Contents

Strategic Action Programme and National Action Plan for Lebanon

Introduction

The Lebanese territory is very small and all the strategic programmes and action plans are usually prepared on a national level and not on regional levels. This is also a consequence of the centralized authority and executing governmental council i.e. the Council for the Development and the Reconstruction (CDR). This Council is directly related to the Council of ministers and is the main party that is involved, either directly or indirectly, in the implementation and execution of all the projects executed on the national level. The role of the Council for Development and Reconstruction is based on the national strategies that are set and approved by different ministries.

Therefore, the proposed Action Plans that we have mentioned here are applicable to the coastal zone as a whole without dividing it into different regions (the coastal region was also considered as one entity and was not divided into regions when the baseline budget was prepared).

These Strategic programmes are prepared after extensive meetings and consultation with all concerned stakeholders especially inter-ministerial consultation and working groups or committees. The stakeholders are all the concerned national authorities that have designed a contact person who could contribute to this report.

The national authorities involved are the following:

- Ministry of Environment
- Ministry of Energy and Water
- Ministry of Agriculture
- Ministry of Public Health
- Council for Development and Reconstruction (CDR)
- Municipalities

Non-Governmental Stakeholders

- Environmental NGOs
- Public Health NGOs
- Agricultural NGOs
- The syndicate of farmers
- The association of Lebanese industrialists

For any action plan to be successful, it must have some milestones that are mentioned in the following points:

Legislation and regulation

The formulation of the different types of legislation in terms of laws, decrees and decisions or resolution and the enforcement of such legislation is a very important step for achieving environmental goals and objectives to be set by the government.

Incentives and penalties

There must be incentives and penalties in order to encourage people to implement environmental action plans. This instrument is very essential for the government to couple with the legislation issued or the legislation in preparation. The incentives may be economic incentives i.e. financial like tax reduction or rewards and may be moral like granting environmental certificate that the industries can use in their marketing strategies.

Education and dissemination of information

The ministry of Environment in Lebanon has a separate department for guidance and awareness rising. Moreover, Lebanon has a great number of active non-governmental organizations whose role is to cooperate with the ministry of Environment in order to raise the awareness of the different stakeholders. Each year, these NGOs prepare a proposal for an environmental project whose main objective is to increase the awareness of the concerned parties *vis à vis* the environmental problems and the corresponding solutions. The Government funds these projects from the budget of the ministry of Environment.

International agreements

The international agreements or conventions are very important for the execution of projects that helps in the implementation of the provisions of these agreements. It is very important to mention here that once the government ratifies an agreement, a special law is issued on the national level in order to abide by the provisions of this agreement. Consequently, the government of Lebanon seeks international funding if local funding is not available in order to execute projects for the implementation of these laws.

Objective

1. Set integrated management objective:

   All the stakeholders who were represented in the national committee consulted the national diagnostic analysis for Lebanon, and they were all involved in the preparation of this action plan each in his or her area of authority and expertise. The issue of the integrated management was always highlighted as well as the issue of mainstreaming the work of the committee into the different processes and decisions taken by the different stakeholders.

2. Establish an institutional framework:

- Ministry of Environment: responsible for setting the national environmental strategies in the country in addition to the development of the environmental legislation and the enforcement of these legislations. It is also responsible for the implementation of the programmes targeting the reduction of the pollution in the natural environment as well as in the urban environment e.g. impose environmental conditions of the different industries to be abided by if not penalties will be imposed. It is also responsible for issues related to the conservation of natural and the prevention from the impacts of technology and natural hazards in addition to the issues related to capacity building and raising awareness among the community and other stakeholders.

- Ministry of Energy and Water: in addition to the development of regulations regarding the water and energy in the country, this ministry is responsible for setting up strategies and plans for the exploitation of the national waters in the most effective way. It has a department that is responsible for the environmental issues and this department is always represented whenever the issues of water and environment or water pollution are discussed. This ministry is responsible for the set up of a national wastewater treatment plants and it must control the sound management of the national wastewater. As far as the energy is concerned, it sets the standards for all the imported combustibles (fuel oil, gasoline, and diesel) and it has its own laboratory for testing the quality of these combustibles. The power generation sector is under the custody of this ministry as well.

- Ministry of Agriculture: it is responsible for the importation and distribution and use of the imported pesticides in the county. It is responsible for the development of legislation regarding the pesticides and fertilizers in the country. The minister of agriculture heads the national committee of the agricultural medicines. This committee regulates in cooperation with the ministry of agriculture and under its direct supervision the allowed and prohibited pesticides imported to Lebanon.

- Ministry of Public Health: this ministry is a stakeholder in the project because the environmental problems will directly influence the health situation in the country and because this ministry has the right to allow the importation and use of DDT for public health issues.

- Council for Development and Reconstruction (CDR): this council is the main body responsible for the national planning and the execution and implementation of development projects. It is the main entity that can secure funds for such projects either from international fund providers or from the government budget.

- Municipalities: these are considered the local authorities that will receive the development projects, thus they must be involved in the process from the very initial steps. The municipalities also reflect the local problems that they cannot be noticed by the central government.

Non-Governmental Stakeholders

- Environmental NGOs
- Public Health NGOs
- Agricultural NGOs
- The syndicate of farmers
- The association of Lebanese industrialists

All The stakeholders possess the human resources and capacity in terms of experts and experience in their field. They are aware of the problems or obstacles facing the environmental sector in the country. They are very familiar with all the rules and regulations applied or not applied in the country and why this is the case. They are fully aware of the international agreements and conventions signed and ratified by the Lebanese government. They always follow training workshops and seminars in issues related to the environment and to their area of expertise.
They had previous experience in mainstreaming and even lobbying for environmental issues. On the other hand, they often don't succeed in securing funds for the implementation of the projects recommendations. The main body that can secure funds or loans for the implementation of development projects and in our case pollution reduction development projects (incentives, wastewater treatment plants, networks…etc) is the council for development and reconstruction.

3. Formulate principles, approaches, measures, priority actions and deadlines for the implementation of the strategic action plan within the national framework

Each stakeholder will responsible for the tasks that fall under the jurisdiction of the authority or the party he or she represents. The approaches used in the preparation of these plans are those mentioned in the guidelines developed by Medpol for the preparation of national action plan for the reduction of pollution of the Mediterranean from land based sources. The priorities were selected based on the national diagnostic analysis and the baseline budget report where the scoring exercise set by Medpol was used. The priority actions were selected in relation with the priorities of the pollution problems mentioned in the national diagnostic analysis and baseline budget report.
The timetable for the national action plan won't be detailed in this report because it is unforeseeable and beyond the jurisdiction of the national committee that helped in the preparation of this report. However, the suggested actions are to be implemented within a 10 years time span, some actions are already under implementations and some others are yet to come. Another obstacle for the setting of an exact timetable is that the funds must be secured first in order to commit us to a specific timetable with assigned deadlines for each action.

Monitoring and evaluation of the suggested action will be affected and mainly this monitoring and evaluation will be the job of the ministry of environment. This ministry will monitor and evaluate the success of the activities via the environmental and development indicators that were set by a project implemented in the ministry and called the Lebanese Environmental and Development Observatory.

4. Prepare the resulting investment portfolio

For this purpose, and based on the description previously given on the mandate of the different stakeholders, this responsibility is that of the council for development and reconstruction. And if a stakeholder wants to take over this responsibility of securing funds for an investment, this must be done via and in cooperation of this council. These investments must respond to the developed national action plan framework and to the selected national priorities.

- Definition of financial resource needs.

- Cost estimates of no action: this was estimated in a study undergone by the World Bank and that has estimated the cost of the environmental degradation referred to as the damage cost. Damage cost is presented for each of the following environmental categories: water, air, land and wildlife, waste, coastal zones and cultural heritage, and the global environment. For each of these categories cost estimates are presented for: health/quality of life, and natural resources.
It should be noted that these estimates are orders of magnitude and therefore only an indication of actual costs. The main reasons for not having precise estimates are that available data are often aggregates that do not reflect important geographic variations across Lebanon, precise data or estimates on the consequences of environmental degradation are unavailable or incomplete, and the valuation of these consequences are very rough estimates.
The cost of environmental degradation in Lebanon in 2000 is estimated at 2.8-4.0 percent of GDP, with a mean estimate of US$565, or 3.4% of GDP.
By economic category, the cost to health and quality of life is about 2.1% of GDP and 1.3% of natural resources.
The following table shows the cost of environmental degradation for each environmental category:

	US$ millions per year	**Percent of GDP**
Air	170	1.02
Water	175	1.07
Land, wildlife	100	0.60
Coastal zones	110	0.68
Waste	10	0.05
Subtotal	**565**	**3.4**
Global environment	90	0.5
Total	**655**	**3.9**

These figures are calculated on the national level and they are not specific to the environmental problems that the coastal zone is suffering from. However, the coastal zone cost of environmental degradation share from the overall cost is very high since most of the population is concentrated in the coastal area.

- Benefits derived from the project.
The project will certainly improve the environmental situation of the coastal area since it is expected that in a period of 10 years all the major types of pollution and mainly those caused by the domestic wastewater, will be reduced. The implementation of this action

plan even if it will be a partial implementation will certainly improve the environmental situation in the coastal zone.

- Relevant resources and environmental services.
The human resources are available in Lebanon and they recently became more specialized and more active in the environmental fields. On the other hands, the national authority will seek some professional international experts for the sake of capacity building and for the implementation of success stories proven effective elsewhere in the country. Moreover, if the loans or the funds that will be secured are from international agencies, international expertise will be involved in the implementation of the action plan. We must not forget here, the continuous support the experts in the Medpol programme are giving for the development of the national diagnostic analysis and baseline budget of pollution and now the development of the national action plan and before the grants given for the monitoring of the quality of sea water and the different workshops and training courses that built the capacity of the environmental experts in the country in terms of analytical skills and overall environmental expertise in different environmental areas.

- Identification and mobilisation of partners.
As far as human resources and technical expertise is concerned, all the local partners are willing to cooperate in the development of action plan and they are even willing to cooperate in terms of cooperation in the field work and in the monitoring and control based on the assigned authority of each partner or stakeholder.
On the other hand, no one of the local partners can help in providing funds for the implementation of such plans. The only national stakeholder that can secure funds from international partners and funds providers is the council for development and reconstruction, or such funds will be secured via this council.
The international funding agencies are mainly the World Bank, the Global Environment Facility and some other international funding agencies like the Japanese cooperation agency, the Arab Banks. Etc.

- Development of public-private partnerships.
The private public partnership is already present in Lebanon. The Lebanese industrial association has established a committee dedicated to the environmental issues. This committee is always represented and usually very active in all the environmental and development projects. The individual industries are sometimes helping in the implementation of projects of their own and that are related to the reduction of the environmental pollutions. For instance the cement factories are equipped with high technological air pollution control and monitoring systems, some other industries are equipped with industrial wastewater pre-treatment plants…etc.

5. Define the baselines and the priority activities for issues/actions of a transboundary nature

In terms of international waters, Lebanon has two main rivers that are shared with the neighbouring countries. One in the south of Lebanon and is not a coastal river, it is located in the inner land and it does not end up in the Mediterranean. As for the second river, it is located on the north and it draws the Lebanese Syrian boundaries and it ends up in the river. However, the area there is poor in industries and it is not heavily

populated in the common part. Domestic wastewater problem starts in the part of the river that is specific to Lebanon and that ends up in the Mediterranean sea.
As far as the air pollutants are concerned, all the studies showed that Lebanon contribution to the global pollution is among the least polluting countries compared to the countries in the Mediterranean.

6. Identify NGO's and stakeholders' role in the process, and encourage regional cooperation

The role of the NGOs is very important since it is always imposing pressure on the national authorities to implement corrective measures. And since the work nature of the NGOs is with people in the field, they are they can detect and locate the problem more often faster that the central government or event the local authorities. The Lebanese NGOs are becoming more and more active and experienced in the environmental fields and they are developing partnerships with other NGOs in the Arab and the Mediterranean region and they are attracting international and local funds especially for projects related to the capacity building and increasing the environmental awareness among on the community level.

7. Elaborate monitoring and reporting system

All the parties that were identified in the national diagnostic analysis as contributing to the pollution in the Mediterranean will be invited to workshop to be organized by the ministry of environment for discussing the results and for showing them the national action plan that is developed by the different national stakeholders. During the workshop the different polluting parties will be encouraged to set up their own environmental management plans and programmes no matter how primitive that would be. They will be informed as well that the national authority will control their environmental activities and that it will monitor their progress in this respect and according to the national standards and regulations.

Moreover, the guidelines for the evaluation of the effectiveness of the strategic action programme for the Mediterranean region that describes the reporting system adopted by the Contracting Parties for the evaluation of the effectiveness and compliance to SAP will be extensively explained and discussed with the different stakeholders.

Phase 1: the national diagnostic analysis and baseline budget

- Identification of the nature and severity of problems:

The power generation sector is the most important contributor to releases of pollutants into the air, mainly concerning the organic compounds (such as the polyaromatic hydrocarbons, toluene, dioxins, and furans), heavy metals (mainly chromium, mercury and nickel), and other inorganic components.
Cement production, fertilizer production and the transportation sectors are also important contributors to air emissions.
As for the pollutants released to the sea, the releases are more scattered between the different sectors. As far as the organic pollution is concerned, the main sources of pollution are the farming sector, and the domestic wastewater. As far as the chemical pollution is concerned in terms of chemical oxygen demand, the main sources of pollution are the paper industry, the tanning and textile sectors, and as far as the releases of heavy metals and other inorganic compounds are concerned the main sources of pollution are the tanning sector and the urban wastewater discharges.

- Identification of the contaminants:

The following table shows the most important contaminants and their corresponding load per year:

1-Air emissions:

Pollutant	**Total release (kg/year)**
Benzanthracene	0.9
Benzene	3,923.6
Benzo(b,k)fluoranthene	0.3
Benzo(g,h,I)perylene	0.4
Biphenyl	7.5
Cadmium, Cd	2,065.3
Chlorobenzene	19.4
Chromium, Cr	169.5
Chromium, hexavalent, Cr(VI)	48.0
Copper, Cu	336.0
Dioxins and Furans (PCDD/PCDF)□□g I-TEQ/year	5,130,039.0
Dust	192,040.0
Fluoranthene	1.0
Fluorides, F-	8,291.0

HCl	60,625.0
Hexane	495,000.0
Hydrogen Floride, HF	55,440.0
Indeno(1,2,3-cd)pyrene	0.4
Lead, Pb	339,913.0
Mercury, Hg	290.4
Nickel, Ni	16,000.0
Phenanthrene	2.3
Phenol	134.0
Polynuclear Aromatic Hydrocarbons (PAH)	945.0
Toluene	1,427.0
Volatile Organic Compounds (VOC)	786,600

2-Liquid releases

Pollutant	**Total release (kg/year)**
Ammonia, NH3	38,310
Biochemical Oxygen Demand (BOD5)	154,327,087
Benzo(a)pyrene	8
Cadmium, Cd	100
Chemical Oxygen Demand (COD)	3,183,388
Chlorides, Cl-	838,965
Chromium, Cr	738
Cyanides, CN-	225
F- + Pb + As + Cr + Hg	66,000
Fluorides, F-	672,000
Lead, Pb	1,000
Nitrates	44,056
Oil and Grease	51,039
Phenols	276
Phoshphorous, P2O5	1,513,539
Phosphorous, Total	932,000
Polynuclear Aromatic Hydrocarbons (PAH)	110
Sulfates	97,336
Sulphides, S-	54,060
Total Kjeldahl Nitrogen (TKN)	24,718,850
Total Suspended Solids (TSS)	303,956

- Identification of the physical alterations and degradation of habitats:

The following table shows a list of coastal hotspots resulting from the physical alterations of the coastal zone and thus resulting in the degradation of the marine and coastal habitats:

Sensitive Area/Hot Spot	*Status*	*Rationale*
1. Akkar beach and dunes	B	Beach degradation and erosion
2. Akkar agricultural plain	A	Potential loss of agricultural area due to urbanization and free trade zone
3. Coastal stretch from IPC (Beddawi) to El-Mina port	C	Site of future wastewater plant. Possible site of future solid waste landfill on land reclaimed from the sea. Calls for re-classifying existing coastal tourism zone as an industrial zone
4. Ras en Natour & Enfe	B	Characteristic landscape (salinas, historic port) threatened by mass-scale tourism development
5. Ras ech Chaquaa, w/ Chekka and Selaata industries (from Chekka to Batroun)	A	Outstanding natural beauty and biotope of rich biodiversity, threatened by industrial growth and quarries (Chekka and Selaata). De-classified stretch of coast (previously industrial) offers opportunity for sound management
6. Nahr el-Jawz valley and Msaylha fortress	A/B	Cultural, archeological, and natural landscape requiring protection. Visual impacts of illegal quarry behind Msaylha fortress.
7. Batroun marine reserve	B	Declared reserve ill-defined with no management or conservation plan
8. Amsheet-Jbail coastal area	A	Tourism development pressures could hinder public access to the beach and spoil landscape. Rocky mountain (w/ garrigues) and green area could serve as urbanization buffer zone
9. Nahr Ibrahim valley	B	Unique ecology and legendary landscape devastated by quarrying and currently still threatened by industry and urbanization
10. Jounieh and mountain	C	Characteristic landscape and quality of life degraded by uncontrolled urban growth
11. Nahr el-Kalb valley and river mouth	B	Geology, paleontology, biodiversity, and history of this unique site threatened by infrastructure (highway and power plants) and rampant urbanization. Jeita spring source threatened by increased pollution
12. Metn-Nord	C	Beaches either lost forever or privatized. Opportunity for planned urban development of reclaimed land. High environmental impacts of supplying required aggregate and sand
13. Beirut, w/ Grotte aux Pigeons	C	Several hot spots (port, Normandy landfill) and sensitive areas
14. Airport and ELISSAR	C	Beaches either lost forever (if land reclamation options selected) or privatized. Delicate relocation of industries and people
15. Damour plain	B	Agricultural plain/green space threatened by tourism development pressures
16. Nahr Hammam valley	A	Pristine valley with interesting ecological habitat needing legal protection
17. Saida coastal area	C	Northern beaches threatened by urbanization and tourism development pressures. Coastal highway project would separate old city from fishing port and Sea Castle. Environmental and socio-economic impacts of SIDON port
18. Rmeileh beach	A	Sandy coast to be protected (*Oceana* private beach club)
19. Zahrani area	C	Old refinery site and industrial area requiring rehabilitation

Sensitive Area/Hot Spot	*Status*	*Rationale*
20. Litani sea shore and valley & Kasmieh plain	A	Ecological and economic importance of river needs special protection. Sandy coast and scenic valley to be protected. Agricultural plain threatened by ribbon urbanization along new highway
21. Mhaylib coastal area	B	Publicly-owned "beach reserve," currently partially occupied by illegal housing
22. Tyre, to Rashidieh camp south	B	Unique historic and cultural sites. Access to the sandy beach north and south beach threatened by tourism development projects
23. Rashidieh to Ras el-Ain	A	Competing interests of conservation, agriculture, and tourism need integrated planning and management approach
24. Iskandarouna beach	A	Sandy coast to be protected
25. Ras en-Naqoura	A	Distinctive landscape and ecological importance threatened by rushed development in the event of regional peace. Opportunity to reroute inland the southern stretch of coastal expressway before expropriation and building activities begin

- Identification of the spatial areas of concern:

The entire coastal zone consist the spatial area of concern. For the industrial air pollution and industrial liquid effluents, the main spatial areas of concern are situated in the Mohafaza of north of Lebanon and the Mohafaza of Mount Lebanon. As for the domestic wastewater pollution, the main spatial areas of concern are situated in all the coastal Mohafazas. As for the air pollution resulting from transport, all the coastal cities are suffering from sever impacts of such pollution. As far as the physical alterations, all the coastal zone from the north to the south are under threat and the mount Lebanon, Beirut, and the north of Lebanon Mohafaza have already lost most of their natural beaches.

Phase 2: National/administrative regions issue/impacts matrix

For the purpose of the development of the national diagnostic analysis and baseline budget of pollutants releases and emissions, the coastal administrative region was considered as one entity (all along the Lebanese coastal line), including the different districts naming the south, the north, the Nabatiyeh, the greater Beirut, and mount Lebanon) due mainly to three main reasons:

1. The relatively small size of the Lebanese coastal region which is approximately 200km long, and
2. The fact that the different districts are subject to a central administration
3. Many of the data used in the calculations made in this report are based on national estimates or figures.

The same region is considered for the purpose of this national action plan.

Phase 3: Set up administrative regions plan

Since the coastal administrative region is considered as one entity for the previously mentioned reasons, this national action is developed for the whole coastal region without dividing it into smaller regions.

