enterprises, such as intensive farming under glass) or pesticide users; and *compliance checking* and *enforcement*.

All the components of the management chain must be in place and effective, as the whole cycle breaks down at the weakest link, and there is considerable uncertainty in all three of the above areas in Lebanon at present.

Setting standards is essential to provide industry (and other sectors) with clear information as to what they are expected to achieve. The MoE has prepared a set of standards for air and water quality and some emissions standards, based on USEPA and French standards. However, these are in urgent need of review as they are currently unenforceable (as discussed earlier in the DSOER) [1]. In general though, to adapt standards from other countries to make them appropriate for Lebanon is a reasonable approach to this review.

Industry and enterprises find it difficult to operate effectively in an atmosphere of uncertainty, and standards must be explicit and relevant. They must also be acceptable, and should be established with *industry consultation*. In Lebanon this step has been omitted from the process, although it could take place through the Lebanese Industry Association etc.

In order to ensure the completeness of the process a permitting system must be introduced in Lebanon, again with discussion with industry representatives. All industrial operators (possibly excluding smaller enterprises) should be issued with *permits* which define their operations and emissions. The permitting process could involve training and support in waste minimisation as well as pollution control at end of pipe; the permit could also include conditions for eventual remediation of environmentally damaging activities, such as the rehabilitation of quarry sites. It should be noted that permitting is an area which is potentially open to abuse; although one effective tool for minimising this is *public information* so that all permits are publicly available for scrutiny [2].

Compliance checking and *enforcement* is the final link in the chain. As we have noted many times in this report, enforcement of regulations and requirements is very weak in Lebanon but again, *public information* is a powerful tool.

Typically, the process of management of the control process is separate from the policy/legislative body, in an independent agency, although management can be delegated to other bodies. Standards could be set within an independent agency, but some powers of enforcement delegated to municipality level.

1.4 CRITERIA FOR SELECTING POLICY OPTIONS

In general, policies adopted should, as far as possible, represent *win-win* policy options. In other words, they should address the environmental issue in hand without imposing constraints on other activities, and with additional benefits outside the direct environmental sphere. For example, measures to address urban air pollution from vehicles can also encourage more efficient

(1) As an example, no averaging periods are given for air quality standards, so that any measurements obtained are meaningless.

(2) Public information is a powerful tool for promoting compliance with the permitting procedure, and is used in for example the USA through the Toxic Release Inventory, or in Germany, where the level of pollution charges and emission standards required for industry are publicly available and are readily scrutinised by the public, through from example environmentally concerned NGOs.

use of imported gasoline, and reduce traffic congestion. Given this basic aim, criteria for evaluation of possible policy options can be expressed as:

- *Effectiveness*: any policy instrument must work towards achieving the specific objective, and it is important that the objective is clearly identified.

- *Technical feasibility:* some options which have been used successfully elsewhere may not be technically feasible, for reasons specific to Lebanon. For example, storage of water in reservoirs could be used in theory to offset the seasonal imbalances in water supply, but there are very few suitable locations for water storage in Lebanon.

- *Cultural feasibility (acceptability):* policy instruments are most effective when they are acceptable to the groups they are trying to influence. If they are not acceptable, then people will attempt to evade and avoid compliance, which can negate benefits. Policy instruments are likely to be more acceptable if they are *transparent*, that is, it is clear what they are trying to achieve, and how, and where revenues are raised, it should be clear how these are spent. A further factor affecting cultural feasibility is *equity;* instruments should be perceived as being fair.

- *Institutional and legislative feasibility:* a policy tool which can be introduced with minor adjustments to an existing regulation or institution is easier to implement than one where primary legislation or major institutional reform or strengthening is required.

- *Economic feasibility:* the benefits associated with any policy instrument should not be exceeded by the costs of implementation, and economic feasibility levels will therefore depend on the capital and operating costs associated with administrating, monitoring and implementation.

Economic instruments should ideally be set to internalise the external costs associated with the 'polluting' behaviour, although in practice the value of external costs may be difficult to quantify (and certainly beyond the scope of this study). Second best options, such as setting a pollution charge at a level related to the costs of clean up or abatement may be more practicable. Furthermore, policy options should be *financially sustainable*, and should aim to achieve full cost recovery wherever possible.

The policy options discussed in this report have been identified both through the analysis carried out in the DSOER, and through discussions with the World Bank in Lebanon in March 1995. As a result of these processes a short list of potential policy options has emerged, forming the basis for this Policy Options Report.

2 CROSS SECTORAL POLICY OPTIONS

2.1 INTRODUCTION - ISSUES ADDRESSED

In this chapter we are concerned principally with four main areas of policy which are relevant across many of the economic and environmental sectors which have been described and analysed in this Report.

- Institutional framework.
- Tools for environmental management
- Economic policies and the environment.
- Environmental funds.

In many cases these themes have been picked up in *Chapter 3* and *Chapter 4* where specific policy options are addressed. Where this is the case (such as information needs or removal of subsidies on specific services), the discussion in this chapter is confined to generic principles.

2.2 INSTITUTIONAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT [1]

2.2.1 *Introduction*

As discussed at some length in the DSOER, there are three fundamental problems in Lebanon.

- As a legacy of past legislation, there are overlapping responsibilities between a number of organisations covering almost all aspects of environmental management, within which the new MoE needs to define an effective and respected role.

- Most of the Ministries in Lebanon are under-resourced, under staffed and with no recent history of effective operation. They are mostly supported by contract staff, or their executive roles have been effectively taken over by CDR.

- The level of enforcement and management of the environmental process in Lebanon is still very weak, with the MoE carrying responsibility for both policy formulation and enforcement but without clear procedures, or clear delineation of its executive functions *vis a vis* other organisations.

For specific sectors, there are some positive changes in hand; solid waste management is being delegated to private sector operation; the Water Authorities are to be reorganised to five Mohafaza based authorities which bear a closer relation to watershed boundaries than the present caza based authorities do, and policy responsibility for waste water management is to be

(1) This section discusses institutions with a specific remit for environmental management. In discussion of land use planning in *Chapter 3* we have also made some recommendations for institutional changes, and indeed, there is an institutional element for most of the key environmental concerns discussed in that chapter.

placed with the MHER, giving it responsibility for water resources water supply and water treatment. Privatisation of the power sector opens the door for greater efficiency in supply of energy and for economic pricing of electricity.

The weak resourcing of Ministries constrains their effectiveness as executing agencies, and there is a strong case for bringing private companies and NGOs more fully into environmental management alongside the line ministries and within a policy framework developed by MoE. However, this is only feasible where financial resources can be made available to support private sector or NGO implementation activities (eg infrastructure investment or afforestation programmes).

We argue a number of structural changes to the institutional framework would greatly facilitate improved environmental management in the Lebanon:

- the role of the MoE should be limited to legislation and policy formulation;
- an separate enforcement agency should be set up, taking on the role of management of the environmental process now held by the MoE; such an agency could be at least partly financed through permitting charges;
- there should be greater levels of consultation between policy makers and those groups affected; and
- there should be greater delegation of responsibility to other organisations such as NGOs and the private sector, in order to make best use of the resources available in the Lebanon.

These points are discussed in turn below.

2.2.2 *Role of the Ministry of the Environment*

In this section, we review the role and capacity of the MoE and consider how it can most effectively develop a clear role in environmental management in Lebanon. There are several points to be made.

- The staffing and resources of the MoE are very small. At present they have a full time staff of 13, compared with the 139 specified in the establishing law; in May 1995 the Ministry was allowed to recruit up to 20 technical staff on salaries beyond the public sector pay scales, but this still represents a small body of expertise.
- The Ministry is charged with responsibility for policy formulation, environmental protection and 'fighting pollution'; and for enforcement of remedial measures for existing industrial, agricultural and quarrying/ mining facilities.

- Since the MoE is newly established, it is still defining its role in government and in relation to other line ministries and executing agencies (eg LIBNOR).

The range of duties with which the MoE is charged are beyond the capacity of the organisation at the present time, and there is a case for some restructuring, supported by an institutional strengthening programme. One possible approach is to change the remit of the Ministry so that it becomes a body with responsibility for *policy formulation*, while *execution and implementation* are delegated to other appropriate bodies, including line Ministries (MHER for water resource management for example), private sector companies and NGOs. *Enforcement* could be carried out through line ministries, or could be the responsibility of a separate *independent agency*. This refocusing of the MoE would have a number of advantages:

- it would clarify the split of responsibilities between the Ministry and other agencies, reducing areas of conflict and overlapping responsibilities;

- by removing executive powers from the MoE, it would be in a stronger position to ensure environmental considerations are taken fully into account by other organisations, since it would no longer be 'competing' with other ministries, but would be providing the policy and operating guidelines.

- it would allow the Ministry to focus clearly on research, analysis and policy formulation, thus filling what is still a weak area in Lebanon. Such a role would include revision of standards for emissions and ambient environmental quality, but would then exclude enforcement of regulations, which could be delegated, as appropriate to other organisations. Private laboratories could be contracted for testing and monitoring; relevant line ministries would be responsible for implementation of environmental policies in specific sectors (eg agriculture and industry) which would provide a mechanism for incorporating environmental objectives in sectoral development programmes, following a policy lead from the MoE.

- the MoE would step into a more strategic role, possibly reporting directly to the Presidency or the Council of Ministers, enabling it to work directly to influence CDR's activities as well as the line Ministries.

The newly defined MoE would need powers to ensure that environmental policies are carried out by executing agencies. There are precedents for this type of structure. For example, in Chile, CONAMA is responsible for research and policy formulation but not for execution (see *Box 2.2a*) and the authority of the Commission is ensured since it derives directly from the President.

- taking responsibility for assessing compliance with permitted standards, and enforcement, through the effective use of fines etc for non compliance, and using public information as a tool to encourage compliance.

These three steps are the key to the process of environmental management, and all need strengthening in the Lebanon.

The enforcement agency should work to develop consultation with industry and municipalities etc, in order to ensure both that standards and permitting are acceptable and practical. The Agency could also provide training and guidance in waste minimisation as well as requiring end of pipe pollution control where appropriate. The permitting process could entail conditions for the eventual remediation of environmentally damaging activities, such as the rehabilitation of quarry sites once exploitation has ceased. The agency should also be responsible for drawing up *Codes of Practice* for the management of hazardous chemicals, such as pesticides and hazardous wastes.

For small enterprises, where permitting is not appropriate, some element of best practice assessment and compliance checking, perhaps by NGOs, may be more suitable.

As noted above, permitting and enforcement are areas which are readily open to abuse. The availability of permits and guidelines for public scrutiny can provide an effective means of reinforcing the compliance message.

The agency can work with other line ministries in execution of policies, and where appropriate enforcement roles could be allocated to other organisations. For example, Municipalities could take a role in execution of waste management policy and the management of landfill sites. Working through the municipalities would also provide a route for managing activities outside the coastal zone and the Beirut area.

Costs of Enforcement and Cost Recovery

Costs of enforcement can be met through permitting charges. Revenues could be raised from fines for non-compliance or pollution charges, but this would give the regulatory agency an incentive to collect fines rather than encouraging improvements in environmental performance. In the UK for example, about 60% of the costs of the Inspectorate of Pollution are met directly from the private sector via charges levied for applications for authorisations and permits. The balance is direct from the government.

Further research is required to establish precisely the needs of such an agency in the Lebanon, but drawing for example on the size of the regulatory bodies in the UK (including municipalities which also have an

enforcement role) the complement of people might be around 40 - 60. The annual costs of such an agency could be around US$ 5 million/year [1].

Establishment of an Inspectorate in Lebanon would need considerable technical support, but could draw on the universities and provide a framework for attracting overseas Lebanese to bring expertise drawn from other countries to the agency. NGOs could be involved for example, in managing public information registers and ensuring that the activities of the agency and of regulated organisations are clearly in the public domain.

2.2.4 *Role of the Non Government and Private Sector*

There is considerable scope for involvement of the private sector and NGOs in the environmental management process. Some of the options, which already lie within the capability of the Lebanon are outlined below.

- Testing and laboratory analysis of samples for air and water quality can be undertaken through private sector laboratories, or contracted to Universities.

- The proposed air quality monitoring network could be operated through private sector organisations, under contract to the Ministry of the Environment.

- NGOs and sector associations (eg the Lebanese Industrialists Association, a body with membership of 1,000 representing 12 industrial sectors) can become involved in establishing public participation and information dissemination (as noted above, assuming permitting is accompanied by a transparent register of standards and compliance, NGOs could work with the enforcement agency (or line ministries if this route is followed) to maintain information flows; this is the type of activity where NGOs can be very effective.

- NGOs can become involved in many specific policy actions, such as maintenance of terracing, afforestation; or developing waste minimisation programmes for industries; or management of protected areas.

- The scope for privatisation of activities has been examined at length in earlier reports on the Lebanon [2]; which concluded that privatisation of the power sector should be an immediate priority, and indeed is being implemented. At present water resource management (including sewerage and treatment) is not well enough established for privatisation, although private sector capital could be brought into sewage treatment or water supply in the future.

- The private sector already plays a strong role in municipal waste management (through Sukleen in Beirut) and this can be expanded to

(1) In the UK for example, the costs of regulatory agencies are around US$ 45 million/year; on a pro rata basis, annual costs of the agency in Lebanon might be of the order of US$ 4 - 5 million/year.

(2) Bechtel *et al.*

take in other cities and municipalities, and indeed hazardous waste management (see *Section 3.6*) below.

Box 2.2b lists some of the main private sector or NGO organisations which have the potential to become directly involved in environmental management. Many are small, and will need technical assistance in order to develop an effective role.

Box 2.2b ***Organisations in Lebanon with Potential Role in Environmental Management***

NGOs and Associations

Committee for the Protection of the Environment in Lebanon
Lebanese Committee for Environment and Development
Society for Protection of Nature and Natural Resources (SPNL) - affiliated to IUCN
Green Line - affiliated to Greenpeace
Association for Social and Cultural Development
Centre for Environmental Studies and Documentation
Lebanese Academy for Energy, Environment and Development of Scientific Research
Rene Moawas Centre for Research and Education for Democracy Foundation, (CRED)
L'Association Libanaise pour la Maitrise de l'Energie (ALME)
Lebanese Association for Environment and Development
Mouvement de l'Homme
Lebanese Association for Industrialists
Lebanese Forum for the Protection of the Environment (grouping of 8 NGOs)

Research Organisations

Marine Research Centre
Geographical Research Centre
Energy Research Centre

Laboratories

Agronomic Research Institute
MoE Laboratory
Soils Laboratory (AUB)
Industrial Research Institute

The question of resourcing is fundamental to the success and usefulness of these organisations, and for greater involvement of the private sector. Issues of cost recovery and financing are discussed in *Section 2.4* below.

2.2.5 ***Institutional Strengthening and Technical Assistance***

UNDP is leading the Capacity 21 institutional building programme for the Lebanon, which is focusing on strengthening the existing organisations, such as the MoE.

In order to increase the effectiveness of environmental management, we believe that technical assistance should be provided to develop links and networks between organisations, in order to mobilise as effectively as possible the potential skills and interactions which we have outlined above.

2.3 TOOLS FOR ENVIRONMENTAL MANAGEMENT

2.3.1 *Standards for Emissions and Ambient Quality*

Capacity 21 is currently reviewing the framework environmental law in the Lebanon. Once this is in place it will be necessary to review the regulations pertaining to this law, and in particular those relating to environmental standards. As a priority the following environmental standards require review.

- Air quality.
- Atmospheric emissions standards.
- Drinking water quality.
- Bathing water quality.
- Liquid effluent emissions standards (to sewer, sea or other water body).

Although it is possible for the draft framework law to pass into law without the standards being in place, it would be highly desirable to issue draft environmental quality standards in parallel with the law. As the refinement of new regulations could take some time it would be advisable to begin this process as soon as possible.

Current Status

The proposed air quality standards for the Lebanon were reviewed in *Section 15.4* of the DSOER, and a summary of the proposed standards was presented in *Table 15.4b*. The DSOER also presented comparable standards or guidelines from around the world including World Health Organisation (WHO), European Union (EU) and the United States Environmental Protection Agency (USEPA).

Ambient air quality standards are proposed for nine pollutants in the Lebanon which, with some minor modifications, cover most of the pollutants for which other countries provide air quality standards. However, there is uncertainty over their averaging period which limits their usefulness in terms of human health.

Water standards do exist in Lebanon. It appears that bathing water and drinking water standards are broadly the same as used in the EU (although drinking water standards do not cover all parameters). Industrial waste water emission standards also exist but ut is not clear where they have been derived from. Concentrations of certain dangerous substances are also stipulated and these are at variance with EU values.

Possible Approaches to Standard Setting

The problem with setting standards in the Lebanon is there are currently inadequate resources to monitor compliance with standards or to enforce penalties for non-compliance. It is therefore necessary to devise a system

which puts the onus on industry rather than government, and minimises the need for independent inspection and monitoring.

One way of achieving this 'hands off' approach to managing air quality is to apply a version of the 'bubble concept' as first devised in the US. This would involve defining *'airsheds'* within which air quality standards are set. Industry is then responsible for ensuring that their combined emissions do not cause these air quality standards to be exceeded. Industry is responsible for setting up adequate air quality monitoring equipment within their *'airshed'* and making the data available to government (or their appointed agency). Where necessary, industry is also responsible for devising 'emission reduction plans' to ensure that emissions are reduced to a level which will not cause the air quality standards to be exceeded. Where the air quality in an *'airshed'* is dominated by a few major industries (such as clusters of cement plants) it will be relatively easy to establish where emissions controls are best applied, and industry may wish to employ specialist consultants to advise them on how to meet their obligations. Where there are many sizeable industries within an airshed, a system of tradeable emissions permits might be appropriate so that emissions reductions take place within the industries where the marginal cost of pollution control is least.

An alternative approach is to set emissions standards for each type of industry, and then monitor compliance. The burden of monitoring should rest with industry, the data made available to government of its agency, and independent checks should take place from time to time. This system must be complemented with air quality monitoring and regional and local planning, to provide a mechanism for preventing the build up of emissions in one area and therefore an unacceptable deterioration in air quality in nearby residential areas. This approach is more conventional, but relies more heavily on government intervention than the approach outlined above.

However, in Lebanon, the industrial sector is dominated by small industries located amongst mixed development, where this type of system would be impossible to operate. Small industries would be incapable of carrying out routine air quality monitoring, and this would be inappropriate in any case. The best practicable management tool in these areas would be to develop guidelines for best practice for small industries, and carry out periodic inspections of their operations by an independent inspectorate and enforcement agency.

In the case of water, one commonly used approach is to set *effluent discharge limits* in terms of concentration, according to the receiving water body (which is dependent on its uses and quality). Hence effluent discharge limits are set for a wide range of parameters for discharge to sewer, to rivers and streams, to groundwater and to the sea. This is complemented by *Water quality standards* which are normally only set for drinking and bathing water so that no specific quality standards are set for particular water bodies.

This approach would be appropriate in Lebanon, but must be complemented with a system for monitoring effluent from industrial outfalls, and enforcing penalties if an industry is found to be discharging prohibited substances or

concentrations of permitted substances. A system whereby industry is required to monitor its own effluent, combined with a policy of public disclosure of the data and periodic spot checks by government or its agency, would be appropriate in Lebanon. If public awareness of environmental issues can be raised, any industry illegally polluting a waterway will find itself under considerable pressure from the local community. NGOs can play an important role in bringing violations of effluents standards to the attention of the government.

2.3.2 *Environmental Impact Assessment*

Environmental Impact Assessment (EIA), if used well, is a valuable tool for ensuring that any potential environmental impacts of a proposed development project are adequately taken into account in the design of the project, and that all reasonable efforts will be made by the project proponent to minimise residual environmental impacts through mitigation, management and monitoring. If, on consideration of the EIA report, the responsible authority consider that the project will not have significant environmental impacts they may grant permission to the developer to proceed. The EIA also provides a baseline against which to monitor the impacts of a project during construction and operation, and a checklist against which the responsible authority can ensure that the developer is honouring their commitments to monitoring, mitigation and management of environmental impacts. These commitments may include specific requirements for decommissioning and/or restoration and rehabilitation.

Given the current number of reconstruction projects proposed in the Lebanon over the next 10 - 15 years, EIA provides a useful tool for anticipating, understanding and managing the environmental impact of these projects. Although EIA works best within a fully functional environmental management framework, it is nevertheless quite possible to implement an effective EIA system without capital investment, and in the absence of a full legislative framework and fully strengthened institutions. The quality and usefulness of EIA will improve as other aspects of Lebanon's environmental management system improve.

Legislative Requirements for EIA

At present, we understand that there is little legislation in place regarding the implementation of EIA into the decision making process. The MoE has stipulated that EIAs are required as part of the license application within the new quarrying law. EIAs have not, as far as we know, become part of the legislative framework for any new major infrastructural developments, but we are ware that the UNDP Capacity 21 Programme is looking to undertake an institutional strengthening programme, regarding all aspects of EIA at mid to senior level decision makers within Government.

The requirement for EIA for major development projects should be enshrined in the environmental legislation, and the regulations should clearly distinguish between those types of projects for which an EIA is mandatory, those for which the requirement to undertake an EIA is at the discretion of

the responsible authority, and those for which an EIA is not normally required.

The regulations should also stipulate EIA procedures, clearly stating who is responsible for preparing the EIA, which authority is responsible for evaluation, and provide guidance on timing of EIA within the overall project cycle. Sectoral guidelines should also be provided on the scope of an EIA for different types of project.

For small projects where a full EIA is not necessary, it may be appropriate to require the developer to produce a brief environmental statement (ES), describing the proposed project location, timeframe and operational activities, identifying any potential environmental impacts and describing how these are to be mitigated and managed, for example in the case of individual quarries it would probably also be appropriate to require that the developer produce a restoration and rehabilitation plan. The responsible authority would have the option of requesting further information or clarification if it is not satisfied with any aspect of the ES.

Institutional and Economic Implications

The MoE, perhaps through a new independent agency, would continue to be the responsible authority. The project proponent would be responsible for the preparation of the EIA report, but may sub-contract the work to a suitably qualified consultancy, NGO or academic institution.

Given the current institutional weakness, the lack of resources within government, and the lack of adequate local skills in EIA within the non-government sector, there is an urgent need for training and skills transfer from countries where EIA procedures and practice are well developed. In the short-term project proponents may need to 'buy-in' EIA services from overseas.

However, buying consultancy services to carry out an EIA can be expensive, and EIA can be time consuming, building expensive delays into the project development cycle. For small development projects, these costs may be prohibitive, hence the need to differentiate between the types of project for which formal EIA is required, and those for which a simple Environmental Statement may be sufficient.

