LITANI WATER QUALITY MANAGEMENT PROJECT

RAPID REVIEW REPORT

JANUARY 2005
LITANI BASIN MANAGEMENT ADVISORY SERVICES (BAMAS)

BUREAU FOR ASIA AND THE NEAR EAST
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REPORT PREPARATION

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LIST OF ABBREVIATIONS

AFIAL	The Association of the Friends of Ibrahim Abd El Aal
AICs	Agriculture Input Companies
AREC	The American University of Beirut's Agricultural, Research and Education Center
BAMAS	Basin Management Advisory Services
BWE	Bekaa Water Establishment
CCIAZ	The Chamber of Commerce, Industry and Agriculture of Zahle
CDM	Camp Dresser and Mckee
CDR	Council for Development and Reconstruction
DAI	Development Alternatives Inc.
IDRC	International Development Research Centre
LARI	Lebanese Agricultural Research Institute
LIU	Lebanese International University
LRA	Litani River Authority
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MoEW	Ministry of Energy and Water
MoI	Ministry of Industry
MoPH	Ministry of Public Health
NGOs	Non Governmental Organizations
NPK	Nitrogen-Phosphorous-Potassium composite fertilizer
STP	Sewage Treatment Plant
USAID	United States Agency for International Development
USJ	St. Joseph's University
WESS	Water and Environment Sustainable Solutions s.a.r.l.

1. INTRODUCTION

The upper Litani River basin and Lake Qaraoun suffer from a serious water pollution problem which is due to uncontrolled solid and liquid domestic and industrial waste disposal practices, in addition to agrochemical contamination and lack of sustainable wastewater management. This situation has caused negative water use impacts on public health, environment, and socio-economic development. Hence, there is a need for proper management of the quality of the surface and ground water resources to address these impacts and pave the way for environmentally sustainable and socio-economically viable use of these vital resources. The main objective of the Litani Water Quality Management Basin Advisory Services (BAMAS) Project is to identify and assess management and investment options and scenarios for water quality improvement and pollution remediation for the upper Litani River basin and Lake Qaraoun and develop an environmental management plan for their implementation (Figure 1).

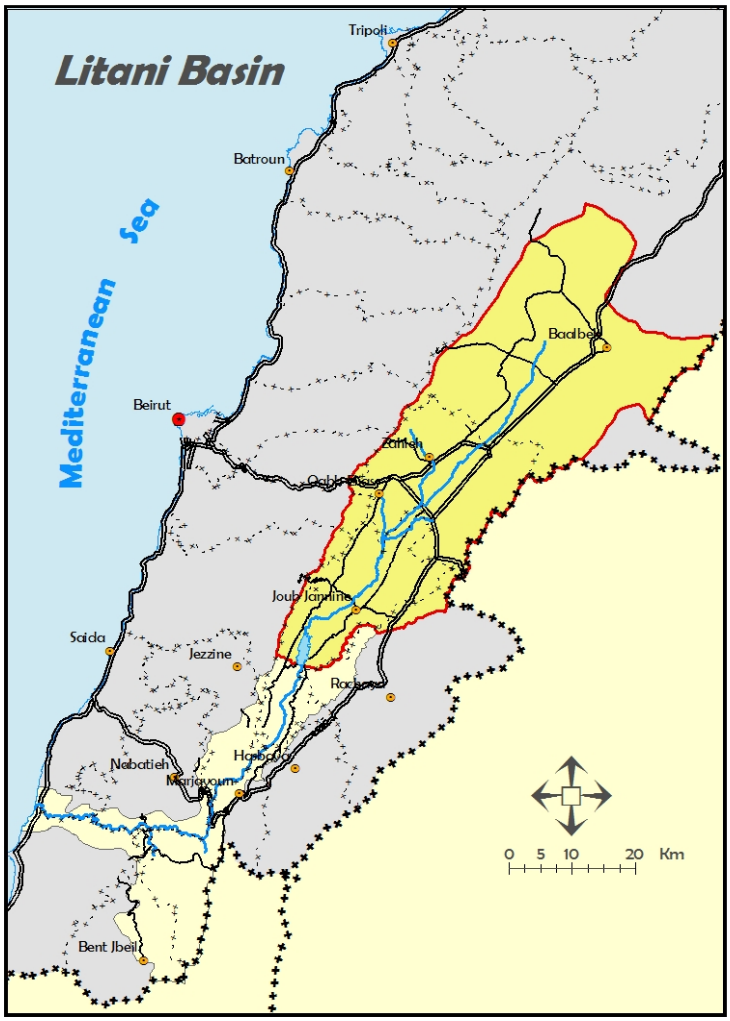

Figure 1. Overview map of the upper Litani River basin

The Project focuses on five tasks which will be implemented through collaborative planning interventions, policy discussions, frequent consultations, workshops, field surveys, socio-economic analyses, exploration of lessons learned from best practices,

institutional strengthening and capacity building, and development of an analytical Decision Support System. The tasks are as follows:

- ***Rapid Review*** of background information related to water quality, identification and interview of key stakeholders, and development of specific recommendations for future project interventions;
- ***Technical Survey*** to collect and analyze additional information based on the rapid review recommendations in order to assist the identification of potential investment and management options related to water pollution remedial and water quality management;
- ***Identification of Potential Options for Water Quality Management and Water Pollution Remediation Investment Options*** based on the findings of the technical survey;
- ***Development of a Water Quality Management Decision Support System***, to help in the selection of water quality management options and scenarios in the basin and formulation of the environmental management plan; and
- ***Capacity Building*** of stakeholder staff through active participation and hands-on experience in various project activities including: data collection, analysis, legal and institutional strengthening, modeling.

This report presents a detailed description of the *Rapid Review* task. Available information within the following three thematic areas were gathered, reviewed, and analyzed:

- ***Theme 1:*** Collaborative planning, legal and institutional aspects including identifying and initiating consultation with key stakeholders at the national and community levels;
- ***Theme 2***: Surface water quality management with attention to water quality and algae proliferation problems in Canal 900; and
- ***Theme 3:*** Groundwater quality management and water quality monitoring.

Major gaps in the currently available information were identified and analyzed for their potential effect on water quality management in the basin. Recommendations were presented on how best to augment information related to each theme during the technical survey task, and promote stakeholder involvement and support for the development of options and scenarios for water quality management and pollution remediation investment. The rapid review ended with a stakeholder workshop that discussed and finalized these recommendations, and initiated the formation of a technical working group that will support collaborative and participatory implementations of project activities.

2. COLLABORATIVE PLANNING, INSTITUTIONAL AND LEGAL ASPECTS

During the *Rapid Review*, Theme 1 team identified key governmental and local community stakeholders. A project leaflet (Appendix A) describing in brief the project background, goal, tasks, and expected outputs was prepared and presented to stakeholders

during the introductory meeting, which opened doors for collaborative participation of stakeholders. Appendix B presents a list of the visited stakeholders. The participatory process was further reinforced by the organization of the first project workshop that gave stakeholders the opportunity to discuss and finalize the *Rapid Review* recommendations related to all three project themes, as detailed in Section 5. This workshop was used as a forum for catalyzing the establishment of the project stakeholders working group that supports project implementation and stakeholder involvement and buy-in.

Meetings with stakeholders will continue and intensify during the technical survey where stakeholders will be interviewed on institutional, legal, and water quality management issues, and will participate in the identification of the preliminary options for water quality management and pollution remediation investments. Institutional and legal aspects for the implementation of these options will be analyzed to identify responsible institution(s) and legal framework for the realization of each option. This section presents 1) a description of the project relevant roles and responsibilities of the identified governmental and local community stakeholders as well as laws and regulations of relevance to surface and groundwater use and quality, wastewater management, solid waste management, and environmental policy on the national level; and 2) recommendations for future project interventions related to collaborative planning, institutional and legal aspects.

2.1 Governmental Stakeholder Identification

Key public-sector stakeholders, including the Litani River Authority (LRA) which is the main governmental counterpart of this project, are listed below with a brief description of their roles and responsibilities:

Litani River Authority (LRA)

The Litani River Authority was created by virtue of a law issued on August 14, 1954. Since its creation, and under the tutelage of the Ministry of Energy and Water (MoEW), the LRA has been tasked with the implementation, as well as technical and financial management, of the Litani Project and provision of water supply for domestic use, irrigation, and hydropower generation within the Project command areas. The LRA is also tasked with carrying out all planning, implementation, and management activities related to irrigation scheme development in the Litani River Basin. As mentioned above, the LRA is the main counterpart and a full partner of the current project.

Bekaa Water Establishment (BWE)

The Bekaa Water Establishment was created by virtue of Law 221 dated May 29, 2000. It is one of the four regional Water Establishments created by virtue of Law 221 and placed under the tutelage of the MoEW. The main tasks of the BWE, as described in Law 221, include provision of water supply for domestic, agricultural, and industrial use, as well as collection, treatment, and disposal of wastewater in the Bekaa. The Establishment is also responsible for protecting water quality, controlling wastewater quality at discharge and treatment plant outfalls, and proposing water tariffs. It should be noted, however, that the BWE (as well as the other regional water establishments) is not yet fully operational because the organizational chart and decrees needed to regulate its activities have not yet been approved by the Council of Ministers. It is also worth noting that, since most of the

Bekaa is within the Litani basin, special attention must be paid to avoid any overlap in the jurisdiction of the BWE and the LRA.

Ministry of Energy and Water (MoEW)

The Ministry of Energy and Water is tasked with the overall management of surface and groundwater resources on the national level. The Ministry is also responsible for devising a national master plan for water and wastewater, and nationwide allocation of water resources for irrigation and domestic/potable uses. The MoEW is also tasked with planning and execution of all water development projects, as well as the protection of water resources. In addition, the MoEW carries out administrative tutelage over LRA and all regional water establishments.

Ministry of Environment (MoE)

The Ministry of Environment was created in 1993 by virtue of Law 216 dated April 2, 1993. It is a key player and stakeholder in all aspects related to the environment on the national level. Its main tasks and responsibilities, of relevance to this project, can be described as follows:

- Drafting laws and developing specifications, and formulating a general strategy and long-term plans for environmental management and natural resources use.
- Formulating detailed plans for environmental protection, including monitoring plans, and control of all sorts of pollution caused by solid waste, industrial waste, domestic wastewater, and air pollutants.
- Carrying out comprehensive surveys of all industrial sites and zones whose wastes could pose a threat to the environment.
- Specifying requirements and conditions for issuing permits for the construction of industrial establishments and plants, industrial zones, various kinds of animal farms, quarries, and cemeteries.

Ministry of Industry (MoI)

The Ministry of Industry is responsible for the issuance of construction and operation permits to industrial establishments as defined and classified in Decree 5243 dated April 5, 2001. Before permits are issued, the MoI is responsible for verifying that the industrial project in question has taken all necessary waste management measures that protect public health and prevent pollution of surface and ground water resources and the environment. The MoI is also responsible for performing regular inspections to check and verify that industrial establishments are always compliant with the conditions specified in their permits (Decree 9765 dated March 11, 2003). Industrial establishments are also subject to inspections carried out by local municipalities as well as inspectors from both the MoE and the Ministry of Public Health.

Ministry of Public Health (MoPH)

The Ministry of Public Health is responsible for protecting and improving public health, supervising private health care institutions, as well as drafting and proposing laws and amendments to existing laws relevant to public health (Decree 8377 dated December 30, 1961). Among the tasks and responsibilities of the Ministry are also (a) carrying out studies and developing action plans aiming at protecting the environment from factors that threaten public health; and (b) developing technical specifications for public and

private sewage networks, potable water supply networks, and collection and disposal of solid waste projects.

Ministry of Agriculture (MoA)

The Ministry of Agriculture is responsible for the general management of the agricultural sector (Legislative Decree 97 dated September 13, 1983). The tasks and responsibilities of the Ministry, most relevant to this project, are (a) providing farmers with appropriate extension and training services; (b) regulating and monitoring pesticide use; and (c) introducing modern on-farm irrigation methods and techniques.

A significant public establishment affiliated to the MoA and placed under its administrative tutelage is the Lebanese Agricultural Research Institute (LARI), headquartered within the Litani watershed. Among the major roles of LARI is to develop and implement research and testing activities needed for improving agricultural production and enhancing water use efficiency in irrigation.

Council for Development and Reconstruction (CDR)

The Council for Development and Reconstruction is a public authority established by virtue of Legislative Decree 5 dated January 31, 1977. The CDR was intended to be a fast-track public agency responsible for reconstruction in the aftermath of the first round of the civil war, and was granted extraordinary powers to carry out its tasks in order to circumvent administrative hurdles. The main tasks and responsibilities of the CDR, relevant this project, are (a) formulating general plans and programs for nationwide and regional reconstruction and development, and proposing economic, financial, and social policies compatible with these general plans; (b) developing draft laws related to development and reconstruction; (c) negotiating and signing agreements with international funding agencies; and (d) implementing infrastructure projects as mandated by the Council of Ministers.

Municipalities

Municipalities are the elected local government and represent individual water users in the basin. Municipalities and municipal federations are vested with a lot of authority within their municipal boundaries (Legislative Decree 118 dated June 30, 1977), and they are responsible for physical development plans in their territorial limits. Among these are cleanliness and public health issues, water works, sewage networks, licensing sewage connections, public transport, urban projects as well as local tax collection. They receive applications and issue permits for construction. They may implement urban master plans with the approval of the Directorate General of Urban Planning, provided they can raise the necessary funding.

The Litani watershed houses 156 villages, 90% of which are governed by municipalities. Unfortunately there exist only 2 municipal federations in the area: The Federation of the Municipalities of the (Qaraoun) Lake, which represents 14 municipalities, and the Federation of the Municipalities of the (West Bekaa) Plain, representing 11 municipalities. Both federations have been historically concerned with the Litani water, and, as such, form ideal partners. There appears to be no federations in the Central Bekaa (Zahleh) or the North Bekaa (Baalbeck) regions.

2.2 Local Community Stakeholder Identification

The Litani River watershed covers 2,468 square kilometers and is home to more than 350,000 people. These constitute the local community which interacts with the basin's resources through their daily activities. In the context of water quality management, the local community may be categorized into 5 distinct groups, namely: Municipalities[1], Non Governmental Organizations, Farmers, Cooperatives, and Industries. Equally important partners of relevance to the current project include private universities operating in the area, agricultural input companies, as well as other water-related development projects.