Phase 4 / Section 1: set up National Sectoral Plans

- **Development of National Programmes for the environmental sound management of Sewage.**
- **Development of National Programmes for the reduction at source and environmentally sound management of urban solid waste in coastal areas.**
- **Development of National Programmes to control air pollution from mobile sources.**
- **Preparation of National Programmes for the reduction and control of pollution by the heavy metals, mercury, cadmium and lead.**
- **Preparation of National Programmes for the reduction and control of pollution by the organ halogen compounds.**
- **Development of National Programmes for the environmentally sound management of wastewater and solid waste from industrial installations that are sources of BOD.**
- **Updating and adopting of national regulations on sewage discharges to the sea and rivers.**
- **Establishing a system of previous authorization by competent authorities for works that cause physical alterations of the natural state of the coastline or the degradation of coastal habitats.**
- **National Implementation Plan for the Stockholm Convention on persistent organic pollutants.**
    - **Phasing out the use of the nine pesticides except for those for which WHO recommendations related to the safeguarding of human life suggest otherwise.**
    - **Prohibiting the manufacture, trade and new use of PCBs.**

1.1- Development of National Programmes for the environmentally Sound Management of Sewage

The total value of studies and works contracts in the wastewater sector to date amounted to U.S.$ 363 million[1]. The plan of the Government in this sector is based on two fundamental considerations:

- Compliance with the provisions of the Convention for Protecting the Mediterranean from Pollution;
- Protection of inland water resources from pollution, knowing that most of the inland water ends up in the sea.

Consequently, the objectives of the plan require treatment of wastewater in all regions of Lebanon.

Sewer Network

Rehabilitation of wastewater sewer networks

This project covered the rehabilitation and extension of wastewater networks in all regions of Lebanon for a total cost of US$ 24 million. It comprised the following:

- Rehabilitation of the two-wastewater pumping stations in Al-Mina-Tripoli and Jounieh cities that are directly located on the seashore.
- Rehabilitation and construction of 820 kilometers of sewer networks.

Work in progress

Beirut coastal wastewater collectors project

This project aims to protect the coastline from Metn to Aley in Mount Lebanon. Wastewater will be collected from the northern regions of Beirut and its suburbs from Dbayeh to Manara and conveyed to Dora. The Carlton-Ghadir-Naameh collector to the Ghadir wastewater pre-treatment plant will convey the wastewater collected from the southern regions of Beirut and its suburbs.

The northern component of this project comprises two wastewater collectors converging on Dora. The first extends from Dbayeh (on the seashore) and the second from Manara (on the seashore), and together they will serve an estimated population of 891,000. This component includes the construction of five wastewater's pumping and lifting stations, and the extension of more than 17 kilometers of wastewater piping networks and culverts. Works of this component started in 1997 and are now complete at a cost of U.S.$ 46 million.

[1] Source: All cost estimations are taken from CDR Progress Report 2003.

The southern part of the collector, which will serve an estimated population of 784,000, includes the construction of two wastewater-pumping stations and 9 kilometers of wastewater sewers. The Islamic Development Bank provided the necessary funding for the construction of the Carlton-Ghadir coastal collector, which commenced during the second half of 2001. The cost of this component of the project amounts to about U.S.$ 10.5 million, of which 15% has now been completed.

Beirut south-suburb sewerage system:: Directlv into the sea!

Primary, Secondary and Tertiary Treatment

Construction of Ghadir wastewater pre-treatment plant

The construction and equipping of the wastewater pretreatment plant serving the southern suburbs of Greater Beirut and the rehabilitation of the associated sea outfall have been completed. This plant was the first wastewater treatment plant in Lebanon. Its construction began in 1974 but was interrupted during the civil war. It was brought into service in November 1997 and its operation and maintenance contracts have been awarded to the private sector.

The Ghadir wastewater pre-treatment plant has an installed capacity of treatment of 36,000 m^3/day, but is currently working on 40% of its capacity.

Protection of the coastline from pollution

Lebanon signed several conventions and agreements for the Protection of the Mediterranean Sea from pollution, which includes the Barcelona Convention and the Genoa Declaration. These agreements underlined the necessity of treating wastewater before discharging it to the sea in cities and towns with populations that exceed 100,000. Many projects have been prepared for the construction of wastewater collector networks and treatment plants in the coastal regions of Lebanon.

On this level, the construction of a treatment plant and wastewater collectors began in Saida during the second half of 2001. The cost is US$ 9.5 million with funding from the Japanese Bank for International Cooperation (JBIC). The ratio of executed works has reached 30%. Similarly, contracts were awarded for the construction of wastewater treatment plants in Chekka (11.3 million euro), Batroun (7.2 million euro), Jbeil (8.8 million euro), Chouf coastal areas (13.1 million euro), and Nabatieh (8.5 million euro). Financing of the construction of these plants was made available through the French Protocol. Execution of works started during 2002.

A contract was awarded for the construction of a wastewater treatment plant in Tripoli (70 million euro) funded by the European Investment Bank (EIB). The contract was awarded to French company *Degrémont* and works have started at the beginning of 2004. But progress is slow and the project will face consistent delay because of expropriation problems.

The project for the rehabilitation of infrastructure in Beirut (first lot) is underway with financing from the Arab Fund for Economic and Social Development (AFESD). The total cost of this project is about U.S.$ 11.3 million. The ratio of executed works was almost 5% at the end of 2002.

Protection of water resources from pollution

A study was undertaken in 1994 to update the wastewater sector master plan which was originally prepared during 1982. This study identified priority areas for the construction of new wastewater treatment plants to protect water resources from pollution.

To accomplish this, financing was secured for the collection and treatment plants in the main inland towns (Zahleh, Baalbeck, Nabatieh, etc.) and in towns close to water resources and springs (Laboue, Qaraoun Lake, Anjar, Hermel, Michmich, Bcharre, Bakhoun, Jbaa, Hasbaya, Chakra, Hrajel and Kartaba). A great portion of the inland waters of these regions ends up in the sea, mainly the southern part of the Litani River and the Hasbani River.

Projects under Preparation

Protection of the coastline from pollution

The ministry of Energy and Water conducted a full study for the Akkar Caza that proposed the construction of a wastewater treatment plant on the coastal village of Abdeh. In addition, detailed designs and tender documents are now ready for the construction of wastewater treatment plants at the coastal areas of Kesrouan and Sour Caza. The Council for Development and Reconstruction is seeking funding for the Kesrouan wastewater treatment plant from the Japan Bank for International Cooperation (JBIC) and for the Sour plant from the European Investment Bank (EIB).

A tender is undergoing for the Dora Wastewater Treatment Plant (north of Beirut), which specifies that the contractor should provide funding for both the design and construction of the plant. A feasibility study has been completed for the extension of the wastewater pre-treatment plant at Ghadir (south of Beirut) to add a secondary wastewater treatment plant to it. While the Council for Development and Reconstruction has already secured about U.S.$ 15 million to cover part of the costs of this extension, it has started negotiations with other funding agencies to secure the needed extra funding.

The Council for Development and Reconstruction is actively seeking to secure funding for the Greater Beirut wastewater treatment project from other funding agencies. This project involves the construction of the sewerage networks to collect and convey the sewerage from the north and south of Greater Beirut to Dora and Ghadir Wastewater Treatment Plants respectively. The European Investment Bank (EIB) expressed interest in funding the construction of the main collectors in the north and south of Greater Beirut, worth approximately U.S.$ 52 million, while the Council for Development and Reconstruction has

proposed to one funding agency the funding of US$ 80 million worth of the sewerage networks for the south of Greater Beirut.

Protection of water resources from pollution

The ministry of Energy and Water and the Council for Development and Reconstruction identified about 20 wastewater schemes located near water resources (springs, rivers, lakes, etc.) in the inland areas of Lebanon.

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Saida coast (in the South): sewerage system.

Design

All the wastewater treatment plants that are under construction or will be constructed are designed to provide secondary treatment of the wastewater with the possibility of being upgraded whenever necessary and upon securing the appropriate funds.

The First Rainfall Separate Collection and Treatment

Maintenance and development of wastewater and storm water sewer networks in the main cities

This project includes the maintenance and repair of wastewater and storm water sewer networks in the main cities and aims to limit overflow and prevent problems resulting from malfunction of existing networks. The works include cleaning of the existing wastewater and storm water sewer networks, in addition to the installation of pipes, fittings and fixtures necessary to improve the efficacy of the networks. The project covers Greater Beirut with its northern and southern suburbs, Tripoli, Zahleh, Jounieh, Saida, Sour and Nabatieh with their suburbs. The project is being carried out in coordination with the ministry of Interior and Municipalities. Works started in 1997.

Rural Areas Discharging Wastewater into the Sea

At present, detailed planning for wastewater treatment exists only for large units. The Government of Lebanon's (GoL) National Wastewater Management Plane foresees that nearly 80% of the population will be connected to major sewage treatment plants by 2020. Even if this program is fully realized and thus only 20% of sewage remains untreated, this implies large inland areas with low population density – perhaps half the national territory

– will be permanently subject to severe environmental pressures from sewage. However, the relevance of rural sewerage policy is considerably larger, as the transition from the 37% of the population presently connected to treatment plants to the 80% envisaged implies decades during which smaller and more distant communities will not be served.

There is, moreover, a second issue of strategic importance for the environment related to sewage treatment for smaller inland communities, which do fall under the 80% target. Two mutually incompatible approaches are currently favored by the two Agencies chiefly concerned with investment in this area. One, the ministry of Energy and Water (MEW), favors collecting and conveying sewage through extended pipelines from inland networks to large coastal treatment plants. The other, favored by Council for Development and Reconstruction (CDR), favors more localized treatment inland through medium-sized treatment plants where feasible.

For the environment, the coastal solution carries grave risks. The large pipelines connecting inland locations to the coast will have to be laid in deep valleys and along the major river watercourses, where they are difficult to maintain and unlikely to be maintained properly. Moreover, during its extended flow time sewage becomes subject to septic conditions, posing problems for adequate treatment at the final destination.

Main elements of a national strategy

- A national plan for rural sewage management
- Standards to be established and enforced for:
  – Septic tanks and leaching fields;
  – Sludge disposal, incl. tanker certification;
  – Constructed wetlands/oxidation lagoons.

Complementary Policy Actions

- Encourage public-private partnership in wastewater management system including collection, treatment and final disposal while maintaining public sector involvement (municipalities, Ministry of Environment, Ministry of Water and Energy) to monitor compliance with regulation and setting future policy/strategies.
- Educational and awareness program mainly in unsewered communities to promote responsible water use.
- Need for a national training center for training wastewater treatment plant operators on the proper operation and maintenance of plants and sampling procedures.
- Develop modular systems for septic tank and leaching field design as well as other suitable onsite treatment systems to enable standardization of equipment and simplifying operation and maintenance.
  - Disseminate these designs through the Syndicate of Engineers (for new building permits).
  - Get the input and approval of Ministry of Public Health.
  - Centralize the process of securing financial support for wastewater projects.
  Prevent duplicate projects from being implemented through presenting the national plan to various donors and municipalities.
- Sludge management
  - Sludge should be disposed of in a manner that is compatible with the national sludge management plan.

- Collect and dispose sludge from septic tanks, especially in unsewered communities, to approved processing facilities/centers and prevent illegal disposal through dumping.
- Certify sludge collection/disposal operators so that septic tank sludge is not illegally dumped in river valley.

Management of other types and/or sources of wastewater (namely: industrial, hazardous and landfill leachate) are also beyond the scope of this action plan, although proper management these wastewaters (effluents and sludge) is also currently deficient.

National Wastewater planning

A National Wastewater Management Plan (NWMP) for Lebanon was initially prepared in 1982; however, none of its recommendations were implemented, until recently.
The wastewater studies focused on assessing existing conditions of sewerage related infrastructures and needs. The ministry of Environment (MoE), created in 1993, was initially mandated with wastewater management (collection, treatment and disposal of effluent and sludge) and thus commissioned a project, "Lebanon's Staged Wastewater Program" (LSWWP), to verify and update the NWMP data, mainly design concept, population statistics, economic/financial data as well as combining the wastewater information from the Council for Development and Reconstruction Damage Assessment reports.

The Engineering Consulting Office, Khatib and Alami (1994) estimated that 28 percent of a total of 1693 inhabited communities (cities, towns, villages) in Lebanon are responsible for generating nearly 77 percent of wastewater. An inventory of sewered and unsewered communities was compiled by the study.

The study listed 116 major cities and town as equipped, to varying degrees, to a sewer line; it listed 788 communities (100 < population < 1000) and 150 communities (population < 100) with no sanitation. Note that these statistics rely on the 1994 estimated population size and it is recommended that this decade old inventory be updated to take into account population growth and recent projects to determine the extent of progress in this sector.

Since then, several preliminary and pre-feasibility design studies for wastewater treatment plants (WWTP) and sewerage networks have been conducted, but progress in implementing the projects has been slow due to lack of adequate financing.

The ministry of Water and Energy plan favors the construction of a limited number of large-scale plants mainly along the coast and major inland cities, totaling around 60 Wastewater Treatment Plants. The Council for Development and Reconstruction, on the other hand, favors the construction of about 110 Wastewater Treatment Plants smaller in capacity and more dispersed in locations. Nevertheless, the lack of adequate funding has hampered the immediate implementation of either plan. Still, the Government of Lebanon through the Council for Development and Reconstruction and the ministry of Water and Energy has prioritized 37 Wastewater Treatment Plants for immediate action.

The ministry of Water and Energy (MEW) through the four regional water authorities is currently mandated with wastewater management (Law 221 and Law 337) and not the ministry of Environment. The ministry of Environment's sphere of influence is currently

limited to review and assessment of any Environmental Impact Assessment (EIA) reports and setting effluent limit standards.

The ministry of Water and Energy's 10 year plan (2000-2010), approved by the Council of Ministers, calls for the:

1. Construction of dams and mountain lakes;
2. Implementation of potable water projects;
3. Rehabilitation and construction of irrigation network projects;
4. Construction of wastewater treatment plants;
5. Prevention of river flooding.

The Council for Development and Reconstruction estimates that its proposed plan will ultimately connect nearly 80 percent of the projected Lebanese population in 2020 to a sewage network. This implies that nearly 20 percent of the population will be left without connection to sewage network and thus potentially inadequate sewage treatment and disposal practices. These population groups would mainly be clustered in high mountain communities or small villages (less than 1,000 inhabitants) in Hermel, Akkar, and South Lebanon and Nabatieh are not anticipated to be connected to sewer networks because of economic constraints.

Small Wastewater Projects outside Government of Lebanon (GoL) Planning

In addition to the GoL projects there are that several community based initiatives/activities currently taking place in various regions for the benefit of local municipalities to mitigate wastewater problems.

The ministry of Environment wastewater follow-up committee estimates that 71 percent of the projected population in 2020 would be served by the 12 largest Wastewater Treatment Plants (Tripoli, Batroun, Chekka, Jbeil, Keserwane, Dora, Ghadir, Saida, Sour, Nabatieh, Baalbeck, Zahleh).

Major Obstacles

The major obstacles to implementing a proper wastewater management system in rural area are:

- Lack of adequate financial resources (it is not financially viable or cost effective) to connect all of the Lebanese communities to a sewage network leading to a wastewater treatment plant (WWTP).
- Relatively high cost for individual households/buildings to install private wastewater treatment systems.
- Inadequate design and construction of septic tanks and limited use of leaching for effluent treatment prior to discharge.
- Need for updating and consolidation of wastewater legislation (including sludge management and effluent discharge standards).
- Scare funds and resources at the municipal level (especially outside the major coastal cities) prevent the implementation of proper wastewater management.
- Lack of an adequate mechanism to recover investment costs of wastewater projects and sustain proper operation and maintenance (municipalities charge an annual tax

for sewage maintenance but it may not be adequate to recover costs of installing networks in rural areas or construction of small WWTP).

- Lack of coordination between the ministry of Water and Energy (MEW) and the Council for Development and Reconstruction (CDR) on prioritization of wastewater project.
- Lack of an administrative framework for international donors that focus on rural development projects (such as US-AID) to finance priority wastewater projects and are thus left to fund various projects without proper coordination with the government agencies.
- International funding for proposed national WWTP and sewage networks is not centralized through a single institution.
- Some of the MEW proposed dam locations might have unsewered upstream communities within their watershed.

Working Policy Steps Required

Working policy steps required to implement a proper wastewater management system in rural areas include:

- Push for a consensus at the highest level of government (MEW, CDR, MoE, ministry of Interior and Municipalities, and the Council of Ministers) for adoption of a unified national wastewater management strategy.
  This strategy should advocate protection of water resources (surface and groundwater) irrigation water and safeguard public health. This consensus could be achieved through the wastewater follow-up joint committee.
- Centralize the process of securing financial support for wastewater projects. Prevent the duplicate projects from being implemented that are not within the government national plan through presenting the national plan to various donors and municipalities.
- Draft and adopt the following wastewater related legislation:
  - Wastewater effluent discharge standards for various media (e.g. discharge onto land, well injection, irrigation - update of MoE Decision 8/1 of 2001);
  - Proper sludge disposal guidelines;
  - Proper design of rural septic tanks (two-compartment) and leaching fields in unsewered communities. (Require high quality treatment, i.e. removal of nutrients, only in areas with significant water resources);
  - Proper design of constructed wetlands or oxidation lagoons;
  - Note that it is currently illegal to irrigate with treated wastewaters (Decree 8735 of 1974).
- Educational and awareness program mainly in unsewered communities to promote responsible water use.
- Encourage public-private partnership in wastewater management system including collection, treatment, and final disposal while maintaining public sector involvement (municipalities, MoE, MEW) to monitor compliance with regulation and setting future policy/strategies.
- Need for a national training center for training wastewater treatment plant operators on the proper operation and maintenance of plants and sampling procedures.

- Develop modular systems for septic tank and leaching field / soak away design as well as other suitable onsite treatment systems to enable standardization of equipment and simplifying operation and maintenance.
  - Disseminate these designs through the Syndicate of Engineers.
- Sludge management:
  - Sludge should be disposed of in a manner that is compatible with the national sludge management plan.
  - Removal/disposal of sludge from unsewered communities to approved processing facilities/centers and prevent illegal disposal through dumping.
  - Certify sludge pumping/disposal operators so that pumped septic tanks are not disposed in river valley.
- Enforcement of existing legislation
  - Prohibit direct discharge of sewage to irrigation or drainage channels, watercourses or the sea (Order 320 of 1926; Decree 2775 of 1928; Decree 8735 of 1974).
  - Construction of small on-site wastewater treatment systems or septic tanks in areas not connected to a sewage system (Decree 7975 of 1931; Decree 2761 of 1933; Decree 8735 of 1974).
  - Prevent disposal of sewage into bottomless pits or wells (Decree 8735 of 1974).
  - Wastewater effluents standards (MoE decision 8/1 of 2001).

Domestic Wastewater Sector Action Plan:

The following are recommended tasks to be undertaken:

- Coordinate with government officials (MEW, CDR) and secure unified support for immediate action for proper and cost effective wastewater management. **To consider coastal wastewater treatment plants as top priorities** (the "shéma d'aménagement du territoire" has considered costal wastewater treatment plant as long term priority; see page 27).
- Prepare necessary wastewater related legislation in coordination with pertinent stakeholders.
- Disseminate the new wastewater effluent standards when they are approved concurrently toward existing standards.
- Education and awareness campaigns
- Obtain updated CAS survey of buildings and establishments data related to locations with sewerage connections, if the data becomes available early enough to include it in the action plan.
- Provide complete sewage network serving the whole population in the coastal administrative zone.
- Assist the Council for Development and Reconstruction in setting up and implementing an investment schedule based on the estimated costs of all proposed wastewater projects (treatment plants and sewage networks), prioritize locations and then meet with potential donors to secure funding.
- Investigate potential to secure international funds (grants/loans) to install sewage networks in small rural villages (1000 < population <5000) focusing on areas with significant water resources.
- Explore with Investment Development Authority for Lebanon (IDAL) and GoL the potential for privatization of portions of the wastewater sector (operation & maintenance of treatment plants),

- Assess the results of the "National Sludge Management Study" and build upon its recommendations within the framework of MSC-IPP Environment.
- Explore with IDAL potential to attract investment in sludge management plants (anaerobic digestion, composting, land application).
- Recommend and assist in setting-up a national training center for training wastewater treatment plant operators on the proper operation and maintenance of plants and sampling procedures.
- Continue to disseminate the currently available MoE wastewater effluent standards (Decision 8/1 of 2001) to local wastewater contractors as well as other interested parties.
- Propose that contractors that have a track record of being able to design and construct WWTP meeting the MoE decision 8/1 be given a special certification from the MoE.
- Create comprehensive map for simplified viewing of wastewater projects to assist in securing funding.
  - Confirm that upstream communities of MEW proposed dam and lake locations is protected by an adequate and functioning sewer network connected to a treatment plant prior to completion of dam/lake construction.
  - Gather data from the MEW and water authorities on the location of the major potable groundwater wells and insure their protection from unsewered upstream communities.
- Complete connection of all the coastal cities and urban agglomerations to an efficient sewer system that do not dispose of in the sea.
- The coastal outfalls must only discharge treated water in compliance with the national standards for discharging treated domestic wastewater into the sea. The discharge into the sea is made only if the treated effluent is not intended to be reused such as for agricultural purposes.
- Insist on the upgrading of the wastewater treatment plants to the secondary and even the tertiary treatment whenever this is necessary.
- Develop operation and maintenance plan in addition to a training plan for the local staff operating the treatment plant in order to transfer the know how to the local technical persons the issue that will ensure the sustainability of the project, the effectiveness of the treatment process and the clean environment.
- Develop plans for the reuse of the treatment effluent for the irrigation of the agricultural plains. The treated must be compliant with the appropriate national and international standards in order to be appropriate for the use in the irrigation practices. This task must be applied in the northern and southern Mohafazas of Lebanon where coastal agricultural plains do exist. For the Mohafazas of Beirut and Mount Lebanon this practice is not feasible for the absence of the agricultural plains. It is recommended to transfer the treated effluent to the north or the south for irrigation if this is needed, if not to discharge the treated effluent into the sea.
- The enforcement of the pretreatment of the industrial discharges before they are disposed of in the sewer network. The legislation already exists in the decision 8/1 that was issued by the ministry of environment in 1/3/2001 but needs to be enforced by the ministry of environment in cooperation with the ministry of interior and municipalities and the different mohafez and councils of municipalities.