Although not often immediately apparent to a developer, EIA can bring medium to long-term economic benefits to a project. For example, by identifying waste minimisation, process design and emissions control measures at the outset the developer can streamline the permitting procedure, reduce production costs, avoid costly retrofitting of pollution control measures when unforeseen problems arise in the future, and possibly even avoid the costs of legal action against them. However, with the exception of reduced production costs as a result of waste minimisation, these 'avoided costs' only apply in countries where pollution control regulations are enforced and public awareness of environmental health issues is high.

Donor funded projects often act as a lever for implementing EIA requirements in a developing country, as most multilateral and bilateral donors require that an EIA is carried out prior to granting funding. This can provide a vehicle for skills transfer and where full scale EIAs are required, it may be possible to attract international donor funding for 'pilot EIAs' as part of an overall training and skills transfer programme.

2.3.3 *Information Collection*

In the following section we briefly discuss why information collection is important in Lebanon, and how this might be achieved. Specific information needs are discussed in greater detail in *Chapter* 3 and *Chapter* 4.

The collection of information is an important prerequisite for effective environmental management in the Lebanon. Information collection can take a number of forms, but the most important categories are:

- monitoring and measurement of environmental quality;
- monitoring and measurement of industrial emissions; and
- natural resource inventories.

Monitoring and Measurement of Environmental Quality

Monitoring and measurement serves the following important purposes:

- as a tool for promoting public health;
- understanding the environmental baseline;
- assessing the scale of environmental problems in the Lebanon;
- setting priorities for environmental action;
- assessing the success of environmental policies;
- predicting (and subsequently assessing) the impact of environmental interventions;
- providing advance warning of environmental damage; and
- checking compliance with environmental standards and guidelines.

However, monitoring is expensive both in terms of capital costs and operation and maintenance costs, and Lebanon will need to prioritise its monitoring and measurement activities. Given this constraint, the main criteria for prioritisation should be the potential of the data as a tool for the promotion of public health.

Routine monitoring of the quality of drinking water supply both as it leaves the treatment plant and in major aquifers and at bathing beaches should be undertaken in the interests of human health as well as to provide a tool for prioritising action, assessing the impacts of proposed projects or policies, and monitoring success of mitigation measures. The same applies to the routine monitoring of urban air quality which is discussed further in *Chapter* 3 in the context of traffic pollution. Air quality data can be used to provide a pollution alert system to warn the urban population when pollution is expected to be dangerously high, or to indicate when industrial output or urban traffic should be limited.

Once the monitoring priorities from a human health perspective have been addressed it would be helpful to extend the air and water monitoring network to provide a wider information base, for example, in the case of water this would include monitoring of the major rivers.

Capital costs of equipment, and technical assistance in the form of training may be forthcoming from the international donor community. The chief constraint to running an effective monitoring system is therefore the lack of adequate human and financial resources to operate and maintain the monitoring system, collect and process data, and make practical use of that data. Given institutional weaknesses within government, the most practical solution would probably be to contract the management of routine environmental quality monitoring activities to a suitably qualified private contractor or NGO, working to the MoE or the new regulatory agency.

Monitoring and Measurement of Industrial Emissions

Monitoring of industrial emissions (to air or water) is an important tool in compliance monitoring. Emissions monitoring can either be undertaken by the industry itself as part of routine operations, or spot checks can be carried out by a government agency or by a private contractor. The most appropriate system will depend on the regulatory framework and the degree of enforcement capability. However the process is managed, the financial burden of emissions monitoring should ultimately rest with the polluter.

The MoIP has proposed to revitalise the Lebanon Standards Institute (LIBNOR) to focus on monitoring of industrial discharges.

Natural Resource Inventories

Natural resource inventories are also important in order to characterise the baseline environment, to help prioritise areas for action, and to provide a benchmark against which to monitor change. Inventories need not be expensive to undertake, and can be contracted to academic institutions or other NGOs. Some of the information required to compile a complete inventory already exists, particularly for archaeological and cultural sites. Data collection activities could be implemented immediately without being too burdensome on already over-stretched institutions, by allowing data to be collected gradually and surveys or research activities being commissioned piecemeal over a reasonable timeframe.

2.3.4 *Dissemination*

The dissemination of information is vital if public perceptions about the importance of the environment, and each individuals role in its protection, are to be changed in Lebanon. Environmental education in schools is of particular importance in raising overall awareness of environmental issues in Lebanon in the medium to long-term. Further, dissemination of targeted information is required in the form of technology transfer and training for specific sectors of the population. For example, industry needs information on the significance of the wastes they produce and on waste minimisation

and pollution control techniques; and farmers need information on the appropriate mechanisms for handling and using agrochemicals.

As discussed in *Section* 2.3 above, a public right to know puts pressure on polluters and is therefore a useful tool in encouraging compliance.

Economic constraints to mounting environmental awareness campaigns may be overcome by attracting international funding for environmental education, training and technology transfer. Institutional constraints can be overcome by contracting out the work to the private sector. However, there are also potential cultural barriers to overcome such as a reluctance to alter traditional hunting practices, or conserve water and energy, which may be more difficult to overcome through information alone. In these cases systems of incentives and penalties may be necessary.

2.4 *ECONOMIC POLICIES AND THE ENVIRONMENT*

2.4.1 *Introduction*

There are three sets of economic concerns which we address in this section:

- the extent to which pricing or fiscal policies in Lebanon reinforce environmental 'bads' and the extent to which they can be changed to support environmental 'goods'; for example, subsidies on energy prices conceal the environmental costs to society and encourage less efficient u of energy; and

- the extent to which economic instruments, pollution charges for exampl have a role to play in environmental management in Lebanon.

We have concluded in *Section* 2.3 above that there is considerable scope for involving private enterprise in environmental management; which has led to identify the following economic policy options:

- GoL to move as rapidly as possible to the removal of subsidies in the areas of water supply and energy supply;

- GoL to maintain its commitment to cost recovery for services provided where possible, and set up a clear programme for moving towards mor effective cost recovery particularly for water supply, waste water treatment and solid waste management;

- the taxation structure to be amended to increase significantly the level tax on gasoline, and reduce the level of tax on imported new vehicles;

- to impose a tax on gas oil to discourage the use of private generators;

- the potential for pollution charges to be evaluated in greater detail, (although we believe that to introduce them until a clear and effective

managed regulatory framework is in place would be premature and possibly counterproductive); and

- GoL to consider setting up an environment fund to access resources from outside the government revenue base.

We are also concerned to ensure the financial sustainability of any programme for environmental management. There are two concerns subsumed here: whether there are sufficient resources in the Lebanon to support desired environmental policies, and are the policies affordable; and how the resources can be accessed, whether through direct cost recovery, government finance or other approaches. This latter concern is particularly relevant when we are considering the role of NGOs (including private sector companies) in environmental management, and the question of cost recovery and affordability is dealt with in *Section* 2.5 below.

2.4.2 *Removal of Subsidies*

Government in Lebanon is committed to an economy where the private sector acts as the engine of growth, and where subsidies for utilities and services are removed. At present however, there are a still number of subsidies in place which encourage inefficient use of environmental resources, and which, if removed, would substantially improve government finances.

Even where fees and charges are levied for services, the low recovery rates effectively constitute a subsidy. There are also a number of services for which no charges are levied, such as solid waste management and sewerage services. The effect of this type of subsidy is to leave the burden of cost recovery on taxation, which is unlikely to fall directly on those making use of the services; it also means that users of environmental services have no incentive to use the service more efficiently. This policy also has negative impacts on the effective provision of the service itself, in that central government funds are vulnerable to other macro economic pressures and may or may not be made available for delivery of the service.

The following subsidies in Lebanon have a direct impact on the environment.

- Subsidies in the *energy sector*, whereby the government finances the costs of fuel oil to EDL, and EDL in turn subsidies the cost of electricity to consumers.

- Subsidies on the *supply of water* for both residential use and irrigation water. There is an effective subsidy on water resources for industry, most of which is drawn from non-licensed privately sunk wells, and for which no abstraction charges are levied.

- Subsidies on *wheat and sugar beet* in the form of price supports, set above the internationally traded price of wheat, with resulting high agrochemical inputs to increase production.

- *Low entry charges* to archaeological and heritage sites in the Lebanon place the burden for care of these resources on public taxation.

Removal of these subsidies would give the correct price signals to resource users, and ensure more adequate funds to government for their delivery. The detailed implications are discussed in *Chapter 3* and *Chapter 4*.

2.4.3 *Amendments to Fiscal Structure*

Government revenues are raised largely through income taxes and indirect (customs and excise) taxes, and in 1994 totalled 15% of GDP. This is expected to increase to 18% by 1997 with the introduction of a generalised sales tax, which while being regressive (ie affects the poorer sections of the community proportionally more than the richer elements) should be neutral in terms of the environment. Government is proposing to streamline significantly the current customs and excise tariffs.

Government is also apparently considering an increase in gasoline taxes; we have argued that this is an important component of an environmental strategy which will significantly encourage more efficient vehicle usage. An increase in gasoline tax by 60%, bringing the level close to the lower end of the range applied in OECD countries, would raise about US$ 380 million/year, and have the effect of reducing the expected growth in gasoline demand by about 60% (compared with what it would otherwise have been) over a 10 year period.

We have also suggested that the heavy import duties on new vehicles could be substantially reduced to provide incentives for restructuring of the vehicle fleet, and the revenues foregone would be more than offset by the increase in gasoline tax. Import tariffs on vehicles should be structured to favour small efficient cars with emissions controls.

2.4.4 *Potential for Economic Instruments*

Economic Instruments (also known as market based instruments, MBIs) are widely seen in the environmental policy literature as an effective means of ensuring environmental compliance at least cost, although they have not yet been widely introduced except as revenue raising tools [1].

As noted in *Chapter 4* of the *DSOER* the entrepreneurial nature of the Lebanese people suggests that MBIs could be highly effective for environmental management. However, it is our view that in the short term the focus must be on:

- establishing a clear regulatory framework within which industry and other actors can develop better environmental practice, and within which policy instruments must operate; and

(1) Exceptions include for example, water pollution charges in the Netherlands, Germany and France, or tradeable permits for air quality in the USA.

- at the same time removing current price and tax based distortions and establishing the principles and mechanisms for cost recovery as discussed below.

The application of MBIs needs careful evaluation in the light of developments in these areas, in order to build on a solid framework where the concept of environmental management is more readily understood than is the case at present. Some specific economic instruments are discussed in *Chapter 3* and proposed in the tables on policy options for the secondary environmental issues in *Chapter 4*. In general we consider that widespread use of such instruments is not yet appropriate in the Lebanon, but must be kept firmly in mind as the policy framework develops and consolidates over the coming five years.

2.5 *Costs of Environmental Programmes and Scope of Cost Recovery Charging*

2.5.1 *Domestic Environmental Services*

The environmental programmes both proposed as a result of this study and already in place will impose a considerable cost burden on the people of the Lebanon. This section considers briefly the scope for direct cost recovery and the extent to which other financial resources will be necessary.

Table 2.5a summarises the main costs associated with providing physical infrastructure and services to the domestic sector.

Table 2.5a *Costs of Main Environmental Programmes*

Programme/service	Cost (US$)	Comments
Waste water collection and treatment	720 million capex + 72 million/year O&M	Proposed in Horizon 2000 Implies annual/capita cost of US$ 50
Water Supply	380 million capex + 38 million/year O&M	Proposed in Horizon 2000 Implies annual/capita cost of about US$ 27 (ERM estimate in *Table 11.6c, DSOER*), equivalent to about US$ 0.46/m^3. Current charge level US$ 0.16/m^3, or about US$ 10/person/year (note that *Bechtel WP18, 1991* estimated that water prices about 60% of long run marginal cost taking account of rehabilitation, suggesting full cost price of water at about US$ 0.3/m^3).
Landfill sites	39 - 40/tonne waste (capex + O&M)	Based on CREED 1994. Annual/capita cost US$ 12 (assuming 0.8 kg waste/person/year)

Notes: Derived from discussions in DSOER.

On the basis of these figures, the immediate programmes of environmental services imply/person costs of around US$ 80 - 90/year, made up of about

US$ 50/year for waste water collection and treatment, US$ 20 - 30 for drinking water and US$ 12/year for solid waste management.

Affordability

This level of cost raises serious questions about the affordability of cost recovery charging. For a family of 5, the annual cost of environmental services would be of the order of US$ 400/year. The minimum wage in Lebanon is US$ 150/month (US$ 1,800/year), under which circumstances the costs of environmental services would be about 20% of household income (assuming one wage earner). This is clearly untenable, and suggests that the charges for the poorest sections of the community must continue to be subsidised. Average household incomes are about US$ 3-5,000/year, in which case, environmental service costs would be about 8 - 10% of family income, which is still a very high proportion [1].

Nevertheless, efforts to move towards full cost recovery charging are essential to the sustainability of infrastructure investments, and subsidies should be phased out as soon as practicable, so that people face the costs of resource use. If they are not affordable at present, then introduction of charges across the board may be a medium term aim, rather than an immediate policy action.

The provision of basic environmental services imposes a significant burden on *households* if full cost recovery can be introduced, and the fact that cost recovery is not affordable by a significant proportion of the population implies a continuing dependence on government finance. We have estimated the total cost of environmental services at about US$ 80/household/year. If, say, 30% of households cannot pay this, then the balance, totalling about US$ 20 million/year [2] will need to be financed by government funds from direct taxation. The current budget for the MHER for all its services in 1994 was US$ 42.5 million.

2.5.2 *Industrial Wastes and Pollution Control*

Investment in plant for the management of *industrial waste and liquid effluent* should also be covered through cost recovery charges. Again the costs of this may be high, but at about 2.5% of industry value added, should be affordable (see *Box 2.5a*). However, given the high cost structure in which Lebanon's industry operates (see *Chapter 6* of DSOER) it may be necessary to phase in full cost recovery charging, as other factors which are currently imposing costs (particularly erratic communications and unreliable energy supplies) are overcome with the rehabilitation programme.

(1) In the UK, environmental services cost around 2% of average household income in 1994.

(2) Assuming average household size of 5 and population of 3.7 million, 30% of households too poor to pay full cost recovery charges means that costs equivalent to the costs attributable to 220,000 households to be met by government, ie about US$ 20 million/year.

2.5.3 *Costs of Environmental Management*

The costs of environmental management include the policy formulation activities of the MoE, regulatory activities (possibly through the new regulatory agency discussed above) and costs for monitoring and testing etc. We have noted above that the regulatory agency may cost around US$ 5 million/year. In 1994, the annual budget for MoE was about US$ 3 million, implying a short fall. Following practice elsewhere, costs can be recovered at least in part through permitting charges; a suitable target might be to recover 20% of costs from permitting after 3 years, rising to 70% after 6 years.

Box 2.5a ***Estimated Cost of Waste Management for the Industrial Sector***

Solid Waste Management

1994, total industrial waste estimated by ERM at 326,000 t/year

Assume 80% non hazardous, average collection disposal costs US$ 40/t, cost is US$ 10 million/year; 20% hazardous costing US$ 100/t, total cost is US$ 6 million/year.

Liquid Industrial Effluent

Total consumption of water by industry is estimated at about 130 Mm^3/year, rising steadily with industria growth at about 8% per year.

Effluent may be about 80% of intake water, ie about 100 Mm^3/year or 250,000 m^3/day. Capital cost for a biological treatment plant with capacity of 20,000 m^3/day is about US$ 6 million, suggesting total investment cost of US$ 75 million.

The total annualized capital cost for simple effluent treatment is therefore US$ 8 million/year. To this cost estimate should be added operating costs, costs of particular treatments for hazardous wastes, and sludge disposal, which might double the cost to US$ 16 million/year.

Costs as % of Value Added

Industry value added (1994) estimated at about US$ 1,100 million [1].

Costs of waste management total US$ 24 - 32 million/year, equivalent to about 1% of industry value added, or US$ 50 - 60/employee, which should be affordable.

(Note that in OECD countries pollution control expenditure is typically 2-3% of industry turn over).

Source: ERM Estimates, 1995.

Laboratory services can be provided through other institutions, and the costs associated with ensuring industry compliance recovered through the permitting charges, or direct charges for effluent testing etc. Clearly a component of MoE funds should continue to derive from central

(1) ERM estimated that industrial output could be contributing about 20% of GDP, which, on the basis of per capita income of US$ 1,500 is around US$ 6 - 6,000 million. See *Part II, DSOER.*

government funds, which should cover the costs of policy formulation, if this becomes the core activity of the MoE as discussed above.

2.5.4 *Areas where Cost Recovery is Difficult*

While pollution control costs can in principle (and probably in practice) be met through direct charging on productive activities, there other elements of environmental policy and management where direct cost recovery is less feasible. These include:

- establishment and management of protected zone;
- establishment and management of conservation areas; and
- afforestation and terrace rehabilitation.

The government budgets are inadequate to meet these costs. Involvement of NGOs which raise their own resources may offset some of the costs of conservation programmes, and community participation in afforestation or terrace rehabilitation could make a contribution, but here is likely to be a shortfall of funds for the large scale programmes which are necessary.

Resources for these sectors where direct cost recovery is infeasible or unaffordable could be met through an *Environmental Fund* set up to access resources from outside the government budget.

2.6 *ENVIRONMENT FUNDS*

Environmental Funds have been set up in at least 20 countries with the aim of mobilising resources for projects to protect and enhance the environment. There are a wide variety of forms and objectives amongst the existing funds, at one extreme the Fund may be closely associated with a particular Government Agency or, at the other extreme, have governing bodies composed entirely of NGOs. Perhaps the most common format is that of a mixed Government/NGO Governing Board.

Typically such Funds attract resources not only from Government budgets, but from a variety of other sources such as:

- earmarked taxes, fines and permit fees;
- voluntary donations (individual, corporate and foundations); and
- bilateral or multilateral donor organisations.

Environment Funds are able to make highly effective use of these resources by financing small scale, often NGO operated projects, building capacity and responding to local needs. Experience tends to show that funds are more effective in such small scale applications than with large scale, capital intensive projects such as waste water treatment schemes or solid waste management disposal which are best dealt with at Government level.

Three themes have run through a number of the discussions of sectoral issues:

- limitations on the funding available through the Government budget for environmental protection and enhancement;
- lack of institutional capability at both central and local level within Government to implement projects; and
- lack of linkage and communication between Government and the voluntary sector of NGOs in Lebanon.

A number of other countries have faced these issues and a solution which is becoming increasingly popular for addressing all three simultaneously is the environmental fund. Although this term covers a wide variety of institutions, its essential elements are:

- some level of independence from Government;
- access to revenues other than those voted annually in the Government budget; and
- some involvement of NGOs in the selection and implementation of projects.

At least 20 such funds have been established over the past few years and the experience of many of them is too short to provide many lessons, but in general one may describe the spectrum of types and experience by summarising the characteristics of two extremes (see *Box 2.6a*).

Environment Fund for the Lebanon

Of these two extreme models, it would seem that the latter is probably more suited to Lebanon's needs at the current time for the following reasons.

- Major pollution control projects are, in general, being tackled by the Government agencies responsible for them on the basis of specific financial arrangements with multi-lateral or bi-lateral funding agencies in sectors where there is scope for direct cost recovery. The greater need in Lebanon is to get funds down to small-scale projects in such fields as soil conservation where it is difficult to put together project packages large enough to attract international donors.
- Only relatively small revenues could be collected from earmarked taxes or specific environmental charges, given
  - the general difficulty of raising revenues in Lebanon; and
  - the relatively limited sources of such revenues in the context of the Lebanese economic structure.

- There is a vital need to involve the NGOs in implementation of environmental programmes and the equal need to develop their institutional capabilities.

Box 2.6a *Characteristics of Environment Funds*

A. Funds Associated with a Government Agency

- can provide a conduit for official development assistance when implementing a national environment strategy;
- can provide support for underfunded governmental responsibilities;
- can be a recipient for ear-marked taxes and other public revenue sources such as charges, fines and permit fees; and
- may be suited to the implementation of pollution control projects and others requiring large financial and other resources.

BUT

- are seen as subject to sudden political changes;
- may not be able to forge strong involvement of the NGO sector;
- can be unresponsive to local needs; and
- may be restricted by Government pay scales and procedures.

An example of this kind of fund is Brazil's National Environment Fund, which is supervised by the Ministry of the Environment and Amazonia Legal and is financed by a US$ 22 million loan from the Inter-American Development Bank, supplemented by contributions from Government sources to give a total budget of US$ 11.5 million/year, devoted largely to national park conservation, land recovery, ecological agriculture, reconstitution of riparian forests, etc.

B. Funds with Governing Boards drawn entirely from outside the Government sector.

- can serve as a vehicle for private donations, either individual or corporate. This may be especially important for overseas Lebanese;
- promotes local participation from outside the political circle;
- can participate in the institutional strengthening of NGOs;
- is more likely to be responsive to local needs; and
- may be best suited to natural resource conservation type projects, requiring more community involvement and less financial resources.

BUT

- may find it difficult to reach consensus. This may be particularly important given the diverse origins and objectives of Lebanese NGOs.

An example of this kind of fund is the Mexico Nature Conservation Fund which was established in 1994 with an initial commitment of US$ 20 million from USAID and US$ 10 million from the Government of Mexico. This is an endowment fund with the target of raising US$ 100 million in five years which will be invested in AAA-grade Government and corporate bonds and stocks to generate an income of up to US$ 6 million/year.

Source: ERM, 1995.

- The need to harness the concern which many people feel about the degradation of the environment in Lebanon and provide a channel through which these concerns can be turned into action. This applies particularly to the overseas Lebanese community.

We therefore recommend that the Government should consider the establishment of an Environmental Fund for Lebanon which might have the following characteristics:

- a Governing Board on which the Government has a limited role and in which the participation of NGOs should be at least 50%;
- an orientation towards projects in natural resource conservation, and those which involve community participation; and
- funding to be sought from international donor agency sources as well as from voluntary donations both individual and corporate.

If the Government were to initiate a study into the feasibility and structure of such a fund before the end of 1995, it should be possible to have its broad lines in place by mid 1996 such that fund raising could be initiated in the second half of 1996 with a view to the Fund starting operations in early 1997.

The scope of such a study is outlined in *Box 2.6b*.

Box 2.6b ***Scope of Study into an Environment Fund***

- Potential sources of funds such as:
  - Global Environment Fund;
  - voluntary donations from:
    - overseas Lebanese;
    - domestic individuals and corporations; and
    - foundation.
  - appropriate taxes such as:
    - a tourism tax; and
    - an "environment" component of a gasoline tax.
- Legal structure of the Fund.
- Procedures for selecting projects and disbursement of funds.
- Ways to involve the banking sector in the management of the Fund.

Source: ERM, 1995.

2.7 *CROSS CUTTING ISSUES - CONCLUSIONS*

This discussion has led to a number of policy options which should be considered:

- establishment of a regulatory agency, partly self financing; and restriction of the role of the MoE to the crucial one of policy formulation,

coordination with line ministries, and developing linkages with other institutions and organisations;

- removal of subsidies on water and energy;
- increase of the tax level on gasoline;
- establish principles and mechanisms for cost recovery for most pollution control activities (some may need to be phased in over time); and
- establish an environment fund to deal with 'public good' concerns where direct cost recovery charging is not appropriate.

