

LITANI RIVER BASIN MANAGEMENT SUPPORT PROGRAM

INITIAL ASSESSMENT REPORT

FEBRUARY 2010

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ACRONYMS

ACOP	Acting Chief of Party
CO	Contracting Officer
COTR	Contracting Officer's Technical Representative
COP	Chief of Party
DSS	Decision Support System
GIS	Geographic Information System
GOL	Government of Lebanon
IAR	Initial Assessment Report
IQC	Indefinite Quantity Contract (a contracting mechanism for USAID)
IRBM	Integrated River Basin Management
IWRM	Integrated Water Resources Management
IRG	International Resources Group (a Washington DC-based consulting firm that is prime contractor for USAID Lebanon)
LOE	Level of Effort
LRA	Litani River Authority (the counterpart agency, a Lebanese governmental agency, also called Office National du Litani)
LRBMS	Litani River Basin Management Support Program
LTTA	Long-Term Technical Assistance
ONL	Office National du Litani (the counterpart agency, a Lebanese governmental agency, also called Litani River Authority)
M&E	Monitoring & Evaluation
MoEW	Ministry of Energy and Water
MoF	Ministry of Finances
MIS	Management Information System
NGO	Non Governmental Organization
O&M	Operation & Maintenance
PMP	Performance Monitoring Plan
RBA	River Basin Agency
RBMP	River Basin Management Plan

STTA	Short-Term Technical Assistance
TA	Technical Assistance
USAID	United States Agency for International Development
USU	Utah State University
WUA	Water User Association

I. INTRODUCTION

I.1. AUTHORIZATION

International Resources Group (IRG) was contracted by USAID/Lebanon (Contract EPP-I-00-04-00024-00 Task Order No. 7) under the Integrated Water and Coastal Resources Management Indefinite Quantity Contract (IQC) II to implement the Litani River Basin Management Support (LRBMS) Program. The period of performance of the contract is September 29, 2009 to September 30, 2012.

I.2. PROGRAM OBJECTIVES

The purpose of the LRBMS Program is to set the ground for improved, more efficient and sustainable basin management at the Litani river basin through provision of technical support to the Litani River Authority and implementation of limited small scale infrastructure activities.

The LRBMS program is part of USAID's increasing support to the water sector in Lebanon. The Litani River Basin suffers the fate of many river basins around the world: increasing demands compete for limited natural resources. Groundwater over-exploitation, deforestation and overgrazing, unplanned urban sprawl, untreated wastewater effluents, and unsustainable agricultural practices contribute to environmental degradation in the form of declining water and soil quality.

Solutions do exist to reverse these trends and establish sustainable management practices. The key to successfully implementing such solutions requires applying the principles of Integrated Water Resources Management (IWRM) through a single river basin authority rather than multiple agencies responsible for different aspects of water management as is the case in many countries. Fortunately, the existence of the Litani River Authority (LRA) provides a unique platform to become such an IWRM river basin authority that will mobilize stakeholders in the river basin and address these challenges in an integrated manner. Successful implementation of LRBMS will prepare the LRA to assume the role of an integrated river basin authority when legal constraints are removed.

I.3. PROGRAM COMPONENTS

Under the LRBMS program, LRBMS will work with national and regional institutions and stakeholders to set the ground for improved, more efficient and sustainable basin management at the Litani River basin. The LRBMS technical assistance team will provide technical services and related resources to LRA in order to improve their planning an operational performance and equip them with the necessary resources for improved river basin management.