Non Governmental Organizations (NGOs)

Theoretically, NGOs represent the grassroots movement for change and good governance. In the Bekaa area, there are currently 19 registered NGOs. They vary in size, focus, and experience. They may also often be fronts to political movements or represent a strict political thought that may undermine their willingness to cooperate and form partnerships with external development projects. However, and especially during the war years, NGOs have been very active in filling the ever increasing gap between the needs of the society and the almost non-existent public services. Within the scope of the current project, one potentially interesting NGO is A Rocha Lebanon, a branch of the international NGO A Rocha, which has been active in environmental conservation in the Ammiq wetlands on the west bank of the Litani for a number of years. A Rocha Lebanon is currently being officially registered.

The Association of the Friends of Ibrahim Abd El Aal (AFIAL), which was founded in 1991, is perhaps the main national NGO with a particular focus on the Litani. It is a scientific association that seeks to highlight the need to establish a national master plan for the management of Lebanon's natural resources, specifically water resources, based on scientific data and long term studies. AFIAL may be a good project partner for nation-wide activities in general and the Litani basin in particular.

Individual Farmers

While few families currently derive their income entirely from agriculture, farming remains a cornerstone of the diversified livelihoods of the area. Farmers are water users (domestic and agricultural). They also contribute (positively or negatively) to water quality through the use of selected agricultural practices. As land managers, their input is invaluable in any management scenario aiming at enhancing the Litani water quality. Some farmers are organized into cooperatives; however, these remain a minority.

Farmers' Cooperatives

Farmers can organize themselves in groups known as cooperatives aiming in principle at implementing a commercial project, in very much the same way as a commercial company would do. The main incentives for forming a farmers' coop is usually the bulk purchase of agricultural inputs and/or the sharing of the use of machinery. Coops receive many benefits, such as seed funding from the government and special tax breaks. There are hundreds of agricultural coops in Lebanon and specifically in the Bekaa. However,

[1] The role of the municipalities is described under governmental stakeholders, given the fact that they are governmental institutions, although they represent the local communities.

the coop experience has been, by large, unsuccessful. Usually, problems of leadership emerge, and accusations of side deals often lead to the paralysis of a lot of these coops.

Two of the most important coops in the upper Litani watershed are the Sugar Beet Growers Coop, founded in 1970 by ex-president Elias Hrawi, and the Potato Growers' Coop, which operates mostly in the central and north Bekaa. In the west Bekaa, especially in the vicinity of Canal 900 and the Qaraoun Lake, no active cooperatives are known to exist.

Industries

The central Bekaa, especially around Zahleh, is home to many industries that dispose of their solid and liquid wastes in the watershed or directly into the River's main stream or one of its tributaries. Poultry slaughtering facilities, limestone factories, paper mills, slaughter houses, tanneries, a battery recovery plant, food industries, the sugar refinery, and others have been identified as potential sources of pollution in Rayak, Qa'a el Rim, Zahle, Arayby and Ghozayel.

The Chamber of Commerce, Industry and Agriculture of Zahle and the Bekaa (CCIAZ) brings together the principal industrial stakeholders (as well as in trade and, to a lesser degree, agriculture stakeholders). It represents their interests and provides its members with information and projects. It helps bridging the gap with governmental and non-governmental bodies, handles litigation issues and acts generally to resolve problems and hindrances. The department of the environment in the CCIAZ is reasonably active and may be a good partner for addressing issues relevant to this project.

2.3 Other stakeholders

Private Universities

There exist three private universities in the Litani watershed. Their locations provide full geographical coverage: The American University of Beirut's Agricultural, Research and Education Center (AREC) in Hawsh Sneid (North Bekaa), the St. Joseph's University (USJ) School of Agriculture in Taanayel (Central Bekaa), and the newly founded Lebanese International University (LIU) in Khiara (West Bekaa). AREC, the oldest, has a long history of partnership with local communities on agricultural extension and environmental issues. USJ and LIU, while more recent, have also profound interest in the Litani water management issues.

Agricultural Inputs Companies (AIC)

In the absence of governmental extension services, AICs have been in charge of technology transfer to the farmers throughout Lebanon. Unfortunately, being short term profit driven, their agenda has mostly been to encourage farmers to rely increasingly on external inputs such as fertilizers and pesticides. However, they remain the most significant source of agricultural extension in the area. The largest companies are: UNIFERT (which has a declared commitment to environmental issues), Comptoir Agricole du Levant, and Debbaneh.

2.4 Other Development Projects

The upper Litani basin has been the focus of interest of a number of international donors. Among the most important projects currently being implemented are:

Small Village Wastewater Treatment Systems funded by the United States Agency for International Development (USAID) and implemented by Camp Dresser and Mckee (CDM) in collaboration with Development Alternatives Inc. (DAI) and Dar Al Handasah Shair and Partners. The project will select small rural communities for the design of cost effective wastewater treatment systems in target areas of the upper Litani Basin where the wastewater treatment systems can be constructed by local contractor firms contracted through NGOs. Our project team works in close collaboration with this project. Coordination is planned, especially in the characterization of wastewater discharges.

Institutional and Social Innovations in Irrigation Mediterranean Management funded by the European Union and implemented by the Agricultural office of the CCIAZ in the Canal 900 area. The project aims to identify and assist water users associations in the upper Litani basin. A number of reports have been collected concerning the water sector including the existing organizations, water resources and water rights. The Lebanese team is working to establish strong relations with water users and to reinforce its cooperation with the LRA.

The Sustainable Management of the Litani River funded by the International Development Research Centre (IDRC) of Canada. A development research project implemented by the National Council for Scientific Research, the Development Studies Association, the LRA, and Cadham Hayes Systems Inc. The aim is to increase knowledge of the river and to develop a participatory management framework for the River's sustainable use. The project also includes a capacity building component for national researchers.

2.5 Legal Aspects and Current Laws and Regulations

A list of all relevant statutes (laws, decrees, and decisions) has been compiled and categorized by topic. Below is a brief analysis of these statutes.

Surface Water Use and Quality

Surface water is generally considered as public property (Decision 144/s dated June 10, 1925) and its use and quality are regulated in a number of statutes that date back as far as 1926. These regulate various aspects of water supply, development, use, and pollution control. The most recent of these statutes is Law 444 dated July 29, 2002, which contains provisions aimed at protecting surface water from pollution or alteration of its physical, chemical, or biological characteristics.

Groundwater Use and Quality

Groundwater use is mainly regulated by Decision 320 dated May 26, 1926 and by Decree 14438 dated May 2, 1970, both of which stipulate that well drilling (whether in public or private property) requires a permit that must be issued by the MoEW. However, for wells drilled in private property, no permit, only notification, is required provided the following conditions are met (Article 13):

- The well is non-artesian
- It has a depth of less than 150 meters
- It is used to extract less than 100 m^3 per day
- Water pumped from the well is not indirectly taken from a river or source.

However, this exemption could be considered as a loophole in the decree, especially that the vast majority of wells in the upper Litani basin, as well as nationwide, are drilled in private property within the above depth and water abstraction limits. In fact, even if pumping exceeds these limits, it is very hard to prove it given the absence of any metering and monitoring systems.

With respect to groundwater quality, statutes regulating wastewater discharge (see part on wastewater) generally allude to the protection of groundwater from pollution, but Law 444 dated July 29, 2002 (Article 35) is most clear and specific in mentioning the necessity to impose adequate measures for the disposal of all kinds of wastes so that groundwater is protected from potential pollution or alteration of its physical, chemical, or biological characteristics.

Wastewater Management

Wastewater discharge and proper disposal in a manner that is compatible with public health protection is regulated in various statutes starting in 1920. These statutes prohibit the discharge of wastewater or the disposal of wastes or organic fertilizers in, or near, public water courses. Several legal decisions state that wastewater should be disposed in a proper way i.e. through public sewage systems when such systems exist or through isolated and specially designed septic tanks.

An important statute that regulates wastewater management is Decree 8735 dated August 23, 1974, which stipulates that: (a) it is forbidden to keep septic tanks uncovered and to allow any seepage of wastewater from them; (b) it is forbidden to reuse wastewater to irrigate vegetables or fruits such as strawberries and the likes; and (c) industrial establishments are mandated to treat their wastewater before discharging it into sewage networks or water courses. The uniqueness of this decree stems from the included regulation of wastewater reuse for irrigation. There does not appear to be any other specific statute on wastewater reuse for irrigation on the national level. Two other significant statutes are Decision 1/52 dated July 29, 1996, and Decision 1/8 dated 2001, both of which are very important because they specify the discharge criteria for wastewater from various sources into sewage networks, surface water bodies, and the sea. However, the ability to implement and enforce these decisions is questionable since they are just a Minister's Decision that could be reversed by another Minister's Decision at any time.

Solid Waste Management

The disposal of solid wastes is mainly covered by Law 444 of 2002, and it is also regulated in other older statutes that prohibit littering and disposal of any wastes in public spaces and water courses and require municipalities to designate special locations for the treatment of solid wastes after having obtained the approval of the Mohafez and the Health Council of the Mohafaza.

Dangerous wastes are covered by Law 64/1988 dated August 12, 1988, which defines these wastes and prohibits their disposal in water courses and any locations where they could be harmful to humans, animals, or the environment. Also, Decree 8006 dated June 11, 2002, defines various kinds of wastes generated by hospitals and health care establishments and specifies the ways to get rid of such wastes. However, most of the statutes have not been implemented so far neither in the upper Litani nor nationwide due to financial and administrative hindrances on the central government level.

Environmental Policy and Protection

The general governmental environmental policy is basically stated in Law 444 dated July 29, 2002, which is a very important legal document. Law 444 is subdivided into more than 20 chapters and covers the following main areas:

- Organization of environmental protection, including environmental planning, financing of environmental protection, and procedures for monitoring environmental pollution.
- Creation of an environmental database and the establishment of a participatory approach to environmental management and protection.
- Environmental protection, including air quality protection, protection of the coastal and marine environments, protection of surface and groundwater resources, protection soils and land resources, protection from noise pollution, definition of chemical and hazardous wastes, natural resources management, and preservation of biological diversity.
- Environmental impact assessment of major development projects.
- Responsibilities and penalties

The Law stipulates the establishment of a "National Council for the Environment" which represents both public and private sectors. The Council acts as an advisory board which evaluates environmental policies, proposes amendments to existing laws, and coordinates between various relevant institutions. The Law also calls for the establishment of a "National Environment Fund" for supporting environmental research and development efforts, financing environmental control and monitoring measures especially those related to the enforcement of Law 444, and supporting sustainable development efforts. However, it should be noted that Law 444 is not yet fully implemented and enforced in view of the fact that it requires a large number of Decrees (that would allow the law to be actually implemented by explaining certain aspects, specifying criteria and procedures, etc.) to be issued by the Council of Ministers and these Decrees have not yet been issued.

2.6 Recommendations

Based on the above identification of stakeholders and the analysis of the institutional and legal aspects relevant to the BAMAS project it is recommended to focus on the following efforts:

- Continue dialogue and consultation with the identified stakeholders via meetings and workshops during the remaining project tasks to build confidence and consensus on

the common benefit of improved water quality management and water pollution remediation in the Upper Litani Basin and Lake Qaraoun.

- Expand stakeholder participation during the implementation of the technical survey task to reach and involve emerging water users associations and coops such as that of the sugar beet growers, AICs, and other farmers and NGOs.

- Establish linkages with the two federations of municipalities, as well as the municipalities of the large agglomerations of the central and northern Bekaa. These municipalities should be encouraged to express their views and opinions concerning potential management scenarios and investment options for the Litani water quality, and to become fully fledged partners in the process.

- Establish a partnership with the CCIAZ; given that contacting directly individual industries may prove arduous and complex, to facilitate communication and make industries part of the solution rather than part of the problem.

- Build on the *Rapid Review* information about the institutional arrangements relevant to BAMAS tasks to carry discussions, especially with the government institutions, in order to clarify possible overlaps that may impact the implementation of water quality management and water pollution remediation options. Note that given the scope and time limitation of the BAMAS project it is not intended to address all overlaps that exist among various players in the upper Litani basin. Only overlaps related to the implementation of water quality management and water pollution remediation options will be assessed and analyzed.

- Build on the *Rapid Review* information about the laws and regulations relevant to BAMAS tasks to gauge stakeholders' support for the need to amend existing laws and regulations for the management of water quality, including regulation of groundwater abstraction and management of wastewater utilities. Note that, given the scope and time limitation of the BAMAS project, only potential law and regulation amendments related to the implementation of water quality management and water pollution remediation options will be assessed and analyzed.

- Determine the willingness and readiness of local small communities to manage and operate wastewater treatment schemes in coordination with the USAID "Small Village Wastewater Treatment Systems" project which is implemented by CDM;

- Gauge stakeholder buy-in for public-private-partnership for management of wastewater facilities;

- Identify institutional strengthening and capacity building needs to improve wastewater community utility performance and capabilities and water quality assessment and management;

- Set directions for developing standards and regulations for reuse of reclaimed wastewater.

3. SURFACE WATER QUALITY AND WASTEWATER MANAGEMENT

Water quality of the upper Litani River and Qaraoun Lake has been deteriorating for a long time due to the effect of various point and non-point sources of pollution in the upper Litani basin. A brief analysis of surface water quality and sources of pollution in the basin, the current status of wastewater management, as well as environmental impacts has been done within this *Rapid Review*.

3.1 Surface Water Quality in the Basin

The major sources of potential water pollution in the upper Litani basin and Lake Qaraoun include domestic wastewater, industrial effluent, agricultural runoff, and solid waste disposal (Figure 2). Pollutants come from point and non-point sources. Point sources include solid waste and wastewater discharge from domestic, industrial, and some agricultural activities, while non-point pollution originates mainly from the chemical-laden runoff of agricultural lands, urban areas, and roads. In fact, irrigated agriculture is a significant potential non-point source of pollution for both surface and groundwater resources in the basin, especially due to loads of nitrates and phosphates in addition to various kinds of pesticide leachate. While the major sources of potential pollution in the upper Litani basin are well known at the sector level (DAI & WESS, 2003a), at times, there is a lack of adequate knowledge of the overall pollution load in general and the composition of this load particularly with respect to industrial discharges.