Chapter 5 brings these policy proposals together with more sector specific ones and suggest some principles for timing and implementation.

3.1 INTRODUCTION

This chapter presents a set of policy options which could be adopted in the Lebanon to address key environmental issues as identified in *Chapter 1* and in the *DSOER*, looking in turn at land use planning, water resource management, soil erosion, urban air quality and hazardous and toxic waste management. For each key issue a set of policy options is profiled in a series of tables, assessed against the criteria discussed in *Section 1.4*. Each policy option is summarised in *Annexes A* to *E*. The main policy issues are discussed in the accompanying text.

3.2 LAND USE PLANNING AND THE COASTAL ZONE

3.2.1 *The Issues*

The need to strengthen land use planning in Lebanon has been highlighted as a key issue. Haphazard development particularly in the coastal zone, coupled with a lack of effective controls on discharges, has led to a cluttered and polluted environment, an eroded landscape and stresses on agricultural land and the coastal land and waters. These general problems are reflected in local concerns, such as destruction of the traditional built environment and urban quality, poor buildings (many of which are not fully completed) impacts from quarrying and construction waste and damage to the archaeological heritage.

Two key factors underlie the difficulties to be addressed:

- an inability to enforce the planning controls (which do exist in theory); and
- lack of real plans or vision for development and conservation, area by area.

3.2.2 *Policy Approaches*

Policy approaches to address the complex issues of land use planning, particularly in the coastal zone, could include regulatory measures such as zoning and enforcement of land use and building permissions, although such measures require a strong and clear institutional context. Our discussion of policy options consequently focuses on institutional issues, and comprises several strands:

- strengthening and enhancing *existing planning control mechanisms;*

Table 3.2a *Potential Policy Options for Priority Areas: Land Use and Coastal Zone Management*

4 I's	Effectiveness	Ease of Implementation: Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Instruments					
• Introduce development completion bonds to provide incentive to developers to complete buildings in conformance with planning guidelines.	***	***	**	**	***
• Establish transferable development rights.	**	**	**	*	**
• Levy development charges.	**	**	*	**	***
• Provide subsidies or grants to encourage conservation of buildings and land.	**	***	**	**	*
Institutions					
• Create a Conservation Development Agency.	***	**	***	**	**

- establishing a national level *Conservation and Development Agency* with a strategic role in developing an overall strategic plan for Lebanon, with a focus on the coastal zone, and other areas outside Beirut;

- fostering *community involvement* in developing local plans reflecting local priorities and local environmental and development concerns;

- *revise the planning law*, to streamline and modernise the legal framework for zoning and planning controls;

- defining *action programmes* for conservation areas; and

- developing specific *policy instruments* to address particular problems, or to encourage better practice, such as completion of buildings and management of public open space. We have profiled some possible instruments in *Annexes A1* to *A4* but note that few are likely to be feasible until the management framework is clearer, and they should be seen as having a role only in the medium term.

A focus of policy should be to build a caucus of professional, responsible personnel who can build a strong nucleus for planning, developing a global vision for the coastal zone and working, with technical assistance, to develop a new level of cadres from, for example, universities and other centres of excellence, either within the existing planning framework, or focusing through a new agency.

3.2.3 *Enhancement of the Existing Planning Framework*

Current Planning Framework

In theory, the main tools for spatial planning and land use management in the Lebanon at present are the Comprehensive Master Plan (SDAU) [1] and the land use plans (Plan de Detail d'Occupations des Sols or PDOS). The SDAU is a general land use plan assigning a preferred distribution of activities, and a general plan of infrastructure services, while the PDOS provides, within the framework of the SDAU, a detailed set of rules and conditions for land use and land development. The theoretical master plans and local plans are supported by a number of specific instruments (see *Box 3.2a*).

However implementation is very weak, and in the DSOER we noted the following underlying reasons:

- absence of a comprehensive Master Plan;

- negative attitudes of municipalities to local master plans on the pretext that they inhibit development of their own private sector;

(1) Schema Directeur d'Amenagement et d'Urbanisme (SDAU).

- weak support by government and the general public for planning controls, with the Council of Ministers failing to support planning controls;

Box 3.2a *Instruments for Implementation of Plans*

Expropriation or Compulsory Purchase of Land (DL4; 1954) with fair compensation to owners

Land Subdivision/assembly and reparcelisation (DL70, 1983) with 25% of total area kept by the administration for development of infrastructure and public amenities

Establishment of Trust Companies (D549 1965) or joint real estate holding agents, initiated by the public sector

Expropriation by zones (Art 22, DL 69/83) for large scale intervention like redevelopment and urban renewal projects

Exchange of Property (Art 23, DL 69/83) in case of environmental conservation of forests and natural sites

Rental contracts (Art 24, DL 69/83) between municipalities and owners of outstanding natural sites or forested land for public accessibility

Source: ERM, 1995.

- deficiencies in building codes in non regulated areas, which represent 90% of the territory with a standard floor-area-ratio across urban, rural and agricultural sites;
- disregard of building laws, which is encouraged by periodic regularisation of illegally built developments; and
- low budget for urban planning and research.

Radical changes are needed and we have considered at some length below the type of institutional arrangement which could be envisaged for planning in the Lebanon.

Planning Conservation and Development Agency

The case for a new institution to take a lead in planning in the coastal zone lies in the present fragmented and corrupt nature of local and regional planning, the disintegration of effective planning controls and the inability of local or municipal authorities to enforce existing legislation. There is a case either for establishing a new planning agency or restructuring and revitalising the *Higher Council of Town and Country Planning*. In either case, the authority should be seen as having a positive role in encouraging development while *supporting conservation* and developing local plans.

Rather than being seen as a controlling body, it should be conceived with a positive remit, to encourage best practice and good planning, and to promote conservation within a coherent vision for the coastal zone. It should be conceived as *providing a service* to local authorities, and over time, should aim to build local capacity in planning and land use management. The new body should be seen as complementary to CDR and work closely with the MoE in developing environmental objectives. In developing a new authority the following points could be considered:

- the authority should have a national level headquarters or *anchor group* of technical specialists, with a number of *specialist/regional* groupings; thus it can ensure that pressures outside Beirut are fully considered, and that for example, areas under special stress such as the coastal zone can be addressed in a coherent manner not necessarily constrained by existing administrative boundaries.

- over a period of, say, 5 - 10 years, the authority should aim to localise most of its activities, maintaining a strategic planning role and specialist services at the centre;

- the structure of the authority should reflect a matrix of *geographical concerns, different skills and different issues;*

- the authority should work to modernise the planning concepts in use in the Lebanon, incorporating concepts of urban environmental quality, public and private partnership, and the dissemination of best practice. (following the lead of Habitat 2). The programmes need to be highly practical, and can build on existing provisions (eg the establishment of Trust Companies, and the preparation of SDAU and PDOS).

- a core task of the authority would be to review and appraise the current *processes* for planning applications and planning consents, building regulations etc and it should lead a study on the appropriate legislative framework for planning in the 21st century (this would parallel the MoE which is now established with policies and programmes while a legislative review is carried out; the lack of coherent or effective legislation should not be used as a reason for postponing the establishment of the new body).

- the authority could have responsibility for developing *Guidance Plans* for each area of the Lebanon, such as the coastal zone (split perhaps between north central and south, mountain areas of Mount Lebanon, the agricultural plain from Zahle to Lake Karaoun) based on strength-weakness-opportunity-constraint (SWOT) analysis to develop priority projects and programmes by area.

- such plans could aim to develop community participation and involvement in planning concerns, and work with local NGOs etc.

- While the legal framework is under review, considerable progress could be made with *non-statutory plans;* working with communities to develop

plans which can provide a binding and committing planning tool, involving the aspirations of local people and developing some form of consensus.

- the authority could also be tasked with developing *Action Programmes* for *conservation areas*; for both rural/natural resources, and the urban/built environment. These can be conceived of quite rigorously, involving effective *financial penalties* for significant non-conforming developments, for wrecking of natural or built heritage or for creation of 'bad' pollution incidents.

- *Staffing*: for a new authority, in the first instance a professional staff of 20 supported by technical assistance programmes could be envisaged, with linkages to organisations such as AUB, training programmes etc, but in time the organisation may be expected to grow to 150 or so professionals. The aim would be to develop within the organisation a *culture of responsibility* for the built environment, which by definition would respect conservation needs and the strengths of Lebanon's social and environmental needs.

- *Finance*: initially the authority would be financed through central government resources, but in the medium term, as the planning framework becomes clearer, fees associated with planning permission and building consents could form the basis for financing the administration. An *Environment Fund* could provide resources for specific projects initiated through the Authority, particularly if local communities or NGOs were involved in implementation.

3.2.4 *Information and Instruments*

The focus of the authority is seen, if only modestly, as a means of changing the ethos of land use planning in Lebanon. To do this, a wide programme of information and education to raise awareness at community level, not only of planning problems, but also of the benefits from coherent planning and conservation policies.

Specific policy instruments and controls should be developed to reinforce planning and conservation objectives. As well as including enforcement of regulations and standards, a number of other instruments could be brought into play, such as *development bonds*, whereby developers lodge a bond which is only recoverable when the building has been completed to the required standard etc; *transferable development rights*, to provide a market based means of compensation to those whose development rights are perceived as being curtailed by the effective introduction of conservation areas; *development charges* so that developers internalise the external costs of loss of landscape of other environmental resources in their plans. *Planning gain* can also be used to ensure that larger developers provide some public good element attached to their private development.

3.3 WATER RESOURCE MANAGEMENT

3.3.1 *The Issues*

The need for stronger water resource management has been highlighted as a priority environmental concern because:

- There are sharp regional and seasonal variations in water availability leading to potential mismatch between demand for irrigation and municipal water uses.

- Water used for irrigation accounts for about 80% of estimated supply; the quantities of water used for irrigation are double the quantities appropriate for the crops grown, partly because of system losses, partly because of high application rates; an effect of this is increasing salination of soils in the Bekaa due to the evaporation effects of flood irrigation systems.

- There has been uncontrolled exploitation of groundwater in the Bekaa and the coastal zone, leading to saline intrusion in the latter area; and there is little knowledge or understanding of the size, storage capacity and sustainable yields from Lebanon's aquifers.

These factors point to the need for much enhanced demand management, which is very limited at present with water supplied effectively free through illegal groundwells or at prices considerably below the marginal cost of supply, and in the case of irrigation water, substantially below the opportunity cost of water in other applications.

Water quality is severely affected in a number of ways; by over abstraction from surface and groundwater, by effluent discharge from communities and industry, and from diffuse intrusion of pollutants from leaking sewers, agriculture (fertilisers, herbicides and pesticides). Water quality programmes, such as waste water treatment, are already being implemented and while there are still policy issues (eg pollution control and cost recovery for waste water treatment) which should be considered, they are recognised by the government of Lebanon and are being addressed. We have therefore focused on the issue of water resource demand and supply management.

3.3.2 *Policy Approaches*

The underlying human factors in excessive water resource use lie in:

- poor infrastructure, resulting in high losses in the water delivery systems;
- lack of incentives for careful water use and conservation; and
- lack of mechanisms for transferring irrigation rights to municipal water needs.

The policy approaches we have identified represents a combination of demand and supply management. In addition, the level of knowledge about the extent and characteristics of groundwater resources is limited, and

research to determine the extent and role of this resource in overall water supply management is urgently required.

Supply Measures - Investment in Rehabilitation and Mitigation

Rehabilitation of supply networks for both municipal and irrigation water is already being undertaken and will considerably improve the efficiency of water usage. We suggest two further measures to enhance the supply and quality of the resources, based on the re-use of treated sewage.

- Re-use of *treated sewage for irrigation*, particularly in the coastal zone; the scope of the potential for water re-use needs further examination, but it appears that with preliminary screening and primary settlement, as is proposed in the major coastal cities, sewage could be diverted to provide irrigation water before any remainder is disposed of via long sea outfalls. The benefits of recycling sewage would be to reduce pressure on groundwater for irrigation in the coastal zone between Sour and Saida, in the stretch of cultivated land between Jounie and Jbail and to the north of Tripoli [1]. Indirectly this application of water would help to recharge the aquifers in the coastal zone which are currently suffering from saline intrusion. Sewage treated to this level would only be suitable for irrigation of citrus and of cereals and legumes (although further treatment might be required for horticultural crops which go direct to market, to avoid risk of transfer of pathogens).

- If further treated, sewage from the coastal cities could be used for *aquifer re-charge*. Secondary treatment of sewage would considerably increase the costs of treatment (see *Annex B3*) but would ameliorate and possibly reverse saline intrusion which is currently effectively reducing groundwater resources.

These options should be studied urgently so that if appropriate (benefits exceed costs) diversion of water for irrigation could be planned into the investment programmes for waste water treatment and disposal.

Demand Management Options

A combination of economic policy instruments, centred around *cost recovery pricing* for water could be introduced to encourage more efficient water consumption, and minimise further infrastructure investment.

Crucially, water should be priced at a level to reflect the capital costs of supply networks and the incremental cost of water supply, for all applications. The price of municipal water supply averages around 60% of the long run marginal cost (or average incremental cost). Thus, in Beirut for example, the charge is around US$ 0.16/m^3, whereas average incremental cost

(1) Primary treatment is proposed for the drainage zones of Kesrouan and Sour; in the latter, secondary treatment is proposed in the longer term. The resulting effluent in both drainage zones would be suitable for re-use as irrigation water.

Table 3.3a **Potential Policy Options for Priority Areas: Water Resource Management**

4 Is	Effectiveness	Ease of Implementation: Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Investments					
• Rehabilitation of distribution networks for municipal and irrigation water.	***	**	**	**	***
• Re-use of treated sewage for irrigation.	***	**	**	**	***
• Re-use of treated sewage for aquifer recharge.	***	*	**	**	*
Instruments					
Economic Instruments					
• Amend price structure for water.	***	***	*	**	***
• Incentives for upgrading farm level irrigation equipment.	***	**	***	***	*
Regulations					
• Rigorous licensing of wells for groundwater.	**	***	*	*	***
Information					
• Educational programmes on water conservation.	n/a	**	**	**	***
• Research into ground water resources and use.	n/a	**	***	**	**
• Measuring and monitoring of water supply and quality.	n/a	***	***	**	***
Institutions					
• Least cost planning approach to water supply buy MHER.	**	***	**	*	**
• Development of water markets to stimulate intersectoral transfers and improve allocation for irrigation.	**	**	**	**	***

is currently estimated at about US$ 0.18/m^3. In Beirut alone, where total daily supply of potable water is about 306,000 m^3, the value of the subsidy is equivalent to about US$ 2 million/year; if subsidies are similar elsewhere in the country, then the total revenue foregone is close to US$ 6 million/year. However, the reality is considerably worse than this, since there have been very high system losses as a result of war damage to the distribution network, and through illegal connections to the system, so that system losses may be as high as 60%. If half the water supplied is lost from the system, then the value of revenue foregone is closer to US$ 12 million, in Beirut alone.

An increase in price of about 40% for municipal water supplies (to take account of planned rehabilitation) would reduce residential demand by about 12% [1]. Price elasticity of demand for irrigation water (ie the extent to which an increase in price affects demand) tends to be higher than for municipal water, and restructuring of pricing for irrigation water could also be effective. Irrigation water is supplied at a price of about US$ 0.02/m^3; unfortunately we have no details of the cost of production of irrigation water, but believe there to be a subsidy component.

With rehabilitation of the water networks, and effective revenue collection, the proportion of the population paying for water will be substantially increased and this will effectively encourage more efficient use of water. As far as possible, charging should aim for full cost recovery, but as we have argued in *Section* 2.5.1, the level of charge required to cover the full cost of rehabilitation is likely to be unaffordable by the poorer sections of the community. Pricing policies for water demands urgent review in order to set out a programme for improving revenue yield and establishing a programme for cost recovery pricing for all applications.

Increasing the price of water to reflect the full costs of supply could be complemented with measures to encourage more efficient water application for agriculture, through discretionary subsidies for the initial installation of modern irrigation schemes, and training and information on water needs and application rates.

In addition to these basic measures, other policy options could be explored, notably *least cost planning* by the MHER for water supply; and *the development of markets in water* in particular; this could be effective in improving efficiency of allocation of water for irrigation, where owners of water rights can sell the right to other users, where the latter option is of more value than own use of the resource. This helps to ensure that water is applied to the highest value uses, thus ensuring greater efficiency in allocation.

As a secondary measure it is important to instigate a programme of research into quality and quantity of both surface and ground water resources. Both of these should be an ongoing programme of monitoring and a full programme of surface water testing would be in the order of US$ 0.5

(1) See *Annex B.*

million/year. The latter is needed in order to establish more clearly the nature of the groundwater resource, and thus enable effective management of its use. Assuming that drinking water is already monitored as it leaves the treatment plant there is also an urgent need to monitor water quality in the major aquifers from which drinking water is currently abstracted. The cost of one 20 m borehole for monitoring purposes is US$ 7,500, however, a survey is urgently needed to establish the number of boreholes that would be required.

3.4 *SOIL EROSION*

3.4.1 *The Issues*

Soil erosion in Lebanon is an irreversible long term concern, requiring urgent attention. The following key factors have led, over many years, to the intensification of soil erosion in Lebanon:

- deforestation;
- land abandonment; and
- agricultural mismanagement.

It is likely that the western flank of Mount Lebanon and the northern Bekaa are areas most prone to soil erosion. Soil erosion leads to:

- declining agricultural productivity (thus reinforcing a cycle of loss of output, land abandonment, loss of terraces);
- permanent landscape loss;
- a decrease in water storage capacity within the groundmass; and
- a reduction in surface water quality due to higher sediment loads.

Soil erosion in the Lebanon is linked to changing socio-economic structures and shifting patterns of rural-urban and urban-rural migration (see the case study of Deir Bada in the Chouf, *DSOER Chapter 13*), which has led to the loss of knowledge in communities of traditional agricultural techniques including the maintenance of terraced lands.

Rehabilitation of terraced lands and afforestation of degraded rangelands are costly and not affordable at an individual farm level; soil management and arrestment of erosion must be seen as a 'public good' with wider benefits to society, and therefore supported at a national level. In this context it is appropriate to harness wider resources from government, communities and NGOs in maintaining the landscape and soil quality of the Lebanon.

So far, the Lebanese government has taken no strategic action to address this problem. The institutional structure for management of the problem does exist within the Ministry of Agriculture (Green Plan) and the agricultural extension service, however, both institutions are heavily under resourced (technically and financially) and tend to focus more on reclamation of new land for agriculture than on conservation of traditional management lands.

Table 3.4a *Potential Policy Options for Priority Areas: Soil Erosion*

4 Is	Effectiveness	Ease of Implementation: Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Investment					
• Invest in developing network of tree nurseries and afforestation programmes.	**	***	**	***	**
• Invest in rehabilitating and maintaining terraces.	***	***	**	**	*
• Invest in a rangeland management programme.	***	***	*	**	**
Information					
• Establish national database or GIS.	n/a	***	***	***	***
• Conduct social assessment (using eg PRA techniques) to develop livelihood strategy.	n/a	***	***	***	***
Institutions					
• Establish a General Directorate of Soil Research within the MoAg.	**	***	***	**	**
• Strengthen existing agricultural extension service.	**	***	***	**	**

3.4.2 *Policy Approaches*

Combatting soil erosion requires a long term strategic view which involves a combination of physical investments to arrest degradation in the worst affected areas; community participation in order to build a culture which will maintain soil quality and limit erosion; and an institutional structure which can link government level interventions (eg establishing nurseries for forest development) with communities and other organisations. These elements should be developed to provide a *Framework for Action for Soil Conservation*, and involves the following steps:

- research and analysis;
- institutional strengthening; and
- physical investment.

Research and Analysis into the scale of the problem

A coordinated research programme should be established to provide scientifically reliable and up-to-date information, which can be accessed through a central computerised data management system. This system would contain information on all aspects of Lebanon's land resources including:

- land use practices employed by rural agricultural communities;
- an assessment of the areas in which soils suffer most from poor quality and are most prone to erosion;
- current livestock production; and
- areas under most stress from livestock grazing.

The research programme will enable prioritisation of areas in most need of action, evaluating the mitigation measures necessary to prevent further deterioration, and determining which investment option is likely to be the most effective. The research programme will always need to address *the needs of the local communities* focusing on:

- the attitudes and perceptions of rural agricultural communities to soil erosion, and their commitment to the preservation of land resources (the majority of these communities are both poor and lack equipment);
- the economics of agriculture in affected areas;
- land use patterns of local communities; and
- areas under most stress, and the main causes (degradation of terraces, livestock etc);

This research may best be carried out through NGOs using social research techniques, for example, Participatory Rural Appraisal (PRA) techniques.

The outcome of the research phase should be a *National Soil Conservation Strategy*.

Institutional Needs

The first step in implementing a soils conservation strategy could be the establishment of a *General Directorate of Soils Research (GDSR)* within the MoAg, with collaboration from appropriate academic institutions. The GDSR should be responsible for the following activities:

- initiating and coordinating the research programme;
- housing the national database and/or GIS;
- coordinating social research, afforestation and rangeland management programmes; and
- providing a communication and information link between relevant line ministries, NGOs, academic and scientific institutions, as well as any other interested parties.

In order to implement the national conservation strategy effectively, other steps will be to:

- *strengthen the existing agricultural extension service* which would be responsible for advice and training of local communities on a wide range of relevant topics, including:
  - introduction of new crops, equipment, technologies and other agricultural inputs, which help to prevent further soil erosion;
  - advising local farmers on afforestation programmes, and running demonstration projects;
  - providing advise for local communities in rangeland management techniques; and
  - develop, through agricultural extension, *strong links* with community leaders and NGOs which can work effectively at a community level in the Lebanon.
- *provide training* in soil management techniques for agricultural extension workers to disseminate amongst the communities.

Investment

The soils conservation strategy will call for a programme of investment in:

- rehabilitation of Lebanon's degraded terraces;
- maintenance of existing terraces;
- afforestation programmes; and
- rangeland management programmes.

Box 5.4a shows the likely costs associated with a ten year soil conservation programme in the Lebanon. The annual costs for such a programme would be of the order to US$ 17 - 25 million/year. The Ministry of Agriculture's 1995 budget is US$ 25 million, and it is clear that additional resources will

need to be sought. Direct cost recovery is not appropriate for soil conservation programmes, but potential sources of finance include:

- community participation through provision of some labour etc;
- resources from the proposed *Environment Fund*; and
- international donor funding to help establish for example a nationwide network of nurseries for trees, and training communities and extension workers in soil conservation management.