To achieve the LRBMS program objectives, the Contractor shall undertake tasks grouped under the following four components:

- 1) Building Capacity of LRA towards Integrated River Basin Management
- 2) Long Term Water Quality Monitoring of the Litani River
- 3) Integrated Irrigation Management which will be implemented under two components:
 - a. Participatory Agriculture Extension Program: implemented under a Pilot Area: West Bekaa Irrigation Management Project
 - b. Machghara Plain Irrigation Plan
- 4) Improving Litani River and Qaraoun Dam Monitoring System which will be implemented under two components:
 - a. Litani Qaraoun Dam Monitoring System
 - b. Litani River Flood Management Model

I.4. PURPOSE OF THIS REPORT

The purpose of this report is to present the initial findings of the LRBMS team regarding :

- The current capacity of the LRA to carry out the tasks prescribed by its mandate;
- The potential of LRA to evolve into an effective River Basin Agency with the expanded role and responsibilities that befits such an organization; and
- The water governance framework (laws, institutions, policies) within which LRA operates.

Per the original RFP, the initial assessment was an opportunity for the LRBMS to:

- Review each of the four proposed components;
- Be customer-driven by interacting with LRA staff and building a consensus on activities and objectives;
- Be results-oriented by clearly identifying the concrete activities to be implemented.

Per IRG's proposal and the Contract signed with USAID, the goal of the assessment is to identify major gaps and develop a focused, mutually agreed-upon project work plan. The assessment will comment on:

- The mandate of LRA, the legal framework and policies under which it operates, and its role and responsibilities compared to those of the MoEW and the Water Establishments.
- The current staffing of LRA, its organizational structure, the responsibilities of each department and unit, and the modifications necessary to transition to the role of an IBRM authority.
- The administrative and financial capacity of LRA staff.
- The existing legal constraints to achieving project objectives.

- The situation of water resources in the Litani River Basin, in terms of location, availability, quality, usages.
- The technical capacity of LRA staff to manage water resources effectively, efficiently, and knowledgeably, notably by identifying and evaluating existing data management systems
- The technical capacity of LRA staff to operate and maintain water structures such as irrigation networks and storage structures (including Qaraoun Dam) and existing O&M procedures.
- The interactions of LRA and LRA staff with other water agencies and with the water users in the Litani River Basin.

The objective was finally to provide guidance to the First Annual Workplan to be produced in January 2010.

I.5. CONTENTS OF THIS REPORT

This report is made up of six chapters and annexes:

- Chapter 1 is the current introduction.
- Chapter 2 presents the main findings of the assessment and identifies the key challenges that may prevent the successful transformation of LRA into a River Basin Agency.
- Chapter 3 presents the assessment findings in more details, component per component., and introduces the activities that are envisioned for year one (until September 2010); these activities will be detailed in the First Annual Work plan due in January.
- Chapter 4 details the priority activities that already being carried out in partnership with LRA.
- Chapter 5 lists the specialist reports included in Annexes
- Chapter 6 provides a list of references and documents consulted during the assessment.

2. MAIN FINDINGS AND KEY CONSTRAINTS

2.1. REVIEW OF COMPONENTS

The initial assessment confirms that the four proposed components cover most of the immediate and long-term themes and activities necessary to turn LRA into a fully empowered and effective River Basin Agency. Integrated Water Resource Management is the objective, as defined by: “the process of promoting the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems”.

Promoting and implementing IWRM requires:

- A conducive water governance framework (i.e. legal backing, institutional coherence and visionary policies); this is covered through component 1;
- The routine collection, dissemination and use of accurate comprehensive data as the foundation for efficient decision making; this is covered through component 2;
- Demonstration and dissemination of better water management practices such as water use efficiency and preservation of water resources; since 80% of water used in the Bekaa valley goes to irrigation, component 3 focuses on this area and these issues;
- Proper identification and management of potential risks such as floods and dam failure; component 4 covers this topic.

The only proposed change is the possible renaming of components 2 and 4:

- Component 2: Water Monitoring
- Component 4: Risk Management

2.2. MAIN FINDINGS

Legal, institutional and policy environment (i.e. water governance):

- The LRA lacks legal authority over critical areas of water resource management that would be required to implement integrated river basin management (IRBM). The most critical elements missing from the LRA’s current legal mandate are:
 - Management and allocation of water resources other than for irrigation and hydropower.