Schéma d'Aménagement du Territoire Libanais

PHASE II

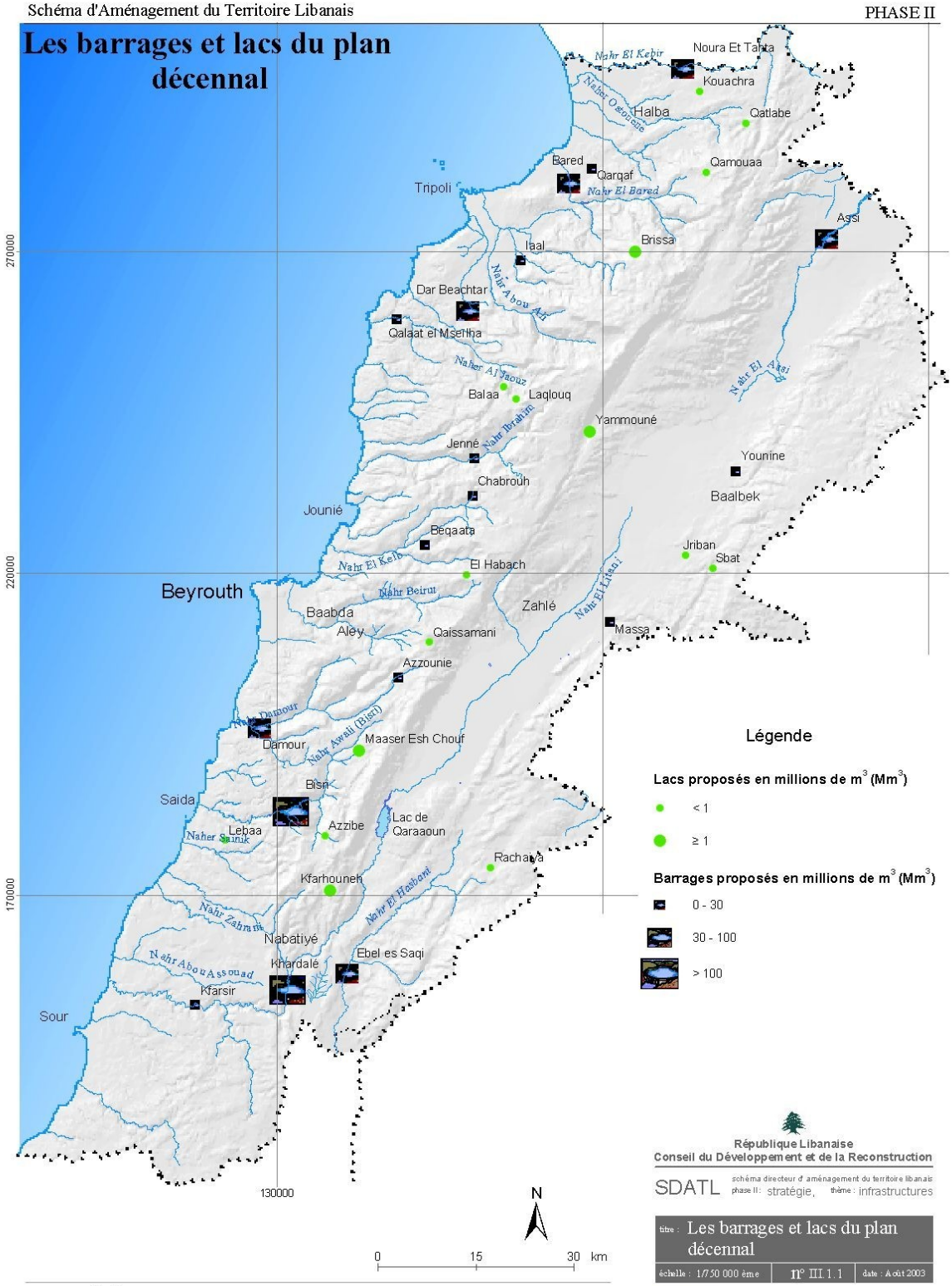

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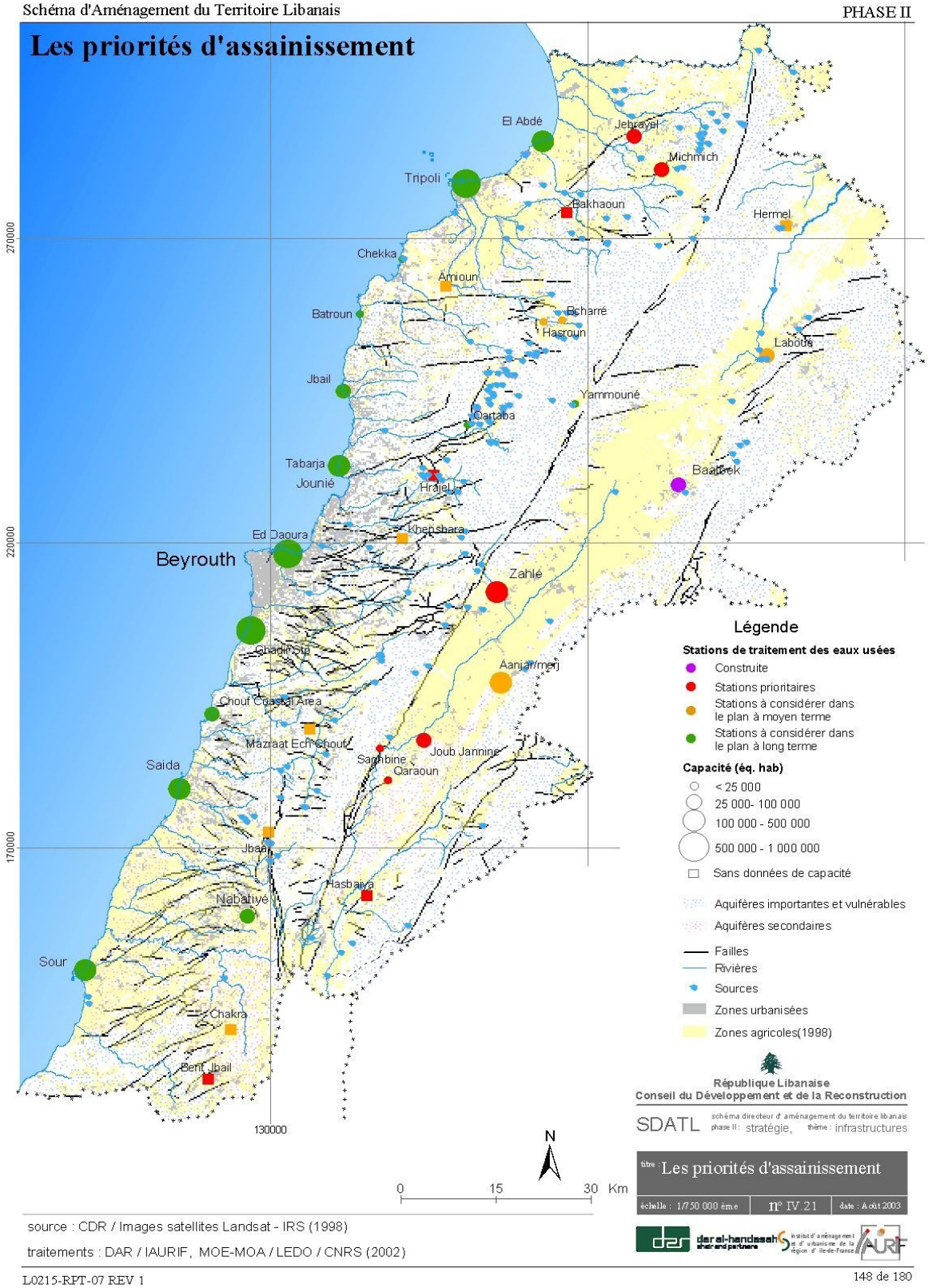
Schéma d'Aménagement du Territoire Libanais

PHASE II



source : CDR / Images satellites Landsat - IRS (1998)

traitements : DAR / IAURIF, MOE-MOA / LEDO / CNRS (2002)

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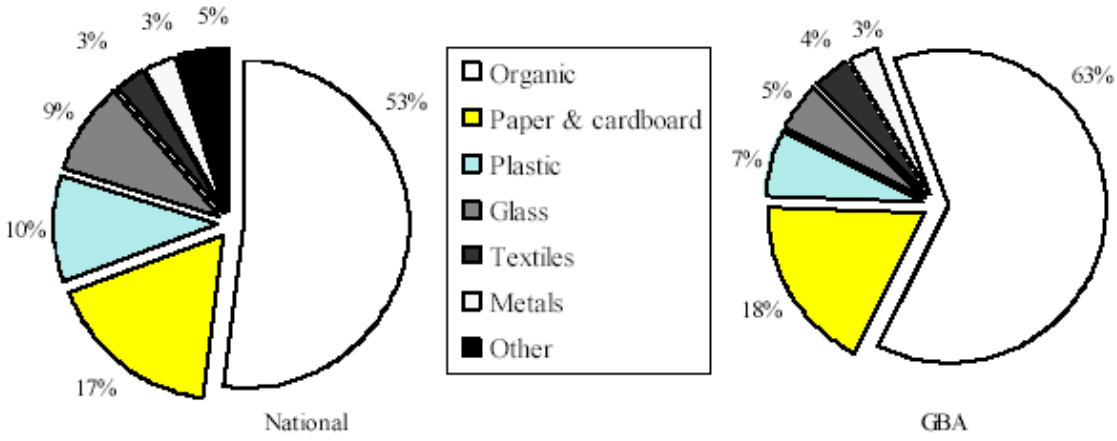
1.2- Development of National Programmes for the reduction at source and environmentally sound management of urban solid waste in coastal areas

Municipal Solid Waste Management

The problem:

1. Greater Beirut Area generates just over half the nation's municipal waste. It has a fully functioning privatized waste management system, which has three major drawbacks:

- It is 2-3 times more expensive per ton to operate than justified.
- It relies mainly (80%) on a managed landfill, which is close to maximal capacity.
- There is limited composting (15%) and recycling (5%).



Composition of MSW in Lebanon and the GBA

2. The rest of the country relies largely (exc. Tripoli) on large poorly managed dumps or illegal waste dumps, with 5% recycling by scavenger activities.
This leads to gaseous emissions (including greenhouse gases), unpleasant odors, fire hazards, ground and surface water pollution, ugly landscapes and rodent infestations.
Continued waste management in Greater Beirut Area (GBA) and introduction of waste management to the rest of the country requires, i.e., new landfills. Increasing the number of landfills faces two major obstacles:

- The shortage of appropriate sites for new landfills
- Money for investment and operation of managed waste facilities.

Coping with the problem of space

For the time being, there is no inherent geographic obstacle to finding sites for new landfills. The political obstacles are partially addressed by a new GoL incentive system for cooperating municipalities, which make sites available. However, in the medium term both geography and local politics make land a serious constraint, which has to be addressed by a waste management strategy, which reduces the need for land filling.

In theory, the amount of waste going to landfills can be reduced by:

- Incineration
- Recycling (paper, plastics, glass, metals)
- Waste minimization

Incineration:

Incineration must be excluded for the time being on cost grounds. Note that the cost of disposal in a medium-sized incinerator is about $ 100/t, i.e. the current cost of the regime in GBA but double the cost of a more competitive and efficient regime.

Recycling:

Recycling can be improved somewhat in GBA[2] by improving links between post-collection sorting and recycling firms. However, theoretical recovery rates based on northern European examples require highly disciplined sorting at source that will only be adopted very gradually (cf. Italy). A pilot strategy for increased sorting in selected neighborhoods should, however, is part of future waste management contracts.

Waste minimization:

Minimizing packaging waste is not so far the object of official policy initiatives. The scope for such a strategy and instruments for carrying it out require further study.

Composting:

It appears as the main technology able to reduce volumes significantly. The arguments in favor of greater reliance on composting is (a) the high organic content of Lebanese waste (63% in GBA and 53% elsewhere); and (b) its cost, roughly half that of incineration.
The actual contribution to reducing waste-for-landfill may, however, be limited to 35% of total volumes. However, together with recycling and waste minimization, only 50% of wastes need to be disposed in landfills (cf. 95% ex-Beirut).

Problems of composting:

There are two major problems related to composting:

- Disposal
- Economics

Both problems are linked to the poor quality of the compost, the consequence of the need to rely on inherently incomplete post-collection sorting in Lebanon. The resulting product cannot find a market (and revenue!) in high-value agricultural applications.

The disposal problem could be solved either by land filling (reduced, safer volumes relative to raw waste) or land reclamation schemes (quarries, erosion damage). In either case, the compost generates little or no revenue.

[2] GBA here denotes Beirut and the Mount Lebanon Cazas of: Aley, Baabda, Chouf, Metn, Keserwane

Enforcing present legislation requiring quarry owners to restore quarries could generate demand for compost, perhaps making a small contribution to cost-recovery. Financing the investment and operation of composting plants can only be assured by a combination of measures proposed below, including an element of user charging.

The strategy of the management of MSW (i.e. household/commercial waste) and other solid waste sources (namely: industrial, hazardous, medical, construction and demolition or sludge) are beyond the scope of this strategy, although proper management of these solid waste types is currently lacking.

Municipal Solid Waste (MSW) disposal options

2.1 Current situation

In the Greater Beirut Area:

1. 80 percent of waste is disposed in landfills;
2. 15 percent of the waste is composted;
3. 5 percent of recovered material is recycled;
4. Incineration is not practiced.

Outside the Greater Beirut Area:

1. 95-100 percent of waste is disposed in dumpsites;
2. 5 percent of waste is recycled by scavenger activity;
3. No composting currently takes place, although there are a number of proposals by individual/group of villages to start small scale composting facilities in their area;
4. Incineration is not practiced (although open burning is practiced).

2.2 Proposed options

There are numerous waste treatment and disposal methodologies available worldwide. The table below presents a comparative summary of various MSW treatment and disposal methods. However, three management schemes are proposed for Lebanon:

1. Land filling of waste without sorting and minimal recovery of recyclables;
2. Land filling nationwide combined with incineration in the GBA;
3. Waste sorting with emphasis on composting of organic fraction combined with recovery of recyclables (plastic, metals, glass, paper& cardboard) prior to land filling of residual waste. The first scheme is currently being practiced in the regions outside the GBA. However, without the benefit of sanitary landfills, waste is currently being disposed haphazardly in dumpsites (Zahle is the only exception since it has recently completed construction and started operation of a sanitary landfill). The recovery of recyclable material is limited to scavenger activity.

Disadvantages are mainly excessive land requirements in a country were land is scarce. The second scheme is being proposed to maximize waste volume reduction although the costs of implementing it are prohibitively high in the current economic climate of the country. This

scheme is highly dependent on the effective source separation of organic matter (kitchen and garden wastes) from other waste types for the efficient operation of the incinerators.

Disadvantages are mainly:

- High costs;
- Land filling of organic matter leading to elevated leachate and methane generation rates;
- No recycling.

The third scheme presents the most integrated approach to MSW management in Lebanon. Although this option is currently being inefficiently executed in the GBA, it can be improved by increasing composting capacity and should be applied at the national level.

Recommendations

The small area of Lebanon and its mountainous geomorphology suggests that availability of land resources suitable for proper land filling activities is in short supply, thereby underscoring the need to maximize the capacity and duration served by sanitary landfills through minimization of the waste stream entering them. Furthermore, the organic rich content of the MSW in Lebanon presents an opportunity to biologically treat a majority of this waste through composting thereby reducing the total waste quantity land filled at a unit cost lower than incineration. In addition, the recovery of recyclable material (source separated and in sorting plants) is essential in further reducing land filled waste volume.

In line with the above needs, nationwide waste treatment/recovery targets of 35 and 10 percent for composting and recycling, respectively and land filling for the remaining portion (55 percent) should be achieved.

The following table shows the waste treatment/disposal rates:

Treatment / disposal method	Capacity (tons/year)	Estimated average cost* (US$/ton)
Composting	10,000 20,000 50,000	70-80 40-70 30-60
Anaerobic digestion	10,000 15,000 20,000 50,000 70,000	130 110 90-100 70-80 70
Incineration	50,000 100,000 200,000 300,000 600,000	230 140 105 85-97 65
Pyrolysis	20,000 50,000 100,000 200,000	150 100-110 85 70
Landfilling	50,000 100,000 150,000 300,000 500,000	50 35 28 20 17

*** Waste figures are for the year 2000**

It is recommended that several Areas/Cazas work together to jointly build and operate a single landfill and/or compost plant to benefit from reduced costs associated with economies of scale. This is dependent however, on availability of suitable land area and the additional transport costs involved in transferring waste.

The contracts awarded in the solid waste sector have covered the construction of landfills and procurement of supplies, in addition to contracts for the operation of waste collection and treatment. The total value of these contracts amounted to about US$ 682 million, the majority of which are long-term operation contracts, extending up to ten years.

The Solid Waste Environmental Management Project (SWEMP), financed by the World Bank, continues to form the only framework for a plan of action in this sector. The project encountered implementation difficulties that lead to a reduction in the original World Bank loan for the SWEMP project to US$ 25 million.

This amount shall cover the construction of 3 out of the 10 sanitary landfills originally planned under SWEMP. The Council for Development and Reconstruction is working at present, in cooperation with the concerned ministries, on preparing a comprehensive plan for solid waste management in Lebanon.

Achievements to Date

The Urgent plant for the treatment of solid waste in Greater Beirut

Following the closing of Bourj Hammoud dumpsite in January 1997, the Lebanese Government decided to implement an urgent plan for the treatment of solid waste in Greater Beirut. For this purpose, a contract was signed with SUKOMI to expand and increase the capacity of Amrousieh and Qarantina treatment plants, and to improve the process of sorting the waste, extracting recyclables, and composting the organic material. This plan also included the construction of sanitary landfills for Greater Beirut and its suburbs. According, two landfills were constructed, one in Naimeh and the other in Bsalim. Both landfills are currently operational.

Bourj Hammoud dumpsite.