Box 3.4a *Scenario for Ten Year Soil Conservation Programme*

Based on the following assumptions, it is possible to come up with some indication of the costs needed to fund a ten year soil conservation programme:

- of the 36,000 ha of degraded terraces in Lebanon, 50% will need complete rehabilitation and 50% simply maintenance; and
- approximately 100,000 ha of low to medium forest cover (crown closure of between 10 - 30%) are in need of afforestation programmes to increase crown closure density.

Over a ten year period, assume that 3,600 ha of terraces (split between complete rehabilitation and maintenance) and 10,000 ha of forest will be covered by the programme each year. Based on these assumptions the total cost for the programme/year will be broken down as follows:

Activity	*Area (ha)*	*Cost (US$/ha)*	*Total Cost (US$ million/year)*
Rehabilitation of Degraded Terraces	1,800	6,000 - 8,000 (1)	11 - 14.5
Afforestation Programmes	10,000	150 - 600 (2)	1.5 - 6
Rangeland Management Programme			4.3 (3)

The ten year programme would cost between US$ 17 - 25 million/year. In addition, the costs of maintenance of terrace lands has been estimated at about US$ 240/hectare (4).

Source: ERM estimates, 1995.

(1) ERM DSOER, 1995.

(2) These figures are based on an afforestation programme recently carried out in Chile, and differ greatly from the afforestation figures presented in *Table 13.5c* in the DSOER. As the data presented in *Table 13.5c* have been derived from UK costs, and are probably highly over-estimated. We feel that figures from a recent study, such as the programme in Chile, provide a much more realistic indication of costs that may occur in Lebanon. We shall amend *Table 13.5c* for the Final State of the Environment Report.

(3) This figure represents an estimated expenditure by the Jordanian government to achieve its National Programme for Range Rehabilitation and Development between 1994 and 2000 (7 years).

(4) ERM, DSOER, 1995.

3.5 HAZARDOUS WASTE MANAGEMENT

3.5.1 The Issues

Industrial waste is disposed of haphazardly throughout the Lebanon. Most industrial waste is non-hazardous, and can be disposed of either with municipal solid waste or as part of industrial waste water, but the hazardous component poses health and environmental risks. Hazardous waste is generated by many of the dominant industries in the Lebanon, namely tanneries, textile dying and metal finishing; either in liquid effluent or as solid waste. In addition, clinical waste (including sharps) is disposed of with no control with municipal solid waste posing a considerable health hazard to waste contractors and scavengers at waste dumps. Furthermore, the toxic waste imported during the war period remains an urgent issue which has not yet been dealt with.

However, management of hazardous waste poses difficulties for several reasons typical of developing countries:

- most industrial enterprises are small;
- low awareness among waste generators that their wastes are hazardous;
- low awareness among waste generators of the risks to health;
- lack of access to technical information as to how to manage wastes;
- zero enforcement of waste management at present; and
- inadequate resources for management and enforcement (institutional weakness).

With the exception of a few industries (tanneries, metal plating etc) most industries do not produce hazardous liquid waste and most can safely be disposed of direct to the sewer with the wastewater. However, it should be noted that *if* Lebanon were to follow a policy of secondary sewage treatment (see *Section* 3.3 above) it would become necessary to remove metals from the waste stream as they would otherwise damage the treatment plant. This would give rise to sludges with high concentrations of heavy metals which would then be classed as hazardous.

As a first step, Lebanon is undertaking a detailed industry inventory which will eventually provide the basis for assessing the characteristics and quantities of hazardous waste.

3.5.2 Policy Approaches for Hazardous Waste Management

Hierarchy of Management Options

The Lebanon is proposing to develop a master plan for hazardous waste management, which will define in greater detail the scale of the problem in Lebanon. Analysis of waste management in Lebanon has, to date, focused on waste disposal; *waste minimisation*, ie reducing the volume of waste actually generated for disposal, should be seen as a policy priority, followed by *waste recovery for reuse and recycling*. Final disposal should be seen as th

Table 3.5a **Potential Policy Options for Priority Areas: Industrial and Clinical Hazardous Waste**

4 Is	Effectiveness	Ease of Implementation			
		Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Investments					
• Invest in hazardous waste disposal facility.	***	***	*	*	*
• Invest in clinical waste incinerators.	***	***	**	**	**
• Establish shared treatment facilities for some potentially hazardous industries (eg tanneries).	***	**	**	**	**
Instruments					
Economic Instruments					
• Disposal charges for wastes.	*	**	*	*	***
• Deposit refund schemes for certain wastes eg batteries, pesticide containers.	**	**	**	*	**
• Product or raw material charges.	**	*	**	*	**
• Support for waste minimisation.	***	***	**	**	**
• Subsidies for treatment or establishing facilities.	**	**	**	*	**
Regulations					
• Registration of waste generators.	**	**	*	**	**
• Registration/licensing of those involved in hazardous waste management.	***	**	*	**	**
• Specification of vehicles and containers for holding wastes.	**	**	*	*	**
Information					
• Hazardous waste management plan.	n/a	***	***	***	***
• Technical support to industry on waste minimisation and management	n/a	***	**	**	***

4 Is	Effectiveness	Ease of Implementation			
		Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Institutions					
• Seek private sector investment for hazardous and clinical waste facilities.	n/a	***	***	**	***
• Strengthen role of associations (eg Industry Association) develop voluntary agreements with government.	**	***	**	*	**

last option once every effort has been made to ensure waste minimisation. This approach improves waste management practices and typically leads to cost savings in industry. We would argue that an approach to waste management in Lebanon should take the following steps:

- education of industry in the nature of hazardous waste and the potential for its reduction; identification of the potential for recovery, re-use and recycling;
- establishment of clear guidelines for the management of hazardous waste; and
- development of safe disposal routes.

Waste Minimisation and increasing awareness of waste management options

A policy for hazardous waste management should focus on small enterprises, which are the backbone of Lebanon's industry, as well as the larger enterprises which are more readily identified. Strategies for improving the management of hazardous wastes from small enterprises include [1]:

- focusing on local management and actions for problem solving;
- introducing good housekeeping measures and more efficient processes with an emphasis on waste avoidance and minimisation;
- involving NGOs in technology transfer, and university departments (AUB is collaborating in an information network for industry in Lebanon);
- voluntary agreements and approaches involving local industry associations etc; and
- encouraging the strong involvement of industry associations, NGOs and various information/technology networks to provide widespread dissemination of information on the nature of hazardous waste and need for strict controls.

Establish Clear Guidelines for the Management of Hazardous Waste

There are two clear steps to be undertaken:

- conduct a survey of hazardous waste arisings and current disposal practices, possibly carried out through the MoIP industry survey, to clarify the scale of the problem; preparation of hazardous (and clinical) waste management plan; and

(1) See Benavides L, Hazardous Waste Management for Small Scale and Cottage Industries in Developing Countries, paper prepared for Expert Group Meeting on Local Management of Hazardous Wastes from small scale and cottage industries, October 1992, Urban Management Programme (UNDP/UNCHS/World Bank) and Wilson DC Hazardous Waste Management in Developing Countries, paper presented to ISWA Annual Conference 1993, and other DC Wilson papers.

- formulate a clear regulations and requirements for hazardous waste management, and effective enforcement (taking care that facilities are available to enable compliance).

Development of Hazardous Waste Disposal Strategy

Development of legislation and long term treatment and disposal facilities for hazardous waste takes at least 10 - 15 years; it is essential that in the short term *interim* or *transitional facilities* for hazardous waste management are introduced to allow current uncontrolled dumping of waste to be phased out quickly. Examples of possible interim approaches are *controlled* co-disposal of hazardous wastes in municipal landfills until waste treatment facilities are established; solidification of inorganic hazardous wastes prior to landfill disposal; or communal or shared treatment of certain types of wastes, eg those from tanneries or textile dyeing [1].

The timing of legislation and development of facilities (or short term disposal options) must be carefully implemented to avoid the *implementation conundrum*, ie how to implement and enforce legislation in the absence of facilities which allow the waste generators to comply.

Therefore a programme for control of hazardous wastes in Lebanon will require a feasibility study of alternative disposal options or waste treatment facilities and short term options such as controlled co-disposal with municipal wastes to landfill. Options such as shared facilities, concentrations of particular industries on industrial estates with shared facilities and linking of management plans with the industrial estates programme should be considered. Waste minimisation must become a key element of the strategy, and the costs of disposal of hazardous waste can be high (see *Annex D*).

Even though sanitary landfills are planned in the Lebanon, there is still likely to be a significant lead time before these are in place and there is an opportunity for managed co-disposal. For industrial hazardous wastes it is recommended that Codes of Practice for storage and handling of hazardous wastes on site are prepared, and best possible use of existing landfill sites is made to dispose of these wastes safely, pending sanitary landfills. For clinical wastes we recommend that immediate consideration is given to commissioning specialised incinerators for clinical wastes serving the major urban centres of Beirut and Tripoli. The time taken in commissioning these incinerators could be comparable to the planning timeframe of providing adequate landfill facilities, and therefore might represent the most efficient solution for disposal of clinical wastes.

Implementation of a Waste Management Strategy

Given institutional constraints in Lebanon, there is likely to be an ongoing need for technical assistance and technology transfer to industries.

(1) These approaches have been adopted in Hong Kong, Australia (Brisbane), Mexico and Thailand respectively, ERM, 1990 - 1995.

As in other policy areas, effective waste management depends on the waste generator receiving the correct signals encouraging desired behaviour; and on the institutional and financial sustainability of investments in disposal equipment.

In the medium term, direct cost recovery charging for collection/treatment, could include deposit refund systems for specific waste streams, (eg batteries or pesticide containers) which would facilitate collection and treatment. Waste disposal charges as a means of cost recovery are an alternative means of achieving cost recovery but would be difficult to enforce as they create a disincentive to comply. In any event, cost recovery mechanisms can only be implemented once treatment/disposal routes are established.

It may be appropriate also to assess the potential for attracting private sector capital for waste treatment plants. The cost varies widely, according to the type of facility, from US$ 1 million as in Thailand (see *Annex D1*) to US$ 10 million (as in Hong Kong) for a hazardous waste treatment plant, and around US$ 10 - 25 million for a clinical waste incinerator.

In addition to these approaches, there are a number of more sophisticated policy instruments which can be used to improve management of hazardous waste (product charges, raw material charges, producer responsibility for waste management); waste management is at present at such an early stage that sophisticated instruments, most of which carry heavy administrative requirements, are unlikely to be effective in Lebanon where the emphasis must be on establishing better practice and providing information to waste generators to enable them to improve their practice.

3.6 *URBAN AIR QUALITY AND VEHICLE RELATED POLLUTION*

3.6.1 *The Issues*

The key factors contributing to poor urban air quality in the Lebanon are:

- vehicular transport;
- emissions of pollutants, particularly particulates from small industrial enterprises and privately operated power generators; and
- dust associated with construction activity.

Although there are no actual air quality measurements, our observations and preliminary modelling work carried out for the DSOER indicate that transport is the main contributor to poor air quality in the urban areas. For this reason the primary focus of policies should be to address this sector.

3.6.2 *Policy Approaches for Pollution from Urban Transport*

The underlying causes of pollution from urban transport which must be addressed, if possible through environmental policies are:

- high level of vehicle ownership, comparable to much wealthier countries;

Table 3.6a *Potential Policy Options for Priority Areas: Urban Air Quality*

4 Is	Effectiveness	Ease of Implementation: Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economical Feasibility
Investment					
Economic Instruments					
• Increase tax on gasoline.	***	***	*	***	***
• Remove/reduce excise duty on new vehicles with TWC.	**	**	**	**	***
• Price incentive for unleaded gasoline.	***	***	**	***	**
• Tax on gas oil for private generators.	**	***	*	**	***
Regulatory Instruments					
• Enforce requirements for vehicle maintenance through testing/inspection.	**	**	*	*	*
• Registration of privately operated public transport, enforce vehicle testing.	**	**	*	*	**
• Introduce mandatory requirement for new cars to meet emission standards.	**	**	*	*	***
• Zoning for industrial areas.	***	**	**	*	**
• Controls on dust (code of practice) from construction.	**	***	*	*	***
• Ban vehicles from city centre at times of poor air quality.	**	*	*	*	*
• Limit cars through rotating number plate ban.	**	*	*	*	***
Information					
• Monitoring of urban air quality.	n/a	**	***	**	**
• Registration of vehicles, deregistration of old vehicles.	n/a	**	**	**	***
• Education campaigns on air quality and health.	n/a	***	**	*	**
Institutions					
• Establish air quality monitoring body.	***	***	**	*	**
• Establish clear air quality standards and enforceable emission limits.	**	**	**	*	***

- the age structure and condition of the vehicle fleet [1]; and
- the dominance of private cars over public transport for journeys to work.

The following policy options could be used to address these issues.

- Increasing the tax on gasoline to bring its price closer to European countries (say to US$ 0.46/l from US$ 0.24/l); this has the advantage of raising government revenue (US$ 380 million/year), and could reduce demand for gasoline by 60% from what it would otherwise have been, through short term effects (less use of vehicles) and longer term effects (use of more fuel efficient vehicles).

- Reducing import tariffs on new vehicles with TWCs to accelerate upgrading of the vehicle fleet; the revenues foregone (say US$ 300 million/year on imports of 50,000 vehicles/year) can be offset by the increased tax revenues on gasoline.

- The introduction of TWC requires widespread availability of unleaded petrol, which would have the added benefit of reducing lead emissions. This could be encouraged through differential pricing accompanied by incentives to gas stations to switch to supply of unleaded fuel. The introduction of TWC could be accelerated by mandatory requirements that all new registrations would be TWC cars.

- Enforcing requirements on regular vehicle inspection to encourage better maintenance, perhaps by providing incentives for test/inspection centres to become licensed (such as grants for retooling) and harsh penalties for abuse of their license. This would need to be supported by a concerted public awareness campaign on the importance of vehicle testing and the potential health effects of poorly maintained vehicles.

- Regularising and encouraging the already strong private sector provision of public transport (through company buses, *taxi-services* and *bostas*); registration and licensing of such vehicles could permit them to take advantage of possible incentives, eg higher import duty reductions for new public service vehicles than for private own-use vehicles.

- Rigorous review of parking policies to discourage the use of cars for journeys to work and to require vehicle owners to face the full cost of urban parking.

- Although their efficacy remains unproven, Lebanon may wish to consider the potential for number plate systems in Beirut, along the lines of those operating in Athens, Mexico City or Santiago. Under these systems vehicles are prohibited from entering the urban areas on one day/week depending on the colour or configuration of their number plate. The

[1] The average life of vehicles appears to about 16 years; and vehicles are typically poorly maintained with low engine efficiency, high emissions and no emission controls (three way catalytic converters (TWC)).

tendency to purchase a second car to overcome these restrictions will be driven by market forces.

- As mentioned in *Section* 2.3.3 information from air pollution monitoring networks (when in place) can be used as part of a traffic management scheme. These systems rely on the monitoring network to alert the responsible authority when high background levels of pollution and unfavourable meteorological conditions are likely to give rise to serious health effects in asthma sufferers or other vulnerable groups. When this occurs, parts of the urban area can be closed to cars until the emergency has passed.

- Proper registration of vehicles and de-registration of vehicles no longer in use, in order to provide information for planning and monitoring the effectiveness of other policy instruments.

Traffic management measures, such as improved public transport, parking restrictions in inner cities and other disincentives to use the private car, will also help to reduce traffic congestion which is itself a barrier to development. Control of urban traffic pollution therefore presents a clear set of *win-win* policy options.

These measures could be introduced with relative ease from a technical and institutional perspective. However, the cultural attachment to the private car, combined with the present absence of alternatives, means that restrictions on their use will not be welcomed, and measures will need to be accompanied with public awareness campaigns to increase understanding of the linkages between pollution from vehicles, individual responsibility for vehicle management and human health.

3.6.3 *Policy Approaches for Emissions from Industry and Private power generators*

The main emissions are those associated with combustion in private generators in urban areas. Emissions from private generators could be addressed through:

- tax on the use of fuel for private generators; supported by

- rehabilitation of EDL to enable users of privately generated power to switch to national supplies, at what should be a lower cost (even if the subsidy on electricity supply is removed).

Removal of Energy Subsidies

Energy is sold by EDL at about 80% of the production costs. The value of the subsidy is about US$ 0.02/KWh (based on current production costs and price). On annual consumption of 5000 GWh, the total value of subsidy is US$ 100 million/year. Furthermore, the price of fuel oil to EDL is subsidised to the value of about US$ 18 million/year. Removal of the subsidy to consumers on electricity would have the effect of stimulating energy efficiency and accelerating technology/efficiency gains, with the result that in

the medium term energy demand would be reduced by about 6.25%, and the increased revenues to EDL would enable them to pay direct for fuel oil, thereby stimulating greater production efficiencies.

Compounding the problem, recovery rates for electricity charges have been put as low as 50%, and in the impoverished areas of Lebanon (the south and north of the country), charges are effectively not collected at all. There has also been a problem of illegal tapping of the distribution network. Recovery rates in the main urban centres have now improved and there are proposals to raise the price of electricity to reflect generating costs, once the rehabilitation of power infrastructure is completed. Rehabilitation and renewal of transmission lines will provide a means of controlling illegal connections.

Industrial pollution from small enterprises in the residential areas of the cities (eg the southern suburbs of Beirut) is also largely the result of combustion processes, and a review energy pricing should also help to persuade industry to buy electricity from EDL rather than from private generators. Relocation of industries to industrial estates and zones as proposed by the MoIP will also significantly reduce the impact of industrial emissions on human health.

3.6.4 *Policy Approaches for Construction Dust*

During the reconstruction period construction dust from buildings and demolitions will continue to be a problem. It can be addressed to some extent by:

- introduction of Codes of Practice for contractors for containment and control of dust; there are a number of low cost and accessible techniques which can be used (see *Box 3.6a*); and

- linking plans for dust control during construction of major projects with the issuing of building permits or planning permission; imposition of fines for non-conformance.

3.6.5 *Monitoring and Measurement*

In order to identify the magnitude of the problem of poor air quality, and evaluate the effectiveness of policy measures, a network of air quality monitoring stations should be established. We suggest that a minimum initial monitoring network for Beirut should comprise:

- one to two monitoring stations for urban background measurement, located over 30 m from the nearest significant road, to provide continuous, on-line automatic analysis for NO, NO_2, CO, SO_2, PM_{10} and O_3;

- two or three monitoring stations to measure roadside concentrations, possibly limited to NO_x, CO and particulate matter (ie those pollutants particularly associated with vehicular pollution); and

Box 3.6a *Techniques for Dust Control for Contractors*

Materials Storage

- All materials stockpiles should be enclosed at all times and dusty materials damped down using suitable and sufficient water sprays during dry weather.
- The surfaces of long term stockpiles should be sprayed with chemical bonding agents.
- The mixing of large quantities of concrete should be carried out only in enclosed or shielded areas.
- All handling areas should be maintained in a dust free state as far as is practicable. Static sprinklers, bowsers and hand held hoses should be employed to prevent dust escape from the site boundaries.
- Procedures should be established so that the site is regularly inspected for spillage of dusty or potentially dusty materials and any such spillage dealt with promptly.
- Completed earthworks should be sealed and/or re-vegetated as soon as reasonably possible.

On Site Haul Routes

- All medium and heavily used haul routes should be permanently surfaced.
- Such routes should as far as practicable, be kept free of dust and regularly cleaned. Static sprinklers should be employed to maintain the surface of the road in a moist condition.
- Unsurfaced haul routes and verges should be regularly damped down.
- Appropriate speed limits should be established and enforced over all unmade surfaces.

Public Highway Cleansing

- Subject to approval from the Highway Authority, the public highway should be cleaned using vacuum sweeper brushes and other specialised road cleansing equipment, as required, and as appropriate.
- The edges of roads and footpaths should be cleaned by hand broom with damping, as necessary.

- passive monitoring for VOCs (particularly benzene) and NO_2.

The capital costs are of the order of US$ 150,000/monitoring station. Passive monitoring would cost about US$ 15,000/year for VOCs and about US$ 7,500/year for NO_2 diffusion tubes (including analysis costs). Establishment of a measuring and monitoring programme should include training and technical assistance.

As discussed in *Section* 2.3 monitoring data provides a useful tool for raising public awareness and can even be used as the basis for a public alert system. Public education in itself creates a valuable positive feedback in environmental management. For example, if people are aware of the

connections between asthma and lung disease and PM_{10} emitted from badly maintained vehicles, they may be more receptive to regulations requiring regular vehicle maintenance.

4 POLICY OPTIONS FOR SECONDARY ISSUES

4.1 INTRODUCTION

There is a wide range of policy options addressing the full scale of environmental issues of importance in the Lebanon. The priority issues and appropriate policy options for addressing these issues were discussed in detail in *Chapter* 3 and in *Annexes A* to *E*. This chapter presents an overview of 'secondary issues' by evaluating, in tabular format, (see *Table 4.1a* at the end of the chapter) a wide range of possible policy options against the criteria described in *Chapter 1*. We then go on to pick up a number of key policy themes, based around the 4 Is, which are of general applicability in the Lebanon across the wide range of secondary issues.

4.2 INVESTMENT

The main thing to notice from *Table 4.1a* is that all investment policies score low against the criteria of economic feasibility, with the notable exception of those which are already committed namely:

- solid waste management for which World Bank financing has been committed for identification and development of sanitary landfill sites;
- industrial estates with shared waste water treatment facilities for which private sector funding would be appropriate; and
- measures to reduce atmospheric emissions from industry and power stations which could have overall economic benefits in terms of reducing process costs or improving product quality, for example improvements in operating efficiency in power stations and in electricity distribution infrastructure.

The low economic feasibility assigned to other policy options in *Table 4.1a* could be improved if international funding could be secured for investment projects which are feasible against most other criteria, and for which no other source of funding is immediately obvious. Examples include:

- clean up of contaminated land;
- environmental education and awareness campaigns;
- regional museum development programme to protect antiquities;
- improved sewage disposal in rural areas;
- collection points, and recycling disposal services for used oils; and
- strategy and facilities for collection and disposal of CFCs.

In some cases, policy options score low against the criteria of economic feasibility, not because of high investment costs, but because the burden of operational costs is unlikely to be sustainable. These and other policy options mentioned on *Table 4.1a* score low against several of the criteria and

are therefore probably unlikely to be feasible in Lebanon, at least in the medium term.

4.3 INSTRUMENTS

There are a number of themes that recur throughout *Table 4.1a* in relation to *instruments* for environmental management across a wide range of issues, these are discussed in turn below.

4.3.1 *Regulation, Codes of Practice and Penalties*

The establishment or reform of the regulatory system, combined with systems for enforcement, is a theme which runs through almost all of the issues in *Table 4.1a*. Institutional issues relating to enforcement of environmental quality standards were discussed in *Section* 2.2, and possible approaches to the setting of environmental quality standards are discussed in *Section* 2.3. Assuming the general constraints to regulation and enforcement at a national level can be overcome, there is a need to establish specific codes of practice for certain activities within the agricultural and industrial sectors. Codes of practice relating to priority action areas were mentioned in *Chapter* 3. Those noted in *Table 4.1a* in relation to secondary issues are:

- storage, handling and disposal of agrochemicals;
- storage, and handling of potentially contaminating materials (chemicals, oils, metals etc) on industrial sites;
- industry operating in or near ecologically important areas; and
- any intrusive activity that knowingly or unknowingly takes place in an area of archaeological importance.