- Water quality management.
- Groundwater management.
- The organizational structure and staffing of LRA are barely adequate for its current missions and insufficient to carry out water resources management activities.
- Most of the executive decision power of LRA resides with the Board of Directors or even higher at the levels of the MoEW, the MoF, or the Council of Ministers when it should be delegated to the General Director; conversely none of these entities provides strategic vision to guide water resources planning and management.
- The legal basis for stakeholder participation in water management is at best unclear.

Water monitoring:

- Human activities (mostly the direct disposal of untreated sewage and industrial effluents into surface watercourses, and the excessive use of fertilizers and pesticides by farmers) are degrading the quality of water resources in the Litani River Basin.
- LRA has a national mandate to monitor river flows and also conducts water quality monitoring activities in the Litani River Basin.
- Most of the resulting water data is:
 - Recorded and stored under Excel spreadsheets which are ill-adapted for this purpose;
 - Of uncertain quality;
 - Not easily accessible; and
 - Seldom used by decision makers (field managers and policy makers) and water users (such as farmers and residents whose wellbeing and incomes are impacted by the quality and availability of water resources).

Irrigation management:

- The mandate of LRA specifically involves the task of studying new irrigation projects and managing them in all of Southern Lebanon and South Bekaa.
- About 75,000 hectares are agricultural lands in the Litani River Basin, out of which:
- About 60,000 ha are cultivated , usually with regular or supplemental irrigation, out of which:
- About 45,000 ha are irrigated through groundwater pumping and about 15,000 ha are irrigated through surface or pressurized networks;
- Several irrigation schemes (representing several thousands hectares) are also irrigated from Litani River waters but are geographically outside of the river basin mostly in the south and along the coast from Saida to Tyre);

- Farmers tend to over-irrigate, even those using drip and sprinkler irrigation, as they have limited, if any, notion of irrigation scheduling.
- Relationships between farmers and governmental employees are at best distrustful (with possibly LRA having a better image than other agencies).
- Few farmers are members of cooperatives and these do not seem very effective; the one recent (1994-01) World Bank experience for establishing 27 WUAs throughout Lebanon was a failure.
- Banks rarely lend money to farmers and do so only with collateral (usually in the form of a land title). Most farmers receive fertilizers, pesticides, and other inputs from agricultural dealers who encourage over-application and get reimbursed by receiving a part or the entirety of the crop at discounted prices.
- LRA manages the Conveyor 900 main canal to deliver pressured irrigation water to a 2000-hectare Pilot Project area around Joub Jenine. Sprinkler (on wheat, potatoes, and forage corn) and drip (vegetables) are the LRA-mandated irrigation methods. Only 700 ha are currently irrigated from the canal, reasons being over-irrigation and reluctance from farmers to use canal water because they consider it polluted, unreliable, and more expensive than groundwater pumping.
- A new, sophisticated and fully functional soil and water testing laboratory was provided by the EC-funded IRWA project to LRA Kherbet Kanafar Extension Service Center. Unfortunately it is not operating yet and has been awaiting administrative approval for some time.

Risk management:

- Qaraoun dam is performing satisfactorily under normal operations.
- A comprehensive dam safety program would include:
 - Monitoring and ongoing maintenance;
 - Periodic (annual) dam safety examinations;
 - Periodic (every five years) dam safety reviews;
 - An emergency response plan.
- A standard dam monitoring equipment package is being defined, but this equipment (along with monitoring procedures) should be tailored to the specifics of the dam and its area through the carrying out of a failure mode analysis;
- Regarding seismic vulnerability, the dam presents positive features (such as proper cleanup of the foundation at the time of construction) and negative factors (strong seismic potential in the

area, steepness of the slopes); a quantitative assessment would require a site specific seismic hazard assessment and a deformation analysis of the dam

- The Feb 2003 flood seems to be the largest in recent memory: the Damascus highway was flooded and not passable by traffic near Bar-Elias during several days; flood levels and damages were magnified by riverbed infringements by riparians and farmers (e.g. pump sumps) and obstructions such as low bridges; impacted buildings were recent constructions in floodable areas;
- Previous floods are still being identified but some flooding events seem to be the consequence of persistent winter rains that saturate the clayey soils and cause waterlogging (and not necessarily large flows of the Litani River and subsidiaries);
- One previous flood model has been identified but is too basic to be of much use.