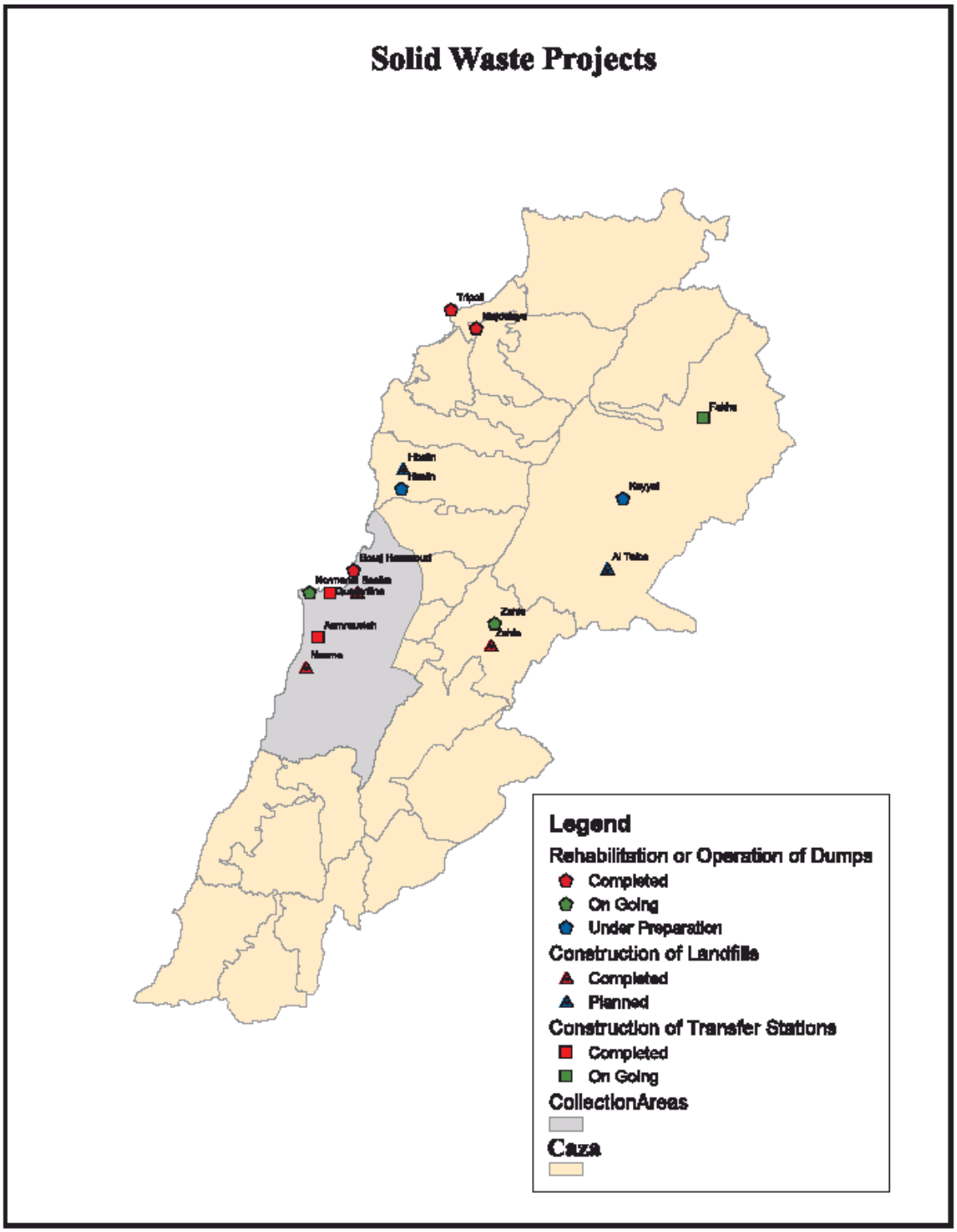
Saida dumpsite.

Normandy dumpsite (Beirut,) after treatment.

Rehabilitation of Tripoli dumpsite

The uncontrolled solid waste dumpsite, located at the seashore of the city of Tripoli was rehabilitated, whereby a sea wall was constructed around it to limit the negative impacts on the environment. Additionally, needed equipment for the operation of the dump was

procured to improve solid waste management in the Tripoli region. The dumpsite is currently operational.



Procurement of waste collection equipment for various regions

The World Bank, within the framework of SWEMP, funded the procurement of waste collection equipment, including vehicles, street sweeping machinery in addition to special containers. The procured equipment was distributed to all Lebanese regions. In a second phase, the World Bank, within the framework of SWEMP, funded the procurement of waste collection and street sweeping equipment designated for the regions in which landfills were constructed or uncontrolled dumpsites were rehabilitated, such as Zahleh and Tripoli.

Projects in Progress

Operation contracts

After the Council for Development and Reconstruction, who was given the responsibility to implement the Urgent Plan for Greater Beirut, signed a contract with SUKLEEN for the collection of household solid waste and street sweeping in Beirut and some regions of Mount Lebanon, and two contracts with SUKOMI for the operation of Amrousieh and Quarantina solid waste treatment plants and Coral compost plant, as well as the construction and operation of the Naameh and Bsalim sanitary landfills.

The Council for Development and Reconstruction was recently directed through Council of Ministers Decision No. 27/2002, to merge the three contracts related to waste collection, street sweeping and land filling into one contract.

After cells (1) and (2) of the Naameh site, operated within the framework of the emergency plan for Greater Beirut and which cover an area of 120,000 m2 with a combined capacity of 2 million tons of waste, had been fully utilized, an additional area of 62,000 m2 was used as a new cell (3) that should provide the needed capacity until mid 2003.

Waiting the merging of the three waste collection contracts, the period of the contract for the solid waste collection and street-sweeping contract in Greater Beirut that had expired on 31st December 2000 has been extended since on an annual base (and is currently undergoing).

Operation of Tripoli dumpsite

Following an international tender in 1999, the CDR signed a contract with BATCO for the operation of the Tripoli dumpsite. The contract is renewable annually, and is financed by the Federation of the "Al-Fayha'" Municipalities. The purpose of this contract is the proper land filling of incoming waste, and the extracting and burning of generated gases.

Treatment of the Normandy dumpsite

The remediation of the uncontrolled dumpsite that is located along the seashore of the Normandy area, near Beirut center, has been included in the reconstruction and development plan for the Beirut Central District, which the government had awarded to Solidere. The project consists of sorting and treating the existing waste and recovering materials suitable for backfilling and the reclamation of an area from the sea. The cost of the

project is about US$ 53 million. A technical control consultant (Dames and Moore) has been appointed to supervise the execution of the project.
About 75% of the works has been performed and the project is expected to be fully completed by the end of 2004.

General vue of sanitary landfill-Naameh

Treatment of hospital waste

The Council for Development and Reconstruction awarded a contract to Environment Resources Management (ERM) for the preparation of a study, funded by the World Bank, concerning treatment of hospital waste. Several phases of the study have been completed and this has allowed the taking of decisions on the best treatment methodology for this type of waste. The ministries of Environment and Public Health together with The CDR, and in accordance with international specifications and standards, have agreed to the concept of constructing a central incinerator working at a minimum temperature of 1200^{o} C for the treatment of hospital waste. CDR is investigating the sitting of a location that can meet the criteria specified by the consultant and that can have the approval of local authorities.

Marketing of compost and recyclable materials

A feasibility study has been commissioned for the marketing of organic compost and recyclable materials resulting from the operations at Qarantina, Amroussieh, and other treatment plants. The study is financed by the World Bank as part of SWEMP and has been completed in 2003.

Projects in Preparation

Sanitary landfills

Preparations are underway for the construction of two sanitary landfills in Jbeil and Baalbeck/Hermel, after making the necessary site expropriations by the municipal authorities.

The Council for Development and Reconstruction launched an international tender for the rehabilitation of Hbaline dumpsite (Jbeil Caza) and the construction of a sanitary landfill in its place. The related contract has been awarded and the landfill is currently operational.

The Council for Development and Reconstruction has also completed the tender documents for the construction of a sanitary landfill in Baalbeck. The invitation to tender, which shall be open to international firms, is expected to be issued very soon. The World Bank as a part of SWEMP finances these works.

The Council for Development and Reconstruction also intends to award a contract for a study covering the rehabilitation of the uncontrolled dumpsite in Al-Kayal-Baalbeck area through a tender restricted to local consultants. The award of the rehabilitation works contract is planned for the end of 2004.

A contract for the construction of a solid waste transfer plant in Hermel is expected to be awarded by end of 2004 – beginning of 2005 through an international tender, funded by the World Bank.

Procurement of equipment and vehicles

Invitations to tender shall be issued for the procurement of equipment for the operation of new sanitary landfills, waste collection, and street sweeping. The World Bank is funding this project.

Municipal Solid Waste Sector Action Plan

- Secure funds for the investment and operation of managed waste facilities.
- Secure more sites for new sanitary landfills.
- Secure more space for waste segregation and sorting.
- Upgrade the present composting plant to produce good quality compost and to be able to compost all the organic waste of the country.
- Secure a market for the produced compost.
- Initiate recycling projects and encourage and facilitate their implementation.
- Investigate on the incineration option of wastes.
- Secure funds for the rehabilitation of the polluting coastal zone open dumps.
- Establish an effective and a complete collection of the solid waste in the coastal zone.
- Develop and implement a decree on the management of industrial solid waste in order to remove it from the domestic solid waste stream.
- Develop and implement a decree on the management of medical solid waste in order to remove it from the domestic solid waste stream.
- Encourage and impose the implementation of projects for the environmentally sound management of industrial and hazardous and medical solid waste as required by the legislation.
- Development and implementation of training programs for the reduction, reuse and recycle of the solid waste generated from the different households and institutions. In this respect, there are success stories in Lebanon regarding the waste segregation from the source and other success stories in the recycling industrial sector.
- Develop incentive programs for the municipalities implementing waste reduction and recycling programs.
- Develop incentive programs for the municipalities receiving a sanitary landfill within its boundaries.

1.3- Development of National Programmes to control air pollution from mobile sources

Transport sector

The law No. 246 dated 17 July, 1993 and its amendments covers the costs of completion of new road projects, together with the upgrading road services in Greater Beirut. Furthermore, the total cost of the plan for the rehabilitation and development of classified roads in Lebanon (international, main and local) is about LL 1800 billion. This plan has been included as a project law in the government's general budget in 2002, to be implemented over a period of ten years. It is still in the initial phase of implementation through a pilot project valued US$ 66 million, partially funded by the World Bank.

Achievements to Date

Penetrator roads

The completion of Beirut ring road and the associated penetrator roads are expected to reduce traffic congestion at the entrances of the capital and improve travel between the North and the South of Lebanon. The penetrator roads are comprised of three sections:

- The coastal highway
- The central section
- The southern coastal penetrator roads

Rehabilitation of roads in the suburbs of Beirut

Northern suburbs

Works are complete on the Bourj Hammoud, Jdeideh, Zalka sectors; the roads parallel to Nahr el Maout and Nahr Antelias, the roads in Dbayeh sector, Nahr Beirut-Dora road, and the road replacing the railway track in Bourj Hammoud and the Bikfaya road. Rehabilitation works of Sin el Fil road and Saloumi- Naba'a-Nahr el Maout road are also complete. These works represent a total value of about US$ 62 million.

Southern suburbs

The works completed to date are the Chiyah Boulevard and the adjacent streets, Choeifat-Khaldeh, Haret Hreik drainage tunnel, the Mreijeh, Kassis, Ghobeyri, Haret Hreik, Bourj el Barajneh, Furn ech Chebak and Ain el Roumaneh road sections.
Rehabilitation works of Jamous road and its related general services are also complete. These works represent a total value of about US$ 130 million.

Projects in Progress

Penetrator roads associated with Beirut ring road

The works for most other sections of the penetrator roads are in progress. The present state of progress is as follows:

- Bourj Hammoud-Naba'a
- Haret Hreik-Airport road link:
- Ajaltoun interchange
- Kafaat-Lebanese University campus road: The works are in progress.

Southern suburbs Coastal roads

- Rehabilitation of Doha- Aramoun road network and infrastructure (wastewater, storm water, potable water, electricity, telephone, construction of three water reservoirs, water supply wells in Mechref and mains to Doha-Aramoun). The works were 92% complete at the end of 2002.
  Completion of pavement works in some streets is under-way.

- Hay es Sulum
  Rehabilitation of Hay es Sulum roads and related public service networks (wastewater, storm water, potable water, electricity, telephone, street lighting, etc.). The tendering process has been completed but the works contract has not yet been awarded.

North of Lebanon coastal Roads

Rehabilitation and development works of Tabarja-Chekka expressway are in progress. The European Investment Bank funds this project and the end of 2004 expects completion of work.

South of Lebanon Coastal Roads

Work is also in progress on the Saida -Sour expressway and on the Seafront Boulevard of Saida.

Projects in Preparation

Penetrator roads from the Beirut ring road

The Beirut northern entrances have been split into two projects that are funded by the Kuwait Fund for Arab Economic Development.

Invitations to tender for the first section comprising the Dbayeh-Antelias and Naccache-Rabieh links were issued in 2000. The works have started and are estimated to cost about US$ 11.7 million. Design work is currently in progress for the second section between Antelias and the Beirut Port, which will be the subject of a subsequent tender.
The construction of Ouzai bridge has been awarded but site problems have delayed implementation.

Rehabilitation of road networks in Beirut suburbs

Southern suburb: Four new work packages will be put out to tender as soon as funding becomes available. These packages are:

- Nahr al-Ghadir (Lot V);
- Old Saida road (Lot V1);
- Dohat el Hoss;
- Khaldeh area.

Greater Beirut urban transport project

This project aims at improving traffic flow in Greater Beirut. It comprises three components; namely:

- Improvement of main traffic routes that includes provision of overpasses or underpasses at 19 crossroads as well as carrying out other works along the main roads.
- The installation of 220 traffic signals, 30 traffic-monitoring cameras, traffic signs, road marking, the construction of a traffic monitoring and management center and the upgrading of pedestrian walkways.
- Parking management program for 5,000 car spaces using parking meters. The project cost is estimated to be about US$ 115 million. The World Bank, which is funding part of the cost (around US$ 65 million), has conducted a project appraisal. Tender documents are being finalized for the various components of the project and pre-qualification of contractors and consultant engineers is underway.

Beirut eastern entrances

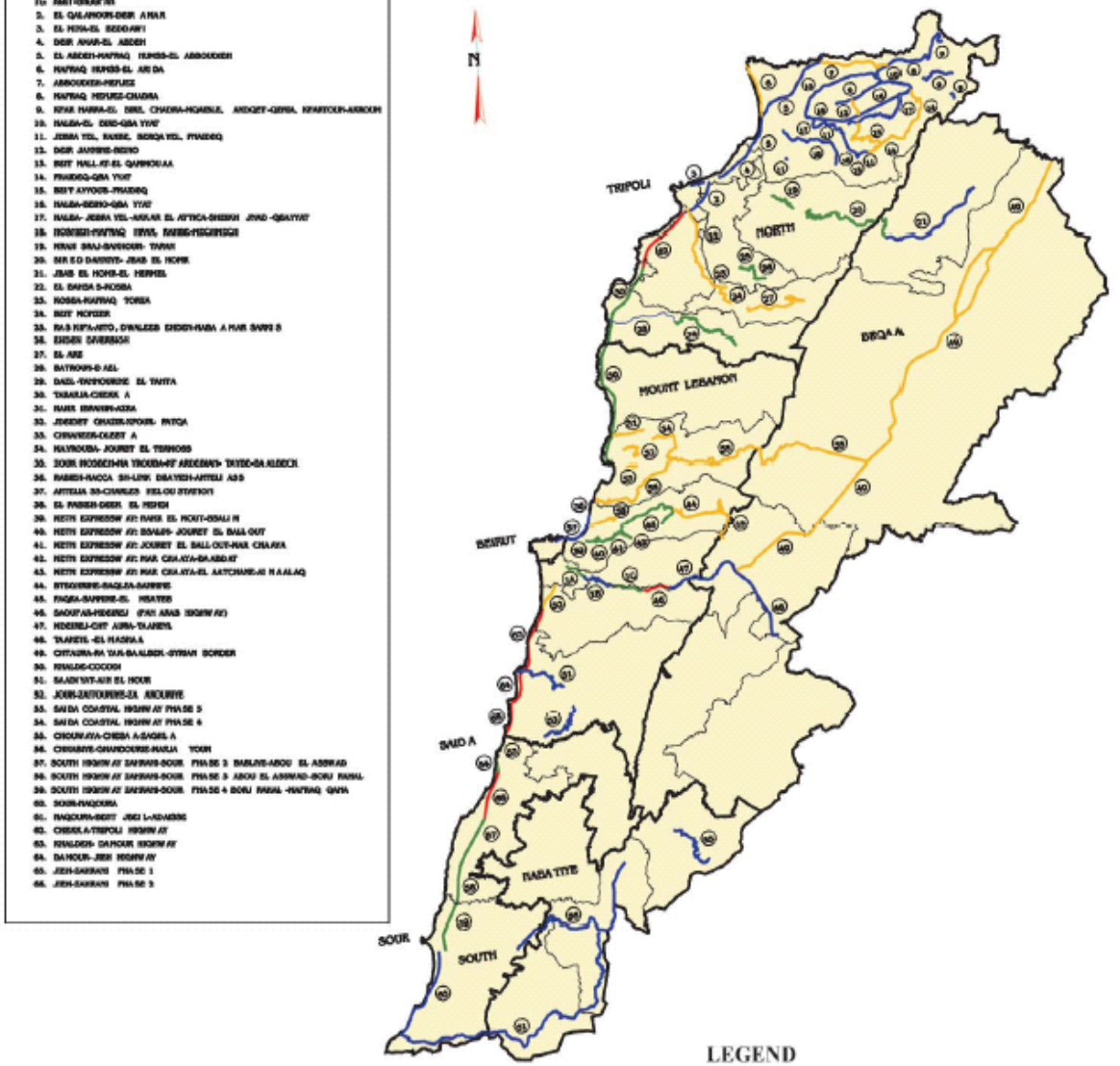
The project is financed by the Kuwait Fund for Arab Economic Development for about US$ 34 million. It includes the upgrading of a number of crossroads and the rehabilitation of Damascus road between Hazmieh and Sofar.

The design study for the Hikmeh-Charles Helou Station in the capital is progress. This connection will link the center of Beirut (BCD) and seaport with As-Sayyad interchange and Damascus road through the Adlieh-Chevrolet-As-Sayyad penetrator.

The design studies and preparation of tender documents have started in 2002.

The rehabilitation of the road network and infrastructure is a very important step to enhance the public transport efficiency and would encourage people to use such services.

Roads Projects



The National Transport Action plan

Based on the information available in the ministry of public works and transport, the government of Lebanon adopts this plan for the land transport sector. This adoption was based on the government recognition of the fact that transportation policy is required to ensure that transportation serves the vision of rebuilding the Lebanese economy and creating better quality of life in all aspects of living including a healthier and environmental friendly life.

Objectives:

- Provide affordable passenger mobility, thereby improving on the quality of life and enabling wider participation in the labor force, which in turn would lead to the creation of more work opportunities and encourage increased economic investments.
- Diversify the transport modal choices available to users by developing a high quality public transportation system, and providing an integrated multi-modal transport system, serving trip demand within capacity constraints, and reducing negative impacts on the environment and the economy.
- Provide an efficient and cost effective internal goods movement and distribution system in urban and rural areas.
- Remove the financial burden of the transportation system from the budget by developing a transportation trust fund adequate to support-to the extent possible- the cost of bringing the system to a state of good repair, maintaining and improving it, and improving the public transportation system. The fund is to be financed by a system of user charges on the automobile use.
- Develop and maintain high standards of visual beauty throughout the transportation infrastructure through the extensive use of street trees and plants, attractive bus shelters, pedestrian friendly amenities such as benches, strict access control on highways, agricultural easements to contain urban sprawl, and enrichments to the visual environment.
- Preserve transport-related infrastructure and protect transport related assets, including right-of-ways, roads, terminals, and others.
- Build a world-class intellectual and entrepreneurial capability in the transportation and logistics field with strong international partnerships with the developed countries.

In order to achieve a more coherent policy driven set of government actions in land transport, the authority for transport policy setting will be consolidated, with all the official stakeholders.

No public funds should be expended in the transportation and public works sector without the explicit approval of the different stakeholders and mainly the ministry of public works and transport which may attach policy conditions as it sees appropriate and necessary to coordinate the timing, design, implementation, or modification of public actions in the transport sector whether the source of funds may be appropriation, loans, fines, toll revenues or direct dedicated taxes.

The government will establish policies and procedures to implement this strengthened plan and build the strong technical capacity necessary to carry it out.

A transportation trust fund with annual funding equal to the average amount of spending for transportation purposes is to be established. The ministry of public works and transport, in cooperation with the ministry of finance shall develop a proposal for a set of user fees on vehicles, fuels and parking to finance this fund. This fund shall be available annually without further appropriation for expenditure on transportation purposes based on an integrated multi-year program to implement this transportation policy.

The transportation trust fund would support the cost of bringing the national transportation system to a state of good repair, maintaining and improving it, and improving the public transportation system. The fund shall be used to prioritize achieving and maintaining a good state of repair on all transportation facilities throughout the country, improving the quality and quantity of public transportation services, and upgrading the visual environment of streets and highways through tree planting, acquisition of visual/agricultural easements, and high quality maintenance.