Penalties for non-compliance with regulations or codes of practice is also a recurring theme, although the evaluation in *Table 4.1a* indicates that unless cultural and institutional barriers can be overcome, merely imposing penalties is unlikely to be effective.

4.3.2 *Pollution Charges*

In the longer term, pollution charges to industry for atmospheric emissions or liquid effluent could be very effective and feasible against all criteria. Costs could be recovered through charges to the consumer. The main constraint will be institutional as success will depend upon adequate human and technical resources to assess each industry and set the appropriate charge, instigate an adequate monitoring system (which could be managed by industry as long as the reporting is subject to periodic independent checks), and collection of charges.

4.3.3 *Incentives and Subsidies*

There is a range of policy options that involve either removing existing subsidies or price incentives that have a negative effect on the environment, or implementing new ones that could bring about environmental gain. In

relation to secondary issues, the former category includes those described in *Box 4.3a*.

According to the evaluation in *Table 4.1a*, the only subsidy that could be removed effectively without other major technical, cultural or institutional constraints is that on fuel oil so as to discourage private generators.

Box 4.3a *Subsidies and Price Incentives with a Negative Impact on the Environment*

Energy Prices

Energy subsidies were discussed in some detail in *Section 3.6.3* in respect of reducing urban air pollution. Although the large users probably make a smaller contribution to ground level concentrations of the major pollutants in urban areas, price reform should help to improve energy efficiency in these users also. EDL power stations are also included in this 'secondary issues' category and price reform is clearly an important mechanism to ensure that they internalise the environmental costs of electricity generation in the Lebanon in the long term.

Wheat and Sugar Beet Prices

Support prices are paid for wheat and sugar beet above the internationally traded price for both (although we do not have details on the precise level of support nor on the total value of support paid [1]); it is alleged that this encourages farmers to use very high levels of agrochemicals in order to boost yields, with implications for water quality. The price support is an incentive adopted by the Government to dissuade farmers from growing illegal crops, and if the subsidy is to be abolished other policies for preventing the growing of illegal crops will need to be implemented. The question arises as to whether Lebanon should grow wheat at all, for which it has no comparative advantage compared with other wheat growing countries.

Low charges to Historic Sites

Charges levied at historic sites are very low, yet the Department of Antiquities is heavily under resourced (annual budget in 1991 for Department of Antiquities was US$ 11,000). There is considerable scope for increasing entry charges substantially particularly for foreign visitors (a two tier charging system for locals versus foreigners could be used to ensure continued accessibility for the Lebanese people; such systems are widely practised internationally).

Of the 'new incentives and subsidies' category, there are several possible options that have potential. These include the following.

- Community incentives to enhance landscape, amenities and environmental protection.
- Incentive payments to landowners to protect habitats and restore degraded lands.
- Price incentives for use of unleaded fuel.
- Deposit refund system for used oils.

(1) This information was sought from both the Ministry of Agriculture and the Ministry for Economy and Trade.

- Price incentives for industry to switch to non ODS [1] coolants and aerosols.

However, of these the only options that are not significantly constrained by economic feasibility are those that involve price incentives. The others all require considerable government subsidy, at least in the short-term until self-financing mechanisms can be established.

4.3.4 *EIAs*

The need for EIAs was discussed in *Section* 2.3.2 and is applicable to most of the secondary issues in *Table 4.1a*.

4.3.5 *Planning*

For many issues, one of the most important policy measures is to ensure that environmental considerations are fully, and explicitly incorporated into national (and/or coastal zone) land use plans. This is particularly important in the cases of:

- habitat and wildlife conservation;
- cultural heritage preservation; and
- industrial zoning.

In the absence of an effective national (and/or coastal zone) plan, it is strongly recommended that sectoral plans are developed to address these key issues.

4.3.6 *Funds*

The setting up of 'funds' to support work on particular issues is a recurring theme. In particular it is suggested in relation to clean-up of contaminated land, protection of wildlife, biodiversity, and cultural heritage.

The scope for establishing an '*Environment Fund*' in the Lebanon has been discussed in *Section* 2.6. In the case of an 'antiquities fund' there is scope for setting up an independent fund drawing on revenues raised through entrance fees to cultural heritage sites.

4.4 *INFORMATION*

As discussed in *Section* 1.3 and *Section* 2.3 '*information*' can be usefully divided into 'collection' and 'dissemination'.

4.4.1 *Collection*

The collection of information is an important prerequisite for effective environmental management in the Lebanon. As indicated in *Table 4.1a*

[1] ODS refers to ozone depleting substances.

information needs to be collected for a variety of purposes, which can be summarised as follows.

- *Impact Studies*: (eg agrochemicals on soils, agriculture on key habitats, waste dumps on water resources). Impact studies are only likely to be carried out where international funding can be obtained, or where the costs of the study are low and do not call for major programmes of sampling and analysis.

- *Inventories*: (eg contaminated land, flora and fauna, archaeological sites). Inventories of contaminated land are constrained by the costs of sampling and analysis, similarly a full inventory of archaeological sites would require extensive excavation. However, initial inventories can be compiled based on existing information and centralised data management systems can be established. The inventory can then be developed in a piecemeal fashion as resources allow.

- *Routine Monitoring*: (eg flue gases, industrial liquid effluents, air and water quality). Emissions monitoring (to air or water) can either be undertaken by the industry itself as part of routine operations, or spot checks can be carried out by a government agency or by a private contractor. The most appropriate system will depend on the regulatory framework and the degree of enforcement capability. Routine monitoring of drinking water quality as well as water quality of rivers, aquifers and at bathing beaches should be undertaken in the interests of human health as well as to provide a tool for prioritising action, assessing the impacts of proposed projects or policies, and monitoring success of mitigation measures. The same applies to the routine monitoring of urban air quality which has been discussed in *Section 3.6* in the context of traffic pollution. The main constraint to any kind of routine monitoring is institutional and economic. Technical assistance from the international community in the form of training and equipment would be of significant benefit in this area.

4.4.2 *Dissemination*

The dissemination of information is vital if public perceptions about the importance of the environment, and each individuals role in its protection, are to be changed in the Lebanon. Further, dissemination of targeted information is required in the form of training for specific sectors of the population (agriculture, industry etc). The types of information dissemination identified in *Table 4.1a* can be summarised as follows.

- *Agricultural extension services:* it is understood that prior to the war effective agricultural extension services existed in Lebanon. There is now an urgent need to re-establish this vital service. Extension services are particularly important in relation to the use of agrochemicals, soil erosion, and irrigation and cropping practices. The only real constraint is economic and institutional sustainability.

- *Public education and awareness*: the need for public education and awareness across all aspects of environmental protection was discussed in

Section 2.3.4, and it was noted that public information was a vital component in achieving compliance with standards and Codes of Practice. As can be seen from *Table 4.1a* there is also a particular need to raise public awareness in relation to wildlife and habitat conservation, preservation of cultural heritage sites, and waste disposal. Apart from the economic and institutional constraints of mounting such campaigns, there are also potential cultural barriers to overcome such as a reluctance to alter traditional hunting practices.

- *Networking:* there are no constraints to continuing to encourage cooperation between Lebanese academic institutions, developing links with academic institutions around the world, raising the profile of Lebanese environmental issues by publishing widely and encouraging media coverage.

- *Training:* In addition to the agricultural extension services mentioned above, targeted training is required for both government and industry personnel. In particular training is needed in the following important areas: EIA; auditing; pollution control; waste minimisation; monitoring techniques; and alternative technologies. Again the only real constraints are economic and assistance could be sought from the international community.

4.5 INSTITUTIONS

Institutional weakness is a constraint to many of the policy options discussed in this report, and is a cross-cutting issue that has been discussed in *Section* 2.2. We have suggested that the MoE become a *policy making* body with executive power delegated to the line ministries, and *enforcement* carried out by a separate independent agency. An important role for the non-government and private sector has also been identified in *Section* 2.2.4.

Specific institutional measures that would assist in the implementation of many of the secondary issues evaluated in *Table 4.1a* include the following:

- encourage inter-governmental cooperation;
- improve training (see information above);
- support and encourage NGOs working in the environmental field; and
- establishment of new governmental agencies with responsibility for a) environmental auditing and b) wildlife and protected areas.

Issue	4 Is	Effectiveness	Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Overuse of Agrochemicals	**Instruments**					
	• Establish pesticide control regulations.	***	***	**	***	***
	• Enforcement of penalties for mis-use of regulated agrochemicals.	***	***	**	*	**
	• Differential pesticide charges .	*	***	***	*	**
	• Reconsider price incentives for overproduction of wheat, sugar beet, with heavy fertiliser use.	**	***	*	*	***
	• Registers (imports, distribution, use).	**	***	**	**	**
	• Codes of pratice for storage, handling and disposal of agrochemicals.	**	***	***	***	***
	Information					
	• Extension services to provide information and training.	n/a	***	***	**	**
	• Study impacts of agrochemicals on soils.	n/a	**	***	**	*
	Institutions					
	• Recruit extension workers.	***	***	***	**	**
Soil Contamination	**Investment**					
	• Clean-up fund for most contaminated sites.	***	**	***	*	*
	• Sanitary landfills/incinerators etc.	*** (underway)	**	***	**	*
	Instruments					
	• System of spot audits for industry and penalties for violation of codes of practice.	**	**	**	*	**
	• Codes of practice for storage and handling of potentially contaminating materials (chemicals, oils, metals etc) on site.	***	***	***	***	***
	• EIA for all major new industrial developments.	***	***	***	**	**
	Information					
	• Public awareness campaigns for safe disposal of all types of waste.	n/a	***	**	***	***
	• Training in environmental auditing and site investigation for government, industry and consultants	n/a	***	***	***	**
	Institutions					
	• Establishment of an auditing (inspection) unit within government (eg a new regulatory agency)	***	**	***	*	*

Issue	4 Is	Effectiveness	Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Loss of Special Habitats and Wildlife	**Investment**					
	• Fund for community based environmental protection projects, education and awareness programmes	***	***	***	***	**
	Instruments					
	• Community based incentives to enhance landscape, amenities and environmental protection.	***	***	**	**	**
	• Incentive payments to landowners to protect important habitats and restore degraded lands.	***	***	**	*	*
	• EIA's for development projects to include assessment of ecological impacts.	**	***	***	**	**
	• Integrate protected area plan into Comprehensive Master Plan (SDAU).	**	***	***	**	**
	• Develop conservation plans for protected species.	**	***	***	**	**
	• Codes of practice for industry operating in or near ecological sites.	**	***	**	**	**
	• Review of hunting licensing procedures and enforcement mechanisms	***	***	**	**	**
	• Regulate gun ownership for hunting	*	**	*	**	**
	Information					
	• National inventory and database of flora, fauna and habitats.	n/a	***	***	**	**
	• Study on the impact of agriculture/industry on key habitats.	n/a	***	***	**	**
	• Education and public awareness campaigns about protection of wildlife with the aim of altering traditional practices particularly hunting.	n/a	***	**	**	**
	Institutions					
	• Support and encourage development of NGOs with ecological interests	***	***	***	**	*
Damage to Cultural Heritage Sites	**Investment**					
	• Creation of regional museums	***	**	***	**	**

Issue / Is	Effectiveness	Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Instruments					
• Levy taxes to help finance the Beirut National Museum.	**	***	*	*	**
• Prohibit issue of further export licences to dealers, until sufficient institutional strengthening has taken place.	**	***	**	**	***
• Two-tier entry charging mechanism for national and foreign tourists.	***	***	***	**	***
• Incorporate cultural heritage preservation and conservation into Comprehensive Master Plan (SDAU).	**	***	***	**	**
• Request US Information Agency impose an import ban on Lebanese artifacts.	**	***	**	***	***
• Review and amend legislation with regard to protection, expropriation, and management of cultural hertiage sites and artifacts.	***	***	***	**	**
• Set up protection fund.	***	***	***	**	*
• Code of Practice for activities taking place in or near cultural heritage sites.	***	***	***	***	***
• EIAs for development projects to include assessment of impacts on cultural heritage.	***	***	***	**	**
Information					
• Cooperate with regional and international organisations on the exchange of antiquities and archaeological information.	n/a	***	***	***	***
• Prepare detailed survey and index of archaeological and historical sites.	n/a	***	***	**	**
• Provide information on sites *in situ*.	n/a	***	***	**	**
• Provide training for tour-guides and information officers.	n/a	***	***	*	*
• Education in schools.	n/a	**	***	**	**
• Encourage academic study and research, and publish results.	n/a	***	***	***	**
• Create regional museums.	n/a	***	***	*	*
Institutions					
• Establish cooperation between Directorate Generals of Urban Planning and Antiquities.	**	***	**	**	***
• Make protection of cultural heritage (particularly vernacular architecture) explicit in CDR's remit.	***	***	***	**	***
• Strengthen the Department of Antiquities.	***	***	***	**	**

Issue	4 Is	Effectiveness	Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Contamination of Water Resources	**Investment**					
	• Controlled landfill sites to eliminate leachate problems (WB project already identified).	*** (underway)	**	**	**	*** (WB)
	• Improve sewage disposal facilities in rural areas (urban areas covered by CDR).	**	**	**	*	*
	• Industrial estates with shared waste water treatment facilities.	***	**	**	**	**
	• Secondary treatment of municpal waste water and sewage (requiring removal of metals from waste stream at source).	**	**	***	*	*
	• Collection points, and recycling/disposal service, for used oils.	**	***	**	*	*
	• Provision of reception facilities for ship's waste (oil and garbage) at Lebanese ports.	*	*	***	*	*
	Instruments					
	• Zoning of industry as part of Comprehensive Master Plan (SDAU), and regional Structure Plans.	***	***	***	**	**
	• Pollution charges to encourage investment in waste minimisation and treatment plant.	***	***	**	**	***
	• Cost recovery through service charges to consumers.	**	***	*	**	***
	• Price incentives for use of unleaded fuel will help reduce Pb in coastal waters.	**	***	**	***	***
	• Deposit refund systems to encourage recycling/collection of used oils.	**	**	**	**	**
	• EIAs of development projects to include assessment of potential impacts on water resources.	**	***	***	**	**
	Information					
	• Raise awareness of potential of sewage sludge as fertiliser and liquid effluents in irrigation.	n/a	***	**	***	***
	• Training for industry in waste minimisation, recycling and recovery.	n/a	***	***	**	***
	• Site investigation of existing unmanaged waste dumps to assess damage to ground and surface water.	n/a	**	***	**	*
	• Locate and plan for disposal of toxic waste (see *Section* 3).	n/a	***	***	**	**
	• Assess potential for composting.	n/a	**	**	**	**
	• Raise awareness of the PPP (Polluter Pays Principle) and the Precautionary Principle.	n/a	***	**	**	***

Issue	4 Is	Effectiveness	Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
	Institutions					
	• Regional utility authorities.	**	***	**	*	*
	• Role of the private sector.	***	***	***	**	*
SO_x and NO_x from industry and power generation	**Investment**					
	• Improve operating efficiency (ie reduce emission factors).	**	**	***	**	**
	• Consider abatement equipment (particulates, SO_x, NO_x).	**	**	***	**	*
	• Lower sulphur fuel (say 1%).	*	***	***	**	*
	• Promote use of natural gas.	*	*	***	**	*
	• Improve electricity distribution infrastructure to encourage take-up of centrally supplied power.	***	**	***	***	**
	Instruments					
	• Pollution charges to encourage investment in emissions control.	***	***	**	**	**
	• Penalites for non-compliance.	***	***	**	*	**
	• Remove barriers to imports of clean technologies.	**	***	***	***	***
	• Remove fuel oil subsidies to discourage private generators.	***	***	**	***	***
	• Pricing *full cost recovery* of 'new' power from rehabilitated EDL to discourage private generators.	***	***	**	**	**
	• Set stricter industrial emission limits.	**	***	**	**	**
	• EIAs of development projects to include assessment of air quality impacts.	***	***	**	**	**
	Information					
	• Continuous monitoring of flue gases in key industries/power stations.	n/a	**	**	*	*
	• Routine monitoring of air quality in urban areas (see *Section 3*).	n/a	**	***	*	*
	• Training for industry and consultants in auditing and pollution control.	n/a	***	***	***	**
	• Provision of information on monitoring and pollution control techologies.	n/a	***	***	***	***
	• Raise awareness of the PPP (Polluter Pays Principle) and the Precautionary Principle.	n/a	***	***	**	***
	Institutions					
	• Strengthen enforcement capabilities and mechanisms.	**	***	**	*	**

Issue	4 Is	Effectiveness	Technical Feasibility	Cultural Feasibility	Institutional Feasibility	Economic Feasibility
Global Issues	**Investment**					
	• Development of an effective collection and disposal for old refigerators and air conditioning units (controlled incineration for CFCs).	***	***	***	***	*
	Instruments					
	• Incentives to industry to switch to non ODS coolants and aerosols.	***	***	***	***	***
	• Legislative controls on the import, use and disposal of ODSs.	***	***	***	**	***
	• Enforcement of MARPOL Annex I and II requirements to protect international waters.	**	*	***	*	*
	Information					
	• Public awareness campaign on global environmental issues, particularly the use of CFCs and other ODSs.	n/a	***	**	**	**
	• Training for industry in alternative technologies to help phase out of ODSs.	n/a	***	***	**	***
	Institutions					
	• Establish fund for institutional strengthening (especially with regard to biodiversity protection).	***	***	***	**	*
	• Establishment of government department for wildlife and protected areas.	**	**	**	*	*

particular on the coastal zone; and with a particular mission to strengthen planning and controls at a local level.

In addition, we have identified a number of key environmental areas for priority action; notably urban air quality, water resource management, soil erosion and hazardous industrial waste. The key policy options which address these priority areas are summarised in *Table 5.1a*, together with some broad estimate of the possible costs associated with them, and an indication of possible timing. Planning for the secondary issues becomes a component of the research programme to restructure the MoE and establish the regulatory agency.

The following series of priority studies should also be undertaken to develop detailed action plans:

- study into the structure and design of the proposed new MoE and Regulatory Agency (10 man months);
- study into structure of proposed *Conservation and Development Authority* (10 man months);
- research study to develop strategic plan for water resource management; covering both policy and institutional analysis and a physical assessment of the hydrological regime;
- study into management of hazardous waste from both industry and clinical waste; and
- study into the state of soil in the Lebanon, in cooperation with the Ministry of Agriculture to identify priority areas for mitigation of soild erosion programmes and to establish a "*National Soils Conservation Strategy*".

Most of these policy options, and studies, will require technical assistance, and all are suitable for attracting international donor funding.

Table 5.1a *Summary of Main Policy Options*

Policy Action	Cost	Timing	Comments
Institutional restructuring study		Urgent	
Establish Regulatory Agency	US$ 5 million/year Potential partial cost recovery from permitting fees	Within 2 years	
Water pricing study		Within 2 years	Falls within water resource strategy study
Increase gasoline tax, giving minor incentive for unleaded	Gain for government about US$ 380 million/year	Begin process within 12 months	May need to phase in increases say over 3 years
Cost recovery charging for environmental services - study on prices and affordability	Not applicable	Phasing with rehabilitation of environmental infrastructure	Need to establish affordability, set minimum charges for poorest, devise pricing structure so that larger users pay higher marginal rates.
Study into Environment Fund	US$ 75,000 (about 6 work months)	Within 18 months	In parallel with institutional strengthening and restructuring
Study into structure and role of proposed *Conservation and Development Agency*	10 work months		
Treatment of waste water for (a) irrigation or (b) aquifer re-charge	Capital cost about US$ 6million for biological treatment works serving 180,000 people	8 - 10 years (with completion of sewerage rehabilitation)	(a) primary treatment as planned acceptable; additional cost lies in water channels (b) requires secondary treatment at capital cost of about US$ 0.09/m^3 (1)
Research Programme into water resource management	Policy and institutional analysis - (15 - 20 months); physical assessment of hydrological regime, water quality (20 - 30) months; total cost about US$ 675,000	Within 2 years	
Hazardous waste study	15 - 20 man months US$ 225 - 300,000	Within 12 months	ToR already prepared

(1) Based on capital cost of about US$ 2.5 - 4 million for plants treating 2,500 or 5,000 m^3/day, annualised over 15 years at 8%. Capital cost for 20,000m@3@/day is US$ 6 million, annualised cost/m^3 is US$ 0.09.

Policy Action	Cost	Timing	Comments
Industrial waste incinerator	US$ 1 - 10 million. Use for hazardous waste water for eg tannery and textile wastes.	10 years	Very wide range of options depending on design, specification, wastes dealt with. Seek private capital or management.
Clinical waste incinerator	US$ 15 million capital cost (capacity of 6,000 t/year)	5 years	Treatment costs/tonne around US$ 370 including collection costs. Seek private capital contribution
Establish air quality monitoring network	US$ 150,000/ monitoring station. Annual costs of passive monitoring for VOCs and NO_2 about US$ 22,500/year	Over 5 years	Needs strengthening of laboratories for analysis. Scope for private sector involvement
Soil resource and erosion study	US$ 120 - 600/ha 20 man months	Over 2 years	Needs major research inputs prior to development of action plan
Afforestation	US$ 120 - 600/ha	Over 10 years	Lower cost relates to fertile areas, higher cost to arid, poor soils, probably more applicable in Lebanon. Involve communities and NGOs
Terrace rehabilitation	US$ 6 - 8,000/ha	Over 10 years	Need prioritisation and selective programme. Involve communities and NGOs
Industrial waste water treatment on industrial estates	US$ 75 million	Over 5 - 8 years	

Annex A

Policy Options for Land Use Planning

A1 Instruments: Development Completion Bonds

Description Development Completion Bonds could be introduced to provide an incentive to developers to complete their buildings in conformance with planning guidelines. At present, there are many unfinished real estate developments along the coastal zone; as noted in the DSOER, the majority of buildings are own financed family constructions, built without recourse to loan finance. Developers therefore have less of an incentive to complete buildings than if they were fully commercial enterprises with a requirement to repay loan finance. Development Completion Bonds could be levied and repaid on completion; if building remain uncompleted for more than an agreed period, then interest charges on the bond would be levied, and as a final resort, the value of the bond could be forfeited. Similarly bonds could be posted on for example quarries to ensure that land is properly reinstated when the quarry is no longer in use.

Effectiveness Bonds are widely used for major developments in Europe to ensure that plans are fully met or that land is fully reinstated after use.