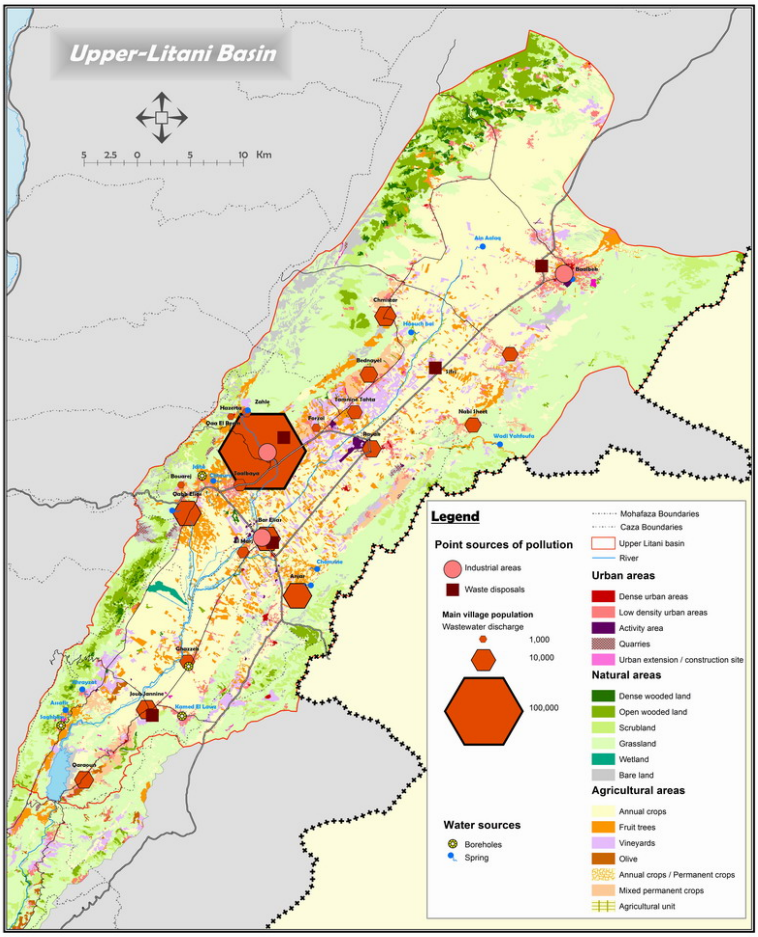

Figure 2. Point and non-point sources of pollution

In this *Rapid Review*, previous surveys of surface water quality in the basin were re-examined. In this context, efforts to characterize the water quality in the basin are limited to the years of 1993[2], 1994[3], 1995[4], 1999[5], 2001[6], 2003[7], and 2004[8]. The main indicators that have been tested during various surveys with the range of detection and a comparison with relevant MoE standards are presented in Appendix C. In general, Lake Qaraoun and the upper Litani River with its three major tributaries (Berdaouni, Qabb Elias and Ghozayel rivers) have been affected mostly by the discharge of untreated domestic wastewater that increases the levels of organic matter, ammonia, and wastewater-related bacteria to the extent that the water has been deemed unsuitable for domestic use or bathing.

While reported levels, from different surveys, of heavy metals in water have been inconsistent, these are likely to be more adsorbed to sediments in the riverbed or the lake bottom and remain largely uncharacterized. Pollution from agrochemicals, particularly chlorinated organic compounds, has not been alarming whereby most concentrations registering below the detection levels with the exception of two compounds that were detected in one sample. Similar to heavy metals, agrochemicals remain largely uncharacterized in both water and sediments of the lake and the riverbed. Note that most surveys targeted water sampling with minimal examination of sediments and fish tissues. The latter can provide a better understanding of the accumulation of pollutants in the environment.

In short, various surveys are sporadic in nature often consisting of single or multiple sampling expeditions that that have taken place at different times of the year. Evidently, in the absence of systematic and well-coordinated continuous monitoring, fluctuations in reported water quality data are expected due to the variability of river flow, inconsistency of sampling locations, variability in the occurrence and discharge rates from polluting sources, as well as differences in sampling and analysis techniques. Nonetheless, the available data are still useful for a general understanding of the causes and effects of poor water quality in the upper Litani basin and Lake Qaraoun and more importantly to define the gaps for further work. In this respect, given the time and budget constraints of the current project, water sampling along the upper sections of the Litani river and its tributaries should focus on assessing the impacts resulting from major pollution hotspots (upstream and down stream of major polluting sources) along the river. Similarly, water, sediment, and fish sampling in Lake Qaraoun should be conducted. Particular attention should be placed on quantifying nutrients responsible for potential eutrophication as they directly relate to the uncontrolled algal blooms in Canal 900.

[2] Ministry of Environment, 1993

[3] Ministry of Environment, 1994

[4] Jurdi, M., Korfali, S.I., Karahagopian, Y., and Davies, B., 2002

[5] MVM Konsult AB, 2000

[6] Litani River Authority, 2001

[7] DAI & WESS, 2003a, b

[8] A water quality sampling program has been recently initiated along the Litani River as part of the IDRC funded Environmental study: The Sustainable Management of the Litani Basin Project that is being implemented by the Remote Sensing Center of the NCSR. While data from this project have not been made available to date, coordination with this project is ongoing to ensure minimal overlap and optimal complementary monitoring activities.

The geographic location of potential sources should be better defined using Global Positioning Systems (GPS). These locations could then be super-imposed above a land use map within a GIS framework. To the extent feasible, the overall pollution load and its composition should be ascertained, measured or estimated depending on the type of source and accessibility. Domestic wastewater and solid waste sources can be more readily defined and characterized in comparison to industrial or non-point sources.

Water, sediment, and fish samples should be analyzed for a pre-defined set of bacteriological, physical, and bio-chemical indicators which can be selected on the basis of the results reported in the previous surveys. To the extent feasible, efforts should be made to use the same sampling locations as those where samples have been collected during previous water quality surveys in the basin to allow the build up of a meaningful database that can be used for comparative assessment and trend delineation. Finally, attempts should be made to establish a source-sink association between the measured pollutant concentrations and the discharge sources.

While an environmental audit of industrial facilities is beyond the scope of the present project, it is desirable to obtain information about the total production and environmental management practices at these facilities to allow the definition of the total discharged load and its characteristics, particularly that, during the First Project Workshop held on January 12, 2005, several industrialists expressed their willingness to allow access to their facilities. On the other hand, agrochemical usage being a non-point source in nature can present a challenge in estimating the load that will ultimately reach the water resources in the basin. Estimates can be made on the basis of import records and application practices by farmers.

3.2 Current Status of Wastewater Management

As mentioned in the previous section, domestic wastewater is considered to be a major source of pollution in the upper Litani basin. Wastewater in the basin has been discharged for a long time into the Litani main stream or its main tributaries as raw sewage without any treatment. The effect of the direct discharge of raw sewage into the Litani River is magnified by the widely used practice of combining storm water drainage and collection of domestic and industrial wastewater in the same networks, which outfall directly into the river.

Out of all collected reports and documents within this Rapid Review, two master plans were developed by consulting companies for sewage treatment plants within the upper Litani catchment area. The first plan was the National Waste Management Plan for Lebanon, which was completed in 1982 (Camp, Dresser & McKee and Khatib & Alami, 1982) and updated in 1991 (Khatib & Alami, 1991). The second one was the National Emergency Plan for Wastewater Management in the Bekaa Cazas of Baalbeck, Hermel, Zahleh, West Bekaa, and Rachaya (Jouzy & Partners, 1992). Both studies recommended a series of sewage treatment plants across the basin in order to tackle the problem of direct discharge of domestic and industrial wastewater into the Litani River and its main tributaries. It should be noted that some towns in the West Bekaa region are excluded from service in both studies. Table 1 shows the details of the proposed sewage treatment plant (STP) locations and excluded towns in both studies.

Table 1. Proposed wastewater treatment plants for the Upper Litani Basin

Station	*Caza*	*Areas served*	*Population served*	*Treatment method*
Camp, Dresser & McKee / Khatib & Alami				
Hawsh al Rafka	Baalbek	Bednayel, Shmestar, Hawsh al Rafka, Bednayel, Taraya	34,400 (yr 2000) 74,300 (yr 2040)	Screening
Britel	Baalbek	Britel area	7,700 (2000) 16,600 (2040)	Screening and Sedimentation
Hawsh Hala	Zahleh	Temnin el fawka, Temnin el tahta, Niha, Nabi Ila, Ferzol, Ryak, Hawsh Hala, Hay El faykani, Ali El Nahri, Sahm El Tawbeh, Hawch El Ghanam, Sarain El Fawka, Sarain El Tahta and Nabi Shit	54,200 (2000) 117,000 (2040)	Screening
Barr Elias	Zahleh	Kaa El Rim, Zahleh area, Taalbaya, Jdita, Saadnayel, Swayri, Aanjar, Majdal Aanjar, Barr Elias, Qabb Elias, Mreyjat, Bwarej, Taanayel, Makseh and Ksara	310,000 (2000) 670,000 (2040)	Screening
Joub Jannine	West Bekaa	Joub Jannine and Kamed el lawz	15,900 (2000) 34,300 (2040)	Screening and Sedimentation
Qaraoun	West Bekaa	Kherbet Kanfar, Aain Zebdeh, Saghbin, Deir Aain El Jawzeh, Aaytanin, Mashghara and Qaraoun	47,100 (2000) 101,700 (2040)	Screening
Areas not covered		Marj, Hosh El-Harima, Ghaza, Lala, Rawda, Khyara, and Baaloul		
Jouzi & Partners				
Shmistar	Baalbek	Taraya and Shmistar	71,000 (2017)	Screening
Bednayel	Baalbek	Bednayel, Almasnaa, Hawsh el rafka	25,000 (2017)	Aerated ponds
Britel	Baalbek	Britel area	16,000 (2017)	Aerated ponds
Nabi shit	Zahleh	Nabi Shit, Sarain El Fawka, Sarain El Tahta	33,000 (2017)	Aerated ponds
Hawsh hala	Zahleh	Kaser Naba, Temnin El Fawka, Temnin El Tahta, Nabi Ila, Ferzol, Ryak, Hawsh Hala, Ali El Nahri, Ablah	53,000 (2017)	Screening
Taanayel	Zahleh	Qaa El Rim, Wadi El Arayech, Almaalaka, Zahleh, Hawsh El Omara, Ksara, Saadnayel, Taalbaya, Shtoura, Jdita, Jlala, Mreyjat, Qabb Elias, Taanayel and Makseh	465,000 (2017)	Screening
Aanjar	Zahleh	Majdal Aanjar and Aanjar	105,000 (2017)	Screening
Ghaza	West Bekaa	Ghaza area	16,500 (2017)	Aerated ponds
Kamed el lawz	West Bekaa	Kamed El Lawz area	11,500 (2017)	Aerated ponds
Joub Jannine	West Bekaa	Joub Jannine area	15,000 (2017)	Aerated ponds
Qaraoun	West Bekaa	Qaraoun area	15,000 (2017)	Aerated ponds
Mashghara	West Bekaa	Mashghara area	23,000 (2017)	Aerated ponds
Areas not covered		Barr Elias, El-Marj, Hawsh El-Harimeh, Khyara, Kherbet Kanafar, Soghbine, Lala, and Baaloul		

However, what is currently being implemented is the CDR plan, which proposed seven STPs in the study area, that use secondary/tertiary treatment (an activated sludge system followed by ultraviolet disinfection). Table 2 presents the details of the STPs and their current implementation status as stated in the CDR July 2004 Progress Report.

Table 2. Status of the CDR Wastewater Treatment Plants Master Plan (CDR, 2004)

Station	*Caza*	*Areas served*	*Population served*	*Capacity (m^3/day)*	*Status*
Baalbek	Baalbek	Baalbek and Douris	130,600	19,600	Completed in Summer 2000 Financed by the World Bank
Timnine Et-Tahta	Baalbek	Niha, Nabi Aila, Tamnine Et-Tahta, Saraain, Nabi Chit, Ablah, Fourzol, and Riyak	-	-	Contract preparation is under way
Zahle	Zahle	Hazerta, Zahle, Saadnayel, Taalabaya, Jdita, Bouarej, and Qabb Elias.	212,700	31,900	Construction commenced mid 2004 Financed by the Italian Protocol
El Marj	Zahle	El-Marj, Majdel Anjar, and Souairi	-	-	Contract preparation is under way
Joub Jannine	West Bekaa	Aana, Mansoura, Soultane Yaaqoub Al-Faouqa, Joub Janine, and Khamed El-Laouz	-	-	Contract preparation is under way
Saghbine	West Bekaa	Bire, Lala, and Saghbine	-	-	Contract preparation is under way
Qaraoun	West Bekaa	Baaloul, Qaraoun, and Machgara	24,000	24,000	Contract preparation is under way

As presented in Table 2, there is only one existing, but non-operational, STP within the upper Litani basin. This STP, which is located in the Caza of Baalbek, has been designed to serve several towns and villages within the catchment area including Timnine El-Tahta, Timnine El-Fawka, Qasar Naba, Bidnayel, Hawsh El-Rafqa, and Tarayya. However, as mentioned above, the STP is still idle in spite of its completion, because most of the towns and villages that are supposed to be served still lack the necessary sewage networks.

3.3 Environmental and Health Impacts of Surface Water Pollution

Potential environmental and health impacts of surface water pollution in the basin are multi-faceted and can be classified under direct and indirect impacts depending on the exposure pathway. Direct impacts are the result of direct exposure to low quality water such as the consumption of polluted water that could result in a variety of adverse implications to human, animal, and aquatic well-being, as well as damage to soils and plants (i.e. phosphorous buildup or heavy metal absorption) and damage to industrial or agricultural equipment such as corrosion. Indirect impacts are the result of indirect exposure to polluted water such as the consumption of damaged plants, impacted animals, fish, or food products, and the development of eutrophication associated with algal blooms that in turn damage agricultural equipment, restrict water flow in canals, and produce foul odors and insects.

In fact, algal blooms are readily apparent in Canal 900, which withdraws water from Lake Qaraoun for a large irrigation scheme in the southern part of the Bekaa Valley (Figure 3). The Canal was rehabilitated in 2001 with refurbishment of 14 kilometers and the construction of an additional 4 kilometers. It extends from the Qaraoun Dam to a closed end near the village of Kamed El Louz.