2.3. KEY CONSTRAINTS

Several key obstacles have been identified that would prevent LRA from becoming a real River Basin Agency:

- Weak water governance framework:
 - Despite the 2001 water sector reform (law 221), it remains unclear which institution has controlling jurisdiction over given water issues; overall water management responsibilities remain under the centralized purview of the MoEW (which lacks staff and capacity to implement them or provide a necessary strategic vision for the sector);
 - The current mandate of the LRA is ill-adapted to water management functions, but updating this mandate may require overhauling roles and responsibilities of different institutions in the water sector; it is unclear if the new Parliament and new government will support such an effort by including water sector reform in its priorities.
- Centralization/lack of subsidiarity: most executive decision power that would be expected to lay with the General Director (such as recruitment, budgeting, etc.) is actually handled by the Board of Directors or even at MoEW level; this centralized decision making leads to delays and inadequate decisions;
- Insufficient staffing: LRA like most governmental agencies suffers from the recruiting ban imposed since the late 90s (due to the government's indebtedness); the financial autonomy of the LRA (funded through the sale of electricity and not from governmental funds) should exonerate it from this ban; a revised organigram and staffing request is pending Ministerial approval;

- Stakeholder participation: while essential for efficient water resource management, its legal basis is at best unclear. Water users and residents are not involved nor consulted and rarely informed about water issues. It remains to be assessed what level of stakeholder involvement (from simple public information to actual consultation of stakeholders, or further to participation in decision making, and eventually to decentralization and empowerment) is feasible, and what level of commitment can be expected from stakeholders.

While these fundamental issues should mainly be addressed through donor lobbying at higher levels of the GoL, the LRBMS Team will support and lobby for necessary water governance changes. Since these changes may take time, our parallel approach will be to develop LRA’s capacity to operate as a river basin agency. It is however possible that the LRA could be challenged for undertaking new water resource management activities (even if no other entity is currently implementing those).

2.4. KEY PENDING QUESTION: GEOGRAPHIC AREA

Proper river basin management usually applies on a watershed, that is the entire area drained by a river up to a certain point along its course (which may or not be the river mouth).

The LRBMS Team intends to work in the entire Litani river basin (up to the sea). This is relevant for some activities (flood impacts, routing of flow in case of dam failure), possibly less for others, but the integrated approach requires so. Pragmatism will guide us along with access and security conditions.

It should be kept in mind that the Litani waters also supply hydropower generation (on the Awali river) and irrigation (Kasmiyeh area for example) outside of the river basin. For hydrologic coherence, it could be considered in the future to extend the LRA’s geographical area to include the basins of small coastal rivers such as the Awali, Sainiq, and Zahrani. The situation of the Hasbani river basin is more complex: geographic coherence would lobby for its inclusion as well, but its transboundary nature would complicate matters greatly.

2.5. ENVIRONMENTAL ASSESSMENT

Per the Contract, an Environmental Assessment is to be performed within three months of the award if necessary. As most activities under LRBMS are technical assistance activities, they would qualify for a categorical exclusion pursuant to 22 CFR Part 216.2 (c)(2) items:

- (i): "Education, technical assistance, or training programs"
- (iii): "Analyses, studies, academic or research workshops and meetings".
- (v): "Document and information transfers".

(xiv): "Studies, projects or programs intended to develop the capability (...) in development planning".

The construction of the Machgharra pipeline may be an exception and thus require an Environmental Assessment. We propose to await a draft design of the pipeline to reassess this possible requirement.

3. FINDINGS AND PROPOSED ACTIVITIES PER COMPONENT

A very complete physical description of the Litani River Basin was prepared in 2007 under the EC-funded SPI-Water program. This physical description activity was not repeated here but information from this report was used to guide or confirm LRBMS assessment.