Ease of Implementation

- *Technical Feasibility* - the posting of bonds could be linked to the issuance of building permission.
- *Cultural Feasibility* - there are no precedents for bonds in Lebanon, and while they are transparent, they are likely to be unacceptable to developers.
- *Institutional Feasibility* - the effectiveness of this instrument is linked to effective enforcement of building controls, and as in most other policy instruments aiming to change patterns of behaviour a political will is essential.
- *Economic Feasibility* - the use of bonds does not impose significant additional administrative costs. The level of the bond would need to be set at a sufficiently high level of provide an effective incentive.

A2 *Instruments: Transferable Development Rights (TDRs)*

Description

TDRs can provide an effective market mechanism which allows land owners in conservation areas to capture some of the economic rent associated with real estate development which is available to land owners outside the conservation area. The concept of a TDR is as follows: where is a land owner is not permitted to develop in a conservation zone, he can 'sell' the right to developers operating in unprotected zones, in return for which the latter gains the right or permission to develop to a density higher than would be permitted without the acquisition of the 'sold' development right. This provides an alternative mechanism to payment of straight compensation, as the market, rather than government, determines the value of the 'additional' development.

Effectiveness

TDRs have been successfully used in the USA where the planning control framework is weak, for conservation of natural resources, and in Nicosia (Cyprus) to support conservation of the old buildings in the old city, as a means for offsetting pressures for higher density real estate development in conservation areas.

Ease of Implementation

- *Technical Feasibility* - TDRs need clearly articulated land use objectives to be effective, which are not yet in place in Lebanon. They also need to be linked to effective enforcement of planning controls.

- *Cultural Feasibility* - the concept of market based compensation has been used in the Lebanon, eg by Solidère in the central district of Beirut where they have provided compensation for the loss of buildings in the city centre.

- *Institutional Feasibility* - the issuing of bonds in the central area depended on the existence of a strong enough body, in this case Solidère, to enforce plans. The legal framework in Lebanon permits payment of compensation for expropriation of property rights.

- *Economic Feasibility* - TDRs can provide a means for compensating land owners for potential losses of property value as a result of the creation of a public good (ie urban or rural conservation area). If TDRs are transacted through existing real estate agents, the transaction costs may be low, but it should be noted that the initial setting up costs for systems based on tradeable permits have typically been high. More research is required to establish the feasibility of this tool.

A3 *Instruments: Development Charges*

Description Development charges can be levied as a form of 'pollution charge' reflecting the external costs imposed on society by developers, for example, in damage to landscape quality, or in waste generation. The charges could be structured to reflect environmental quality, so that developments in the most environmentally sensitive areas would attract the highest charges, since the social costs associated with development would be highest. Charges could be levied as a one off payment on construction of a new building; or regularly over the life of the building, but in the latter case there is higher risk of noncompliance than with a one off payment which can be linked to building permission.

Effectiveness The incentive effect of development charges should depend on the level of the charge.

Ease of Implementation

- *Technical Feasibility* - estimating the appropriate level for a development charge would be difficult. Basing a charge on the value of land would be an imperfect measure of environmental 'cost'; other possibilities for assessing charges could be to base it on the cost of mitigation of environmental damage; or through willingness to pay for environmental quality. Once the appropriate level of charge is determined, it could be based on the area of building to be developed.

- *Cultural Feasibility* - non-compliance on tax payments has been very high in Lebanon, and unless payment of the charge is linked clearly to some action (such as issuing building permits) without which the developer cannot proceed, then high levels of avoidance (and evasion) are likely, and there would be scope for corruption.

- *Institutional Feasibility* - at the present time, planning controls are only weakly enforced; until planning and building permission are enforced more seriously, there is little chance of a charge being effective or even feasible.

- *Economic Feasibility* - in designing a charge, it should be simple and if possible avoid setting up systems requiring duplicate information collection. The revenues raised from the charge could serve to finance an environment fund, or to provide subsidies and support to conservation programmes directly.

A4 *Instruments: Subsidies or Grants*

Description Financial supports to encourage conservation could be used to encourage new initiatives for conservation and preservation of natural resources or buildings of particular quality.

Effectiveness Subsidies or grants could be effective in stimulating an interest in conservation of buildings and land, and are justified in that the costs of conservation of building in styles compatible with environmental objectives and are widely used in OECD countries for both.

Ease of Implementation

- *Technical Feasibility* - eligibility for grants or other subsidies (eg tax relief) could be determined on the basis of planning permission applications for new buildings (or alterations to existing buildings).

- *Cultural Feasibility* - subsidies are likely to be acceptable, but it is important that their purpose is clearly transparent and monitorable, so that they do not become a vehicle of abuse.

- *Institutional Feasibility* - at present there are no clear guideline on conservation of buildings, or definition of conservation areas etc, and it is important that clear guidelines for good practice are established to provide a basis for eligibility of projects for subsidy.

- *Economic Feasibility* - subsidies could in principle be funded from revenues raised from development charges.

Annex B

Policy Options for Water Resource Management

B1 Investments: Investment in Rehabilitation of Distribution Infrastructure for Irrigation and Municipal Water

Description Following the war years, supply networks for both municipal and irrigation water are in a very poor state, as a result of which it is estimated that system losses account for 60% of deliveries for municipal water (130 Mm^3/year) and 20 - 40% of irrigation water. Programmes for both have been prepared under the reconstruction programme.

Effectiveness Rehabilitation of water supply networks will be effective in achieving more effective water resource use, so long as the programmes are financially and institutionally sustainable.

Ease of Implementation

- *Technical Feasibility* - plans are already prepared and rehabilitation of networks poses no major technical problems;

- *Cultural Feasibility* - need for improved drinking water supplies and the present risks to health from contaminated supplies is well recognised by the Lebanese people, who seek to return to the pre-war situation. Use of water for irrigation is linked to property rights and current patterns for payment are based on hours of flood irrigation rather than volumes of water.

- *Institutional Feasibility* - there are plans to establish five larger water authorities based on Mohafaza boundaries, which provide a more logical framework than the system of caza based water authorities. The restructuring of water authorities will facilitate transfer of resources to water short cazas from those with adequate resources. The Mohafaza boundaries largely reflect watersheds in Lebanon.

- *Economic Feasibility* - According to Bechtel [1] water tariff levels need to be increased by about 40% to reflect long run marginal costs of supply including the rehabilitation programme, which would bring the costs to around US$ 0.18/m^3, or about US$ 5/month/household. This is roughly equivalent to 1% of household income, (see discussion of affordability in *Chapter* 2).

[1] Bechtel WP26, 1992.

B2 *Investment: Re-use of Treated Sewage for Irrigation Water*

Description Treated sewage could be used for irrigation water for a number of crops, easing water shortages in the summer months and providing a safe disposal route for rural sewage. The degree of treatment required would depend on the type of crop. Preliminary screening would be adequate for irrigation of cereals and other arable cops, irrigation water used for horticultural products would need primary settlement. There would be a need to dispose of sewage sludge.

Effectiveness Re-use of water is an effective means of reducing total water demand, and would have beneficial impacts in the dry months, in helping to redress the seasonal imbalance between demand and supply.

Ease of Implementation

- *Technical Feasibility* - small scale standard biological treatment plant would be appropriate. Other technical options include the use of settlement ponds.

- *Cultural Feasibility* - there do not appear to be any cultural constraints to the use of recycled sewage for irrigation, as it appears that this is a practice which is already in use.

- *Institutional Feasibility* - could be managed at village level and have localised benefits.

- *Economic Feasibility* - The cost of treatment and re-use would depend on the size of population served (there are significant economies of scale in sewage treatment works), whether the delivery system is based on pump or gravity, and whether a 'new' network is required. The costs of biological treatment for a medium sized treatment plant (serving a population of about 150,000) would be of the order of US$ 6 million, implying a cost of water of US$ 0.09/m^3. This is very high compared with the current price paid for irrigation water, but may be justified in areas of higher value crops, such as citrus, particularly in the coastal zone, where over-abstraction of groundwater is causing saline intrusion.

B3 *Investment: Re-use of Treated Sewage for Aquifer Recharge*

Description Under current plans, domestic sewage in the coastal zone will be collected and discharged after primary treatment via long sea outfall to the Mediterranean. Instead of discharge, the sewage could be further treated and used for aquifer recharge to ameliorate the current saline intrusion and effective loss of groundwater resources.

Effectiveness Aquifer recharge can be very effective.

Ease of Implementation

- *Technical Feasibility* - it is important to choose the re-charge site carefully, and monitor water levels. It may be necessary to undertake secondary physical and chemical treatment, polishing and crude bulk disinfection. This may obviate the need for further treatment of groundwater when subsequently abstracted for domestic consumption.

- *Cultural Feasibility* - no cultural constraints to water re-use for aquifer recharge.

- *Institutional Feasibility* - no institutional constraints to water re-use for aquifer recharge.

- *Economic Feasibility* - costs of biological treatment might be of the order of US$ 0.09/m^3 but secondary treatment with polishing and disinfection would be extremely expensive, and likely to be higher than the costs of water supply from other sources, such as desalination, where the costs have fallen significantly over the past decade from US$ 10/m^3 to between US$ 1.5 - 2 /m^3.

B4 *Investment: in New Water Supplies*

Description Options for increased water supplies from surface water include building more reservoirs and desalination. The objective would be to counter seasonal imbalances by storing/providing additional water resources.

Effectiveness Additional infrastructure could alleviate seasonal imbalances, for municipal water supplies, but would have less impact on the imbalances between irrigation demand (in Bekaa, Akkar and South Lebanon) and supply (which is concentrated on the western slopes of South Lebanon, without interbasin transfers.

Ease of Implementation

- *Technical Feasibility* - the topography of Mount Lebanon with narrow sharply sloping valleys provides limited scope for significant increases in the capacity of storage reservoirs, and interbasin transfer is typically expensive and undermines efforts to develop a framework for watershed based water resource planning. The geology should be impervious and much of the Lebanon is limestone, restricting the number of suitable sites. *Desalination* is becoming an increasingly feasible option, in terms of capital costs which have declined from US$ 10/m^3 to between US$ 1.5 - 5/m^3 over the past decade.

- *Cultural Feasibility* - no constraints.

- *Institutional Feasibility* - water development projects would fall under the remit of MHER and the five new water authorities, and investment in capital works could be readily assimilated in the institutional structure.

- *Economic Feasibility* - current water supply costs are estimated at US$ 0.185/m^3, taking account of the rehabilitation programme. The cost of water from new investments in infrastructure would be higher (US$ 0.30 - 0.46/m^3 [1] is much higher, and, given the wastages in the system and the lack of incentive, particularly for irrigation water, for efficient use of water resources, demand side measures offer a more cost effective mechanism for bridging the gap between supply and demand than investment in new infrastructure.

(1) Estimates from Bechtel WP18, 1992 and ERM 1995, see *Table 11.6c* in DSOER.

B5 *Instruments: Revise Price Structure for Water*

Description

To achieve more efficient resource allocation, water pricing should be based on marginal social costs of supply. Water charges are currently about 40% below average incremental costs (long run marginal costs) of supply for drinking water, at US$ 0.16/m^3; charges for irrigation water are around US$ 0.02/m^3, but we have no data on the marginal costs of supply. In addition, no charges are levied for abstraction of water, which should be set to reflect the marginal value (or opportunity cost) of the water resource.

Effectiveness

Water charges have a major impact on demand. The price elasticities of demand for water are high, at:

- Municipal (residential) water supply -0.29 to -0.60;
- Industrial applications, -0.45 to -1.37;
- Irrigation, -0.37 to -1.50 [1].

Industrial water use is currently only 15% of total demand, but could be expected to increase relatively as the industrial sector is expected to grow rapidly.

Ease of Implementation

- *Technical Feasibility* - water charges are based on rather crude measures of water use - the 'orifice system' for municipal water supply, and an area/time formula for irrigation water. Accurate marginal cost pricing requires the installation of water metres, but this is expensive, and the efficiency gains may be outweighed by the investment costs for existing users (water metering can be installed on new developments). The orifice system may continue to provide a reasonable measure of water consumption.

- *Cultural Feasibility* - water charges can be regressive, hitting the poorer sections of the community hardest. This problem can be overcome through 'lifeline' pricing whereby a minimal price is charged of the poorest, where the benefits of some supply considerably outweigh the costs of resource use. A progressive price structure has the desired effect of penalising the wealthiest, largest water consumers more than poorer consumers.

- *Institutional Feasibility* - collection rates have been low but this is being addressed in Lebanon with some success. It is essential that water charges are sufficient for full cost recovery, at a minimum, or the system cannot be managed and maintained. Under traditional irrigation systems, water is managed through traditional techniques, largely outside the jurisdiction of the local water authorities - some legislation may be

(1) Empirical estimates of water price elasticity based on a number of case studies, compiled in Bhatia, Cestti and Winpenny Water Conservation and Reallocation: 'Best Practice' cases in improving economic efficiency and Environmental Quality, World Bank-ODI study, published in draft 1994.

B6 *Instruments: Incentives for Installation of Modern Irrigation Delivery Systems*

Description

Flood irrigation techniques, the most widely used in the Lebanon, tend to be inefficient, and do not reflect the incremental water demand for individual crops. Excessive use of water through flood techniques can also contribute to the build up of salinity in the soil, which appears to be occurring in the Bekaa. Thus water cannot easily be allocated to those crops where it has the greatest value. Incentives and subsidies (eg grants contributing to the costs of installation of new systems, access to credit through the National Bank of Agricultural Development or the National Union of Cooperative Credit) could be used in parallel with training and extension services to encourage the installation of modern irrigation distribution systems.

Effectiveness

It is estimated that actual water application to crops is, on average, about 30 - 40% above the optimal quantity required. Inefficient on-farm management is probably attributable to the flat rate, low price for irrigation water. Switching from flood irrigation to more carefully tailored irrigation techniques is necessary so that farmers can respond to price incentives.

Ease of Implementation

- *Technical Feasibility* - there are many well tried approaches to irrigation. The current programme of rehabilitation of irrigation infrastructure could be accompanied by campaigns to encourage improvements in on-farm delivery systems, training and community participation programmes.

- *Cultural Feasibility* - reform of irrigation systems mean changes in traditional practices. The irrigation rehabilitation programmes all incorporate community participation and social development components and this should be tapped into encouraging better on farm water resource management.

- *Institutional Feasibility* - the Green Plan within the Ministry of Agriculture could provide the organisation for improvement of irrigation water use, in association with agricultural extension services.

- *Economic Feasibility* - the costs of financial support to modernising irrigation should be assessed against the gains in more efficient allocation of water resources. Subsidies should only be used on a one-off basis to stimulate technology investment which might otherwise not be undertaken because of constraints on access to capital etc, or to accelerate the rate at which investments are undertaken.

B7 *Instruments: Rigorous Enforcement of Licensing for Groundwater Use*

Description In the past twenty years, many groundwater wells have been sunk without licensing or accompanying monitoring or controls, with a result that there is serious saline intrusion in the coastal zone, and there is little understanding of the impacts of current usage on groundwater resources. Licenses are required for ground water wells but the practice of licensing has fallen into disuse, and should be reinstated urgently, with the imposition of serious fines for violations.

Effectiveness Control and management of groundwater resources is essential and licensing of wells provides information on the quantity of water being used. As information on groundwater becomes more complete, licensing becomes an effective tool for water resource management.

Ease of Implementation

- *Technical Feasibility* - no technical constraints.
- *Cultural Feasibility* - once the relevant institutions regain the strength for control, there is no reason why in Lebanon that licensing of water resources should not be acceptable to the people.
- *Institutional Feasibility* - responsibility for licensing of groundwater wells rests with water authorities. The institutional restructuring should enable water authorities to adopt more actively their control functions over water supply and resources, although shortages of technically qualified personnel in water authorities is a weakness.
- *Economic Feasibility* - no major constraints or economic issues.

B8 *Information: Educational Programmes on Water Conservation*

Description All the proposed policy options should be accompanied by campaigns at local and community level to develop an understanding of the significance of water resources, and the role which individuals can play in better water resource management.

Effectiveness Educational campaigns alone are likely to have little impact, but are a necessary element of a package of policy options.

Ease of Implementation

- *Technical Feasibility* - constraints may lie in the lack of technically qualified personnel in the water authorities.

- *Cultural Feasibility* - information and education programmes should accompany new policy options (such as increasing the price of water) in order to overcome resistance and to enable individuals to make rational decisions about their own use of the resources, and take appropriate conserving actions.

- *Institutional Feasibility* - education in water resource management should be a component of community development programmes (eg those linked with irrigation programmes, or the Baalbek-Hermel programmes), and agricultural extension services, and NGOs, taking a cross-sectoral approach, and requiring some coordination between various involved institutions. The educational campaigns should be set in the context of a wider water resource management strategy.

- *Economic Feasibility* - there are no particular economic issues associated with dissemination of information and education.

B9 *Information: Measuring and Monitoring of Water Resources, Water Supply and Quality*

Description

Water quality monitoring in Lebanon is urgently needed to:

- protect human health;
- establish existing ground and surface water quality, as a basis for determining policy priorities;
- assess the effectiveness of water quality management programmes; and
- provide information to inform the issuing of effluent permits from industrial sites (which would take account of actual and desired river quality).

Ground Water

The appropriate scope for groundwater testing requires some preliminary desk research to establish the number and location of the major aquifers. However, as groundwater is abstracted as drinking water this is a priority in terms of human health, as well as part of a wider water resource inventory survey.

Surface Water

Monitoring of bathing water at key points along the coast is a priority in terms of human health. At least daily samples should be taken and analysed for BOD, Total Coliform and E. Coli, and other water borne pathogens.

Water quality monitoring stations should also be established on each of the larger water courses: the Litani, Nahr Abou-Ali, Nahr El-Bared, Nahr Ibrahim, Nahr Damour, Nahr Awali, and Nahr El-Zahrani, each of which has an average annual flow rate of around 10 m^3/s, and each of which carried significant loads of industrial and domestic effluent.

A minimum of three samples at each sampling station should be taken each month (given the lack of existing data), which could be reduced to seasonal samples after two or three years, when baseline data has been collected. The number of sampling stations would depend on water use along the course of the rivers; for the Litani, sampling at a number of points (eg north and south of the Karoun dam, plus one or two points downstream); for the other, measurements near the mouth would give a good indication of river quality, and the effects of changing river quality up stream.

The parameters measured would be: flow, temperature, pH, suspended solids, nutrients, metals, trace organics and pesticides.

Ease of Implementation

- *Technical Feasibility* - hand sampling at each sampling station would be appropriate. The lack of technical skills in Lebanon suggests that a programme should be established within the framework of a technical assistance programme with considerable focus on skills transfer.

- *Cultural feasibility* - no constraints to establishing an effective water monitoring service.

- *Institutional Feasibility* - the water monitoring programme could be established under the remit of the MHER, but analysis could be undertaken by private sector laboratories.

- *Economic Feasibility* - ground water sampling costs would depend on the necessary depth of the borehole, and the accessibility of the borehole to main settlements (ie the costs are higher in more remote locations). Very broadly, the cost could be about US$ 7,500 for sinking a 20 m borehole for monitoring purposes. Until a survey of groundwater resources has been undertaken it is not possible to assess how many boreholes would be required for monitoring purposes, but a total capital cost of US$ 750,000 may be a reasonable estimate.

  Based on seasonal sampling the annual costs (based on UK values) would be around US$ 45,000/station/year. For a full programme of surface water testing as outlined above then the annual cost would be of the order of US$ 450,000/year (including laboratory analysis).

B10 Instruments: Least Cost Planning

Description

The MHER should adopt a least cost planning approach to meeting water supply targets (set in government policy at 160 l/day), reflecting the fact that reductions in demand for water or more efficient consumption is likely to provide a lower cost option for meeting water needs than provision of new water supply infrastructure (excluding the rehabilitation of the existing water supply network). This approach is widely used by electricity utilities in the USA, which have a duty to meet current energy needs, but also in many states are facing generating capacity constraints. It is more cost effective for the utility to invest in energy conservation measures for consumers than to invest in new power generating plant.

Effectiveness

The least cost planning approach is effective in ensuring that the most cost effective means for supplying water needs will be sought by MHER and the water authorities.

Ease of Implementation

- *Technical Feasibility* - there are many direct interventions which could be adopted to encourage water conservation without reducing consumer utility; such as programmes to encourage water re-use and recycling, technical solutions such as the introduction of low water use toilets, maintenance of the water supply network to minimise system losses.

- *Cultural Feasibility* - the main concern of the Lebanese people is security and quality of water supply. We are not aware of any fundamental constraints to the concept of water conservation providing these two goals are met.

- *Institutional Feasibility* - least cost planning objectives can be incorporated into the development of a strategic water resource management plan which should be developed within MHER for the Lebanon.

- *Economic Feasibility* - least cost planning should offer significant economic gains compared with the construction of additional water supply infrastructure (storage reservoirs etc), and will be compatible with other policy options (eg marginal cost pricing and water re-use).

B11 *Instruments: Develop Markets in Water*

Description

At present water resource management faces two serious problems; one physical, in the geographical and seasonal variations in water supply and demand; the other institutional, in that water rights have been granted over time to individuals, families and villages, which can affect the water authorities from development of a resource or effective management of it. Setting up of a water market whereby owners of water rights can sell the rights to the resource to other users can improve allocation efficiency and ensure that water is used for higher value uses.

Effectiveness

Purchase/sale of water rights has been used in the USA to transfer farm owned water, otherwise used for irrigation, to municipal supplies. Chile established a comprehensive water law entitling secure, tradeable and transferable water rights for both surface and groundwater. The impacts have been mixed; there has been an increase in efficiency of use and allocation of water within the agricultural sector, but little increase in inter-sectoral transfers. In certain areas, eg where there are large mines, the water rights have been purchased at high price reflecting the marginal value of water to the mining enterprises, but at the expense of poor subsistence farming communities. In Lebanon there are no comparable dominating industrial users so this would not be a problem.

Ease of Implementation

- *Technical Feasibility* - effective water markets require some adequate level of infrastructure to ensure water transfers. The topography of Lebanon means that in many cases water can be transferred by gravity flow from areas with substantial quantities to those less well endowed.

- *Cultural Feasibility* - with appropriate institutional mechanisms, trading in water rights should be acceptable in Lebanon although there could be sectarian conflicts which would limit the effectiveness of the market.

- *Institutional Feasibility* - changing the nature of water rights would require legislative changes. It is suggested [1] that the following conditions are necessary prerequisites for the successful functioning of water markets:

  - a fair and adequate initial allocation of water rights, and mechanisms for reallocating water rights as the need arises;

  - competing demand for the resource, and reasonable reliability of the resource; and

[1] Simson LD Are Water Markets a Viable Option, Finance and Development, June 1994, Vol 31 No2, quoted in Bhatia et al, 1994, *op cit.*

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- a good administrative and regulatory structure.

At the present time in Lebanon, the preconditions may be too arduous but water markets are an option worth considering as a mechanism for ensuring efficient water allocation at some stage in the future.