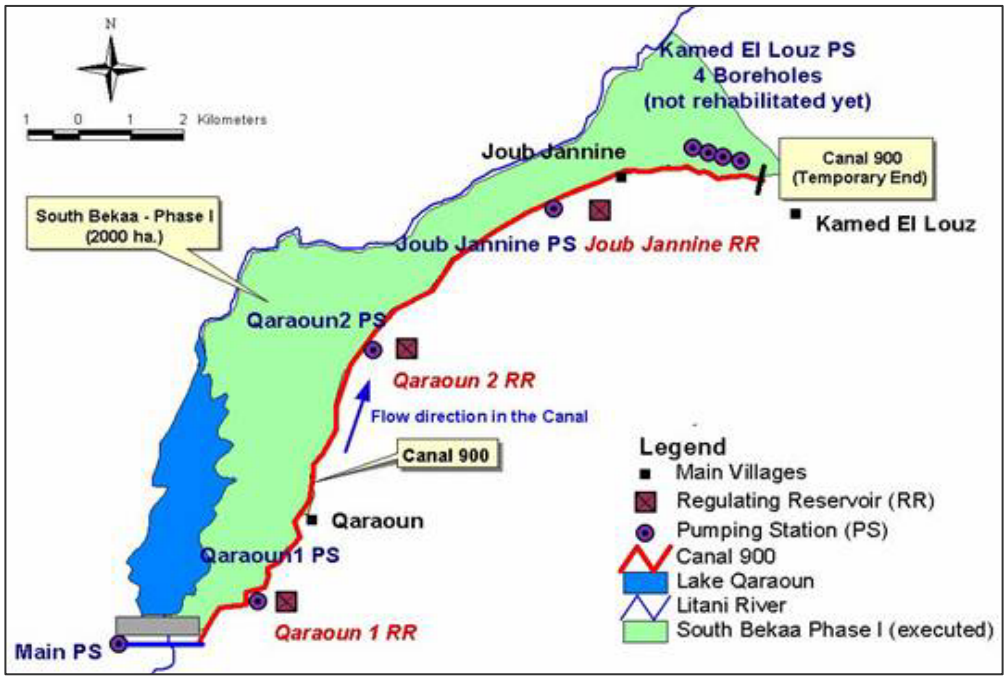

Figure 3. Overview map of Canal 900 (DAI & WESS, 2003b)

Algae proliferation in Canal 900 has persisted since its rehabilitation, thus impeding water flow in the canal; blocking pumps, sluices, and filters; and clogging drippers. This problem is attributed to nutrient build up in Lake Qaraoun associated with domestic and industrial wastewater discharge along the Litani River as well as agricultural runoff laden with agrochemical nutrients into the river.

In this *Rapid Review*, water quality and algae proliferation in Canal 900 were re-examined. In this context, field surveys and water quality analysis conducted in September 2003 during the dry season (DAI & WESS, 2003b) revealed that the water in the Lake and the Canal has elevated concentrations of phosphorous and nitrogen that are conducive to algal bloom under appropriate environmental conditions (i.e. sunlight, temperature, water stagnation and depth). No surveys or sampling were conducted during the wet season to better understand the cycle of algal bloom in the canal. Furthermore, no other sampling and analysis efforts have been reported by others beyond the DAI & WESS study. While several options for the control of algae proliferation have been outlined (DAI & WESS, 2003b), the feasibility of these options was not investigated. Therefore, a technical and economic comparative assessment of various alternatives that could be adopted should be conducted to assist in selecting the optimal alternative that could ultimately be implemented.

In all cases, both direct and indirect impacts are often translated into a burden on socio-economic development in the region[9]. Figure 4 is an attempt to depict the elements linking surface water usage to socio-economic development through the various potential impacts that may result from surface water pollution.

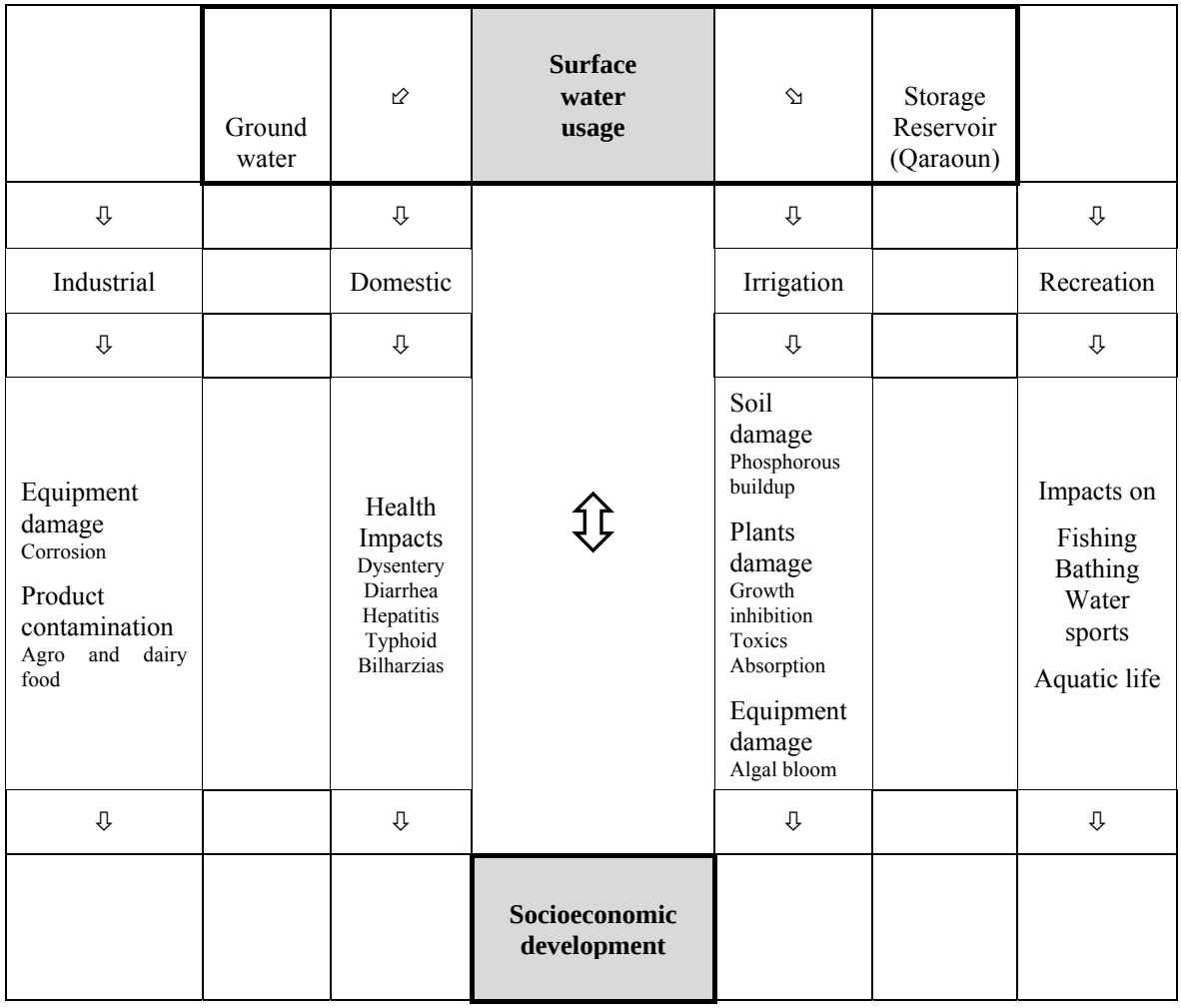

Figure 4. Surface water usage pollution impacts

In general, there is a lack of adequate data required to correlate the existing pollution levels with the health and socio-economic impacts in the area. As such, data should be sought on the occurrence and number of water borne diseases in the basin by developing a specific questionnaire based survey that should be administered to the main hospitals and clinics operating in the basin. Equally important data that should be sought through a similar survey questionnaire should target stakeholders responsible for the main socioeconomic activities in the region namely agriculture, industry, and recreational activities. Both sets of data can be used in the assessment of environmental and socio-

[9] Poor water quality can be translated into an economic value that is lost due to restrictions or limitations on the use of water for irrigation, fishing, swimming, or other recreational activities, or higher costs incurred to treat water and render it suitable for use; and most importantly water-related diseases impose an economic cost on individuals and society through cost of illness and forgone earnings associated with lost productivity. These latter costs are limited by the absence of dose-response functions for water-related health effects, the assumption that reported illness cases are water-related, underestimation in the number of cases due to under-reporting, uncertainties in mortality and morbidity valuations, and assumptions on the value of such items as lost productivity and the costs of transportation.

economic impacts of water pollution (cost of illness and lost productivity, cost of water treatment and water purchase, cost of damage to agricultural and industrial equipment, cost of damage to soil and crop growth, etc).

3.3 Recommendations

In order to augment the available information on wastewater management in the upper Litani basin, which have been gathered and presented in this *Rapid Review*, the field survey should include the following activities:

- Update the currently available information regarding the proposed sewage treatment plants in terms of location, design capacity, treatment process, etc. and collect the latest available data so that cost estimates could be established for the proposed STPs.

It is also recommended to address the algal bloom in Canal 900, which is a priority issue for LRA, through the following activities:

- Conducting a canal survey and collection/analysis of water samples during the wet season. This can be conducted in conjunction with the planned survey and sampling for surface and ground water. Efforts should be made to use the same sampling locations with the previous DAI & WESS study and testing for similar indicators of eutrophication (dissolved oxygen, total phosphorous, total nitrogen, and transparency) and pollution (pH, nitrates, sulfates, phosphates, chemical oxygen demand, total coliform and fecal coliform)
- Examination of the various alternatives for algae proliferation control through a comprehensive feasibility study based on a technical and economic comparative assessment of these alternatives
- Selection of the optimal alternative and preparation of a scope of work for a pilot area where this alternative can be tested before full implementation

Additionally, a number of monitoring and survey activities are recommended for a better definition of surface water quality and potential sources of pollution in the absence of long-term and reliable surface water quality data for the upper Litani basin and Lake Qaraoun. Testing for various indicators will allow a more comprehensive understanding of corresponding environmental and socioeconomic impacts. These activities are prioritized below on the basis of the overall objective of the current project which is the development of a decision support system for water quality management in the upper Litani basin:

- Collection of data on the occurrence and number of water borne diseases
- Collection of data on the main socioeconomic indicators in the region namely agriculture, industry, and recreational activities
- Sediment sampling and analysis at Lake Qaraoun
- Fish sampling and analysis at Lake Qaraoun
- Sediment sampling and analysis along the upper sections of the Litani River
- Water sampling and analysis at Lake Qaraoun
- Water sampling and analysis along the upper sections of the Litani River
- Soil sampling in the upper sections of the Litani basin and in the agricultural lands along Canal 900 to measure impacts of water pollution and algae proliferation

- Effluent sampling from selected industries discharging in the upper Litani River basin
- Coordination with CDM on wastewater effluent characterization in the upper Litani River basin
- Definition of the geographic location of potential sources of pollution in the upper Litani basin and superposition of the geographic location of these sources on a land use map within a GIS framework
- Wherever feasible, estimation of the overall pollution load and its composition from various potential sources

It is important to note that every effort will be made to supplement existing information with an adequate set of field measurements Table 3 presents a summary of the activities that will be undertaken to allow a better understanding of the various elements relating surface water usage with socioeconomic development depicted in Figure 4 and that are intended to be used in the development of the Decision Support System for water quality management in the upper Litani basin.

Table 3. Summary of proposed activities for Theme 2

Description or sector	*Medium*	*Indicator or mechanism*	*Mechanism*	*Location*	*Frequency*
Health indicators	Humans	Dysentery, diarrhea, hepatitis, typhoid, and bilharzias	Questionnaire and previous records	Hospitals and clinics	Once per year
Domestic water		Water purchase	Questionnaire	Sample households	Once per year
Wastewater		Population and total discharge Network systems Septic systems	Questionnaire Field estimation Field observations	Municipalities	Once per year
Solid waste		Quantity generated and disposed	Questionnaire Field observations Previous records	Municipalities	Once per year
Agriculture		Equipment damage Agrochemical usage Soil damage Crop damage	Questionnaire Import records	Sample farmers and coops LRA and water authorities Suppliers of agrochemicals	Once per year
Industry		Equipment damage Product damage Production quantities Total waste and wastewater generation Environmental management practices	Questionnaire	Industries	Once per year
Recreation	Lake Qaraoun Litani river	Fishing Bathing Water sports Aquatic life	Questionnaire Field observations	Fishermen Municipalities LRA and water authorities	Once per year

Table 3.Summary of proposed activities for Theme 2 (*cont'd*)

Description or sector	*Medium*	*Indicator or mechanism*	*Mechanism*	*Location*	*Frequency*
Bacteriological	Water, sediment, and fish	Total and fecal coliforms, and salmonellae	Sampling and laboratory enumeration	*Lake Qaraoun* Sediment samples at bottom of the lake	Twice a year Wet and dry
Physical	Water and sediment	pH, temperature, transparency, suspended solids, conductivity/alkalinity Flow rate	Sampling and laboratory analysis Field measurements	Fish samples Surface, mid depth, and bottom water samples Mid depth and bottom water samples at Canal 900 intake	Twice a year Wet and dry
Biochemical	Water, sediment, soil, and fish	BOD, COD, ammonia, total nitrogen, nitrates-nitrogen, total phosphorus, ortho-phosphate, sulfates, gammahexachloro cyclohexane, hexachlorobenzene, lead, mercury, cadmium, copper, chromium, zinc, and iron	Sampling and laboratory analysis	*Litani river* Upstream and down stream of Mimosa tissue plant, the Sikomo paper and cardboard facility, the sugar refinery, the battery factory, the existing landfills, as well as the main sewage outfalls. Other sampling locations can be added during the field surveys as deemed necessary. *Canal 900* Water samples along the Canal's length Soil samples along the Canal's length *Industrial effluents* Depending on allowed access to industries	Twice a year Wet and dry Once a year Wet season Once a year

4. GROUNDATER QUALITY MANAGEMENT AND WATER QUALITY MONITORING

Within the framework of the *Rapid Review*, available information on groundwater quality in the upper Litani basin and Lake Qaraoun have been gathered and analyzed in order to identify point and non-point sources of groundwater contamination and provide recommendations for the following field survey task within the current project.

4.1 Groundwater Quality in the Basin

Contrary to the significant number of studies that covered surface water in the basin, starting with the famous work of Ibrahim Abdel Aal in the early 1950s, very few studies tackled the quantity and/or quality of the basin's groundwater resources. Consequently, very scarce information is available on groundwater quality in the upper Litani and Lake Qaraoun Basin.

Nevertheless, the information that could be gathered from some analyzed samples, shows groundwater contamination and certain high levels of organic matter, iron, zinc, and mercury (MVM Konsult AB, 2000). No primary or secondary data or any other information could be gathered on bacteriological contamination, as well as nitrate and phosphate concentrations in the basin's groundwater. However, high concentrations of all these contaminants are expected to be present in the groundwater due to the prevailing

uncontrolled wastewater discharge practices in addition to the common agricultural practices and heavy use of agrochemicals in the region.

4.2 Point and Non-point Sources of Groundwater Pollution

According to gathered information during this *Rapid Review* (MVM Konsult AB, 2000), the main *point sources* of groundwater pollution in the upper Litani and Lake Qaraoun Basin are:

- *Solid waste dumpsites*: None of the used dumpsites in the basin is lined and/or equipped with any facilities for leachate collection and treatment.