LRBMS findings are presented here for each of the four components, along with proposed activities. These activities will be detailed in the First Annual Work plan due in January 2010, in terms of content, volume, responsible LRBMS team members, deliverables, expected outcomes, and timing. Some of these activities are already being carried out and are detailed in chapter 4 hereafter.

3.1. COMPONENT I: BUILDING CAPACITY OF LITANI RIVER AUTHORITY TOWARDS INTEGRATED RIVER BASIN MANAGEMENT

The goal here is to assist the transition of LRA from a resource mobilization mission into a water resource management role. This transition is necessary to deal with the water challenges in the Litani River Basin.

In the 21st century, it is short-sighted to assume that water problems can be simply solved by increasing the supply through infrastructure development. First experience has shown many times that infrastructure often fails when staff is not trained and empowered and when proper Operation and Maintenance (O&M) procedures are not in place. Second addressing water issues such as pollution through the construction of new water structures demands significant financial resources. Third it has proven feasible, more efficient and definitely cheaper to improve the use of already mobilized resources through approaches such as stakeholder participation (to promote better use behaviors and preservation of water resources) or demand management (reduction of leaks in networks, improvement of water use efficiency in irrigation, etc.)

Those are the types of activities the LRA should be equipped and empowered to carry out.

3.1.1. FINDINGS

As mentioned earlier, a conducive water governance framework (i.e. legal backing, institutional coherence and visionary policies) is essential to allow the transition.

Based on the report of Dr Carl Bruch and other team members, findings are that:

- **The LRA lacks legal authority over critical areas of water resource management** that would be required to implement integrated river basin management (IRBM). According to the 1954 Law that created the LRA, the institution has the authority to:
 - Execute the Litani project for irrigation, potable water, drainage, and electricity production within the national water master plan;
 - Install a network of electricity plants throughout Lebanon; and
 - Construct transformation stations and transmission and distribution lines throughout Lebanon.

Subsequent legal decrees have granted the LRA the authority to undertake project studies and to manage all irrigation schemes in Southern Lebanon and South Bekaa.

- **It remains unclear which institution has controlling jurisdiction within the Basin over given water issues. The most critical elements missing from the LRA's current legal mandate are:**
 - **Management and allocation of water resources other than for irrigation and hydropower.** LRA has no clear legal authority to monitor or regulate surface water withdrawals for other purposes. Law 221 (and subsequent amendments) created four Water Establishments (WEs) in 2001 and confirmed LRA's mandate but did not clarify the overall water management responsibilities which presumably remain under the purview of the MoEW.
 - **Water quality management.** According to Law 221 (2000), the MoEW has the authority to set water quality standards for surface and groundwater and to protect water resources from pollution. In 2002, however, Law 444 granted the Ministry of Environment (MoE) the authority to protect the surface and groundwater of Lebanon from pollution. Under the current legal framework, there remain questions as to which ministry has the lead responsibility for water quality management, and how the various water agencies coordinate on this topic.
 - **Groundwater management.** The LRA has no legal authority to manage groundwater in the Litani Basin. This is a critical issue, because of the illegal creation of wells and increasing withdrawal of groundwater throughout the Basin. However, groundwater

management throughout Lebanon remains the sole purview of the MoEW, but there does not appear to be sufficient capacity or willingness to enforce the law.