The user fees would be structured in such a manner to provide more disincentives against the use of the private cars, and not to compromise the competitiveness of the freight industry. Cost allocation to users will assess costs primarily based on impact on traffic capacity and only secondarily based on the physical impact which heavy vehicles place on the roadways. The focus on capacity relates to congested conditions and implicitly prioritizes goods movement over auto use of infrastructure by reducing cost recovery requirements for trucking.

To implement specific multi-year transportation initiatives a series of World Bank or private sector loans will be developed. Such multi-year initiatives may involve bringing all roadway infrastructures to a state of good repair, revitalizing the transit and developing high quality bus rapid transit. Gradual programmed user fee increases will be adopted to secure the loan and eventually support the ongoing transportation trust fund. These fees will occur in stages over a ten-year period, so that people only pay increased user fees as they see actual delivery of improvements. Expenditures from the trust fund will be identified with specific packages of projects that satisfy equitable distribution of benefits across geographical regions and income groups.

In order to avoid worsening of congestion, adequate levels of restraint of demand for automobile use in urban areas shall be pursued.
Improved traffic control shall be introduced at all major urban intersections in a manner that prioritizes pedestrian safety and comfort, public transportation, and goods movement, over the movement of private automobiles. Public transportation shall be interpreted to include buses, service, and taxicabs.

A system of regulation of uses of curb parking, loading and unloading of passengers from buses, loading and unloading of passengers from service and taxicabs, loading and unloading zones and times for delivery of goods and other reasonable regulation of the uses of streets to prioritize the comfort and convenience of pedestrians and public transportation shall be developed by the ministry of public works and transport and enforced by the ministry of interior.
A determination of the maximum amount of on and off street parking which can be supported based on reasonable street capacity shall be undertaken. Policies to limit parking

supply at or below reasonable levels shall be developed. No parking facility can be built or operated without a permit from the concerned stakeholders.

Prioritization of public transportation services through a system of exclusive lanes with convenient transfer centers and well-marked bus stop with amenities such as shelters shall be developed.

All plans for further highway or toll road construction shall be held in abeyance until the priority Beirut transport public transportation initiative and coastal railway shall be complete.

Public transportation services and taxi-service shall be permitted to offer competitive services on the public streets, subject to reasonable regulation of vehicle quality and safety, driver training, and reasonable circulation and stop controls to be promulgated by the ministry of public works and transport and enforced by the ministry of interior.

A plan to use the coastal railway for public transportation priority system shall be developed as soon as possible. This is to be viewed as high priority initiative to expand the access opportunities for the Lebanese people and provide for growing economy. This plan should reflect the eventual establishment of coastal rail service linking Beirut to the major coastal cities and to the airport and Damascus.

The government shall support the preservation of the national road network, one of the nation's most expensive infrastructure assets, though rehabilitation, timely maintenance, and prevention of damage caused by overloaded vehicles.

A plan shall be developed to improve the functional and visual quality of the roadway system through a system of access control, tree planting, acquisition of visual and agricultural easements, and improved maintenance.

A determination of the appropriate size of the Lebanese vehicle fleet consistent with roadway capacity shall be undertaken. Plans to limit the fleet size and upgrade its technical standards shall include whatever combination of incentives, regulations, fines, and fees as the government sees fit and be presented to the parliament for consideration.

- The government executed a plan for the complete elimination of the leaded gasoline and for the modernization of fueling facilities to completely control the escape of vapors.

- The government is now implementing an inspection program that includes a test for the exhaust emissions in order to phase out the non-compliant vehicles.

- The government shall establish a unit for the harmonization of the international freight movement all in conformity with the environmentally recognized guidelines to reduce the pollution incurred from such transportation.

- The technical capacity and the awareness must be raised regarding the issue of the transport sector in order to achieve efficient services with the least harm possible to the environment.

Climate change

Three projects in the field of climate change are ongoing:

1. Climate Change Top-Up project managed by the Ministry of Environment and financed by Global Environment Facility (GEF US$ 100,000);

2. Energy Efficient Buildings Project, managed by the directorate General of Urban Planning, and financed by GEF (US$ 494,000); and

3. The Energy Center Project managed by the ministry of Energy and Water and financed by GEF (US$ 3.9 million).

Ozone

Three projects are ongoing for the protection of the Ozone layer. These are:

1. The Ozone Office Project, phase II, managed by MoE and financed by UNDP, Montreal Protocol Unit and Multilateral Fund (UNDP/MPU-MLF) (US$ 150,000).

2. *Methyl bromide alternatives in the industrial sector:* Managed by MoE and financed by UNDP/MPU-MLF (US$ 885,000).

3. *Methyl bromide alternatives in the agricultural sector:* Managed by MoE and the private sector, and financed by MLF (US$ 3.4 million).

Ozone

Final elimination of Ozone layer depleting materials project. The cost of this project is estimated at about US$ 2 million and is funded by the EU.

Land Use Conservation and Urban Development Projects in progress

Comprehensive land use plan

This project is commissioned by the Council of Ministers for the preparation of a National Land Use Plan, in coordination with the General Directorate of Urban Planning. Its objective is to evaluate land use in all of Lebanon, taking into consideration, all data related to demographic social, economic and employment activities, as well as highlighting environmental and urban planning issues and constraints.

The study will form the basis for a medium and a long-term land and urban development plan. It will propose to the Council of Ministers possible alternatives for the preparation of a comprehensive national land use plan. The implementation of this contract started in March 2002 and will last for two years. The results of the first phase were submitted at the end of 2002. They include a diagnosis of the actual situation in the various sectors, in addition to maps designating the present characteristics of the actual land use within the framework of a Geographic Information System (GIS) database.

Air Pollution Sector Action Plan

- Secure funds to complete the road network master plan.
- Implement the transport policy of the ministry of transport in terms of public transport high quality service.
- Impose and regulate the quality of fuel oil, diesel and gasoline imported to the country.
- Collect samples from the imported fuel oil, diesel and gasoline and analyze them in a local accredited public laboratory.
- Upgrade and improve the inspection on the vehicles and impose penalties on the non-compliant vehicles.
- Improve the traffic flow through the major coastal cities.
- Increase and improve the parking lots areas.
- Install traffic signs.
- Increase the green areas that act as sinks for some of the pollutants emitted from the exhaust of the vehicles.
- Endeavor to sigh the Kyoto protocol and secure funds for the implementation of clean development mechanism project especially in the most polluting sectors (transport and power generation sectors)
- Phase out all the ozone depleting substances used in the country and use the ozone friendly alternatives.
- the leaded gasoline is already phased out from the Lebanese market. The second step is to develop and implement a program for testing the compliance of the imported unleaded gasoline, diesel and fuel oil with the national standards.
- Develop a plan for continuous update of the standards related to the quality of the gasoline, the diesel and the fuel oil.
- Play an active role in the project related to the development of gas market between the Arab countries and the European countries under the project related to the neighborhood policy within the framework of the Euro-Mediterranean partnership.

1.4- Preparation of National Programmes for the reduction and control of pollution by the heavy metals, mercury, cadmium and lead

All these decisions need to be enforced by the ministry of environment and they need to be monitored on regular intervals.
The monitoring programme must have its own unit in the service dealing with industrial pollution in the ministry with the human resources and financial and technical resources needed to monitor these pollutants in the sea water as well as in the treated effluents released directly from the industries into the sewers or release from the different coastal wastewater treatment plants.

Heavy metals

The national diagnostic analysis and the baseline budget reports that were prepared by national experts on the behalf of the ministry of environment have identified the sources of the different pollutants and have also quantified and evaluated the emissions and releases of these pollutants.

This action plan, when implemented, must reduce the emission and the releases levels in compliance with the provisions of the strategic action plan.

The concerned authority must review the operating licenses of the different industries. Moreover, the government, mainly the ministry of Environment must enforce the decision 8/1 issued on 1/3/2001 and that demands the installation of a pretreatment plant in each industry in order to have its effluents and emissions in compliance with the environmental limit values set in this decision.

In their role, the different industries and small workshop must benefit from the cooperation set between the ministry of Environment and the association of Lebanese industrialists via its environmental committee in terms of the implementation of the good housekeeping guide and the environmental audit manual that were prepared by the ministry of environment. This good housekeeping guide and the environmental audit manual are considered as first step in the transformation of the different industrial sectors into environmental friendly industries.

Monitoring

The enforcement of the laws and the implementation of action plans do not achieve the objectives of having a better environment unless these are couples with effective monitoring programs. The national authorities must execute these programs if they have the technical, financial and human resources, otherwise, third party on the behalf of the national authorities must perform these monitoring activities. This third party player must be certified and well recognized for the integrity and competitiveness. Nevertheless, its monitoring activities must be supervised and controlled directly by the national authority mainly the ministry of Environment.

Requirements for the success of the action plan

The appropriate legislation must be put in place. This legislation must contain achievable targets and clear provisions understandable to the technical and the decision makers. The proposed solutions must be accessible and monitoring must be practical.

The expenses for the implementation of the action plan must be allocated either from the official budget of the government or proposals must be prepared in order to apply for external funds either on the national level or funds from the international funding agencies.

All the local authorities and stakeholders must be in support of this action plan. Moreover, these stakeholders must consider this action plan when issuing decisions or when preparing plans and programs of their own institutions or ministries. In other words, all the stakeholders and especially the decision makers must be fully aware of the plan and must be committed to its content.

Action plan:

- Review all the legislation related to the national standards in order to update the standards of the heavy metals to comply with the targets concentrations stated in the strategic action plan (0.050 mg/l maximum concentration of mercury release into the sea; 0.2 mg/l maximum concentration of cadmium and cadmium compounds release into the sea; non alkaline chloride electrolysis sector in Lebanon).
- Review the operating conditions of the sources of these metals (like the power sector, the cement sector, the domestic wastewater, the fertilizers industrial sector and the secondary lead smelting sector), and impose new and stricter operating environmental conditions.
- Impose the installation of a pretreatment units or an air pollution control system.
- Perform regular sampling and analysis in order to control the compliance with the maximum allowable concentration.
- Preparation of national workshops in order to increase the awareness of the industrialists toward the environmental issues.
- Try to prepare a mechanism inside the ministry of environment to give incentives for the industrialists in order to implement an environmental management plans in their industries, and try to give some benefits for the industries that are compliant with the national standards in order to encourage the others to comply with the environmental requirements.

1.5- Preparation of National Programmes for the reduction and control of pollution by the organo halogen compounds

The local authorities should establish and implement a program of toxic-waste reduction for industries that discharge directly into receiving waters or sewage treatment facilities.

The Reduction must comply with the limits set in the strategic action plan of the MED POL protocol.

Funds must be made available to assist industries in implementing this goal. Part of the waste-minimization program should include an environmental audit team to assist the industries and businesses to reduce their toxic usage in principle.

The local authorities should reduce oil entering the environment through enforcement of adequate collection regulations.

The authorities should enforce legal provisions requiring large retail facilities to provide collection containers. In addition, the foreseen legislation should pass a refundable tax on each can of oil sold. A special area must be allocated to establish a boat-waste collection program with regulatory tools.

The local authorities should collect and properly dispose of household hazardous waste on a continuous basis for the sake of reducing the contribution of the households to the hazardous waste mixed with the domestic waste and sewage streams.

The concerned ministry, in this case the ministry of Interior and Municipal Affairs should facilitate the permitting process for municipalities to create collection facilities for hazardous waste. Moreover, the municipalities should develop an aggressive program to educate the public about the use of alternatives to common household products. These programs must be planned for and executed in close cooperation and collaboration with the ministry of Environment and the active local NGOs.

The municipalities, possibly through departments of health and the ministry of Environment, should collectively agree to ban the sale of septic-system cleaners, especially those using organic degreasers.

The municipalities and the ministry of Public health must impose strict regulation on the use of pesticides in the household for rodents or for the plants.

In Lebanon, the production of paper pulp, the manufacturing of PBBs and PBDEs don not exist. More over, the pesticides are not produced in the country, they imported for use only. As it was mentioned earlier in the national diagnostic analysis report, most of the organo halogenated pesticides were banned in the country. The following action plan is intended to target all the types of pesticides used in the country.

Pesticides

There is lack of detailed reliable data on agricultural practices in Lebanon in general and more specifically on water resources and on chemical use.
There is poor education of farmers who lack knowledge on the impact of their profession on the environment and specifically on water resources. There is poor enforcement of the regulations when these are available. The general lack of knowledge, information and legislation has and will lead to environmental degradation and to a loss of productivity of agricultural land. To prevent the occurrence of such a scenario and to mitigate the impact of agricultural activities, best management practices must be implemented as part of a general environmental policy.

Agriculture project on the southern coast:: directly into the sea.

Proposed Action Plan

There are several barriers for the implementation of best management plans (BMPs) in the agricultural sector. The most critical barrier to be overcome is the knowledge/awareness barrier. Once this is overcome then the other barriers could be dealt with in an easier manner.

How to overcome the different barriers

Knowledge/Awareness
- Awareness raising campaigns
- Extension programs

Economic/Financial
- Government purchase assistance programs
- Tax reduction
- Tariff removal
- Low interest, long term loans

Technical/Materials
- Extension programs
- Seminars by NGOs
- Demonstration projects by government, Universities, …

NGOs
- Private sector involvement
- Effective management of cooperatives
- Involvement of ministry of Agriculture in research and extension work

Legal
- Enforcement of laws
- Development of Laws that target agricultural pollution
- Penalties for polluters

Incentives
- Financial: e.g. marketing assistance for farmers implementing BMPs

Knowledge/Awareness Barriers

As stated earlier, the main barrier to implementing BMPs is the lack of knowledge and awareness amongst farmers on how agrochemicals impact the environment. The only method to overcome this shortcoming is through education. Educating farmers is not sufficient, decision-makers and the general public must also be informed of the impact of agrochemicals on the environment. They must also be informed on the means available to mitigate this impact. The best education tool is awareness campaigns coupled with demonstration projects to tangibly prove that BMPs would be effective and eventually financially rewarding if properly implemented. The awareness campaign must target farmers, decision-makers, schools, professionals, and the general public.

Target Group Information Relayed

Farmers
- Damage to water and soil from agrochemicals
- Damage to their crops from excess chemical use
- Damage to health from agrochemicals
- Costs of pollution from agrochemicals
- Different types of BMPs
- Methods of implementing BMPs
- Costs and Benefits of BMPs
- Local, Regional and International Programs that help in financing BMPs
- Incentives programs for implementing BMPs
- Legal ramifications of polluting water and soil
- Sources for technical, financial and legal assistance
- Role of farmers

Decision Makers (Ministers, Director Generals, ministry officials – mainly from ministries of Agriculture, Environment, Energy and Water, Interior and Municipalities - mayors, municipality officials, politicians, clergy, etc)
- Damage to water and soil from agrochemicals
- Damage to health from agrochemicals
- Costs of pollution from agrochemicals
- Costs of water treatment
- Methods of water pollution control
- Costs and benefits of BMPs
- Successful programs (nationally or internationally) in implementing BMPs

- Role of decision makers
- Institutional and legal setups and role of different agencies

Professionals (Engineers, health professionals - doctors, nurses, public health practitioners, etc.)

- Damage to water and soil from agrochemicals
- Damage to health from agrochemicals
- Costs of pollution from agrochemicals
- Costs of water treatment
- Methods of water pollution control
- Costs and benefits of BMPs
- Successful programs (nationally or internationally) in implementing BMPs
- Role of professionals

Target Group Information Relayed

Schools and the General Public

- Damage to water and soil from agrochemicals
- Damage to health from agrochemicals
- Costs of pollution from agrochemicals
- Costs of water treatment
- Methods of water pollution control
- Costs and benefits of BMPs
- Successful programs (nationally or internationally) in implementing BMPs
- Role of the general public

The awareness campaign must also contain lectures and seminars by extension agents clearly showing the link between agriculture and pollution of water bodies. Lectures must be tailored to the audience. Field trips to and audiovisual examples of areas that have been adversely affected by agrochemicals are critical aids in making sure that the target audience grasps the message being sent. The best method of relaying the message would be to include a pilot project that shows that BMPs will have an effect on pollution and that clearly demonstrates that the costs associated with BMPs are more than offset by gains involved. Identifying a suitable area for demonstration may however not be straightforward and the demonstration site should be carefully selected. Finally the assistance and participation of local universities, local experts/consultants, various stakeholders and NGOs would allay the fears of many participants who otherwise would not readily accept the advice of "strangers" who "know nothing" of their area or region.

Other Barriers

The barriers discussed in this section are the financial/economic barrier, the technical/materials barrier, and the legal and incentives barriers.

Financial/Economic Barrier

This should be addressed through two perspectives. The first is that of the farmer and the second is that of the general public. If the implementation of the BMP is too costly for a farmer in terms of forgone profit, then farmers will not change their practices. However, if

BMPs were not implemented, then water supplies would be threatened by pollution from agrochemicals. Treatment of this polluted water or seeking alternative sources might prove too costly for a community to sustain. Therefore, government programs must be created which offset the costs borne by farmers in implementing BMPs. Some of these programs are cost-share programs in which the government pays for part of the cost of implementing Best Management Practices (BMPs). Another program involves tax reductions for farmers implementing BMPs. Yet another program involves the removal or reduction of tariffs on material and equipment used in BMPs. Finally, the government must enable farmers who implement BMPs to borrow money at reduced rates.

Technical/Material Barrier

This barrier is readily overcome through extensive extension work by the government and NGOs. The key is to identify the technical problems facing farmers and addressing those through a series of seminars and lectures that are accompanied by visits to demonstration projects were the technology or material in question are being utilized. Effective management and utilization of cooperatives would tremendously increase the dissemination of information on technical matters. Cooperatives will also aid in making available to farmers required material at a cheaper rates.

Legal and Incentives Barriers

These barriers represent the carrot and the stick with the latter being the carrot. A good incentive program that involves financial and materials rewards would assist convincing farmers to adopt and implement BMPs. Such programs may be admission into export or marketing cooperatives that will help market the produce of farmers who implement BMPs. At the same time, heft fines would serve to deter farmers from practices that have been outlawed by law. To this end, Law 444 (Environment Code) has introduced this principle; however, application decrees still need to be developed, approved and enforced. If laws were not enforced, the "stick" would not be deterrent enough to force farmers to implement BMPs.

Immediate actions (short-term actions)

- Initiate awareness campaigns for farmers and decision makers;
- Promote political consciousness and will:
- Setup mechanisms for enforcement of existing laws
- Effectuate role of relevant ministries ensuring that departments are active, data are collected, processed and shared, and effective coordination is maintained (such as between the customs and the Ministry of Agriculture in the import of agrochemicals);
- Follow-up draft resolution on import, distribution, and sales of agrochemicals submitted by the order of engineers and architects;
- Promote research and work on:
  - Economic aspects of BMPs
  - Efficiency of BMPs
  - Cost of agriculture practices on the environment

Medium to Long-term actions

- Educate farmers and other stakeholders through:
  - Seminars
  - Extension programs
  - Demonstration projects
- Setup and maintain monitoring networks for water quality and agrochemicals use.
- Setup a monitoring board for maintaining, processing and disseminating the data (the LRA could eventually assume this role since it already monitors discharge in the rivers and may become the institution responsible for irrigation in the entire country (there is draft resolution awaiting for final approval).
- Design the network (locations, mechanisms, parameters, etc.).
- Secure funds to implement the network.
- Incorporate technology in information gathering and distribution.
- Acquire needed hardware (computers, monitoring stations, relay stations, GPS, internet servers).
- Acquire needed software such as databases, GIS, Internet publishing.
- Train personnel on acquired hardware and software.
- Update and enforce legal and institutional frameworks.
- Review and update the institutional setup related to agriculture practices in Lebanon.
- Prepare application decrees for non-point and point source pollution relate to the polluter-pays-principle (Law 444- code of the environment).
- Update the water tariff system.
- Setup a system of incentives, tax reductions and cost sharing plans to promote implementation of BMPs.
- Enforce standards on agro-chemicals quality set by LIBNOR.
- Ensure compliance with environmental requirements setup by Euro-Med agreements by enforcing agriculture practices such as:
  - Type of agrochemicals used
  - Timing of application
  - Rate of application
  - Implementation of BMPs
  - Monitoring/testing produce for agrochemicals residuals.
- Develop a national agriculture policy that defines agriculture practices in a way to ensure sustainability (economic and environmental).
- Develop a national water policy plan for proper water allocation, tariff structure, monitoring, and management in the country.

Finally, the development of a policy aimed at preserving the quality of water bodies requires the establishment of institutions and services throughout the country but particularly in the rural community. Key services that may be provided for farmers that would overcome several of the listed barriers are security of land tenure, adequate markets and transportation to these markets, and easy access to technical assistance.

However, once the awareness barrier is overcome, economic analysis will invariably guide farmers. Therefore, it is with this in mind that all approaches to overcoming barriers must be designed.