- *Domestic wastewater*: Sewage system outlets and indequatly maintained septic tanks cause groundwater pollution.

The main *non-point source* of groundwater contamination, on the other hand, is irrigated agriculture. Heavy use of fertilizers and pesticides in the agricultural sector is among the major threat to the quality of groundwater in the basin. As mentioned above, the most significant nutrients affecting groundwater quality are nitrogen in the form of nitrates and phosphorus as phosphates. Various types of pesticides are also among important pollutants that could be leached down to groundwater depending on their retention and adsorption properties.

Agriculture statistics (FAO, 2000) show that about 65% of arable land in the study area is irrigated and intensively cultivated with an occupation ratio that may exceed 150%. The cropping pattern is mainly formed of cereals, green vegetables, fruit trees, grape vineyards, industrial crops (Sugar beet), olive trees, and a limited area of green houses. Intensive applications of fertilizers (mainly NPK 17-17-17) and pesticides (various kinds of fungicides, insecticides, and herbicides) on all these crops are practiced routinely in the agricultural areas within the basin. Typical cropping pattern of annual crops, along with the current agricultural practices, in the study area are presented in Appendix D.

Geological maps show that most of the cultivated areas within the basin lay on alluvial deposits. The maps show also that this formation, which is porous in nature, is in direct contact with groundwater aquifers in the region. On the other hand, most of productive wells within the basin are located in porous formations on the eastern and western limits of the alluvial zone, on flans of surrounding mountains to the east and west of the region, and on the contact of the limestone formations J4 and C4 with quaternary deposits.

The combined effect of the current agricultural practices and the basin's geological characteristics magnifies the risk of groundwater pollution from agricultural activity in the basin and raise it to a very high level. Therefore, improvement of on-farm agricultural practices should be sought in order to reduce potential contamination of groundwater aquifers in the basin.

4.3 Water Quality Monitoring in the Basin

Gathered information during this *Rapid Review* show that there is no routine water quality monitoring program in the upper Litani and Lake Qaroun basin. All water quality

data gathered have been collected from previous studies. Although information available on surface water quality is significantly greater than that found on groundwater quality, still all the primary data that could be gathered and analyzed in the review have been collected within intermitent sampling campaigns, and mainly based on single time events.

In the absence of systematic and well-coordinated continuous monitoring, fluctuations and discrepancies in reported water quality data have been evident. In fact, such discrepancies can be always expected in the prevailing conditions under which data collection and water quality sampling have been done in the basin so far. The variability of river flow in wet and dry seasons and in the pollutant loading rates at point sources, in addition to the inconsistency of sampling locations and sampling collection/analysis techniques, are the main drivers behind these fluctuations and inconsistencies in the upper Litani basin and Lake Qaraoun water quality data. Therefore, the reliability and representativeness of the data collected under such conditions are always questionable, especially when conflicting results are reported.

In fact, the absence of reliable surface and groundwater water quality data, due to the lack of a long-term monitoring system in the upper Litani basin, is a major constraint towards assessing water quality in the basin which in turn limits efforts aiming at introducing pollution control measures and developing proper water quality management options and policies for the basin. This calls for an urgent need to develop a framework to ensure the establishment of a *standardized long term monitoring system* for surface and groundwater quality in the basin. Such a long-term monitoring program would be used to check for compliance of potential polluters with water quality management policies and directives, and to monitor the resulting water quality trends and general outcomes of such policies that might be adopted.

In order to eliminate various sources of discrepancy and inconsistency in water quality data, the developed long term monitoring program should be characterized with the following:

- Quarterly or monthly sampling frequency should be adopted in order to reflect the effect of seasonality on water quality data.
- Standard sampling collection and analysis procedures should be implemented to ensure consistency.
- The number and distribution of assigned locations of monitoring stations should have enough coverage over the basin with special focus on known and suspected pollution "hotspots" along the river.
- Priority in monitoring should be given to tracing pollutants with the most serious health impact on the basin's population. Elements with significant socio-economic and/or environmental impacts within the basin should also be given priority in tracing them.
- Standard procedures should be developed for data acquisition, quality control, management and dissemination; along with standard techniques for data analysis and interpretation.

4.4 Recommendations

The above review of available information clearly calls for the following project interventions:

- Identify potential sites for long term surface and groundwater quality monitoring locations to characterize industrial and domestic waste and agrochemical contamination and their impacts on water quality in the river, lake, Canal 900, and aquifers. Priority should be given to pollutants that have health, socio-economic, and/or environmental impacts.
- Conduct groundwater quality sampling and analysis during the technical survey task with the following specific objectives:
  - Obtain a preliminary characterization of the prevailing situation of groundwater quality under the effect of heavy metals, pesticides, fertilizers, and biological pollution; and
  - Establish a reference groundwater quality profile in the remote areas of the catchment, where groundwater is normally unpolluted by human activities.

Bearing in mind the above cited objectives, and considering the variability of water quality with the seasonality of the basin hydrologic regime and the variation of the pollution loads, the sampling campaign will be conducted during two different periods:

- Winter (February to April 2005)- lowest levels of pollution are expected during this wet period due to dilution effect.
- Summer (July 2005)- the pollution level will build up during this dry period due to the low dilution and the increase of pollutant load.

Based on the known sources of pollution on the sectoral level, four families of pollutants will be traced over the catchment as follows:

- Heavy metals (Ni, Cd, Cr, Hg, Cu, Zn), resulting from industrial sector and solid waste landfills
- Nitrates, Phosphates, resulting from agricultural activity and domestic sewage
- Biological pollution, resulting from sewerage and certain industries
- Pesticides, resulting from agricultural activity

Taking into consideration the above-mentioned time and budget constraints in the current project, the sampling campaign shall be organized as follows and shall be scheduled as proposed in Table 4:

Heavy metals

- Reference samples to detect any natural concentrations in major springs
- Samples to detect the impact of landfills in Zahle, Joub Jannine, Barr Elias, and Sifri
- Samples to detect the impact of domestic wastewater downstream of major cities such as Zahle, Anjar, and Qabb Elias

Nitrates

- Reference samples to detect any natural concentrations in major springs
- Samples from locations across the catchment, including agricultural areas

Phosphates

- Reference samples to detect any natural concentrations in major springs
- Samples to detect the impact of domestic wastewater downstream of major cities such as Zahle, Anjar, and Qabb Elias
- Samples from wells in the vicinity of agricultural areas

Pesticides

- Samples to detect the impact of landfills in Zahle, Joub Jannine, Barr Elias, and Sifri
- Samples from wells in the vicinity of agricultural areas to be selected according to various crops

Biological indicators

- Samples to detect the impact of wastewater discharge downstream of major cities such as Zahle, Anjar, Qabb Elias, and at various locations throughout the catchment

Table 4. Proposed calendar of groundwater sampling

	January	February	March	April	May	June	July	August	September	October	November	December
Nitrates												
Phosphates												
Heavy metals												
Pesticides												
Biological data												

First campaign - Baseline, low pollution level

Early Summer, high pollution pressure

In addition to the sampling campaign, and due to the significantly high risk of groundwater non-point pollution from agricultural activity in the study area, the status of the cropping pattern and irrigation/fertigation/pesticide practices need to be analyzed in order to assess the impact of improving on-farm agricultural practices in reducing the level of contamination in the basin.

5. FIRST WORKSHOP

Following the gathering and analysis of technical, institutional, and legal information related to water quality improvement and pollution control, the BAMAS project organized its first stakeholder workshop on Wednesday January 12, 2005 at Chtaura Park Hotel, Chtaura, Bekaa. The main objectives of this workshop are summarized as follows:

- Present the project to the national and local stakeholders (LRA staff, relevant governmental authorities, and local stakeholders such as municipalities, industries, and farmers) and obtain their endorsement;
- Present the results of the rapid review;
- Solicit feedback on the recommendations and work plan of the rapid review; and
- Catalyze the formation of the national working group.

5.1. Attendance

Consultation of stakeholders during the rapid review activity has significantly contributed to the large turnout. A total of 83 participants attended this first workshop, representing the following entities (Figure 5):

- United States Agency for International Development
- Litani River Authority
- Municipalities (32 were represented)
- Ministries of Environment, Energy and Water, Public Health
- Bekaa Water Establishment
- Research centers
- NGOs
- Local farmers and farmers coops
- Industries
- Agriculture Inputs Companies
- Academic institutions
- Other projects in the Litani Basin
- National Council for Scientific Research
- BAMAS Team Members
- Press

Figure 5. BAMAS First Workshop

A detailed attendance sheet is included in Appendix E.

5.2. Presentations

The meeting kicked off with welcome addresses by the LRA Director General, Mr. Ali Abboud, and by the USAID Mission Director, Mr. Raouf Youssef. Following that, Dr. Hussein Rammal presented an overview of the achievements of LRA, and Dr. Mohamed Chebaane followed with a concise presentation of the project, focusing on its structure and objectives.

The technical presentations (see Appendix F for the workshop agenda and Appendix G for the corresponding presentations) were clear and representative of the contents of the *Rapid Review*. They elicited a great deal of questions by the participants. Clarifications were offered by the BAMAS team.

5.3. Discussions

The crux of the workshop was the last session, the discussion session, which also included recommendations for the formation of the national working group. During this session, the participants made several pertinent interventions, and addressed important issues such as:

- The need for the enforcement of environmental regulations
- The role of the water authorities in wastewater treatment
- The willingness of the industries to cooperate and be part of the project
- The need for implementation provisions for Law 444 for the Protection of the Environment
- The health problems encountered by LRA staff working in the Abd el Aal power station
- The need for monitoring of water quality
- The importance of prohibiting well drilling
- The need for transparency and collaboration in project implementation
- The roles of the municipalities in wastewater management
- The significance of involving the local community at the various stages of the process

At the end of the session, Mr. Ali Abboud of LRA closed the workshop by stating that all stakeholders need to work in partnership to address the issue of the pollution of the Litani. He recognized the importance of the BAMAS project in providing the LRA with an action plan for pollution control, and committed to seek funding for its implementation.

5.4. Evaluation and Feedback

A questionnaire developed specifically for the BAMAS project was administered to participants to solicit their feedback and recommendations regarding the findings of the *Rapid Review*, the plan of work, and the formation of the national working group (Appendix H).

Twenty-nine (29) evaluation sheets were collected. There was general endorsement of the *Rapid Review*, the plan of work, as well as of the mechanism for project implementation. The comments are summarized below:

Table 5. Summary of comments/recommendations put forth by the attendants

Intervention	*Disagree with Intervention*	*Remarks*
Surface water	None	
Canal 900	1	Weed scientist needed to solve the problem
Ground water	None	
Technical Survey	None	
Collaborative planning	None	

In response to the above comment regarding the need of weed scientist to address Canal 900 algae control, the project has already made contacts with a US weed scientist/ algae pollution control specialist to characterize the Canal 900 algae, and consulted the head of an irrigation district in California to identify a seasoned expert in algae treatment in irrigation canals.

5.5. National Working Group

Twenty (20) out of the twenty nine (29) respondents indicated their willingness to participate in the national working group.

The respondents recommended the following institutions / individuals for participation in the national working group:

- Concerned municipalities
- Association of Industrialists
- Chamber of Industry
- Ministry of Energy and Water
- Ministry of Environment
- Ministry of Agriculture
- Ministry of Interior
- Ministry of Health
- Litani River Authority
- National Council for Scientific Research
- Farmers Representatives
- Asaad Zgheib: Zahle's mayor (President of Municipality)
- Fayad Haydar: Qab Elias mayor
- Aazar El-Chouairy: Qab Elias deputy mayor
- Qasem El Aamayfi: Qab Elias municipality (member)
- Dr. Omar Kanaan: Environmental Club of West Beqaa (NGO)
- Dr. Mohammad El-Khawlie (NCSR)
- Eng. Rabiaa el-Fourzli
- Dr. Abd El Rahman El-Saghir
- Dr. Moustafa Haidar

Based on the above recommended list, the Collaborative Planning, Institutional and Legal Aspects project team will contact the above suggested institutions and individuals during the end of January early February to select a concise and representative team of 8 to 10 members to form the Project National Working Group.

6. CONCLUSION

The rapid review task characterized the current state of knowledge of water quality and water pollution issues in the Upper Litani and Lake Qaraoun basin illustrating the lack of groundwater quality information, and the need to fill in data gaps in surface water quality. It also identified and described the current regulations and roles of the public institutions and local communities' stakeholders and initiated stakeholders' dialogue on water quality management and pollution control. Recommendations were presented on how best to augment information related to technical, institutional, legal, health, and socio-economic aspects of water quality management during the technical survey task. The workshop clearly achieved its objectives in endorsing the project tasks and approach by a wide representation of stakeholders. General consensus was reached on the *Rapid Review* recommendations and various issues raised by both the participants and the project consultants. Finally, the number of suggested names for participation in the national

working group exceeded expectations and provided a further indication of the relevance of the project to the various stakeholders.

Building on the above achievements and recommendations, the project team started the design of the technical survey, which will be implemented in close collaboration with stakeholders during the months of February-March.

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LIST OF APPENDICES

APPENDIX A- Project Leaflet

LITANI WATER QUALITY MANAGEMENT PROJECT

There is a serious water pollution problem in the upper Litani River basin and Lake Qaraoun. This is due to unregulated solid and liquid domestic and industrial waste disposal practices, in addition to agrochemical contamination and lack of sustainable wastewater management. This situation has also caused negative water use impacts on various sectors such as tourism, including a threat to public health. As such, there is an urgent need for proper and sustainable management of surface and ground water quality in the area to avoid these impacts.

OBJECTIVE

The objective of the LWQM project, funded by the United States Agency for International Development (USAID), is to identify water quality management options and scenarios for the upper Litani River basin and Lake Qaraoun and to develop an environmental management plan for the implementation of such options, while involving stakeholders in all the steps of the process.

OUTPUTS

- Management and investment options and scenarios for Water Quality Management and Water Pollution Remediation.
- Action Plans ready for implementation.