- *Economic Feasibility* - trading rights to water resources should provide an efficient means for ensuring that water resources are used for the highest value use (eg water use would focus on high value, water efficient crops rather than low value water intensive crops), and even if intersectoral transfers are limited they could help in efficient allocation of irrigation water. There may be externalities to the market, such as the example of the large mining enterprise in Chile, which would need to be addressed. Even if a full market system is too complex in the near future, the fact that individuals who own water rights can sell any 'surplus' to other uses with higher value than the owner can obtain, would for example, help resolve some of the current misallocations in particular areas where water is used for irrigation while the local community faces shortages of household water supplies.

required in order to change the mechanism for payment for irrigation water (see discussion of water markets below).

- *Economic Feasibility* - for full efficiency, water prices should reflect the marginal cost of supply, including distribution, storage, treatment etc, and the opportunity cost of the resource itself. Bechtel WP18, 1991 suggested that municipal water prices should be based on a combination of the incremental cost of supply and a periodic lump sum payment to reflect the capital costs of the system.

Annex C

Policy Options for Addressing Soil Erosion

Republic of Lebanon
Office of the Minister of State for Administrative Reform
Center for Public Sector Projects and Studies
(C.P.S.P.S.)

ANNEX C: POLICY OPTIONS FOR ADDRESSING SOIL EROSION

C1: *Investment*

Investment to combat soil erosion entails five components:

- ***Research Programme to Determine Extent and Areas Most Prone to Erosion***

Description The research programme would aim to assess the extent of soil erosion within the country, determine rates of erosion, and evaluate areas which are most at risk, and most in need of remedial action. Early research is a key component to developing a "*National Soils Conservation Strategy*".

- ***Afforestation Programmes and Tree Nurseries***

Description An afforestation programme for Lebanon should seek to develop a network of nurseries in order to develop tree types which are best suited to conditions in Lebanon. This is important since mitigation of soil erosion through planting will only be effective if the most appropriate trees are selected, and the most appropriate technologies employed. The perception of local communities regarding the conservation and preservation of land resources will be essential in gauging the programme's effectiveness.

- ***Rehabilitation of Terraces in Key Areas***

Description A programme to halt the degradation of abandoned terraces and reverse soil erosion would aim to put selected terraces back into productive use, and maintain these terraces thereafter. As the cost of terrace rehabilitation is very high, a careful programme to prioritise and plan rehabilitation over time would be needed, based on analysis undertaken under the proposed research programme.

- ***Development of Appropriate Crops, Technologies and Practices***

Description A programme for developing and testing appropriate crops to reduce soil erosion and enhance economic returns from terrace farming on different types of degraded land (terraces, rangelands, deforested slopes). Such a programme could include:

  - nurseries and pilot projects to test combinations of crops, such as tree crops (eg citrus, essential oils, saffron) with grasses or legumes; and
  - rehabilitation/rangeland management/afforestation techniques.

The results of this research would be used to support local farmers in their efforts to adopt more sustainable land use practices.

- *Rangeland Management Programme*

Description A rangeland management programme would seek to change animal husbandry practices by providing training to farmers and foster an understanding among communities of the importance of conservation and sustainability of soils.

Ease of Implementation of Investment Programmes

- *Technical Feasibility* - a soils research programme could be undertaken at relatively low cost, using handheld GIS systems (see *Annex* C2) supported by existing base maps and possibly linking with GPS (global positioning system) which can be used to refine base maps by using satellites to determine the exact coordinates of any location.

There is a body of expertise in Lebanon with knowledge of agricultural practices, terrace rehabilitation and crop types, both within the local communities themselves (probably through village elders) and academic institutions. However, there is scope for technical assistance and specialist post graduate training and skills transfer to ensure the sustainability of the programmes.

- *Cultural Feasibility* - all these programmes aim to reverse a situation which has developed over many years as a result of agricultural mismanagement, socio-economic trends and rural-urban migration; and the civil war. In each case it is essential to bring communities into the programme and develop ownership and commitment. Practical difficulties result from the longer term socio-economic trends, so that knowledge of traditional agriculture has been lost. Development of programmes will need to take account of community wishes, the role of women in agricultural work, as well as the economic returns associated with the investments.

- *Institutional Feasibility* - the Green Plan have in the past been responsible for supporting the rehabilitation and maintenance of Lebanon's terraced lands, through loans and credit systems. The establishment of each of these programmes will depend on the existing extension service, and the Green Plan should work with local communities through the network of NGOs. The programmes should seek to develop clear linkages between academic institutions, the extension services, communities and NGOs, in order to integrate research studies on appropriate technologies, crops and practices, and social research activities. Ensuring local community participation will be essential in securing a long term conservation strategy, where local communities are given a sense of project ownership and feel they have a direct responsibility for the preservation and conservation of their land resources. The number of NGOs working with

rural communities and livelihood development will grow as the framework for social research develops.

The soils research programme could be undertaken under the auspices of the MoAg (possibly through a General Directorate of Soil Research - see *Annex C4*) working with academic institutions.

- *Economic Feasibility* - capital costs for implementing a crop research programme could be financed through an Environment Fund, or with assistance from the international community. The key objective is to maximise economic returns to rehabilitated land.

The cost of a soil erosion research programme including soils survey would amount to:

- 1 person year at US$ 12,000/month - say US$ 120,000; and
- the total cost of research and establishment of a GIS (see *Annex C2*) would be around US$ 150,000.

A soils research programme would attract donor funding, and could be resourced partly through university research funds.

The following box (see *Section 3.4*) shows the cost implications of a 10 year programme to rehabilitate most of the degraded lands in Lebanon. The net costs will be reduced if profitable crops can be developed. The direct investment costs are likely to be of the order of US$ 15 - 25 million/year, which lies outside the scope of the MoAg's budget (US$ 25 million in 1995). However, because soil is considered to be a 'public good' the finances needed for its preservation should not be borne by any one individual, and therefore some funds could be sought through the proposed environment fund, as well as from international donor groups.

A further concern is the continued maintenance of rehabilitated terraces; the costs of maintenance have been estimated at US$ 240/ha/year (see *DSOER, Chapters 5, 13*).

Based on the following assumptions, it is possible to come up with some indication of the costs needed to fund a ten year soil conservation programme:

- of the 36,000 ha of degraded terraces in Lebanon, 50% will need complete rehabilitation and 50% simply maintenance; and
- approximately 100,000 ha of low to medium forest cover (crown closure of between 10 - 30%) are in need of afforestation programmes to increase crown closure density.

Over a ten year period, assume that 3,600 ha of terraces (split between complete rehabilitation and maintenance) and 10,000 ha of forest will be covered by the programme each year. Based on these assumptions the total cost for the programme/year will be broken down as follows:

Activity	*Area (ha)*	*Cost (US$/ha)*	*Total Cost (US$ million/year)*
Rehabilitation of Degraded Terraces	1,800	6,000 - 8,000	11 - 14.5
Afforestation Programmes	10,000	150 - 600	1.5 - 6
Rangeland Management Programme			4.3

The ten year programme would cost between US$ 17 - 25 million/year. In addition, the costs of maintenance of terrace lands has been estimated at about US$ 240/ha/year.

Source: ERM estimates, 1995.

C2 *Information: Develop GIS System as Management and Planning Tool*

Description Develop existing GIS capabilities within Lebanon to collect and manage landuse data, including data on soil erosion and areas of stress. The data would be managed centrally and used to map areas of concern and monitor changes in the condition of the land. The information would be a vital tool in the soils research programme proposed as a component of *Annex C1*.

Ease of Implementation

- *Technical Feasibility* - a handheld GIS system (supported by base maps) and possibly linking with GPS (global positioning system) would be adequate to carry out soil research in the first instance. The GIS can be used to incorporate the key factors contributing to soil erosion (eg slope, wind direction and speed, rainfall) in order to provide a diagnostic approach to soil survey. The system should be able to provide a resolution of about 1:25000.

- *Cultural Feasibility* - not a constraint.

- *Institutional Feasibility* - there is technical capability in GIS in the Lebanon in the AUB and some consultancy companies.

- *Economic Feasibility* - establishing GIS, using existing data source, wind and precipitation etc - around US$ 30,000 (including use of handled GIS equipment at about US$ 5-6,000).

C3 *Information: Conduct Social Assessment to Develop Livelihood Strategy*

Description To assess the perceptions and determine the views of rural communities and farmers regarding agricultural practices and new approaches to land conservation, in order to develop a livelihood strategy.

Effectiveness The implementation of such a programme will be very effective if conducted properly. Social research is a complicated and delicate issue, and requires trained personnel in social research techniques.

Ease of Implementation

- *Technical Feasibility* - social research is well developed in Lebanon with a number of NGOs focused on the development of rural communities. However, the use of Participatory Rural Appraisal (PRA) is a new concept, and there would need to be a certain amount of skills transfer, aimed at developing the social research skills, and very much at the community level in developing a 'bottom-up' approach.

- *Cultural Feasibility* - addressing the needs of these communities will largely depend on gaining their acceptance and involvement. Developing an understanding of their perceptions and gathering information from various sectors within the community (eg women, village elders, young farmers etc) will help shape the livelihood strategy, in such a way such that their needs and wishes can be met in the most effective manner.

- *Institutional Feasibility* - the network of NGOs with coordination from the agricultural extension service are the best people to initiate social research. The techniques used must be carried out in a low key and informal manner, and therefore, large groups of technicians, scientists etc would not be the most effective method to collect information.

- *Economic Feasibility* - PRA exercise and social research are inexpensive to conduct. Studies could be sponsored by the agricultural extension service or even the proposed General Directorate of soil Research within the MoAg.

C4 *Institutions: Establish a General Directorate of Soil Research (GDSR) within the MoAg*

Description To establish a GDSR which shall be responsible for activities such as initiating and coordinating a nationwide research programme, housing a national database or GIS on land resources, coordinating research on developing appropriate technologies and crops, and conducting Environmental Impact Assessments (EIAs) of proposals which aim to significantly change land use patterns.

Effectiveness The GDSR will provide a recognizable authority for local communities, NGOs, academic institutions, etc which they can readily approach for up-to-date information, as well as providing a communication link between other Ministries and the MoAg regarding soil resources.

Ease of Implementation

- *Technical Feasibility* - establishing a GDSR will include hiring agricultural planners, socio-economists, agro-economists etc. Some of this technical expertise will already be available in the country, whereas other more specialised disciplines will possibly require skills transfer programmes through international projects.

- *Cultural Feasibility* - inter-ministerial conflicts and politics might make it difficult to establish such a Directorate. It will be very important that the GDSR is able to effectively liaise with the water authorities and the MoE in order to implement programmes, develop standards, enforce legislation, conduct on-going monitoring activities etc.

- *Institutional Feasibility* - the GDSR could form the fourth autonomous board as part of the MoAg. Once established the GDSR will have to undertake an institutional strengthening programme, particularly aimed at developing EIA capabilities.

- *Economic Feasibility* - all Ministries are financially constrained, but there may be some opportunity for partial cost recovery through the provision of consultancy services to agricultural communities.

C5 *Institutions: Strengthen Existing Agricultural Extension Service*

Description To strengthen the existing agricultural extension service to provide farmers and local communities with information, support and guidance.

Effectiveness The acceptance of a "*National Soils Strategy*" and its objectives by farmers will largely depend upon the extension service, since it is one arm of the government in close contact with the community. The ability of the extension service to stimulate interest in conservation will form the backbone to the whole strategy and conservation programme.

Ease of Implementation

- *Technical Feasibility* - willingness to work within the extension service will depend heavily on the salaries that can be offered for its workers. Ministerial workers traditionally in Lebanon are very poorly paid, and many have to take up another job outside government working hours. The technical capabilities are available within the universities and possibly NGOs, but salaries and other benefits will need to be reviewed before employees can be attracted to such posts.

- *Cultural Feasibility* - further development of the extension service will provide an invaluable link between responding to the needs of rural communities and the implementation of government policy through this government agency.

- *Institutional Feasibility* - the extension service already exists within the MoAg providing the institutional framework to establish an efficient organisation. However, it suffers from weak institutional management, technical capabilities and is heavily under financed.

- *Economic Feasibility* - the extension service needs substantial financial support, which can come either from the MoAg's annual budget or must come from external funding sources.

Annex D

Policy Options for Hazardous Waste Management

D1 *Investment: in Hazardous Waste Disposal Facilities*

Description Hazardous waste treatment facilities would need to treat both liquid and solid waste. Options could include shared facilities for certain industry sectors (eg tanneries, metal finishing).

Effectiveness Hazardous waste can be fully controlled by treatment, but requires effective enforcement of Codes of Practice or of hazardous waste management regulations.

Ease of Implementation

- *Technical Feasibility* - the scale and scope of a hazardous waste treatment facility would be determined following study and analysis of hazardous waste arisings in the Lebanon, taking into account geographical differences (most wastes are likely to arise in the Mount Lebanon area); and the scope for alternative waste management options, beginning with waste minimisation at source.

- *Cultural Feasibility* - all wastes have been disposed of without control for many years and considerable effort will be required to ensure that proper waste management procedures are undertaken, through training and information and technical assistance programmes.

- *Institutional Feasibility* - attracting private sector investment can provide necessary resources and can be done in a number of ways:

  - through joint venture between municipality, government and industry;
  - government led project with design, construction and operation in the private sector (eg Hong Kong); or
  - joint venture with international waste contractor and minority government shareholding.

  The two latter may be appropriate for Lebanon. For private sector involvement, certain conditions are necessary, see *Annex D11*.

  The establishment of industrial estates for industries provides a mechanism for formalising the treatment of hazardous (and non-hazardous) industrial wastes.

- *Economic Feasibility* - waste treatment facilities for plant to deal with around 200 t/day (Hong Kong, possibly similar to Lebanon's waste production) can cost anything between US$ 50 - 200 million, with associated treatment charges of between US$ 100 - 2000/t, depending on the type of waste (and the government charging policy) [1]. Lower cost

[1] DC Wilson Attracting Investment in Hazardous Waste Facilities in Developing Countries, ISWA Times, No 1 1995 and other papers.

facilities have been used; in Bangkok, a plant to deal specifically with wastes from small metal finishing and textile dyeing factories (which together accounted for 80% of hazardous wastes) was constructed by the government at a cost of about US$ 1 million.

Full cost recovery charging for the latter scale of plant may be possible, but for a larger and more sophisticated facility is unlikely to be feasible in the short term. This is partly because of the cost impacts on industry, but also, since the policy aim is to change the behaviour of waste generators and their waste management practices, imposition of charges may act as a disincentive to formal disposal of wastes. It is therefore necessary also to ensure compliance with regulations and codes of practice but usually advisable to phase the policy in over time (again as in Hong Kong).

D2 *Investment: in Clinical Waste Disposal Facilities*

Description Establish purpose built incinerator(s) for clinical wastes, or safe alternative disposal routes.

Effectiveness When correctly operated, clinical waste incinerators will deal with pathogens etc, but if badly managed.pathogens become effectively dispersed through the stack. Rigorous separation of clinical wastes at source is essential.

Ease of Implementation

- *Technical Feasibility* - Lebanon's generates an estimated at around 5,000 t/year (570 kg/hour) of which over half would be in Beirut. With the possible exception of Tripoli, smaller volumes may not justify incineration plants, and controlled burial in new sanitary landfills may be an option for other cities.

- *Cultural Feasibility* - management of clinical waste has deteriorated in the past 20 years and information and training necessary to re-establish good practice for management of clinical wastes.

- *Institutional Feasibility* - need for strengthening of institutions for enforcement of regulations, and technical assistance to hospitals, clinics etc on management of clinical wastes.

- *Economic Feasibility* - a clinical waste incineration plant with capacity for say 6000 t/year would cost around US$ 25 million [1] (around US$ 400/t of waste treated [2]), with annual operating costs of about US$ 3 million. The cost of collection from larger hospitals and smaller waste generators (eg dentists, clinics) is estimated at around US$ 370/t of waste, of which US$ 335 reflects operating costs. The scope for cost recovery charging should be investigated; in many places clinical waste plants are built, designed and operated by private contractors.

(1) ERM Hong Kong, 1995 estimates. Note that capital cost includes a high proportion for gas cleaning equipment which may not be required in Lebanon.

(2) Calculation based on capital cost annualized over 20 years at 8% discount rate.

D3 *Investment: Establishment of Shared Treatment Facilities for Hazardous Industrial Wastes*

Description Shared treatment for certain types of waste can be developed between industries, either on industrial estates or in central location with wastes transported for treatment from other locations

Effectiveness Hazardous waste can be controlled by treatment, but requires effective enforcement of codes of practice or of hazardous waste management regulations. It could be focused on sectors generating the most hazardous waste.

Ease of Implementation

- *Technical feasibility* - an example of a successful operations for a small plant is a centralised hazardous waste water treatment facility constructed in Thailand by the Ministry of Industry in 1987, and operated under franchise by a private sector contractor. The facilities focused on metal finishing and textile dyeing wastes

- *Cultural Feasibility* - as above - considerable need for training and technical support, possibly initial incentives to ensure compliance or participation

- *Institutional Feasibility* - joint facilities are consistent with the plans by MoIP for establishing industrial estates with shared treatment facilities for liquid waste effluent. The principle could be expanded to include shared facilities for management of solid wastes. Operation could be contracted to local company.

- *Economic Feasibility* - cost of small focused plants lower than chemical waste treatment plants dealing with wider range of wastes. The Thailand plant cost US$ 1 million (1987 costs). MoIP plans propose charging industries on estates the operating costs for waste treatment.

D4 *Instruments: Waste Disposal and Treatment Charges*

Description Charges for collection and disposal of wastes can act as an incentive to waste generators to minimise waste arisings. Charges can be levied at point of disposal/treatment based on weight/volume of waste dealt with. There are a number of specific mechanisms for charging (vouchers,.payment on basis of actual weight) etc; selection of appropriate mechanism depends on local circumstance.

Effectiveness Charges provide a clear incentive for waste minimisation, but in the short term may encourage avoidance of regulations and continued disposal of waste in rivers and on uncontrolled dumps. Possible option is to phase in charging over time, following pattern established in Lebanon by plans to charge households for waste collection and disposal.

Ease of Implementation

- *Technical Feasibility* - no constraint, there are many technical options for charging.
- *Cultural Feasibility* - in the short term charging will be resisted, but resistance can be offset by provision of support through eg technical assistance to encourage waste minimisation. Charging is also more acceptable when it is seen to be applied across the board (ie perception of fairness) and in return for service rendered (transparency).
- *Institutional Feasibility* - proposals to introduce charges for waste treatment on industrial estates provides foundation for charging for hazardous waste.
- *Economic Feasibility* - charging mechanism are typically straightforward and do not impost high administrative cost burden. Costs will be incurred in ensuring compliance with regulations and requirements for disposal. The issue of affordability for small businesses will need to be analysed.

D5 *Instruments: Deposit Refund Schemes for Selected Wastes*

Description

Deposit-refund schemes can be used, particularly for hazardous wastes which occur in the domestic waste stream, to encourage return of hazardous materials for safe disposal. On purchase of the commodity, the consumer pays a deposit to the retailer which is then returned when the item in question is returned. The value of the deposit provides an incentive to the consumer to return the product.

Effectiveness

Can achieve high recovery rates but value depends on what can be done with the returned material. Deposit refund systems are not appropriate for batteries since there is no treatment system for batteries in Lebanon, but deposit/refunds for chemical and pesticide containers could ensure correct collection and then disposal. This may be more appropriate as a longer term possibility together with a more complex range of policy options. Removal of waste from municipal or other waste streams reduces the health hazard to scavengers at waste dumps.

Ease of Implementation

- *Technical Feasibility* - research required to establish technical feasibility (including eg identification of sales outlets, how to manage returned hazardous waste).
- *Cultural Feasibility* - deposit refund schemes operate for beer and wine bottles and are culturally familiar. Dealing with hazardous wastes requires more management to avoid the waste getting back into waste streams.
- *Institutional Feasibility* - in the short term, the institutional demands for management of recovered wastes may be too complex for the resources of the various authorities. In the longer term, private sector can manage deposit refund schemes within clear regulatory framework.
- *Economic Feasibility* - deposit refund schemes impose costs on consumers through loss of convenience, but are not typically high in administrative costs.

D6 *Instruments: Other Economic Charges - Product or Raw Material Charges*

Description Product charges are levied on hazardous products to encourage use of alternative products; raw material charges are levied on raw material (or hazardous material) inputs to products.

Effectiveness The effectiveness tends to depend on the level of the charge and the extent to which a charging system is supported by other regulatory measures. Product charges have been applied to pesticides (eg in Scandinavia), but they have had little effect on use of pesticides as charge levels have been too low [1], although they have provided a source of revenue which could, in the case of Lebanon, be used to support pesticide management schemes.

Ease of Implementation

- *Technical Feasibility* - not a major limitation.
- *Cultural Feasibility* - no precedent in Lebanon for product/raw material charges, but if accompanied by education and technical information could be acceptable in certain products.
- *Institutional Feasibility* - raw material charges and product charges can impose a heavy administrative burden in identifying products and monitoring for compliance. Product charges can be levied at point of sale which may require additional administrative layer. May be feasible for pesticides as the regulatory framework develops for proper management including registration of importers and sellers of pesticides.
- *Economic Feasibility* - where administration is not complex, or can be built on an existing structure (as with pesticides) then economic efficiency not impaired. Revenues raised could be earmarked for particular programmes.

[1] Research in the UK (Department of the Environment, 1993) showed that to have any impact on the use of pesticides charge levels needed to be more than 100% of the price of the chemicals.

D7 *Instruments: Support/subsidies for Waste Minimisation or Establishment of Waste Treatment Facilities*

Description Subsidies could be in the form of concessionary finance or grants for specific schemes over a specific time frame in order to support programmes to change attitudes towards waste management, to encourage waste minimisation and encourage investment in treatment facilities.

Effectiveness Subsidies can be effective in stimulating new initiatives or attracting private sector investment. Subsidies should only be used to encourage new initiatives where initial costs or uncertainties may provide a barrier. Subsidies should be defined with a finite life and application.

Ease of Implementation

- *Technical Feasibility* - does not pose a problem.
- *Cultural Acceptability* - subsidies are usually acceptable to beneficiaries but run counter to objectives of cost recovery.
- *Institutional Feasibility* - not a constraint, some problems in ensuring the system is not open to abuse. Initiatives for waste minimisation can be developed through cooperation with the private sector; there are examples of such schemes in the USA (eg Waste Wi$e) where companies make a commitment to waste minimisation in agreement with government authorities.
- *Economic Feasibility* - subsidies may not be affordable given constrained government finances. Subsidies in the form of shared capital contribution may be important in attracting private sector investment in treatment facilities to overcome problems in early years when volumes of waste treated may be lower than levels required for financial viability.

D8 *Instruments: Identification and Registration of Hazardous Waste Generators*

Description Identification of hazardous waste generators provides essential information for planning and controlling hazardous waste disposal. A registration system for generators of hazardous waste would be tied to permits for operation, annual reporting on waste generated, disposal or treatment options etc.