As for the halogenated aliphatic and aromatic hydrocarbons, and the chlorinated phenolic compounds, they are not produced in the country; however they are imported for use as solvents or for the wood treatment.

The ministry of environment on the national level must adopt the following action plan:

- Establish a mechanism of cooperation between the ministry of environment and the customs directorate general in order to control the quantities imported to the country.
- Establish a mechanism of cooperation with the ministry of industry and the association of Lebanese industrialists in order to impose environmental conditions on the institutions importing this type of compounds
- Organize awareness raising workshops for this issue.
- Prepare a decree or a decision to be signed by the minister of environment in order to regulate the use of these compounds and the disposal of their wastes. This decree will adopt the measures specified in the strategic action plan for the control of pollution by these compounds and that are adopted by the parties.

1.6- Development of National Programmes for the environmentally Sound Management of wastewater and solid waste from industrial installations

Treatment on site of the industrial effluents before entering the sewer network

Although the management of industrial and hazardous wastewater and landfill leachate is beyond the scope of this action plan, the necessary regulations are in place as per the decision numbered 8/1 issued by the ministry of Environment on the 1st of March in 2001. This decision requires that each industrial institution generating any type of industrial liquid effluents to pre-treat these effluents before discharging them into the sewer network or the surface water or the sea.

So_2 storage at Chemical Lebanon (North).

Industrial wastewater discharged directly into the sea.

The treatment level must respect the national standards that are prepared by the ministry of environment and published in the official gazette under the decision numbered 8/1 dated 1/3/2001.

Environmental Limit Values (ELV) for wastewater discharged into the sea

Column 1 shows the regulated pollution parameters, column 2 gives the emission limit values for existing facilities and column 3 for new facilities. Emission limit values of Column 2 will automatically expire when the Republic of Lebanon ratifies the Barcelona LBS protocol. In this case the emission limit values of column 3 will become automatically valid for all kind of facilities.

The outlet of the pipeline for coastal outfalls, its length and depth should be designed according to:

- Sea bed data
  - Sea bed levels
  - Sea bed soils
  - Sea bed stability or movements

- Environmental data
  - Wind speed frequencies and direction
  - Local topography and effects on currents, winds and waves
  - Shipping, dredging, fishing, shellfishery, bathing and other activities
- Effluent data
- Receiving water characteristics
  - Time for bacteria to die (T_{90})
  - Horizontal and lateral dispersion coefficients
  - Vertical dispersion coefficient
  - Temperature, salinity and density profiles.

1	2	3
Parameter	**ELV for existing facilities**	**ELV for new facilities**
PH	5 – 9	6 – 9
Temperature	35°C	35°C
BOD_5 mgO_2/L	100	25
COD mgO_2/L	250	125
Total Phosphorous mgP/L	16	10
Total Nitrogen mgN/L[3]	40	30
Suspended Solids mg/L	200	60
AOX	5	5
Detergents mg/L	3	3
Coliform Bacteria 37°C in 100 ml[4]	2,000	2,000
Salmonellae	Absence	Absence
Hydrocarbons mg/L	20	20
Phenol index mg/L	0.3	0.3
Oil and Grease mg/L	30	30
Total Organic Carbon (TOC) mg/L	75	75
Ammonia (NH_4^+) mg/L	10	10
Silver (Ag) mg/L	0.1	0.1
Aluminum (Al) mg/L	10	10
Arsenic (As) mg/L	0.1	0.1
Barium (Ba) mg/L	10	2
Cadmium (Cd) mg/L	0.2	0.2

3 Sum of Kjeldahl-N (organic N + NH_3), NO_3-N, NO_2-N

4 For dischargers in close distance to bathing water a stricter ELV could be necessary.

1	2	3
Parameter	**ELV for existing facilities**	**ELV for new facilities**
Cobalt (Co) mg/L	0.5	0.5
Chromium total (Cr) mg/L	2	2
Hexavalent Chromium (Cr^{VI}) mg/L	0.5	0.2
Copper total (Cu) mg/L	1.5	1.5
Iron total (Fe) mg/L	5	5
Mercury total (Hg) mg/L	0.05	0.05
Manganese (Mn) mg/L	1	1
Nickel total (Ni) mg/L	2	0.5
Lead total (Pb) mg/L	0.5	0.5
Antimony (Sb) mg/L	0.3	0.3
Tin total (Sn) mg/L	2	2
Zinc total (Zn) mg/L	10	5
Active Cl_2 mg/L	1	1
Cyanides (CN^-)mg/L	0.1	0.1
Fluoride (F^-) mg/L	25	25
Nitrate (NO_3) mg/L	90	90
Phosphate (PO_4^{3-}) mg/L	5	5
Sulphate (SO_4^{2-}) mg/L	1,000	1,000
Sulphide (S^{2-})mg/L	5	1

Environmental Limit Values (ELV) for wastewater discharged into surface water

Column 1 shows the regulated pollution parameters, column 2 gives the emission limit values for existing facilities and column 3 for new facilities. Emission limit values of Column 2 will automatically expire when the Republic of Lebanon ratifies the Barcelona LBS protocol. In this case the emission limit values of column 3 will become automatically valid for all kind of facilities.

Surface water is defined as inland water permanently or temporarily flowing in beds or flowing quickly from springs. A minimum flow of 0.1 m^3/s needs to be guaranteed when discharging.

1	2	3
Parameter	**ELV for existing facilities**	**ELV for new facilities**
PH	5 – 9	6 – 9
Temperature	30°C	30°C
BOD_5 mgO_2/L	100	25
COD mgO_2/L	250	125
Total Phosphorous mgP/L	16	10
Total Nitrogen, mgN/L[5]	40	30
Suspended Solids mg/L	200	60

5 Sum of Kjeldahl-N (organic N + NH_3), NO_3-N, NO_2-N

1	2	3
Parameter	**ELV for existing facilities**	**ELV for new facilities**
AOX	5	5
Detergents mg/L	3	3
Coliform Bacteria 37°C in 100 ml[6]	2,000	2,000
Salmonellae	absence	Absence
Hydrocarbons mg/L	20	20
Phenol index mg/L	0.3	0.3
Oil and Grease mg/L	30	30
Total Organic Carbon (TOC) mg/L	75	75
Ammonia (NH_4^+) mg/L	10	10
Silver (Ag) mg/L	0.1	0.1
Aluminum (Al) mg/L	10	10
Arsenic (As) mg/L	0.1	0.1
Barium (Ba) mg/L	2	2
Cadmium (Cd) mg/L	0.2	0.2
Cobalt (Co) mg/L	0.5	0.5
Chromium total (Cr) mg/L	2	2
Hexavalent Chromium (Cr^{VI}) mg/L	0.5	0.2
Copper total (Cu) mg/L	1.5	0.5
Iron total (Fe) mg/L	5	5
Mercury total (Hg) mg/L	0.05	0.05
Manganese (Mn) mg/L	1	1
Nickel total (Ni) mg/L	2	0.5
Lead total (Pb) mg/L	0.5	0.5
Antimony (Sb) mg/L	0.3	0.3
Tin total (Sn) mg/L	2	2
Zinc total (Zn) mg/L	5	5
Active Cl_2 mg/L	1	1
Cyanides (CN^-)mg/L	0.1	0.1
Fluoride (F^-) mg/L	25	25
Nitrate (NO_3) mg/L	90	90
Phosphate (PO_4^{3-}) mg/L	5	5
Sulphate (SO_4^{2-}) mg/L	1,000	1,000
Sulphide (S^{2-})mg/L	1	1

Environmental Limit Values (ELV) for Industrial Wastewater Discharged into the Sewerage System

Column 1 shows the regulated pollution parameters, column 2 gives the emission limit values for existing facilities and column 3 for new facilities. Emission limit values of Column 2 will automatically expire when the Republic of Lebanon ratifies the Barcelona LBS protocol. In this case the emission limit values of column 3 will become automatically valid for all kind of facilities.

6 For dischargers in close distance to bathing water a stricter ELV could be necessary.

Dischargers can agree divergent emission limit values for discharging wastewater to the sewage system with the operator of the sewage treatment plant as long as the respective emission limit values are kept at the outlet of the sewage treatment plant.

1	2	3
Parameter	**ELV for existing facilities**	**ELV for new facilities**
PH	6 – 9	6 – 9
Temperature	35°C	35°C
BOD_5 mgO_2/L[7]	125	125
COD mgO_2/L[8]	500	500
Total Phosphorous mgP/L[9]	10	10
Total Nitrogen, TN mg/L[10]	60	60
Suspended Solids mg/L	600	600
AOX	5	5
Salmonellae	Absence	Absence
Hydrocarbons mg/L	20	20
Phenol index mg/L	5	5
Oil and Grease mg/L	50	50
Total Organic Carbon (TOC) mg/L	750	750
Ammonia (NH^{4+}) mg/L[11]	-	-
Silver (Ag) mg/L	0.1	0.1
Aluminum (Al) mg/L	10	10
Arsenic (As) mg/L	0.1	0.1
Barium (Ba) mg/L	2	2
Cadmium (Cd) mg/L	0.2	0.2
Cobalt (Co) mg/L	1	1
Chromium total (Cr) mg/L	2	2
Hexavalent Chromium (Cr^{VI}) mg/L	0.2	0.2
Copper total (Cu) mg/L[12]	1	1
Iron total (Fe) mg/L	5	5
Mercury total (Hg) mg/L	0.05	0.05
Manganese (Mn) mg/L	1	1
Nickel total (Ni) mg/L[13]	2	2
Lead total (Pb) mg/L[14]	1	1
Antimony (Sb) mg/L	0.3	0.3
Tin total (Sn) mg/L	2	2

7 Assuming an outlet concentration of 25 mg/l and a cleaning capacity of 80%
8 Assuming an outlet concentration of 125 mg/L and a cleaning capacity of 75%
9 Assuming an outlet concentration of 2 mg/l and a cleaning capacity of 80%
10 Assuming connection to a biological wastewater treatment plant. Performance of waste water treatment plant related to the concentration in the inflow: 70 – 80%, ELV at outlet: 15 mg/L N
11 Assuming connection to a biological wastewater treatment plant. Performance of waste water treatment plant related
To the concentration in the inflow: 70 – 80%, ELV at outlet: 15 mg/l N
12 ELV of 0.5 mg/L must be kept at the outlet of WWTP.
13 ELV of 0.5 mg/L must be kept at the WWTP outlet.
14 ELV of 0.5 mg/L must be kept at the WWTP outlet.

1	2	3
Parameter	**ELV for existing facilities**	**ELV for new facilities**
Zinc total (Zn) mg/L[15]	10	10
Cyanides (CN^-)mg/L	1	1
Fluoride (F^-) mg/L	15	15
Nitrate (NO_3) mg/L[16]	-	-
Phosphate (PO_4^{3-}) mg/L[17]	-	-
Sulphate (SO_4^{2-}) mg/L	1,000	1,000
Sulphide (S^{2-})mg/L	1	1

Action plan:

- Impose the installation of pretreatment units in each industry discharging industrial effluents not complying with the national standards.
- Impose the mandatory implementation of an industrial solid waste management system taking into consideration to reduce, reuse and recycle principle.
- Prohibit the direct discharge of the industrial effluents, even if pretreated, directly to the sea. These effluents must be discharged into the sewer system and must be in compliance with the national standards.
- Cooperate with some accredited laboratories in order to monitor the compliance of the different industries with the national standards and impose penalties if they don't.
- The industries that want to discharge their effluents into the sea or into the rivers leading to the sea must apply full efficient and effective treatment to their effluents and that may impose the tertiary treatment sometimes, in addition to the primary and secondary treatments.
- Organize training and awareness raising programs and workshops in order to ensure the sustainability of the environmental management plans implemented in the different waste and wastewater treatment sectors.
- The preparation and implementation of proper composting plants and sludge management plan (the most favorable option is the dewatering and landfilling for the time being). The sludge management plan is still under preparation in the council for development and reconstruction that is collecting the feedback from the different stakeholders in order to finalize it soon.

15 ELV of 5 mg/L must be kept at the WWTP outlet.
16 ELV for total nitrogen has to be kept
17 ELV for total phosphor has to be kept

1.7- Updating and adopting of national regulations on sewage discharges to the sea and rivers

The national standards for the discharge of sewage into the sea and rivers were set in the decision numbered 8/1 published in the official gazette on the first of March of the year 2001. Therefore, these standards are relatively new especially that there is no wastewater treatment plant that is fully operational in order to test its performance against these standards. These standards need to be reviewed and updated within the next two years.

1.8-Establishing a system of previous authorization by competent authorities for works which cause physical alterations of the natural state of the coastline or degradation of coastal habitats

- Establish medium and long term urban development plan.
- Develop a comprehensive national land use plan taking into account the coastal zone as priority area for the physical alterations problem.
- The ministry of public works, which is the competent authority responsible for the public beaches and coastline, must abide by the national plan on land use management and must regularly consult with the ministry of environment whenever an investment or a project is to be developed on the coastline.
- The investment or the project to be developed on t he coastline must present an environmental impact assessment study to the ministry of environment and if this later does not approve the project due to the environmental harm it will cause, the ministry of public works and transport won't provide the necessary license.

1.9- National implementation plan for the Stockholm convention on the persistent organic pollutants

Activities

The development of the NIPs will involve evaluation of the options for management and/or elimination of POPs and identification of effective methods for the reduction/resolution of outstanding problems. Such evaluation will have to encompass technical considerations, but also socio-economic circumstances, policy aspirations and the legislative, management and technical infrastructure available within the countries. Particular care will be taken to utilize where possible existing structures, working groups etc (for example existing inter-ministerial committees). Similarly, the on-going work of international organizations, such as FAO for example, will not be replicated but relied upon.

The following 5 steps will be carried out in each of the participating countries:

Step 1
Determination of coordinating mechanisms and organisation of process

This could include:

- Identification and sensitization of the key national stakeholders;
- Organization of a national coordinating structure (multi-stakeholder national coordinating committee) and focal point;
- Identifying and assigning responsibilities for the various aspects of POPs management;
- Work plan development; and
- Public information and awareness raising (to be continued throughout the project).

Step 2
Establishment of a POPs inventory and assessment of national infrastructure and capacity

This could include:

- Preparation of a National Profile (or core sections thereof as they relate more specifically to POPs);
- Preliminary inventory of production, distribution, use, import and export;
- Preliminary inventory of stocks and contaminated sites; assessment of opportunities for disposal of obsolete stocks;
- Preliminary inventory of releases to the environment;
- Assessment of infrastructure capacity and institutions to manage POPs, including regulatory controls; needs and options for strengthening them;
- Assessment of enforcement capacity to ensure compliance;
- Assessment of social and economic implications of POPs use and reduction; including the need for the enhancement of local commercial infrastructure for distributing benign alternative technologies/products;
- Assessment of monitoring and research and development capacity;

- Identification of POPs related human health and environmental issues of concern, including their trans-boundary nature; and
- Basic risk assessment as a basis for prioritization of further action taking into account, *inter alia*, potential releases to the environment and size of exposed population.

Step 3
Priority setting and determination of objectives

This could include:

- Development of criteria for prioritization, taking into account health, environmental and socio-economic impact and the availability of alternative solutions; and
- Determination of national objectives in relation to priority POPs or issues .

Step 4
Formulation of a prioritised and costed National Implementation Plan, and specific Action Plans on POPs

This could include:

- Identification of management options, including phasing out and risk reduction options;
- Need for introduction of technologies, including technology transfer; possibilities of developing indigenous alternatives;
- Assessment of the costs and benefits of management options;
- Preparation of initial funding request package for implementation, including cost estimates and incremental costs; and
- Development of a national strategy for information exchange, education, communication and awareness raising, taking into account risk perception of POPs by the public, particularly the least educated.

Step 5
Endorsement of NIP by stakeholders

This could include:

- Preparation of an information document/report to be submitted to stakeholders for comments; and
- Organization of workshops and dissemination of information to obtain commitment of stakeholders and decision-makers.

1.9.1-Phasing out the use of the nine pesticides except for those for which WHO recommendations related to the safeguarding of human life suggest otherwise

The phasing out of the nine pops pesticides will follow the action plan to be set during the development of the national implementation plan that is now in the phase of the preparation of the inventories of the twelve persistent organic pollutants. Whenever this national implementation plan will be finished the ministry of environment, which is the competent authority for the implementation of the Stockholm convention, will adopt the national action plan proposed by the project that is hosted by this ministry.

Therefore, regarding the pops issue, we don't have enough information to propose a national action plan, and we are waiting for the results of the project implemented in the country regarding the development of the national implementation plan for the Stockholm convention and the only action plan we can talk about in this moment is the actions to be implemented for the development of the national implementation plan for the persistent organic pollutants.

1.9.2-The Lebanese Government intends to deal with PCBs and related substances as described in this Action Plan, making use of the guidelines set in the Stockholm convention and the different guidelines prepared by the United Nations environment programme – chemicals in this subject.

Prohibiting the manufacture, trade and new uses of PCBs

Future Action

The most likely sources of PCB wastes are items of electrical equipment (mainly transformers), which may be bulky items to handle.

The ministry of Environment is now hosting a project on the persistent organic pollutants under the Stockholm convention and funded by the global environment facility: the National Implementation plan of the Stockholm convention on the persistent organic pollutants.
The major objectives of this project are the following:

Therefore, no data are available on the exact status of the polychlorinated biphenyls in the country, and this project must prepare a national profile of the pops in the country in addition to national action plans.
However, the following is a draft action plan that is developed for the sake of this project and it is based on previous studies on the issue and based on the experience of the ministry of environment[18] in this aspect:

PCBs Action Plan

PCBs Ban

Issue a decision to ban the PCB containing equipments and the PCBs from entering the country.

The ban on the supply and use of PCBs in new plant and equipment will cover:

- All monochlorinated and dichlorinated biphenyls – these cannot effectively be separated from PCBs ;

[18] The MoE has conducted (COGIC Consultants-TREDI) 5 field audit and inventories on EDL plants and sites. These field surveys have shown (through more than 180 samples taken from transformers oil) a 20% PCB contamination in the out of use transformers stock of EDL. A well at the Bauchrieh substation (northern suburb of Beirut) is full of oil and PCBs. This well is a 100m distant from another well selling potable water!

- All mixtures and wastes containing more than 50ppm by weight of PCBs equivalents;
- Any object, e.g. redundant transformer tank and its internal windings, that is so contaminated with PCB equivalents that physical or chemical interaction with another object would produce contamination above the 50 ppm by weight level.

There will be a ban on the use or storage (whether in equipment either in use or held in reserve or otherwise) of PCBs where the PCBs are well contained in the equipments that are registered in the ministry of Environment. On registration of equipment, a target date shall be set for its destruction.

There should be a comprehensive controls on the disposal of PCBs. These must include the safe handling and disposal of PCBs. The PCB Management guidelines must provide detailed guidance on PCB waste toxicity aspects, safe disposal methods and the relevant health and safety at work legislation.

The Guidelines on The Health and Safety must be also developed since the handling and disposal of PCBs present a potential risk for occupational exposure. Maximum Exposure must be developed based on the international values and must be enforced.

Registration and Destruction of PCBs

All stakeholders that possess PCBs containing equipments or bulk PCBs must register in the Ministry of Environment and must provide this competent authority with all the details they already have or any required information that is deemed essential for the environmentally sound management of these hazardous wastes.

Facilities offering PCB destruction and final disposal services are not available in Lebanon or in the neighboring countries. Therefore, such services must be sought from the developed countries according to the rules and regulations of theses countries and under the provisions of the Basel Convention. These facilities need to be licensed or authorized by the Environment Agency in the country of import in order for the Lebanese government to aloe for the waste export for final disposal.

The ministry of Environment must set a specific date for registration and destruction within a phase-out program up to the end of 2025 and the ministry must ensure that the destruction capacity is deployed to the best effect. The destruction companies will, therefore, play a crucial role in implementing this Action Plan. The Government is continuing to discuss with those concerned how they might facilitate the orderly registration and disposal of PCBs and PCB-contaminated equipment.

Holders of individual items of equipment and PCB contaminated materials with a volume of more than 5dm³ and PCB concentrations above 50 ppm by weight will need to submit some very broad information relating to location and description of equipment/materials. (For power transformers the 5dm³ threshold includes the total of the separate elements of a combined set). Where it cannot reasonably be assumed that contamination of equipment with PCBs is below 500 ppm by weight, estimated quantities of PCBs and nature of treatment already carried out or envisaged will have to be recorded. All registered equipment will need to be labeled by holders and a suitable registration form and label will be prescribed.

The holders of the contaminated waste or equipments must implement safe storage and handling of such hazardous waste waiting for disposal. Moreover, safe transport must be ensured when transporting such waste within or out of the facility.