TASKS

The LWQM project focuses on the following five tasks which will be implemented with collaboration and active participation of stakeholders:

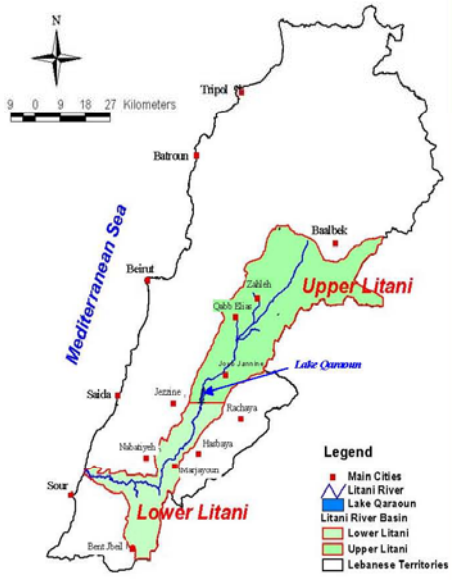
Rapid Review of background information related to water quality, institutional and legal aspects, as well as identification and interview of key stakeholders;

Technical Survey to gather and analyze information that assist the identification of potential investment and management options related to water pollution remedial and water quality management;

Identification of Potential Management and Investment Options for Water Quality Management and Water Pollution Remediation and screening of these options based on socioeconomic, institutional, legal, and environmental aspects;

Development of a Decision Support System to assist stakeholders in selecting optimal scenarios for Quality Management and Water Pollution Remediation and preparation of a an *Environmental Action Plan* to support the implementation of these scenarios.

Capacity Building through active participation of stakeholders.



LWQM Basin Advisory Management Services

Contact person: Mr. Mark Saadeh
Project Manager
Development Alternatives, Inc.
Mobile: 03 174 882
Phone: 01 662 117

In collaboration with:

APPENDIX B- List of Contacted Stakeholders

Governmental Authorities

Ministry/Authority	*Representative Contacted*	*Position*	*Means of Contact*	*Date*
Ministry of Public Health	Dr. Farid Karam	Head of the Sanitary Engineering Department	Meeting	22-12-04
Ministry of Environment	Dr. Berge Hadjian	Director General	Meeting	23-12-04
Council for Development and Reconstruction	Mr. Ismail Makki	Head of the Agriculture and Environment Section	Meeting	03-01-05
Beqaa Water Establishment	Dr. Haykal Rahi	Chairman-Director General	Phone call	05-01-05
Ministry of Energy and Water	Mr. Hassan Jaafar	Head of the Environmental Remediation Department	Meeting	10-01-05
Ministry of Environment	Ms. Lamia Chamas Eng. Assaad Saadeh	Head of Service Conservation of Nature Resources Department Geological Engineer	Meeting	15-01-05

Community Stakeholders

Stakeholder	*Contacted Representative*	*Location*	*Means of Contact*	*Date*
Sugar beet Cooperative	- Mr. George Elhrawi (President), - Mr. Saiid el-Mays (General Director) - Mr. Yousef Chebib, - Mr. Elie Jleilaty - Mr. Anis Abu Ghanem	Zahle	Meeting	17-12-04
The Union of the Municipalities of the (Qaraoun) Lake	- Mr. Rabih Jema'a (President) - Mr. Melhem Zarzour (Head of Kherbet Kanafar Municipality)	Joub Jannine	Meeting	17-12-04
Farmer	- Michel Estfan	Joub Jannine	Meeting	17-12-04
The Union of the Municipalities of the (Bekaa) Valley	- Mr. George Khoury (Vice President) - Mr. Raja Chawich.	Mansourah	Meeting	17-12-04
Zahle – Maalaka Municipality	- Eng. Assad Zogaib (Head) - Eng. Elie Greisaty.	Zahle	Meeting	30-12-04
Chamber of Trade, Industry, and Agriculture	- Eng. Antoine Haddad (Director General)	Zahle	Meeting	30-12-04
Lebanese Agricultural Research Institute	- Eng. Salah El-Haj Hassan	Taanayel	Meeting	30-12-04
Riyak Municipality	- Mr. Emile Maakaron (Vice President) - Eng. Trad Trad	Riyak	Meeting	30-12-04
Institutional and Social Innovations in Irrigation Mediterranean Management – ISIIMM	- Eng. Saiid Jedoun	Zahle	Meeting	07-01-05
Industrial Association	- Mr. Muhieddine Nekhlawy	Taanayel	Phone call	07-01-05
Chtaura Municipality	- Mr. Nicola Assy	Chtaura	Phone call	07-01-05

APPENDIX C- Summary of Indicators Reported in Samples Collected from the Upper Litani Basin and Lake Qaraoun

Indicator		*Unit*	*Reported range*		*MoE standard forsurface water suitable for domestic use*
			Min	Max	
Lake Qaraoun	pH		7.06	9.35	6.5-8.5
	Conductivity	µS/cm	261	388	1,000
	Alkalinity	mg/L	70	112.5	
	TSS	mg/L	160	197	25
	DO	mg/L	5.7	7.8	
	BOD	mg/L	0.7	681	<3
	COD	mg/L	40.5	837	
	NH_3	mg/L	0.05	5.35	0.05
	NO_3	mg/L	0.53	100	25
	NO_2	mg/L	0.04	0.08	
	SO_4	mg/L	18	37	150
	Cl	mg/L	23	60	200
	PO_4	mg/L	0.01	1.57	0.4
	Total Phosphates	mg/L	0.05	0.18	
	Fe	mg/L	0	1.5	0.1
	Al	mg/L	0	19	
	Zn	µg/L	0	670	500
	Cr	µg/L	0.6	30	50
	Mn	µg/L	8	72.18	50
	Ni	mg/L	< 0.002	0.28	
	Cu	µg/L	0.5	28	20
	As	µg/L	< 2	4	10
	Cd	µg/L	< 1	2.9	1
	Hg	µg/L	< 0.5	21	0.5
	Pb	µg/L	< 5	13.5	50
	Fuel derivatives		Absent	Present	0.05
	Fecal Coliform	CFU/100 ml	0	300	
	Total Coliform	CFU/100 ml	< 1,800	4,340	50
	Salmonella	CFU/100 ml	Present		Absence
	Streptococcus	CFU/100 ml	86	144	
River	Fecal Coliform	CFU/100 ml	0	10,000	
	Total Coliform	CFU/100 ml	0	400,000	50
	pH		5.0	8.2	6.5-8.5
	BOD	mg/L	82	110	< 3
	COD	mg/L	160	200	
	NO_3	mg/L	0.39	44	25
	TSS	mg/L	138	142	25
	NH_3	mg/L	0.09	2,375	0.05
	Oil and grease	mg/L	18	22	
	PO_4	mg/L	0	39	0.4
	Total Phosphates	mg/L	1.12	1.24	
	Al	mg/l	< 0.002	38	
	Cr	Mg/l	< 2	1,200	50
	Mn	Mg/l	< 2	510	50
	Fe	mg/l	< 0.013	41.7	0.1
	Ni	mg/l	< 0.002	0.52	
	Cu	Mg/l	< 2	630	20
	Zn	Mg/l	< 2	440	500
	As	Mg/l	< 2	120	10
	Cd	Mg/l	< 2	10	1
	Pb	Mg/l	< 2	6,400	50
	Hg	Mg/l	< 0.5	69	0.5
	Total Nitrogen	mg/l	23	72	
Fish tissue	Fecal Coliform	CFU/100 g	200		
	Total Coliform	CFU/100 g	20,000		
	Pseudomonas		Present		
	Citrobacter freundii		Present		
Sediments	Cr	mg/Kg	2	21.51	
	Mn	mg/Kg	13	560	
	Fe	mg/Kg	710	55,000	
	Ni	mg/Kg	1.8	127.3	
	Cu	mg/Kg	2	18	
	Zn	mg/Kg	8.5	130	
	As	mg/Kg	0.3	1.1	
	Cd	mg/Kg	< 0.1	7.7	
	Pb	mg/Kg	0.7	7.9	
	Hg	mg/Kg	< 0.03	3.1	
	Al	mg/Kg	300	36,000	
	pH		7.44	7.67	
	Total Phosphorus	Ppm	1.09	1.31	

APPENDIX D- Typical Cropping Pattern of Annual Crops, and Agricultural Practices in the Upper Litani Basin

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Wheat		F W	F W		I	H				P		P
Early Potato	P F F	P FF W	W F T	T F I	T I H	T I H						
Middle Potato				P FF W	P FF I F W T	I F T	I T H	I T H				
Late Potato							P FF I W	P FF I W T	I F W T	I F	I H	H
Onion		P FF	P FF	F W	I F W T	I W T	I T H	H				
Tomato				P FF I T	P FF I T	I F T W	I F T W	I T	I H T			
Late Cucumber							P FF	P FF I W T	I F T	P F H		
Late Cabbage								P FF I W T	I H F H T	I H T	I H	
Watermelon				P F F	P FF I	I F	I	I H	I H			
Sugar Beet	P F F	P F W	F T W	I F W	I T	I T	I T	I T	I T H	I T H	H	P FF

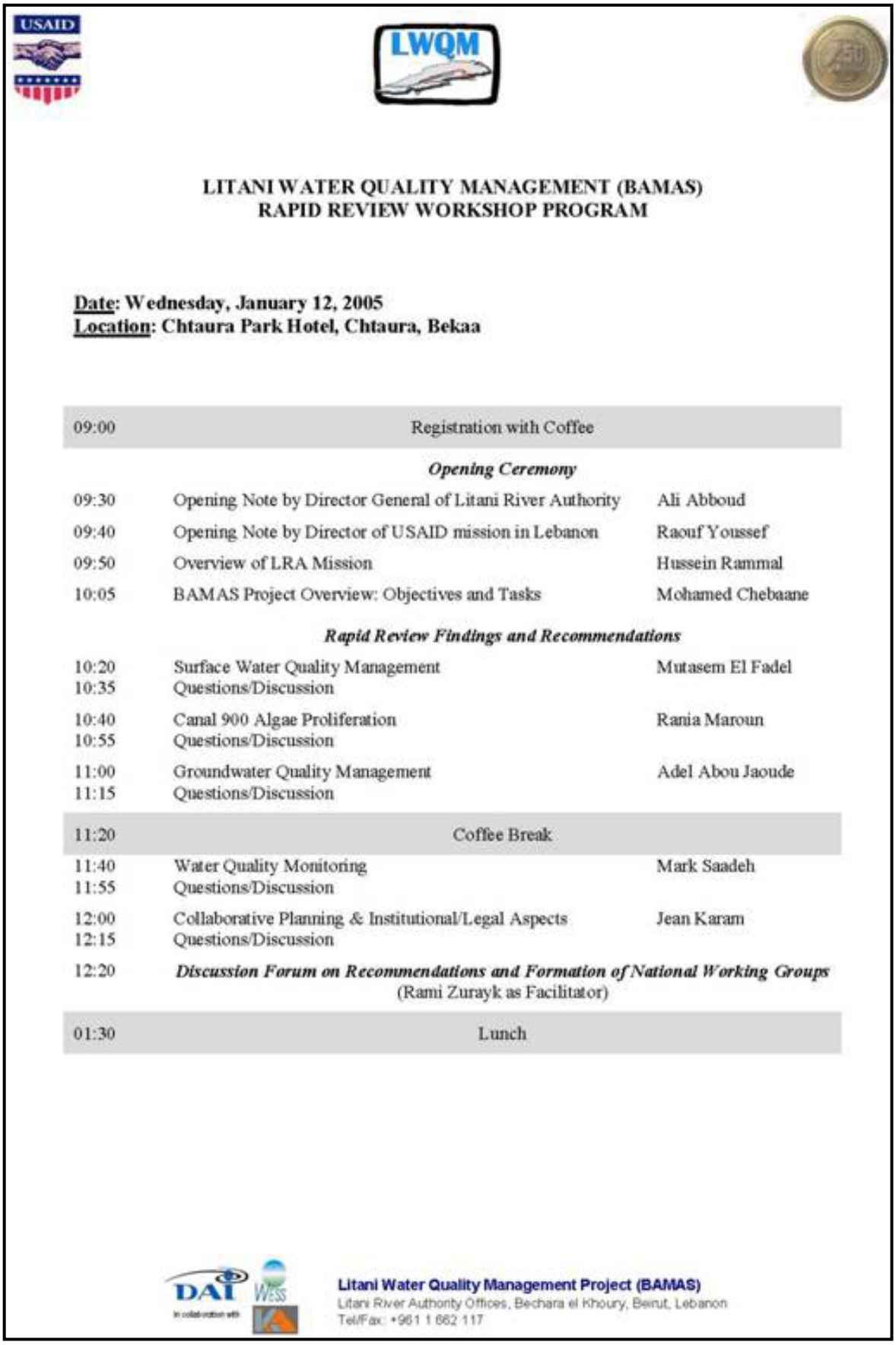
Soil occupation period
- P planting time
- H Harvesting time
- FF Main Fertilizer Application
- F Maintenance Fertilizer application
- I Irrigation
- T Pesticide application
- W Weed control

APPENDIX E- List of First Workshop Attendants

Party		Attendants
United States Agency for International Development		Raouf Yussuf Christine Sayegh Sana Saliba
Litani River Authority	Director General Coordinator	Ali Abboud Eng. Hussein Rammal
	Engineers	Eng. Mahmoud Ibrahim Eng. Jamal Ayoub Eng. Mohamed Dakroub Eng. Hassan Chbaro Kamil Massaad Melhem Monsef Fawzi Azzam Tony Al Kahi Mohamed Ghazal Khaled Nakhlawi Tony Saba Dr. Ali Kassem Yasser Khawaj Eng. Elias Hawi Nassim Abou Hamad Amine Al Ghazal Riyad Khalifeh
Governmental Authorities	Ministry of Environment	Eng. Assaad Saadeh
	Ministry of Public Health	Dr. Farid Karam
	Bekaa Water Establishment	Eng. Mohamed Al Shoubassi
	Ministry of Energy and Water	Ms. Rola Nassrallah Eng. Hani Tarshishi
Municipalities	The Union of the Municipalities of the (Qaraoun) Lake	Rabih Joumaa
	The Union of the Municipalities of the Bekaa	George Khoury
	Municipality of Mansourah	George Khoury Yassine Al Fatquieh
	Municipality of Riyak-Hoch Hala	Emile Maacaron
	Municipality of Qa'a El Rim	Eng. Wissam Tannoury
	Municipality of Zahleh	Eng. Ibrahim Abou Deeb
	Municipality of Chtaura	Elias Fayyad
	Municipality of Taanayel	Assaf Sawaya
	Municipality of Qabb Elias	Mohamed Abou Nassif
Research centers	National Center for Remote Sensing	Mohamed Khawli Amine Chaaban Dr. Talal Darwiche
	Lebanese Agricultural Research Institute	Mr. Fadi Karam
NGOs	The Chamber of Commerce, Industry, and Agriculture of Zahleh and the Bekaa, the Department of the Environment	Youssef Antoun Antoine Saliba Eng. Said Jedeon
	Industrialists Association	Muhieddine Nakhlawi (Maliban) Antoine Saliba (Mimosa)