Effectiveness Registration of generators is a necessary condition for developing an effective management system.

Ease of Implementation

- *Technical Feasibility* - link to re-registration of industrial enterprises.
- *Cultural Feasibility* - low awareness of hazardous waste issues in Lebanon means that registration will need to be accompanied by information and technical support.
- *Institutional Feasibility* - identification of hazardous waste generators can be undertaken through survey, based possibly on the MoIP Industrial Census. Involvement of Lebanon Association of Industries to support government initiative desirable.
- *Economic Feasibility* - costs incurred in personnel and technical assistance, some scope for external aid funding to establish register and technical assistance.

D9 *Instruments: Establish Clear Regulatory Framework for Management of Hazardous Wastes*

Description Control systems need to be established together with a clear understanding of the needs for inspection, enforcement and penalties for non-compliance with hazardous waste regulations. A regulatory framework could include elements such as labelling of containers of hazardous waste, labelling of collection/transport vehicles, licensing of sorting, transport and disposal facilities, registration of producers of hazardous materials and establishing standards for operation of waste treatment facilities, and controls over trans-frontier shipment of wastes (following specifications of the Basel Convention).

Effectiveness Regulatory framework is an essential pre-requisite of effective hazardous waste management.

Ease of Implementation

- *Technical Feasibility* - Lebanon is likely to need technical assistance in developing an appropriate hazardous waste framework, to support strengthening in municipalities and other authorities and develop capacity within the MoE for establishing appropriate and workable requirements for practice.

- *Cultural Feasibility* - as above, low awareness of the issue of industrial hazardous waste among generators (particularly small scale operators) will necessitate strong technical assistance support to enable firms to comply with requirements.

- *Institutional Feasibility* - the MoE is addressing the problems of hazardous waste, but strengthening of inspectorate and technical capabilities for analysis and testing of materials is needed. The general problems of enforcement in Lebanon have been noted elsewhere; public information can be a strong supporting tool, encouraging compliance with requirements.

- *Economic Feasibility* - industry can contribute financially through registration fees to the management costs, but this may need to be phased in over time in order to encourage voluntary participation in hazardous waste management programmes.

D10 *Information: Establish Information Support to Industry and Commerce on a Wide Front*

Description

There is an urgent need to raise awareness of the issues of hazardous waste and mechanisms for dealing with it. There are many information dissemination approaches;

- demonstration projects;
- technical assistance to firms for, eg, preparation of waste plans, training and promotion of awareness of worker safety concerns etc;
- information on waste minimisation; and
- avoidance at source should be a central feature of information and technical support programmes.

Ease of Implementation

- *Technical Feasibility* - not applicable.
- *Cultural Feasibility* - essential to increase understanding and awareness of issues.
- *Institutional Feasibility* - MoE has role in disseminating information, but a number of other organisations can become involved:
  - AUB proposes to set up an *Industrial Consortium* focusing on industrial technology and providing lectures and seminars, sponsored research and technical exhibitions. While this focuses on technology transfer, environmental concerns and technologies which result in waste minimisation could be brought into the concept;
  - UNDP is establishing a *Sustainable Development Network* to disseminate information to industry on environmental matters;
  - the *Ministry of Economic Affairs* is setting up a *Trade Information Centre* which might be used as a vehicle for environmental awareness associated with trade needs.
  - NGOs can be encouraged to develop programmes for industrial support.
  - *UNIDO* is establishing programmes for environmental technology support.
  - *MoIP* can be positively involved in hazardous waste management through the industrial estates programme.
  - the *Lebanese Industry Association* is aware of the pressure for environmental management and should be brought into information programmes to encourage industry participation.
  - leading companies can be used as *role models* of what can be achieved, eg one paint company has adopted a programme aimed to achieve zero emissions.

(Note that these organisations can play a role wider than simply focusing on hazardous waste).

- *Economic Feasibility* - various NGOs have resources, also AUB. Costs of technical support and information dissemination are relatively low but need to be targeted and regularly updates for cost effectiveness.

D11 Private Sector Involvement

Description There is scope for attracting private sector participation in waste management facilities, either as design/build/operate contracts, or as joint participation with government. Provides capital resources.

Effectiveness The advantage of involving private sector lies in accessing additional management expertise which may not reside in government organisations, and may provide a more economically efficient approach to waste management than government run operations.

Ease of Implementation

- *Technical Feasibility* - no constraints.
- *Cultural Feasibility* - no constraint; the success of Sukleen in managing municipal waste in Beirut sets a promising precedent.
- *Institutional Feasibility* - need a strong regulatory framework and management objectives to attract private sector finance, and a commitment by government to enforcement of regulations.
- *Economic Feasibility* - private sector finance will require a clear potential revenue stream which could be met by direct cost recovery charging or through contract with government. In the first instance, cost recovery charging may act as a disincentive to industry to participate, but must be considered in the medium term (in Hong Kong for example, there is no tradition of cost recovery for waste management, charging for operating costs of the chemical waste treatment facility is being phased in over five years). Government needs to take some of the risk associated with private sector investment, and there must be clarity as to liability and ownership of the facilities. In the developed world, most hazardous waste treatment facilities are under private sector ownership, but there are several mixed approaches which could be assessed for Lebanon. It should be noted that most hazardous waste facilities needed some financial support for the initial investment.

Annex E

Policy Options for Addressing Urban Air Quality

ANNEX E: POLICY OPTIONS FOR ADDRESSING URBAN AIR QUALITY

E1 Instruments: Increase tax on gasoline

Description

Taxes on gasoline could be increased to encourage more efficient vehicle use, supporting other measures to renew vehicle fleet with more fuel efficient vehicles. Tax on diesel could remain lower than that on gasoline to encourage public transport vehicles.

Taxes on gasoline currently account for about 24% of the pump price (based on May 1994 prices, price was US$ 242.6/m^3, of which US$ 58/m^3 was tax). In OECD countries, taxes are typically 60 - 75% pump price. If tax levels were raised to a similar level, the pump price in Lebanon would be US$ 460/m^3, of which tax would be US$ 276, total price increase of 90%.

Effectiveness

Assuming short run price elasticity of demand for gasoline is around -0.2 (1), effect could be reduction in gasoline demand by 18%. In the longer run, e=-0.7, so that say within 10 years, gasoline consumption could be 60% lower than it otherwise would have been. This longer run effect takes into account impacts on engine design and efficiency as well as the immediate price effect. Note that fuel consumption in older vehicles is about 11% higher than in newer vehicles (2) so that reduction effected through modernisation of fleet as well as reduced kilometres travelled.

Ease of Implementation

- *Technical Feasibility* - no constraints.
- *Cultural Feasibility* - difficult initially but acceptability improved if revenues raised used to offset other taxes (such as import of new vehicles). Could have differential tax rates for different types of vehicles, eg for registered public transport carriers including buses, taxis and *services*, which would encourage registration of public transport vehicles.
- *Institutional Feasibility* - straightforward as excise duties collected at point of import and easy to administer
- *Economic Feasibility* - based on 1994 gasoline consumption, increased taxes would raise an additional US$ 0.22/l, totalling US$ 380 million/year (3). This revenue could offset losses in import duties on imported new cars, and provide core funding for an *Environment Fund*.

(1) UK Department of Transport.

(2) See *Table 8.3c*, DSOER.

(3) Consumption in 1994 was 1.276 Mt, density of gasoline is 1,350 l/t.

E2 *Instruments: Selective Reduction of Excise/import Duty on New Vehicles*

Description At present excise duties on new cars carry an excise duty of say 50%, plus a surcharge of 35% on vehicles valued at more than US$ 10,000, ie nearly doubling the price. The duty could be reduced to encourage the import of new vehicles, and structured to provide incentives for the purchase of new vehicles for public transport; surcharge should be maintained at a higher rate on vehicles without TWC.

Effectiveness The present high level of duties will discourage replacement of old vehicles which is essential if more efficient engines, TWC and unleaded fuel are to be introduced and efficiency gains in engines (see above) realised.

Ease of Implementation

- *Technical Feasibility* - no technical constraints to implementation
- *Cultural Feasibility* - reduction of import duties on vehicles will be highly acceptable to Lebanese population.
- *Institutional Feasibility* - import duties are now being restructured for simplicity, and this reform could readily be incorporated in new schedule. Differential duty rates for, eg public service vehicles or cars for public transport depend on effective registration of all new vehicles and licenses for offering public transport services (see *Annex E3* below).
- *Economic Feasibility* - On the present rate of new vehicle import of about 50,000 vehicles/year, losses of revenue could be about US$ 300 million/year, but this is offset by additional revenues from higher taxes on gasoline. Modification of import tariffs carry low transaction costs.

E3 *Instruments: Differential Pricing in Favour of Unleaded Gasoline*

Description In most OECD countries unleaded fuel is priced (at the pump) slightly lower than leaded fuel (typically tax accounts for 60 - 66% of pump price compared with 70 - 75% of leaded fuel) to provide a positive signal in favour of use of unleaded fuel.

Effectiveness Price differential is small, and alone probably has little impact, but provides a positive signal reinforcing the decision by consumers to purchase vehicles with TWC. Lower prices for unleaded fuel are highly visible and provide a strong signal to reinforce other policy instruments. (Note that in the shorter term regulations to reduce the lead content of gasoline can have significant effects on the level of air borne lead, but that unleaded fuel is necessary for vehicles with TWC.)

Ease of Implementation

- *Technical Feasibility* - wider introduction of unleaded fuel requires investment at petrol stations in new/separate tanks, and garage owners are unlikely to do this unless their is sufficient demand from vehicles. The government therefore needs to provide grants to garage owners to refit with tanks for unleaded fuel, and simultaneously make retrofitting of existing cars with lead-free fuel systems readily available. In this way the availability of fuel can match the number of cars on the road able to run on lead free fuel. Once lead free fuel is reasonably widely available, consumers would consider purchasing a new lead free fuel only car.

- *Cultural Feasibility* - no particular constraints.

- *Institutional Feasibility* - no particular constraints. Policy would be more effective if accompanied by requirements for the use of TWC (cf EU experience) to force change of vehicles.

- *Economic Feasibility* - costs will be incurred by gasoline stations in investment in new tanks and nozzles to ensure leaded fuel is not put into vehicles with TWC. Investment in new gasoline plant could be supported by concessionary finance.

  There could be some loss in government revenue (based on EU experience, where the typical price differential is about US$ 0.6/l, losses of revenue to government would be of the order of US$ 600,000) but this could be offset by further increase in the tax on leaded fuel.

E4 *Instruments: Tax on use of Private Electricity Generators*

Description Levy a surcharge on gas oil purchased for use in private power generators in urban areas to discourage their use. The surcharge could be passed on to consumers through their bills.

Effectiveness Limited effectiveness in short term as there is no viable alternative supply of electricity; might be effective once EDL rehabilitation completed to encourage consumers to switch to national supply. Effectiveness in achieving this will depend on the level of surcharge and the (unsubsidised) price for electric from EDL.

Ease of Implementation

- *Technical Feasibility* no constraint.
- *Cultural Feasibility* - would face resistance in the short term when there is no alternative supply. It would be more acceptable once national power restored, if the supply is secure and the price is seen as fair.
- *Institutional Feasibility* - it may be difficult to identify purchasers of gasoil for private power generators as distinct from purchases for industrial power - although the latter should also bear the surcharge when located in residential areas. The surcharge would be more acceptable if clearly limited to generators in urban areas where there is a clear pollution impact, but it would be difficult to monitor and ensure compliance at differential rates for different types of users.
- *Economic Feasibility* - may impose additional burden on industrial sector, although charge could be an added incentive to move to designated industrial zones or industrial estates. In practice, the effects of rehabilitation of EDL should be to reduce the long run marginal cost of electricity such that even in the absence of subsidy on electricity prices it should cost less than electricity from small private generators. The surcharge would only be justified if the social costs imposed by their use exceeds the price differential.

E – 4

E5 *Instruments: Enforcement of Requirements for Vehicle Inspection*

Description - Regular servicing and maintenance of vehicles to improve engine efficiency and reduce emissions of CO, unburnt hydrocarbons, and black smoke. This mechanism would help to weed out gross polluters, while generally encouraging higher standards of vehicle maintenance. Vehicles are currently required to undergo annual tests to ensure roadworthiness. The scope of the test could be expanded to test emissions, and the requirement enforced more effectively.

Effectiveness Researches show that CO emissions can be reduced by up to 20% when vehicles are tuned to their maximum efficiency [1]. Emissions of particulate matter can also be substantially reduced. The regulation would encourage use of more modern cars and help to accelerate the desired restructuring of the vehicle fleet.

Ease of Implementation

- *Technical Feasibility* - the measure is technically feasible.
- *Cultural Feasibility* - at present requirements for vehicle testing are widely ignored; supplementary measures are necessary to encourage vehicle owners to take seriously the need for vehicle maintenance. For example, licenses for the use of vehicles for public transport could be revoked if vehicles are not tested regularly, or heavy fines imposed.
- *Institutional Feasibility* - the regulations are not enforced at present and it is doubtful if the Ministry of Transport has the capability. A series of incentives to encourage compliance would help, but weak enforcement remains a constraint.
- *Economic Feasibility* - no particular constraints, although vehicle users will incur costs of testing. These costs likely to be offset in the medium term by enhanced vehicle efficiency and savings in fuel consumption.

[1] UK Department of Transport, Rogers 1984.

E-5

E6 *Instruments: Registration of Private Vehicles Operated for Public Transport*

Description

Information on the role of private sector operators in public transport is essential for planning purposes, and would provide a basis for encouraging privately operated public transport to reduce use of private vehicles for own journeys only, reducing numbers of person-kilometres travelled.

Prior to the war, *services* and taxis were registered and issued with licensed and special number plates. This practice should be reinstated, to enable effective planning and to target traffic planning measures to encourage public transport.

Effectiveness

Private sector public transport can be very effective in meeting transport demand, particularly for journeys to work. Registration is an effective means of managing the growing public transport sector.

Ease of Implementation

- *Technical Feasibility* - no constraints.
- *Cultural Feasibility* - no constraints.
- *Institutional Feasibility* - requires revitalisation of Vehicle Registration Office, and appropriate regulations to ensure coherent operation of private sector transport services.
- *Economic Feasibility* - no constraints. Economic incentives could be attached to licensed public service carriers to encourage development of the presently informal sector.

E-6

E7 *Instruments: Mandatory Requirement for Emission Standards for New Cars*

Description Government could set a target date for compliance with higher emission standards for vehicles, which would encourage the use of TWC on new vehicles.

Effectiveness Improvement in emission standards and introduction of TWC likely to have substantial impact on concentrations of NO_x, HC and CO in and around urban areas.

Ease of Implementation

- *Technical Feasibility* - successful introduction of TWC vehicles requires widely available supplies of unleaded gasoline (see above).
- *Cultural Feasibility* - lack of awareness of the relevance of TWC in Lebanon; requires information campaign to inform vehicle owners, and stress, eg, that TWC does not reduce vehicle performance etc significantly.
- *Institutional Feasibility* - as all vehicles are imported, restrictions on imports of vehicles without TWC is relatively easy, and import controls are already applied to other goods.
- *Economic Feasibility* - retrofitting of TWC costs around US$ 600/vehicle (and are subject to technical difficulties), whereas the cost of TWC in a new vehicle is US$ 400 - 500.

E8 *Instruments: Controls on Parking in Urban Areas*

Description There are a number of means of restricting parking in order to discourage the use of vehicles in the urban area - through price, through licensing and issuing of parking permits to certain types of users, to residents but not commuters for example. Need to rethink the strategy of a major underground car park in central Beirut which will encourage vehicle use. Parking permits could be linked to type of use of vehicles, (eg for public transport). Parking restrictions could be linked to planning zones etc

Effectiveness Unrestricted parking encourages the use of private vehicles and exacerbates congestion.

Ease of Implementation

- *Technical Feasibility* - there are many techniques for parking control which are widely tried and tested - need study to assess most practicable options for Beirut and other cities.

- *Cultural Feasibility* - extremely difficult; ability to park easily is perceived as an essential element of the modern quality of life. Widespread non-compliance is to be expected unless viable alternatives to the use of cars, particularly for commuting, are in place.

- *Institutional Feasibility* - could be managed through the Municipality or Ministry of Transport. Parking charges and fines can provide revenues to local authorities and therefore they have an incentive to enforce compliance. Privatisation of parking controls can be effective (revenues shared between private company and local authority.

- *Economic Feasibility* - parking charges and controls should be net revenue earners.

E9 *Instruments: Controls of Dust from Construction and Vehicles*

Description Reduction in the amount of dust created in cities from construction works and uncovered vehicles would improve air quality and have health benefits. Dust from roads can also be significant, and vehicular movements exacerbate this by crushing particles to a smaller size where their health implications are more serious. There are a number of techniques available for control of dust (see discussion in *Chapter* 3).

Effectiveness Low cost measures for best practice in controls of dust highly effective.

Ease of Implementation

- *Technical Feasibility* - use of water for dust control unsuitable because of high evaporation rate and seasonal water shortages; focus should be on containment and covers.

- *Cultural Feasibility* - construction dust not perceived as a significant problem.

- *Institutional Feasibility* - controls typically enforced through local authorities and planning requirements (eg contractor are required to give details of dust control when applications are made for planning permission or building permits). Could be applied to major contractors (eg Solidère) but hard to enforce for smaller operators. May be a secondary measure to be implemented once planning system strengthened and local authorities strengthened.

- *Economic Feasibility* - costs of controls are generally low, and based on good practice, not technology. If enforcement is linked to existing (enforced) planning controls then efficient system is possible.

E10 *Instruments: Registration and Deregistration of Vehicles*

Description Registration and deregistration of vehicles, and establishment of licensing system for vehicle uses. To provide basic information about the numbers, ages and types of vehicles for planning purposes, and to establish framework for licensing of private vehicles for public transport linked to safety and environmental impacts.

Effectiveness Vehicle registration alone will have little impact on urban air quality but provides a necessary tool for transport planning, and design of incentives and regulations to control vehicle use and improve urban air quality.

Ease of Implementation

- *Technical Feasibility* - no constraint.
- *Cultural Feasibility* - no significant constraint, but possible reluctance by currently unlicensed transport operators to participate. Levying of road tax on all registered vehicles would provide an incentive for owners to deregister when a vehicle is scrapped.
- *Institutional Feasibility* - requirement for strengthening in the Vehicle Registration Office in order to enable effective registration and de-registration.
- *Economic Feasibility* - can be self financing through levying of road tax, initial registration costs of new vehicles (which could be included in price) and possible fines for non-registered vehicles. Commercial operators of vehicles can be required to pay a license fee (potentially acceptable since licensing would be required before commercial operation is permitted).

E11 *Information: Establish Air Quality Monitoring Network*

Description

Routine air quality monitoring requires significant expenditure to be useful and it is inevitable that the largest single constraint on establishing and operating a viable air quality monitoring network will be, the limited capital available and a lack of trained operators and technical resources to operate and maintain the equipment and to ensure that the data are accurate. It is important, therefore, to have a clear set of objectives in mind when designing a network and that an organisational framework exists to support the network.

Approach and Implementation

A prime requirement must be to assess the pollutant concentrations experienced by the majority of citizens in the significant centres of population. The nature of their exposure may be summarised by the concept of an 'urban background' concentration and is taken to mean the concentration resulting from the multitude of diffuse sources in a city, as distinct from a single source such as a busy highway. Provided that a monitoring instrument is sited away from the influence of a single source, the concentration of a particular pollutant across a city can often be characterised very well by such an urban background measurement. As a priority, we suggest that one or two monitoring stations be established at sites chosen to represent the urban background in the major cities. These sites will probably be situated near the city centres, at a distance of greater than 30 m from the nearest significant road. The monitoring stations will include continuous, automatic, on-line analysers for the following pollutants:

- nitric oxide (NO);
- nitrogen dioxide (NO_2);
- carbon monoxide (CO);
- sulphur dioxide (SO_2);
- particulate matter less than 10 μm in diameter (PM_{10}); and
- ozone (O_3).

Each station will require an air conditioned environment for the instruments and the analysers will record data on a datalogger which, in turn, will be connected to a personal computer. The computer will be capable of remote interrogation via a modem link, so that the data can be assessed in near real time and be publicly available on the same day. (Otherwise, the data are of little value to the general public.) It possible to house the monitoring station either in a building or in a purpose built enclosure.

On a much smaller scale, ie over distances of tens of metres, concentrations may vary dramatically where there are strong ground level sources of pollution. Usually, these variations are caused by the presence of roads. Whilst these zones may not be inhabited by the majority of the population, it will be important to measure concentrations at the side of some busy roads, so that the extreme concentrations can be quantified. Some costs may be saved in these monitoring stations by restricting the pollutants monitored to those strongly associated with vehicle emissions, ie oxides of nitrogen, carbon monoxide and particulate matter.

Some other pollutants are worthy of consideration also. Most notable amongst these are the volatile and semi-volatile organic compounds which are potentially damaging to human health. A good example is benzene, a proven carcinogen. Because the health effects arise from long-term exposure, concentrations of these pollutants can be measured effectively as weekly averages, for example. This allows the use of relatively low cost samplers, provided that a laboratory is available for the analysis of the exposed filter medium.

In establishing the optimum sites for the automatic monitoring stations, it would be extremely worthwhile to carry out a preliminary survey using low cost techniques to gain a better understanding of the spatial distribution of pollutants across the large cities. For example, NO_2 diffusion tubes could be used in large numbers over a 6 month period. This would reveal the long-term concentration with a reasonable degree of accuracy and would confirm the overall pattern of pollution attributable to motor vehicles (each tube costs in the region of US$ 15, including analysis, and the exposure time is one to two weeks. They can be mounted on convenient parts of buildings with adhesive tape.)

In addition to the monitoring of pollutant concentrations in urban areas, there would also be merit in monitoring in suburban areas and in rural areas around the cities. This applies particularly to O_3, which might be expected to found in the highest concentrations in these areas because of the photochemistry by which it is generated from the precursor emissions of NO_x and hydrocarbons.

- *Technical and Institutional Feasibility* - if monitoring is to be undertaken on a routine basis in the Lebanon, an organisational framework must be established to ensure that:

  - personnel are available and trained to operate the instruments;

- the data are fully quality assured and controlled;
- the analysers are properly maintained and calibrated; and
- the data are properly analysed and effectively utilised.

The establishment of an agency to manage and operate a network of air quality monitoring stations will require significant investment in terms of training and the recruitment of suitable staff.

- *Economic Feasibility* - the capital costs are of the order of US$ 150,000/monitoring station. Passive monitoring would cost about US$ 15,000/year for VOCs and about US$ 7,500/year for NO_2 diffusion tubes (including analysis costs). Establishment of a measuring and monitoring programme should include training and technical assistance.