Waste oils

Under any circumstances, it is totally forbidden to mix waste oils with waste oils containing PCB for the purposes of regeneration of the oil and storage of waste oil prior to regeneration or disposal.

Identification, Sampling and Testing

The registration details will need to be retained beyond the end date for registration in order to prepare an inventory summary.

It may be difficult in the case of sealed equipment to determine whether it contains PCBs or relevant levels of PCB contamination. Breaking open equipment in use in order to ascertain this information would be inappropriate if that then precluded further use. Owners of such equipment would need to make a reasonable assumption about levels of contamination of equipment. This would mean that they would have to satisfy themselves about the robustness of their assumptions based upon knowledge of their equipment, any operational records, suitable sampling and testing procedures (where necessary and practicable) and any other relevant information. The type, frequency and statistical spread of sampling must depend upon the nature of equipment and its use.

In some cases it may be practicable to deal with the PCB charge contained in the equipment rather than destroy the equipment. The dielectric liquid in transformers may be retrofilled (that is, the PCBs may be replaced with an alternative liquid) or PCB contaminants may be chemically destroyed through dechlorination, which allows the reuse of the treated oils. However, care must be taken to ensure that the residual PCB concentrations leaching from plant internals do not become elevated to unacceptable levels. Repeated treatment, particularly with retrofilling, may be needed to meet the legislative 50-ppm by weight limit.

Large transformers and ancillary equipment including capacitors are readily identifiable. The majorities are within the control of the electricity generating and distributive sector.

Other actions

The Government is concerned that there should be suitable steps to ensure exclusion of direct discharges of PCBs into groundwater and rivers or drains and sewers during the period of elimination. This will require consultation with monitoring and enforcing authorities over the need to pay particular attention to possible sources of PCB wastes during the period of elimination.

Public Awareness Campaigns

The Government is conducting a publicity campaign directed at possible owners of equipment, which may contain PCBs. The campaign aims to raise awareness of potential sources of PCBs and their hazards. It informs owners of the requirements for registration and safe disposal.

Phase 5 / Section 2 : National Action Plan.

Set up the national list of priority actions for 2010

1. Define criteria for the establishment of priorities

The priorities were set according to the scoring exercise for each of the issues associated with each environmental issue human health and marine environment impacts. The scoring scale for the impact is from 1 (as no known impact) to 4 (as severe impact). The weight assigned by the team to the individual impact varied between 1 (as the least important impact) and 10 (as the most important impact).
Accordingly, the issues were then ranked based on the minimum score 0 (representing the no concern) and the maximum score 3 (representing the major concern).

The different stakeholders, who have participated in the preparation of this national action plan, have assigned the following weights to the different impacts:

- The human health impact was assigned a weight of 5.
- The marine environment impact was assigned a weight of 5.
- The socio-economic impact was assigned a weight of 2.
- The global environment was assigned a weight of 1.

1	2	3					4	5
Issue/major geographical area affected	**Indicator of magnitude**	**Impacts**					**Root causes**	**Possible solutions**
		Human health-5-	**Marine environment-5-**	**Socio-economic loss-2-**	**Global environment-1-**	**Total score**		
1-Trace metals -Mount Lebanon -South of Lebanon	High industrial activity in these areas	3*5=15	3*5=15	2*2=4	1*1=1	35	Industries	Pretreatment plants
2-Organo halogens -North of Lebanon -Mount Lebanon -South of Lebanon	High agricultural activities	2*5=10	2*5=10	2*2=4	2*1=2	26	-Industries -Agriculture	Pretreatment plants and integrated best management practice
3-BOD from industrial sources -Mount Lebanon -South of Lebanon	Quality of the river water discharging into the sea	3*5=15	4*5=20	3*2=6	1*1=1	42	Industries	Pre treatment plants
4-PCBs -Power sector-all the plants and the transmission sub-stations all over the coastline	Number of employees directly exposed to PCBs	4*5=20	2*5=10	4*2=8	1*1=1	39	Power sector	Phase out and export for disposal as per Basel convention
5-Solid waste -All the coastal line	Number of open dumps along the sea shore	5*5=25	5*5=25	4*2=8	1*1=1	59	-no integrated plan -no awareness	Comprehensive national action plan for all the coastal zone

6-Domestic wastewater -All the coastal line	Number of outfalls discharging into the sea with no treatment	5*5=25	5*5=25	4*2=8	1*1=2	59	No WWTPS	-network -WWTPs
7-Air pollution from mobile sources -Beirut -Mount Lebanon -All coastal cities (Tripoli, Saida, Tyre, Jounieh)	The cost of the hospitalization due to the diseases related to the air pollution	4*5=20	1*5=5	4*2=8	4*1=4	37	No inspection Bad gasoline and diesel quality	Regular inspection; impose penalties
8- Batteries and chemicals associated to its manufacturing	No environmental management plan implemented in the factory	2*5=10	2*5=10	1*2=2	1*1=1	23	-	-
9-Lub oil -all regions	Absence of a collection and treatment system	2*5=10	2*5=10	1*2=2	1*1=1	23	No national plan	-collection -sound management
10-Physical alterations -All over the coastal zone and mainly from Beirut upward to the north	Very limited natural coastal areas	2*5=10	3*5=15	2*5=10	1*1=1	36	No land use plan No law enforcement	Land use planning Enforcement of the laws

The batteries recycling factory is a small-scale industry but with no air pollution control system and no wastewater treatment system.

We can conclude from this scoring exercise that the priorities are the same referred to in the national diagnostic analysis report with slight medication due to the availability of new information (e.g. the BOD from industrial sources and air pollution from mobile sources). These priorities are as follows:

1. The domestic wastewater and the domestic solid waste
2. The BOD from industrial sources
3. The polychlorinated biphenyls
4. Air pollution from mobile sources
5. The physical alterations of the coastal line
6. The trace metals
7. The organohalogens
8. Lub oil and batteries recycling

Administrative region	Site	Pollutant	Expected reduction %	Stakeholders	Time framework	Tracking method
One administrative region	All sites(mainly where the sewage sea outfalls are located, and the leachacte from the coastal open dumps)	BOD Chlorides Lead(50% reduction) Nitrates Total Phosphorus TSS Oil and grease	- all the major cities with more than 100000 inhabitant will have its own WWTP. -to implement the national solid waste management plan and provide sanitary landfills to serve all the coastal zone -rehabilitate the open dumps all on the coastline	-council for development and reconstruction -ministry of energy and water -ministry of environment -ministry of interior and municipalities (municipalities)	-10 years plan -10 years plan	-meeting with the stakeholders -follow up with the funding agencies -control the management of the waste treatment or disposal facilities -monitoring the effluents discharged into the sea from the sea outfalls and from the open dumps leachate -monitoring of the sea water quality all along the Lebanese coastline

	North of Lebanon (the cement factories, the fertilizers factory, the power plants, one batteries recycling factory, power sector)	Fluorides Phosphorus (P2O5) Sulfates Cadmium HF Ammonia Lead Nickel Hg Copper Dust Dioxins & Furans	50%	-ministry of environment -ministry of industry -ministry of interior and municipalities -association of industrialists	-10 years	-monitoring of the industrial outfalls into the sea -control over the environmental management plans implemented by the industries -control over the pretreatment unit of the effluents -monitoring of the air emissions or estimation of the air emissions.

	Mount Lebanon (power sector, paint industries, tanneries, paper industry, electroplating, food processing, cement)	COD TSS Chromium Chromium hexavalent Cyanides Hg Copper Nickel Benzene Cadmium Dioxins and furans HCl Hexane VOCs	-50%	-ministry of environment -ministry of industry -ministry of energy and water -electricite du liban -association of industrialists -Paint sector -Ministry of Industry -association of industrialists	-10 years	-monitoring of the industrial outfalls into the sea -control over the environmental management plans implemented by the industries -control over the pretreatment unit of the effluents -monitoring of the air emissions or estimation of the air emissions
		PAH Dioxins & Furans Dust Oil and grease PCBs	-25% -phase out plan	-power sector -ministry of energy and water -ministry of environment ministry of energy and water -electricite du liban-institution	-10 years -by 2025	

	Beirut (transport sector mainly)	Benzene Cadmium Dioxins and furans HCl Hexane lead Dust	50%	-ministry of environment -ministry of energy and water -ministry of public works and transport -council for development and reconstruction -ministry of interior and municipalities	-10 years	-ambient air monitoring program -estimation of the air emissions -complete inspection over the vehicles on the roads. -monitoring of the exhaust gases from the vehicles.
	South of Lebanon (tanneries, electroplating, food industry)	Chromium Hexavalent Nickel cyanides Dioxins & Furans	50%	-ministry of environment	-10 years	-monitoring of the industrial outfalls into the sea -control over the environmental management plans implemented by the industries -control over the pretreatment unit of the effluents -monitoring of the air emissions or estimation of the air emissions

The pops pesticides are already prohibited from entering the country. Consequently, they are not used in the country since 1997. The ministry of environment will draft a decree to inhibit the importation of PCBs and transformers containing PCBs. The PCBs management plan will hopefully be fully implemented by the year 2025 as per the provisions of the Stockholm convention on the persistent organic pollutant.

All the coastal administrative regions are considered as one entity and the indication of the site in the table of priorities is just to indicate the location of the problem within the studied area. The site indicates the location where the source of the pollution is and we have to refer to the baseline budget as a complementary part to this table in order to get the industrial activity or the main source of the pollutants mentioned in the table.

2. Identify the stakeholders

The main stakeholders are identified earlier in the sectoral plan part and in the t able of priorities. These are mainly:
-The ministry of environment
-The ministry of energy and water
-The association of the Lebanese industrialists)
-The ministry of public works and transport
-The ministry on interior and municipalities (municipalities)
-The council for development and reconstruction
-The laboratories (for analysis of samples in the monitoring program)

3. Endorse project at national, and as appropriate, sub-national levels

This report is already prepared with the consultation of the different stakeholders, therefore the endorsement from these stakeholders is already given and this endorsement will be made clear upon the presentation of this report in the national workshop that will be organized in order to present the final report.

4. Strengthen the institutional and policy framework

The entire action plan will be reinforced by the necessary regulations and national programmes. These programmes will be prepared and submitted to the council for development and reconstruction for securing the necessary funds for the implementation of the proposed activities.

Moreover, the ministry of environment will mainstream this action plan into the policies and yearly plans of the different stakeholders. Moreover, the ministry will update all the necessary decisions and decrees in order to facilitate the implementation of this action plan.

The ministry of environment must establish and reinforce the inspection systems in order to ensure compliance with the regulations and the proposed activities in this national plan.

Establish a system of granting permits for discharge of liquid effluents into the sea or the sewage system and for emissions into the air.

Prepare plan for the rehabilitation of the hot spots and for the safeguarding of the sensitive areas.

Establish and implement an efficient monitoring programme that will support the establishment of a national database of pollution and the trend of the pollutants over the time.

5. Participation of the private sector

The main stakeholder from the private sector is the association of the Lebanese industrialists. This association will be the main party to cooperate with the national authorities for the implementation of this action plan and is expected to provide the public sector with technical and financial support.

6. Consider information needs, research and monitoring

The research laboratories in the country will provide the analytical services for the implementation of the monitoring programme. But, these laboratories have to stick to their charges and therefore funds must be made available for the execution of this monitoring programme and pay for the analytical services necessary for such programmes.

- Prepare training workshops and seminar for environmental education, environmental impact assessment, assessment of the cost of the environmental degradation, integrated coastal management plan, sound treatment of domestic wastewater, and management of solid waste.
- Prepare policy for the introduction of cleaner production into the industrial sector in the country.

7. Prepare a financial strategy

The proposed financial strategy is based on the priorities identified previously in this report and the cost estimations are either those published by the council of development and reconstruction or they are estimate on the basis of the rates proposed by this council for similar projects.
The main funding stakeholders are the international funding agencies and the international banks. For instance, some of these funding agencies or banks are the Islamic Development Bank, the Japanese bank for international cooperation, the French protocol, the Italian protocol, the Arab fund for economic and social development, the world bank, the European investment bank…etc.
This financial strategy is divided into 3 main categories:

- The investment projects
- The human resources
- The training and awareness raising

The investment projects cover the areas of the domestic wastewater, the municipal solid waste, the industrial pollution, the agricultural sector and the transport sector.

The following table shows the different major components for the implementation of the proposed action plan and the corresponding costs:

Name of the component		Overall cost estimated by the council for development of construction (million USD)	Estimated cost based on rates used by the CDR for similar projects (million USD)	Estimated cost by the council for development and reconstruction for sub projects (million USD)	Status
Wastewater sector		363			
	Sewer network			24	In progress
	Wastewater coastal collector 1			46	Complete
	Wastewater coastal collector 2			10.5	Complete
	Wastewater collectors in north and south Beirut	80			Proposed project
	Wastewater treatment plant of Saida			9.5	In progress
	Wastewater treatment plant of Batroun			11.3	In progress
	Wastewater treatment plant of Jbeil			7.2	In progress
	Wastewater treatment plant of Chouf			8.8	In progress
	Wastewater treatment plant of Nabatieh			13.1	In progress
	Wastewater treatment plant of Tripoli			8.5	In progress
	Wastewater treatment plant of Keserwan		13		Planned
	Wastewater treatment plant of Dora		11		Planned
	Wastewater treatment plant of		15		Planned

	Ghadir				
	Wastewater treatment plant of Sour		15		Planned
Rehabilitation of infrastructure in Beirut		11.3			In progress
Domestic solid waste					
Collection and landfilling for greater Beirut and parts of mount Lebanon		682			
Collection and landfilling projects to cover the rest of the country			500		In progress
Rehabilitation of one dumpsite				53	In progress
Rehabilitation of 4 other dumpsites on the coast			200		Planned
The remaining fund from the world bank for 3 landfills		25			Planned
Transport					
Transport infrastructure		1000			
Sub-project 1				62	Complete
Sub project 2				130	Complete
Industrial waste management (liquid effluents, air emissions, solid waste)			200		Very modest initiatives
Power sector			100		Very modest initiatives
Agricultural sector					
Integrated pest management plan				0.5	Planned
Preliminary studies				0.05	Some in progress

Persistent organic pollutants					
	National implementation plan	350, 000 USD			In progress
	Implementation of this plan	1			Planned
Human resources					
	For inspection and control			1	Planned
	Industrial sector			0.5	Planned
	Agricultural sector			0.5	Planned
Training and awareness raising				1	Planned
Total		**2421**	**1054**	**1557.4005**	

These steps are complementary and very essential for the success of the proposed national action plan:

- **Determination of coordinating mechanisms and organization of process.**
- **Setting technical guidelines and documents.**
- **Setting policies and strategies.**
- **Monitoring and control.**
- **Demonstration projects.**
- **Awareness raising (seminars, workshops, conferences, site visits, etc…).**
- **Training.**
- **Legislation.**
- **Complementary policy actions, funding.**

2.1- Determination of coordinating mechanisms and organization process.

- Identification and sensitization of the key national stakeholders.
- Organization of a national coordinating structure (multi-stakeholder national coordinating committee).
- Identifying and assigning responsibilities for the various aspects of the Sectoral Plans and the National Action Plan.
- Partnership between the Public and Private Sectors:
  - Encourage public-private partnership in wastewater management system including collection, treatment, and final disposal while maintaining public sector involvement (municipalities, Ministry of Environment, Ministry of Water and Energy) to monitor compliance with regulation and setting future policy/strategies.
  - Involve the municipalities in the entire solid waste management plan.
  - Involve all the stakeholders in all other environmental management plans in order to ensure their cooperation and reduce their resistance to any suggested change.

2.2- Setting technical guidelines and documents.

Domestic Wastewater

- Develop modular systems for septic tank and leaching field design as well as other suitable onsite treatment systems to enable standardization of equipment and simplifying operation and maintenance.
- Disseminate these designs through the Syndicate of Engineers (for new building permits).
- Get the input and approval of Ministry of Public Health.
- Propose that contractors who have a track record of being able to design and construct Waste Water Treatment Plants meeting the Ministry of Environment decision 8/1 be given a special certification from the Ministry of Environment.
- Create comprehensive map for simplified viewing of wastewater projects to assist in securing funding.
- Confirm that upstream communities of Ministry of Water Energy proposed dam and lake locations is protected by an adequate and functioning sewer network connected to a treatment plant prior to completion of dam/lake construction.
- Gather data from the Ministry of Water and Energy and water authorities on the location of the major potable groundwater wells to insure their protection from unsewered upstream communities.

Sludge management

Sludge should be disposed of in a manner that is compatible with the national sludge management plan.

- Collect and dispose sludge from septic tanks, especially in unsewered communities, to approved processing facilities/centers and prevent illegal disposal through dumping.
- Certify sludge collection/disposal operators so that septic tank sludge is not dumped in river valley.
- Impose the wastewater effluent standards to various media (e.g. discharge onto land, surface water, sea water, irrigation).
- Update Decision 8/1 of 2001 on the environmental limit values issued by the Ministry of Environment.
- Set and Impose proper sludge disposal guidelines:

- Proper design of rural septic tanks (two-compartment) and leaching fields in unsewered communities. (Require high quality treatment, i.e. removal of nutrients, only in areas with significant water resources);
- Proper design of constructed wetlands or oxidation lagoons;

Note that it is currently illegal to irrigate with treated wastewaters (Decree 8735 of 1974), therefore this legislation needs to be reviewed and updated.

Solid Waste

Composting

It appears as the main technology able to reduce volumes significantly. The arguments in favor of greater reliance on composting are:

(a) The high organic content of Lebanese waste (63% in GBA and 53% elsewhere); and
(b) Its cost, roughly half that of incineration.

Segregation of the collected solid wastes in special centers

Sanitary Landfill

The wastes that cannot be recycled or composts must go to the final disposal in the solid wastes landfills. These landfills must be properly designed for domestic solid waste and must be equipped with leachate collection and treatment system with a special unit for analysis as a part of the quality control program implemented in the sanitary landfill.

Household hazardous waste

The ministry of Environment and the ministry of public health and the non-governmental NGO s must work in close cooperation in order to set national guidelines for the sound management of the hazardous wastes that are generated on the household level.

Transport

- Improving traffic flow in the major coastal cities where the congestion problem is maximal. For this purpose, a public transport system must be put in place. This system must provide sufficient services that must be very efficient and cost effective.
- Establish a transportation trust fund adequate to support-to the extent possible- the cost of bringing the system to a state of good repair, maintaining and improving it, and improving the public transportation system.
- Develop and maintain high standards of visual beauty (adequate landscapes) throughout the transportation infrastructure.

- Adequate levels of restraint of demand for automobile use in urban areas shall be pursued.

- A determination of the maximum amount of on and off street parking which can be supported based on reasonable street capacity shall be undertaken.

- All plans for further highway or toll road construction shall be held in abeyance until the priority Beirut transport public transportation initiative and coastal railway shall be complete.

- Public transportation services and taxi-service shall be permitted to offer competitive services.

- A plan to use the coastal railway for public transportation priority system shall be developed.

- A determination of the appropriate size of the Lebanese vehicle fleet consistent with roadway.

- Keep on implementing the inspection program that includes a test for the exhaust emissions in order to phase out the non-compliant vehicles.

Heavy metals, Organhalogens

The ministry of Environment in cooperation with the ministry of Industry must:

- Review the operating licenses of the different industries.

- Enforce the decision 8/1 issued on 1/3/2001 and the decision number 52/1 regarding the environmental limit values and issued by the ministry of Environment.

- Impose on the polluting industries the installation of a pretreatment plant in each industry for their effluents to be compliant with the national standards.

- Impose the implementation of the good housekeeping guide and the environmental audit manuals that are prepared by the ministry of Environment. These guides and manuals are prepared in order to assist the industrial sector in becoming compliant with the environmental limit values and in developing their own environmental management plan.

Waste Oil

- The local authorities (municipalities) in cooperation with the ministry of Environment should reduce oil entering the environment through enforcement of adequate collection regulations.

- The local authorities (municipalities) should collect and properly dispose of household hazardous waste according to the guidelines set by the ministry of environment.

- The authorities should facilitate the permitting process for municipalities to create collection facilities for hazardous waste.

Pesticides

Short-term actions:

- Effectuate role of relevant ministries ensuring that departments are active, data are collected, processed, and shared, and effective coordination is maintained (such as between the customs and the ministry of Agriculture in the import of agrochemicals)

- Follow-up draft decisions on import, distribution, and sales of agrochemicals submitted by the order of engineers and architects;

- Promote research and work on:
  - Economic aspects of the Best Management Practices
  - Efficiency of the best management practices
  - Cost of the impacts of agriculture practices on the environment and the Cost benefits of the alternatives agricultural practices

Industrial Pollution

- Require the treatment on site of the industrial effluents before being discharged out of the industrial premises as per the decision on the environmental limit values for industrial wastewater discharged into the Sea, the environmental limit values for wastewater discharged into surface water, and the environmental limit values for industrial wastewater discharged into the sewer systems.