Party		Attendants
Local Community	Farmers	Michel Estfan Kassim Omeiri Hussein Bouhemia Safa Issa
	Industry Master Chips/ Poppins	Jalil Al Jakl
	Industry Sugar Beet	Antoine Nohra Abd El Ghani Kassim
	Individual /Tourism development	Elie Baroud
	Water Resources Engineer	Tony Serhal
Agriculture Inputs Companies	Unifert	Antoine Slim
	Debbane	Eng. Mohamed Younes
Academic institutions	Universite Saint Joseph	Yola Ghorra George Al Farn Rola Al Qassouf
	AUB	Dr. Hamed Assaf Linda Slim
Other Projects	Small Village Wastewater Treatment Plants Project	John Crippen Cynthia Carlson Farouk Merhebi
	Lebanon Water Policy Project	Bassam Jaber Salah Zgheib Edmond Issa
	IRWA/ AVSE (NGO)	Emilio Maiandi Berthe Wakim
	International Hydrological Program/ Dar Al Handassah	Dr. Selim Maksoud
BAMAS Team Members	DAI	Mohamed Chebaane Mark Saadeh Roger Melki Jean Karam
	WESS	Mutasem El Fadel Rania Maroun Dany Lichaa El Khoury Ibrahim Alameddine Majdi Abou Najm Rami Zurayk Marwan Oweyjan Raja Bou Fakhreddine
	Khatib and Alami	Adel Abou Jaoudeh Maher Habanjar Karim Kawwa
Press	Al Balad & Al Sharq	Lucy Barfenjian

APPENDIX F- First Workshop Agenda



LITANI WATER QUALITY MANAGEMENT (BAMAS)
RAPID REVIEW WORKSHOP PROGRAM

Date: Wednesday, January 12, 2005
Location: Chtaura Park Hotel, Chtaura, Bekaa

09:00	Registration with Coffee	
	Opening Ceremony	
09:30	Opening Note by Director General of Litani River Authority	Ali Abboud
09:40	Opening Note by Director of USAID mission in Lebanon	Raouf Youssef
09:50	Overview of LRA Mission	Hussein Rammal
10:05	BAMAS Project Overview: Objectives and Tasks	Mohamed Chebaane
	Rapid Review Findings and Recommendations	
10:20 10:35	Surface Water Quality Management Questions/Discussion	Mutasem El Fadel
10:40 10:55	Canal 900 Algae Proliferation Questions/Discussion	Rania Maroun
11:00 11:15	Groundwater Quality Management Questions/Discussion	Adel Abou Jaoude
11:20	Coffee Break	
11:40 11:55	Water Quality Monitoring Questions/Discussion	Mark Saadeh
12:00 12:15	Collaborative Planning & Institutional/Legal Aspects Questions/Discussion	Jean Karam
12:20	***Discussion Forum on Recommendations and Formation of National Working Groups*** (Rami Zurayk as Facilitator)	
01:30	Lunch	

Litani Water Quality Management Project (BAMAS)
Litani River Authority Offices, Bechara el Khoury, Beirut, Lebanon
Tel/Fax: +961 1 662 117

APPENDIX G- First Workshop presentations

مشروع إدارة نوعيّة المياه في حوض الليطاني

LWQM

ورشة العمل الأولى

فندق بارك أوتيل، ضهورة
١٢ كانون الثاني ٢٠٠٥

DAI

برنامج ورشة العمل الأولى

9:00	تسجيل المشتركين	
	الإفتتاحية	
9:30	كلمة مدير عام المصلحة الوطنية لنهر الليطاني	علي عيّاد
9:40	كلمة مدير الوكالة الأميركية للتنمية الدولية في لبنان	روبرت بوسط
9:50	تعريف عن مهام المصلحة الوطنية لنهر الليطاني	حسين زعكّا
10:05	أهداف ونشاطات مشروع إدارة نوعيّة المياه في الحوض الأعلى لنهر الليطاني	محمّد شيمان
	تنسيق وتوصيات المراجعة السريعة	
10:20	إدارة نوعية المياه السطحيّة	مخيمر الفاضل
10:35	مشكلة النمو الزائد للطحالب في القناة ٩٠٠	رانيا مارون
10:50 11:05	إدارة نوعية المياه الجوفيّة أسئلة وحوار	عادل أبو جودة
11:20	إستراحة	
11:40 11:55	رصد نوعية المياه أسئلة وحوار	مارلا سمعان
12:00 12:15	التخطيط التعاوني والنواحي القانونية والمؤسساتيّة أسئلة وحوار	جان كرم
12:20	نقاش عام حول التوصيات وحول تشكيل فرق عمل ورشية (داعم زيتي)	
1:30	غداء	

جدول الورشة

- أهداف ونشاطات المشروع
- إدارة نوعيّة المياه الجوفيّة
- إدارة نوعيّة المياه السطحيّة
- رصد نوعية المياه
- مشكلة النمو الزائد للطحالب في القناة ٩٠٠
- التخطيط التعاوني والنواحي القانونيّة والمؤسساتيّة

أهداف ونشاطات المشروع

أهداف المشروع

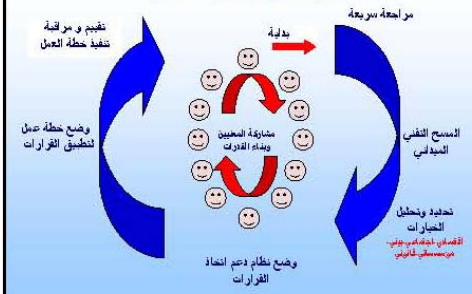
- تحديد خيارات للحلول العمليّة لإدارة وتحسين نوعيّة المياه في الحوض الأعلى لنهر الليطاني وبحيرة القرعون
- وضع خطة عمل لتطبيق هذه الخيارات

إشراك المعنيّين في كافة نشاطات المشروع

أهم المحاور

- إدارة نوعيّة المياه السطحية, مع الاهتمام بموضوع تلوّث المياه والنمو الزائد للطحالب في القناة ٩٠٠
- إدارة نوعيّة المياه الجوفية ورصد نوعية المياه
- التخطيط التعاوني والنواحي القانونية والمؤسساتية

نظام ادارة نوعية المياه



أهم النشاطات (تابع)

تحديد الخيارات المتاحة لإدارة نوعيّة المياه وتقييم الاستثمارات الازمة لمعالجة تلوّث المياه , بناءً على معطيات المسح التقني , مع الأخذ بعين الإعتبار للجوانب الإقتصاديّة والإجتماعيّة والمؤسّساتيّة والقانونيّة والبيئيّة ذات الصلة

وضع نظام لدعم عمليّة اتخاذ القرارات، وذلك لمساعدة المعنيّين على اختيار الحلول والسيناريوهات المثلى لمعالجة تلوّث المياه وإدارة نوعيّتها، مع وضع خطة عمل لتطبيق هذه السيناريوهات

انماء قدرات وخبرات كافة الجهات المعنيّة في مجال ادارة نوعيّة المياه من خلال مساهمة فعليّة ومشاركة ميدانيّة في مختلف نشاطات المشروع

أهم النشاطات

مراجعة سريعة

للمعلومات المتوفرة حول المحاور الثلاثة واصدار توصيات لدعم تحديد الحلول العملية لتحسين ادارة نوعية المياه، بالاضافة للإتصال بالمعنيين وتشريكهم في مختلف أنشطة المشروع

المسح التقني

لتجميع المعلومات الميدانية لتشخيص مصادر التلوث ونوعية المياه وتاثيراتها الصحية والإقتصادية والبيئية وتحليلها بناءً على توصيات "المراجعة السريعة" ، وذلك لتحديد الخيارات لمعالجة تلوّث المياه وإدارة نوعيّتها

نهاية المداخلة الأولى

شكراً

هيكلية ادارة المشروع

إدارة و تنسيق المشروع

محمد شيعان	رئيس المشروع
مارك سعاده	المدير
رانيا مارون	المنسق

خطيب و علمي (Subcontractor)		DAI (Main contractor)		WESS (Subcontractor)	
عادل أبو جودة	نوعية المياه الجوفية	محمد شيعان	إدارة موارد المياه	معتصم الفاضل	الإدارة البيئية
ماهر حبنجر	صرف صحي	بيتر ريس	التخطيط التعاوني	رامي زريق	الإنماء الإجتماعي
كريم كوّى	نوعية المياه الجوفية	غبريل بدرم	تقرير نقني/ إدارة	دالي ليشع الخوري	GIS
إيلي حجار	نوعية المياه الجوفية	جان كرم	تقوية القدرات الإدارية	فرح الأعور	نوعية المياه السطحية
		روجي مثلي	محلل إقتصادي	مروان عويجان	تحليل إقتصادي للموارد
		أرس جورجاكلوس	أنظمة مساعدة على الإدارة	إبراهيم علم الدين	نوعية المياه التلوث
				مجدي أبو نجم	أنظمة مساعدة على الإدارة
				رجا أبو فخر الدين	مسح ميداني

الإستمارة

إدارة نوعيّة المياه السطحيّة

مصادر التلوّث

- المياه المبتذلة
- النفايات الصناعية
- النفايات الصلبة (بما فيه نفايات المستشفيات والمصانع)
- الأسمدة والممارسات الزراعية

الآثار والنتائج السلبية

- صحّة عامّة
- نوعيّة المياه
- إقتصاد

نطاق العمل المقترح

خطط لمعالجة الصرف الصحي

- Camp, Dresser & McKee (CDM) وخطيب وعلمي (1991) وجوزي و شركاء (1992)
- مجلس الانماء والإعمار ووزارة الطاقة والمياه (2004)

موقع العمل	الوضع الحالي	التمويل
جب جنين	تنزيح المشروع	IDB
صفيرين	قيد المناقصة	IDB
عرمل	قيد التصميم	IP
عنجر/ مجدل عنجر	قيد التصميم	IP
زحلة	قيد التصميم	IP
الفرعون	قيد التصميم	IP
القبوة	قيد التصميم	IRP

IDB= International Development Bank; IP= Italian Protocol; IRP= Iranian Protocol

- "مشروع معالجة المياه المبتذلة للقرى الصغيرة" (2004-05) تمويل USAID وتنفيذ شركة CDM

14

خطط لإدارة النفايات الصناعيّة

- الخطوط التوجيهية لعمليّات التصنيع السّليمة الموضوعة من قبل وزارة البيئة (برنامج SPASI)
  - الدبّاغات
  - الورق
  - الزيتون
- التأكد من تقيّد المواقع الصناعية بالمعايير البيئية الموضوعة (القرار 1/8 لسنة 2001)

15

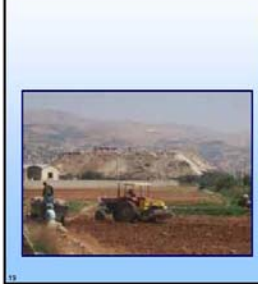
خطط لإدارة النفايات الصلبة

- مطمر زحلة الصحيّ (مشروع SWEMP)
- بوادر حلول عبر تنفيذ خطة متكاملة لمعالجة النفايات الصلبة على نطاق الأقضية أو المحافظات (مجلس الإنماء و الإعمار):

فرز ⇦
إعادة تدوير ⇦ ⇨ مطامر صحية
تسييخ ⇦

16

التلوّث الناجم عن الكيمياويّات الزراعيّة



الآثار والنتائج السلبية

الدراسات السابقة	الآثار السلبية	المقاس	تراوح المستويات
• مسح وزارة البيئة (صيف 1994)	• تردّي في نوعية المياه السطحية	الكولبفورم الغائطة	10,000 – 0 (cfu/100 ml)
• دراسات ال AUB (1995/2001/2003)	• الحدّ من إمكانية الإستفادة من المياه بالطرق والكمية المنشودة (القناة ٩٠٠)	مجموع الكولبفورم	400,000 – 0 (cfu/100 ml)
• الدراسة السويدية (1999)	• إنتشار للأمراض الناتجة عن إستهلاك أو إستعمال مياه ملوثة	إجمالي الفوسفور	12,000 – 1.24 (ملغ/ل م٣)
• مسح مصلحة نهر الليطاني (أيلول 2001)		إجمالي النيتروجين	1,110 - 23 (ملغ/ل م٣)
• دراسات DAI/WESS (صيف 2003)			
• دراسة الIDRC (2004-2005)			

برنامج العمل المقترح

تحاليل مخبريّة لمستوى التلوّث في الحوض

أنواع العينات	المواقع المبدئية	أنواع التحاليل	الوتيرة
• مياه	• مجرى نهر الليطاني الأعلى	• بكتيريولوجيّة	• صيفاً
• ترسّبات	• بحيرة القرعون	• فيزيائيّة	• شتاءً
• أنسجة أسماك	• القناة ٩٠٠	• بيوكيميائيّة	

استبيانات وتخمينات اقتصادية-اجتماعيّة

مؤشرات صحيّة	• التيفوئيد Typhoid • الدوسنتاريا البسيلية Dysentery • الكوليرا Cholera	• البارا تيفوئيد Paratyphoid • التهاب الكبد Hepatitis
مياه الاستعمال المنزلي	• كلفة شراء المياه	
القطاع الزراعي	• تضرّر المعدّات • استعمال المواد الكيميائيّة	• تردّي نوعيّة التربة • تردّي نوعيّة المحصول
القطاع الصناعي	• تضرّر المعدّات • تردّي نوعيّة الإنتاج الصناعي • كميّة الإنتاج	• كميّة النفايات والمياه المبتذلة • ممارسات الإدارة البيئيّة
الترفيه والسياحة	• صيد الأسماك • سباحة	• رياضات مائيّة • الحياة المائيّة

نهاية المداخلة الثانية

شكراً

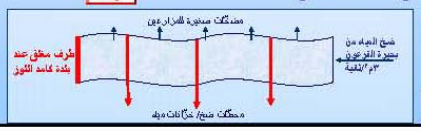
4

مشكلة النمو الزائد للطحالب في القناة ٩٠٠

- نطاق عمل دراسة DAI/ WESS (2003)

- وصف المشكلة
- المسح الميداني
- جمع العيّنات وتحليلها
- الإدارة والتحكّم بالمشكلة

- برنامج العمل المقترح



وصف المشكلة

الآثار المباشرة

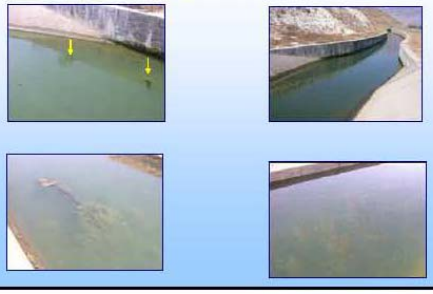
- إعاقة تدفق المياه في القناة
- إنسداد المصافي ومخارج المياه
- تعطيل المضخات
- إنسداد قطارات الرّيّ (drippers)