- **The organizational structure and staffing of LRA is barely adequate for its current missions and insufficient to carry out essential water management and enforcement activities:**
 - The current organigram presents four offices (to tackle the “old school” water resource mobilization objective): administration, technical affairs, hydropower, and irrigation management; each of these offices is divided into different departments; a revised organigram is under consideration at Ministry level; it mostly lobbies for authorization to hire more staff but includes modest organizational changes;
 - Due to the government’s indebtedness, a recruiting ban has been imposed on all governmental organizations in Lebanon for over ten years, and retiring and departing employees are often not replaced; the lack of staff seriously limits the capacity of LRA to even carry out its traditional missions and of course to consider additional activities; it will also hinder LRBMS when building LRA’s capacity; as a side note, the financial autonomy of the LRA (with its own income from power generation) should exonerate it from this ban;
 - LRA has currently a total of slightly over 200 permanent employees and around 200 more temporary staff (paid through a contractor); a request for additional staffing mentions a need for 700 employees;
- LRA staff is competent but its morale is low; due to limited staffing, managers operate in crisis mode without time to properly address long-term issues and to provide strategic vision and guidance to their staff; consequently management practices (human resources, assets, etc.) are often ad-hoc and not properly laid out, disseminated, implemented and monitored;
- Most of the executive decision power of LRA resides with the Board of Directors or even higher at the levels of the MoEW, the MoF, or the Council of Ministers, when it should be delegated to the General Director;
- Conversely the MoEW (through lack of staffing and capacity) does not provide the necessary strategic vision to guide water resources planning and management (for example by providing a framework/guidance and delegate authority to develop river basin management plans).
- **The legal basis for stakeholder participation in water management is at best unclear.** Water users and residents are not involved nor consulted and rarely informed about water issues in the Litani River Basin. Outside communication from the LRA is currently limited to:

- A website (<http://www.litani.gov.lb>) being currently built in multiple languages (Arabic, French and English) to share activities and news with the public.
- An annual administrative report that is only distributed to MoEW and other governmental agencies. It is mostly a descriptive report with limited analytical content.

Without going into details as to the benefits of stakeholder participation, LRA could, for example, provide through website or brochures:

- Role and responsibilities of LRA (most Litani residents ignore its very existence);
 - Water quality information for farmers and residents as useful for their health and/or livelihood;
 - Water availability information such as daily levels of Litani River and/or Lake Qaraoun;
 - Annual O&M plan for canal 900 for irrigating farmers;
 - Information on floodable areas for municipalities awarding construction permits; etc.
- The financial practices of LRA follow Lebanese public accounting standards; these practices focus on incomes and mostly expenses; financial planning is limited, and there is no analytical accounting; these practices are inadequate for a financially autonomous river basin agency.

3.1.2. PROPOSED FIRST YEAR ACTIVITIES

Based on these considerations, LRBMS technical assistance will focus on the following activities (it is yet to be decided which will be carried out during Year 1):

- Draft and support the promulgation of a revised LRA mandate; the most appropriate approach might be to avoid overhauling mandates of other water agencies and focus on providing LRA with complementary management and enforcement functions that are not clearly attributed.
- Progressively adjust LRA's organizational structure and staffing to match the role and responsibilities of a river basin agency; also define corresponding missions or mandates (along with performance objectives) for each unit/department.
- Build capacity of LRA staff to perform its technical, administrative, and most importantly managerial responsibilities; develop guidelines for most processes (inspired by the systematic monitoring and evaluation approach of Quality Assurance, see 3.1.4); also define individual job descriptions and performance requirements for each staff category.
- Strengthen the financial and accounting capacity of the LRA but also its capacity to prepare, implement and monitor a budget according to analytical accounting and financial standards.
- Develop an internal and external communication/awareness strategy for LRA; internal communications will support the development of a corporate culture as it relates to the

principles and practices of good water governance; external communications will involve the main Litani River Basin stakeholders to build trusting relationships between them and IRA, and promote stewardship and responsible water use behaviors.

- Initiate the involvement of stakeholders (water users and residents), engage and build capacity of their representatives.
- Identify and improve LRA's O&M and asset management processes and practices.

Finally and most importantly, the LRBMS will:

- Guide LRA to perform essential water governance functions which are (beyond mobilizing water resources):
 - Sound and accountable strategic planning;
 - Transparent and participatory water resource management;
 - Equitable water allocation; and
 - Fair enforcement of water regulations.
- Support the preparation and implementation of a River Basin Management Plan (RBMP) as the strategic backbone of the transformation of LRA into a river basin management agency (see 3.1.3 hereafter).