- Require the sound treatment and disposal of the sludge resulting from the treatment of the industrial liquid effluents especially sludge resulting from the pretreatment of the hazardous effluents.

- Require the implementation of the "reduce, reuse, recycle" plan of the industrial solid waste.

- Prohibit the disposal of the solid hazardous industrial waste with the domestic solid waste stream.

- The industries must install air pollution control system for the reduction of air pollutants from the polluting industries.

2.3- Setting Policies and Strategies.

The ministry of Environment is working on the setting of national environmental strategies, which consist of the following:

- Push for a consensus at the highest level of government (ministry of Water and Energy, Council for Development and Reconstruction, ministry of Environment, ministry of Interior and Municipalities, and the Council of Ministers) for the adoption of:
  - A unified national wastewater management strategy,
  - A unified solid waste management strategy
  - A unified agricultural management strategy, and
  - A unified air pollution strategy (mainly regarding the pollution from the transport sector).

Working policy steps required implementing a proper wastewater management system in rural areas that include:

- A national plan for rural sewage management because the rural areas are not considered as a priority in the national planning of the central government.

- Standards must be established and enforced for:
  - Septic tanks and leaching field channels
  - Sludge disposal, incl. tanker certification;
  - Constructed wetlands/oxidation lagoons.

- This strategy should advocate protection of water resources (surface and groundwater) irrigation water and safeguard public health. This step could be achieved through the wastewater follow-up joint committee that consists of all the public stakeholders whose mandate is the wastewater management.

- Centralize the process of securing financial support for all the infrastructure projects especially those that are concerned with the pollution reduction and the conservation of the environmental resources. This strategy would prevent the duplicate projects from being implemented that are not within the government national plan through presenting the national plan to various donors and municipalities.

- Draft and adopt the environmental legislation prepared by the Ministry of Environment for the sake of the protection of the environment. The preparation of the necessary environment related legislation must be done in full coordination with pertinent stakeholders.

- Coordinate with governmental stakeholders, like the ministry of Water and Energy and the Council for Development and Reconstruction, to secure unified support for

proper and cost-effective management projects that serve the sustainable development in the country.

- Disseminate the environmental limit values as soon as they are ready and approved.

National Wastewater Management Strategy

- Assist the CDR in setting up and implementing an investment schedule based on the estimated costs of all proposed wastewater projects (treatment plants and sewage networks), prioritize locations and then meet with potential donors to secure funding.

- Investigate potential to secure international funds (grants/loans) to install sewage networks in small rural villages (1000 < population <5000) focusing on areas with significant water resources.

- Explore with the Higher Council for Privatization (HCP) and Government of Lebanon the potential for privatization of portions of the wastewater[19] sector (operation & maintenance of treatment plants).

National Sludge Management Strategy

- Assess the results of the "National Sludge Management Study" and build upon the recommendations the Ministry of Environment and the other concerned stakeholders.

- Explore with the Investment Development Authority of Lebanon the potential to attract investment in sludge management plants (anaerobic digestion, composting, land application…etc).

- Recommend and assist in setting-up a national training center for training wastewater treatment plant operators on the proper operation and maintenance of plants and sampling procedures.

Solid Waste National Strategy

- Develop a national plan for the introduction of the waste minimization concept into the different sectors in the country including the households and the industrial sector as they represent the highest sectors in terms of waste generation.

- Prepare an implementation strategy for the waste minimization plan that would result in the reduction of the amount of waste going to landfills.

- Such a plan would include:

[19] A privatization report on the water and wastewater sector has been prepared by Société Générale Bank in 2002, for the Higher Council of Privatization.

- Minimizing of packaging waste
- Implement the reduce, reuse recycle policy all over the country

- The government of Lebanon must secure the necessary funds for the sound rehabilitation of the coastal open dumps and mainly for:
  - The Segregation the dumped wastes
  - The treatment of the resulting leachate
  - The compost the organic portion
  - The recovery the energy for the combustible non-recyclable material

Transport National Strategy

- Prepare the entire necessary infrastructure for the introduction of the natural gas in the gasoline stations to be used in the different types of the vehicles.

- The technical capacity must be raised regarding the issue of the transport especially after the introduction of the natural gas into the market.

- Establish policies and procedures to implement for the sustainable management of the transport sector in the country.

Pesticides National Strategy

Medium to Long-term actions:

- Educate farmers and other stakeholders through:
  - Seminars
  - Extension programs
  - Demonstration projects

- Setup and maintain monitoring networks for water quality and agrochemicals use.

- Setup a monitoring board for maintaining, processing and disseminating the data (the Litani River Authority could eventually assume this role since it already monitors discharge in the rivers and may become the institution responsible for irrigation in the entire country (there is draft resolution awaiting for final approval).

- Design the network (locations, mechanisms, parameters, etc.).

- Secure funds to implement the network.

- Incorporate technology in information gathering and distribution.

- Acquire needed hardware (computers, monitoring stations, relay stations, GPS, internet servers).

- Acquire needed software such as databases, GIS, Internet publishing.

- Train personnel on acquired hardware and software.
- Update and enforce legal and institutional frameworks.
- Review and update the institutional setup related to agriculture practices in Lebanon.
- Prepare application decrees for non-point and point source pollution relate to the polluter-pays-principle (Law 444- code of the environment).
- Update the water and wastewater tariff structure.
- Setup a system of incentives, tax reductions, and cost sharing plans to promote implementation of Best Management Practices.
- Enforce standards on agro-chemicals quality set by Lebanese Standards Institution.
- Ensure compliance with environmental requirements setup by Euro-Med agreements by enforcing agriculture practices such as:
  - Type of agrochemicals used
  - Timing of application
  - Rate of application
  - Implementation of Best Management Practices
  - Monitoring/testing produce for agrochemicals residuals
- Develop a national agriculture policy that defines agriculture practices in a way to ensure sustainability (economic and environmental).
- Develop a national water policy plan for proper water allocation, tariff, monitoring, and management in the country.
- Development of a policy aiming at preserving the quality of water bodies requires the establishment of institutions and services throughout the country but particularly in the rural community.
- Develop key services that may be provided for farmers that would overcome several of the barriers like security of land tenure, adequate markets, and transportation to these markets, and easy access to technical assistance.
- However, once the awareness barrier is overcome, economic analysis will invariably guide farmers. Therefore, it is with this in mind that all approaches to overcoming barriers must be designed.

Persistent Organic Pollutants National Strategy

Establishment of a POPs inventory and assessment of national infrastructure and capacity:

- Preparation of a National Profile;

- Preliminary inventory of production, distribution, use, import and export;
- Preliminary inventory of stocks and contaminated sites; assessment of opportunities for disposal of obsolete stocks;
- Preliminary inventory of releases to the environment;
- Assessment of infrastructure capacity and institutions to manage POPs, including regulatory controls; needs and options for strengthening them;
- Assessment of social and economic implications of POPs use and reduction; including the need for the enhancement of local commercial infrastructure for distributing benign alternative technologies/products;
- Identification of POPs related human health and environmental issues of concern, including their transboundary nature; and
- Basic risk assessment as a basis for prioritization of further action taking into account, *inter alia*, potential releases to the environment and size of exposed population.

Priority setting and determination of objectives:

- Development of criteria for prioritization, taking into account health, environmental and socio-economic impact and the availability of alternative solutions; and
- Determination of national objectives in relation to priority POPs or issues.

Formulation of a prioritized and costed National Implementation Plan, and specific Action Plans on POPs:

- Identification of management options, including phasing out and risk reduction options;
- Need for introduction of technologies, including technology transfer; possibilities of developing indigenous alternatives;
- Assessment of the costs and benefits of management options;
- Preparation of initial funding request package for implementation, including cost estimates and incremental costs; and
- Development of a national strategy for information exchange, education, communication, and awareness raising, taking into account risk perception of POPs by the public, particularly the least educated.

Endorsement of NIP by stakeholders:

- Preparation of an information document/report to be submitted to stakeholders for comments; and
- Organization of workshops and dissemination of information to obtain commitment of stakeholders and decision-makers.

PCBs

The Ministry of Environment started to work on the PCBs issues since 1995. Several studies were done on this issue and the following preliminary action plan was prepared:

- Issue a decision to ban the PCBs containing equipments and the PCBs from entering the country.

- There should be comprehensive controls on the disposal of PCBs. These must include the safe handling and disposal of PCBs. The PCB Management guidelines must provide detailed guidance on PCB waste toxicity aspects, safe disposal methods and the relevant health and safety at work legislation.

- Registration and Destruction of PCBs

- Prepare a phase-out program up to the end of 2025, and the ministry must ensure that the destruction capacity is deployed for:
  - Waste oils:
  Under any circumstances, it is totally forbidden to mix waste oils with waste oils containing PCB for the purposes of regeneration of the oil and storage of waste oil prior to regeneration or disposal.
  - Identification, Sampling and Testing:
  A sampling campaign must be started in order to identify the PCBs containing equipments and the PCBs contaminated equipment.

Then a phase out program must be put in place according to the deadline specified in the Stockholm convention and based on the recommendation that will result from the National Implementation Plan for the Persistent Organic Pollutants.

Strategic Environmental Assessment

At the institutional level, the ministry of Environment would undertake all necessary measures to mainstream SEA application in the country, assist proponent authorities during scoping stage by reviewing, if requested, the scoping report, review the quality of SEA prepared by proponent authorities, and monitor the overall efficiency of the SEA process in Lebanon.

At the methodological level, it is recommended that the decision-centered model be adopted by proponent authorities, whereby SEA will be used as a decision-support tool at key decision moments by providing decision-makers with the necessary information with respect to the environmental consequences of proposed actions.

While the Strategic Environmental Assessment Project executed by the Ministry of Environment provides general guidelines for SEA implementation in local public agencies, each one of these will need to develop its own guidelines that are tailored to the nature of their decision-making processes.

2.4- Monitoring and Control.

- Develop and Implement effective monitoring programs.
- Assessment of monitoring and research and development capacity;
- Secure the necessary human resources and the financial resources for the monitoring activities
- Prepare training sessions and capacity building programs for the persons responsible for the monitoring activities.
- Identify all the data gaps and prepare a plan for filling in these gaps for the proper planning and implementation programs. Prepare continuous surveys in order to keep all the databases updated when necessary.
- Obtain updated survey of buildings and establishments' data related to locations with sewerage connections, if the data becomes available early enough to include it in the action plan related to the domestic wastewater management.

Monitoring and compare to the baseline budget to make sure if compliance will be complete after 10 years of implementation of the action plan

2.5- Demonstration Projects.

- Implementation of Demonstration or Pilot Projects in order to identify the pros and con or the action plan and to implement corrective measures when implementing the national action plan on the national level.

- Installation of pollution control system.

2.6- Awareness Raising (Seminars, Workshops, Conferences, Site visits, etc….

- Develop educational and awareness programs mainly in unsewered communities to promote responsible water use.

- Education and awareness campaigns for farmers.

- Organize awareness raising campaigns for the decision makers in the country.

- Develop educational and awareness programs for the industrialist targeting the environmental management plans that must be implemented in their different sectors.

- Promote political consciousness regarding all the environmental issues via the organization of meetings, development of brochures and short summarized reports as he decision makers do not read lengthy reports.

- Develop public awareness campaigns in all the areas in the country and involve the local community and the local authorities as well as all the schools.

2.7- Training.

- Need for a national training center for training on the different issues related to the implementation of the environmental projects:

  - Solid waste management plans, management of landfills, incinerators, composting, recycling, etc…
  - Wastewater management plan, treatment plant operators, maintenance of plants and sampling procedures, sludge management plans, etc…
  - Implementation of the Best management Plans in the agricultural sector
  - Implementation of the Best Environmental Practices and Best Available Techniques for the environment protection and pollution reduction and prevention from the industrial sectors.

- Prepare and train the human resources for the implementation of this National Action Plan.

2.8- Legislation.

The ministry of Environment must prepare:

- The application decrees for the environment framework law or the environment code in order to start the implementation process.
- Prepare the application decree regarding the article concerned with the polluter pays principle.
- Disseminate the currently available ministry of Environment wastewater effluent standards (Decision 8/1 of 2001) to local wastewater contractors as well as other interested parties.
- Prepare all the necessary legislation and infrastructure for the introduction of the natural gas in the gasoline stations to be used in the different types of the vehicles.
- Enforcement of existing legislation.
- Setup mechanisms for enforcement of existing laws regarding the pesticides especially the decision number 94/1 issued by the ministry of Agriculture on the 20th of May 1998.
- Prohibit direct discharge of sewage to irrigation or drainage channels, watercourses or the sea (Order 320 of 1926; Decree 2775 of 1928; Decree 8735 of 1974).
- Construction of small on-site wastewater treatment systems or septic tanks in areas not connected to a sewage system (Decree 7975 of 1931; Decree 2761 of 1933; Decree 8735 of 1974).
- Prevent disposal of sewage into bottomless pits or wells (Decree 8735 of 1974).
- Impose strict regulation on the use of pesticides in the household for rodents or for the plants.
- Industrial waste streams should be segregated into high COD waste, toxic waste, low COD waste, inorganic waste
- Impose the penalty articles that are mentioned in the legislation being ministerial decrees, ministerial decisions, or parliament laws.
- Develop new legislation that bans some products that are considered hazardous to the environment and public health from entering the country.

- Update the wastewater effluents standards (Ministry of E decision 8/1 of 2001).

- Assessment of enforcement capacity to ensure compliance;

- A draft decree was prepared to institutionalize SEA application and will be finalized after a series of consultations with key stakeholders is undertaken.

- The adoption at the national level by 2010 at the latest and application of the common measures for preventing mercury pollution adopted by the parties in 1987 (releases into the sea max concentration of 0.05mg/l).

- Set legislation with regard to the mercury emissions in the country. Although these emissions were estimated to minimal in the baseline budget prepared last year, we need to cut on the emissions as per the strategic action plan of the MED POL programme. These emissions or releases are mainly from the industrial sector and the decision 8/1 issued by the ministry of Environment on the 1/3/2001 regarding the environmental limit values set a limit for the heavy metals existing in the industrial effluents. This decision also requires the different industry to pre-treat their effluents before they are released into the sewers.

- Prepare a decision for the adoption at the national level by 2010 at the latest and application of the pollution prevention and control measures for cadmium and cadmium compounds adopted by the parties in 1989 (releases into the sea max concentration of 0.2mg/l)

2.9- Complementary Policy Actions, Funding.

- Centralize the process of securing financial support for wastewater projects.
- Prevent duplicate projects from being implemented through presenting the national plan to various donors and municipalities.
- Allocate Money for investment and operation of waste management facilities.
- An incentive system must be put in place for cooperating municipalities, which makes sites available in order to overcome the shortage of appropriate sites for new landfills.
- Assess the national infrastructure in order to prepare it for the implementation of this national action plan.
- As a national authority responsible for the environment in the country, the ministry of Environment must assist and participate in all the developmental projects especially those concerned with the development of the infrastructure.
- These developmental projects must prepare an environmental impact assessment report to be evaluated and approved by the Ministry of Environment before entering the implementation phase.
- Funds must be made available to assist industries in implementing waste-minimization programs as well as their environmental management.

2.10- Pollutants reduction table.

Air emissions:

Air emissions	Power generation				Cement industry			
	BB(kg/yr)	Estimated emissions for 2010	% reduction	SAP target (25% /50%reduction)	BB(kg/yr)	Estimated emissions for 2010	% reduction	SAP target (25-50% reduction)
Benzene	44	34	22	33	3880	3492	10	2910
Cadmium	75	65	13	37.5kg/yr-0.2mg/l	10	9	10	5 kg/yr-0.2mg/l
Chromium	160	140	12.5	80	9.5	8.55	10	4.75
Copper	336	300	11	168				
Fluorides	7200	6200	14	3600	1091	982	10	545.5
HCl					60625	54562	10	30312.5
Lead					873	785.7	10	436.5
Mercury	22	18	18	11kg/yr-0.05mg/l	268	241.2	10	134kg/yr-0.005mg/l
Nickel	16000	14000	12.5	8000				
Phenol					134	120.6	10	100.5
toluene	1184	1000	15	592	243	219	10	182.25

Air emissions	Fertilizers				Vegetable oil			
	BB(kg/yr)	Estimated emissions for 2010	% reduction	SAP target (50% reduction)	BB(kg/yr)	Estimated emissions for 2010	% reduction	SAP target (50% reduction)
Cadmium	1980	1683	15	990kg/yr-0.2mg/l				
Dust	192040	153632	20	96020				
Hexane					495000	346500	30	247500
HF	55440	49896	10	27720				

Air emissions	Lead smelting			
	BB(kg/yr)	Estimated emissions for 2010	% reduction	SAP target (50% reduction)
Lead	339040	271232	20	169520

Air emissions	PCDD/PCDF (I-TEQ/year)				PAH			
	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target(25%)
Power generation	1344000	Recommend The implementation of best available techniques and best environmental practices as per the provisions of the Stockholm convention on the POPs			704	549	22	528
Cement and lime	403750							
Paper	546690							
Iron and steel	50000							
Aluminum	407000							
Lead	6520							
Glass	13608							
Transportation	2355111							
Residential heating	2002							

Air emissions	VOC			
	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target (50%)
Glass	6480	5184	20	3240
Transportation	330	264	20	165
Textile	4740	4029	15	2370
Paints	774850	658622	15	387425
Beer	200	180	10	100

Releases to the sea:

Releases to the sea	BOD				COD			
	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target(50%)	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target(50%)
Urban wastewater	44000000	35200000	20	22000000				
Farming	105851100	95265990	10	52925550				
Paper	921456	829310	10	460728	1896030	1706427	10	948015
Tanning	227900	205110	10	113950	396267	356640	10	198133
Textiles	39500	35550	10	19750	85000	76500	10	42500
Olive oil	2600000	2080000	10	1300000				
Vegetable oil	475	427.5	10	237.5	806091	72548	10	403045
Wines and spirits	2497	2247	10	1248.5				
Beer	81250	73125	10	40625				
Non alcoholic beverages	128334	115500.6	10	64167				

Releases to the sea	TKN			
	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target(50%)
Urban wastewater	7200000	5760000	20	3600000
Farming	17484000	15735600	10	8742000
Tanning	34850	31365	10	17425

Releases to the sea	Oil and Grease				Ammonia			
	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target
Fertilizers						6720	20	4200
Tanning	38950	35055	10	19475	8400	26919	10	14955
Aluminum	12025	10822.5	10	6012.5	29910			
Glass	64	51.2	20	32				

Releases to the sea	Total Phosphorus				PAH			
	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target(25%)
Urban wastewater	800000	640000	20	400000	110	88	20	82.5

Releases to the sea	Cyanides			
	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target
Aluminum	225	202.5	10	112.5

Releases to the sea	Total Phosphorus				Fluorides			
	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target
Fertilizers	660169	528135.2	15	330084.5	627000	571200	15	336000
Tanning	972	874.8	10	486				
Farming	132000	118800	10	66000				

Releases to the sea	Tanning				Urban Wastewater			
	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target	BB (kg/year)	Estimated emissions 2010	% reduction	SAP target
Cadmium					100	80	20	50kg/yr-0.2mg/l
Chromium	738	664.2	10	369				
Lead					1000	800	20	500
Chlorides	838965	755068.5	10	4194825				
Nitrates	44056	39650	10	22028				
Sulfates	97336	87602	10	48668				
Sulfides	54060	48654	10	27030				
Total suspended solids	303956	273560	10	151978				

The percent reduction of the different pollutants was estimated based on the expected environmental development in the different sectors considered the major source of pollutants. These estimate reduction values are directly dependent on the implementation of the scheduled projects and proposed actions on the national levels, on the enforcement of the legislation, and finally on the availability of funds.
The percent reduction must be reviewed on a yearly basis because continuous change is taking place concerning the environmental development and environmental legislation in Lebanon.
The ministry of environment is now preparing a national action plan for the phase out and the reduction in the emissions of the different persistent organic pollutants as per the provisions of the Stockholm convention on the persistent organic pollutants.

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1. A good part of the information presented and the conclusions and recommendations proposed are based on outcome of several meetings with pertinent stakeholders, an examination of several documents and reports provided by these stakeholders and a review of the 20001 State of the Environment Report (SOER) [ECODIT. (2001) "Lebanon State of the Environment Report". Ministry of Environment and Lebanese Environment and Development Observatory (LEDO), Lebanon.].

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11. The photos are courtesy of Mr. Carl Stephan.