الآثار غير المباشرة

- تردّي نوعيّة التربة
- تردّي نوعيّة المحصول
- تشكيل خطر على الانسان والحيوانات بسبب الروائح وجذب الحشرات الى المناطق المجاورة

المسح الميداني

- تنمو الطحالب بكمّيّات متباينة على طول القناة 900



المسح الميداني (تابع)

تشكو القناة من انخفاض سرعة جريان المياه بسبب انحدارها الخفيف (0.2 بالمئة) وتصبح المياه راكدة عند نهايتها

تتدفق المياه بسرعة اكبر بقرب محطات الضخ وتحول دون تكاثر وتجمّع الطحالب

جمع العيّنات وتحليلها

الميزة/المؤشر	بحيرة القرعون	القناة ٩٠٠	وضع التزايد الغذائي
اجمالي الفوسفور (ملغ/م ٣)	570 - 1,110	50 - 940	وفرة المواد المغذية (>100)
اجمالي النيتروجين (ملغ/م ٣)	<5,000 – 12,000	<5,000 – 12,000	وفرة المواد المغذية (>5000)

المسح الميداني (تابع)

لجأت مصلحة الليطاني الى ازالة الطحالب يدويّا، مستخدمة في ذلك الشباك والمصفّى

برنامج العمل المقترح

- استكمال جمع العينات من القناة وتحليلها
- مقارنة الجدوى الإقتصاديّة والتقنيّة لعدّة بدائل للتحكّم بنمو الطحالب وإختيار البديل الأمثل
- تحضير برامج عمل لإختبار وتلزيم البديل المقترح

الإدارة والتحكّم بالمشكلة

خيارات لمواجهة النمو الزائد للطحالب في بحيرة القرعون والقناة 900

١. حصر حمولات التغذية الخارجية الواردة الى النهر والبحيرة
- تحسين الممارسات الزراعية
- انشاء معامل لمعالجة المياه المبتذلة

٢. معالجة مياه بحيرة القرعون لخفض كميات المواد المغذية
- معالجة مياه وترسبات البحيرة، خاصة لوقف مفعول الفوسفور

٣. المعالجة المباشرة في قناة 900
- معالجة المياه عند دخولها الى القناة
- تنظيف القناة
- تربية نوع معيّن من الأسماك
- وضع فتلات الشعير
- تحسين دورة المياه في القناة

نهاية المداخلة الثالثة

شكراً

إدارة نوعيّة المياه الجوفيّة

- الموارد المائية المستخدمة لمياه الشفة
- أثر نوعية المياه على صحّة الإنسان
- إستعراض سريع للمعطيات و المعلومات المتوفرة
- المنهجية المقترحة ضمن نطاق المشروع
  - متابعة ميدانية لنوعية المياه الجوفية
  - النمذجة الرياضية
- النتائج المتوقعة

أثر نوعية المياه على صحّة الإنسان

- أثر على المدى القصير (24 ساعة)
  - تلوث بيولوجي (بكتيريا و فيروس)
  - تلوث حاد من الأدوية الزراعية (تسمم)
- أثر على المدى المتوسّط (أشهر)
  - نيترات (أثر على كلى الرضع و الأطفال)
- أثر على المدى الطويل (عدّة سنوات)
  - الأدوية الزراعية
  - المعادن الثقيلة (الرصاص، الزئبق، الزنك، الكروم، ...)
  - الفوسفات (أثر على الكلى)

الموارد المائية المستخدمة لمياه الشفة

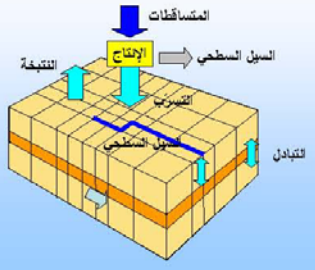
المعطيات والمعلومات المتوفرة

- دراسة المياه السطحية
  - مسح وزارة البيئة (صيف 1994)
  - دراسات ال AUB (1995/2001/2003)
  - الدراسة المويجية (1999)
  - مسح مصلحة نهر الليطاني (شباط 2001)
  - دراسات DAI/WESS (صيف 2003)
  - دراسة ال IDRC (2004-2005)
- **وزارة الصحّة** (التركيبة الفيزيائية و الكيميائية)
- **مصالح المياه** (التركيبة الفيزيائية و الكيميائية - تحاليل بيولوجية)

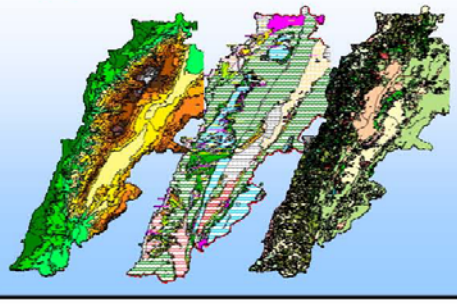
المنهجية المقترحة: المتابعة الميدانية

أنواع العينات	المواقع الميدانية	أنواع التحاليل	الوتيرة
▪مياه جوفية	▪الحوض الأعلى للنهر الليطاني	▪بيولوجيّة	▪صيفاً
		▪نيترات	▪شتاءً
		▪فوسفات	
		▪المعادن الثقيلة	
		▪مخلّفات المبيدات	

المنهجية المقترحة: النمذجة الرياضية (1)



المنهجية المقترحة: النمذجة الرياضية (2)



النتائج المتوقعة

- **فهم خريطة إنسياب الجوفية**
- **تحديد المناطق الحسّاسة بالإستناد الى الشروط الطبيعية:**
  - نوعية التربة
  - الشروط الجيولوجية
  - ...
- **دراسة أثر سيناريوات مختلفة**

نهاية المداخلة الرابعة

شكراً

الإجراءات المتخذة لبرنامج مراقبة نوعية المياه

- أولاً، عبر تأمين نظرة شاملة سريعة للدراسات الموجودة المختصة بنوعية مياه حوض الليطاني خلال المراجعة السريعة.
- خلال المسح التقني تقييم الظروف الحالية لنوعية المياه في حوض الليطاني و تأثيرات مصادر التلوث المختلفة كالتلوث الصناعي، المنزلي و الزراعي على المياه السطحية و الجوفية.
- إعداد برنامج لمراقبة المياه على الأمد الطويل مصمّم طبقاً لحدود و إجراءات "المسح التقني".

رصد نوعيّة المياه

- إنّ الدراسات السابقة التي تمت في حوض نهر الليطاني كانت مشاريع موّجهة و قصيرة الأمد.
- هدف مشروع مراقبة المياه على الأمد الطويل هو تأمين الدعم بغية تحقيق خطة عمل بيئية من أجل تطوير و تحسين نوعية المياه في حوض الليطاني الأعلى.

نهاية المداخلة الخامسة

شكراً

خطوط عريضة لبرنامج مراقبة المياه على الأمد الطويل

- تبنّي نظام زمني (فصلي أو شهري) لعملية أخذ العينات من أجل إظهار تأثير تغيّر الفصول على المعلومات المتعلقة بنوعية المياه.
- تطبيق عملية جمع العينات وإجراء التحاليل طبقاً للمقاييس المعتمدة
- إعطاء الأولوية إلى مراقبة الملوثات ذات التأثيرات الصحية، البيئية، و الإقتصادية

عرض موجز للنصوص القانونيّة ذات الصلة

- هناك تشريعات متعدّدة منها ما يعود لأوائل القرن العشرين وهي تشمل:
  - إستعمال المياه السطحيّة وحماية نوعيّتها
  - إستعمال المياه الجوفيّة وحماية نوعيّتها
  - تصريف المياه المبتذلة ومعالجتها
  - التخلّص من النفايات الصلبة والضارّة
  - حماية البيئة والتخطيط البيئي
- التشريع الأهم فيما يختصّ بحماية البيئة هو القانون 444 تاريخ 2002/7/29 ولكنّ نصوصه التطبيقيّة لم تصدر بعد

النواحي القانونيّة والمؤسّساتيّة والتخطيط عن طريق المشاركة والتعاون

- عرض موجز للنصوص القانونيّة ذات الصلة
- الإدارات والمؤسّسات العامّة والبلديّات المعنيّة
- المؤسّسات الأهليّة ومؤسّسات القطاع الخاص المعنيّة
- نطاق عمل المرحلة الثانية من المشروع

نهاية المداخلة السادسة

بداية حلقة النقاش

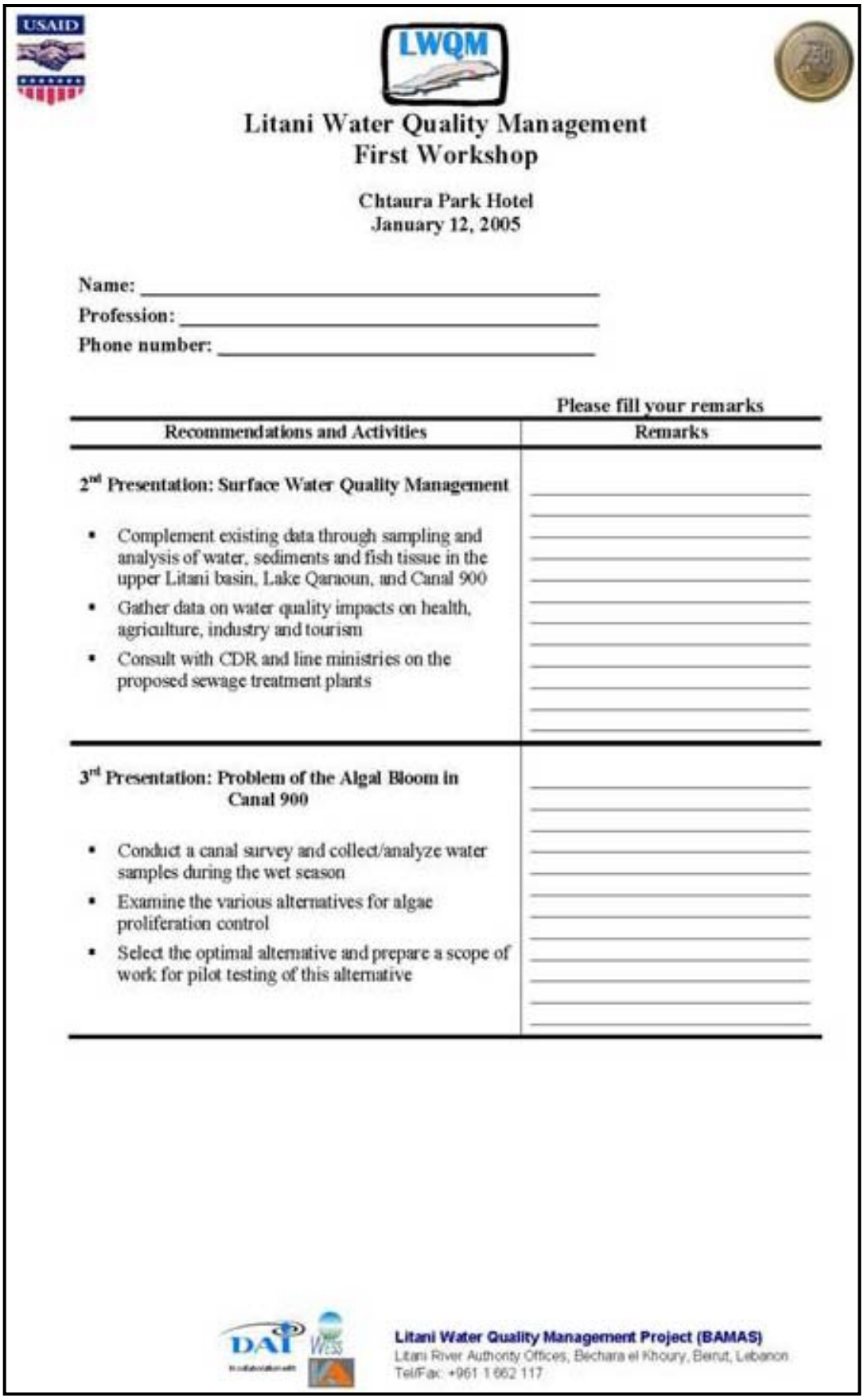
شكراً

نطاق عمل المرحلة الثانية من المشروع

- متابعة التواصل والتشاور مع كافة الجهات المعنيّة في القطاعَين العام والخاص
- إنطلاقاً من نتائج المرحلة الأولى للمشروع:
  - تحليل ومناقشة التضارب الظاهر في الصلاحيّات ما بين بعض الإدارات والمؤسّسات العامّة
  - التشاور مع المعنيّين في الحاجة إلى تعديل وتحديث بعض التشريعات
- **تشكيل فريق عمل وطني يناقش الحلول والسيناريوهات المقترحة**

9

APPENDIX H- First Workshop Recommendations Form



Litani Water Quality Management
First Workshop

Chtaura Park Hotel
January 12, 2005

Name: _____

Profession: _____

Phone number: _____

Recommendations and Activities	Please fill your remarks Remarks
2nd Presentation: Surface Water Quality Management • Complement existing data through sampling and analysis of water, sediments and fish tissue in the upper Litani basin, Lake Qaraoun, and Canal 900 • Gather data on water quality impacts on health, agriculture, industry and tourism • Consult with CDR and line ministries on the proposed sewage treatment plants	_____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
3rd Presentation: Problem of the Algal Bloom in Canal 900 • Conduct a canal survey and collect/analyze water samples during the wet season • Examine the various alternatives for algae proliferation control • Select the optimal alternative and prepare a scope of work for pilot testing of this alternative	_____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

Litani Water Quality Management Project (BAMAS)
Litani River Authority Offices, Bechara el Khoury, Beirut, Lebanon
Tel/Fax: +961 1 662 117

Recommendations and Activities	Remarks
4th Presentation: Groundwater Quality Management	
• Analyze groundwater in the upper Litani basin • Identify potential sites for a long term water quality monitoring	
5th Presentation: Water Quality Monitoring	
• Develop a long term monitoring program based on the result of the technical survey	
6th Presentation: Collaborative Planning and Institutional and Legal Aspects	
• Continue dialogue and consultation with the identified stakeholders • Investigate and analyze overlap in the mandate between different public institutions • Discuss with stakeholders the need to modify and update certain laws	

Do you wish to participate in the foundation of a National Working Group?	☐ Yes ☐ No
Name people whom you think they should participate also in this group	

Litani Water Quality Management Project (BAMAS)
Litani River Authority Offices, Bechara el Khoury, Beirut, Lebanon
Tel/Fax: +961 1 662 117