It remains to be assessed:

- **Which of these activities can realistically be achieved during year 1;**
- **What level of stakeholder involvement is feasible;**
- **What level of commitment can be expected from LRA and stakeholders.**

3.1.3. STRATEGIC PLANNING

The LRBMS TA team will promote and facilitate a participatory strategic planning exercise to produce a five-year planning document (River Basin Management Plan RBMP) that targets water management challenges and identifies priorities and annual objectives for the LRA, its staff, and other main stakeholder entities. The development of this plan will:

- Build consensus on priorities
- Provide LRA with a clear agenda, and guide the allocation of staff, technical, and financial resources
- Enable monitoring and evaluation of progress; and
- Facilitate reporting to decision makers and stakeholders to demonstrate accountability.

The ultimate goal of the RBMP will be to meet water demands in a sustainable, equitable and environmentally sound manner. The RBMP will include the following elements:

- Diagnostic of the current and future water balance, by sub-region or sub-river basin. This hydrologic and hydraulic diagnostic will look at the current situation and at future trends in order to forecast short and long-term water management issues and challenges; it will be essential to develop sound policies, inform and involve decision makers and stakeholders, and promote and implement appropriate management practices.
- Identification and prioritization of short-term and long-term water management challenges.
- Consideration of several water development and management strategies and approaches to address the O&M of water structures, meeting of water needs, water use efficiency, flood management, pollution control, and environmental protection.
- Definition of a favored strategy, with specific objectives, approaches and activities, and with specific roles and responsibilities for LRA, LRA staff and other relevant/stakeholder entities.
- Development of specific timetables and budget plans to implement these activities.
- M&E processes to follow progress and assess performance.

3.1.4. GUIDELINES

The LRBMS TA team will support the preparation of guidelines and promote their use for essential LRA technical, administrative and managerial processes.

Individual professionals learn from experience how to avoid mistakes and delays, how to make the right decisions and how to work more efficiently and more effectively. But as they move up in their administration or out of it, these individuals may or may not transfer their knowledge and expertise to others who replace them. Even with proper mentoring and tutoring, replacements may often have to go through the same time-consuming lesson-learning process as their predecessors. And while individuals climb the learning curve, the organization may not improve since similar mistakes and delays may occur over and over.

Guidelines are tools that enable knowledge held by experts and senior professionals to be available to all of their colleagues for guidance. Guidelines are also a useful reminder for all, even the most experienced staff, on how to efficiently carry out integrated water management activities. Guidelines should be followed under most circumstances, but experienced staff may decide to follow different processes when justified by the circumstances (i.e. when guidelines do not apply properly). They are also essential tools to develop a corporate culture.

3.2. COMPONENT 2: WATER MONITORING

The objective is to improve water monitoring in the Litani River Basin and to identify and mitigate human activities that are degrading the water and soil quality..

3.2.1. FINDINGS

Based on the previous USAID-funded BAMAS project and on the expert reports of Dr Tom Sheng, Dr Mark Saadeh and Mr. Pascal Boderie assisted by Antoine Abou Samra (see annexes):

- **Human activities are degrading the quality of water resources in the Litani River Basin.**

These include, by order of importance:

- Direct disposal of untreated sewage water into surface watercourses; increased levels of BOD, COD, and waterborne pathogens are impacting Lake Qaraoun and the upper Litani River with its three major tributaries (Berdaouni, Qabb Elias and Ghzayel rivers).
 - Excessive use of fertilizers and pesticides by farmers that increase levels of nitrates and to a lesser extent phosphates in groundwater resources.
 - Direct disposal of industrial effluents into surface watercourses with a resulting build-up of organic matter, chemicals, and metals in water systems, and leaching from non-engineered landfills or general dumping of solid waste into surface watercourses thus contaminating surface and ground water with toxics.
 - Quarries and stone cutting also increase the turbidity of surface watercourses.
- **LRA has mandate to monitor river flows in the entire country. Water quantity monitoring activities** are handled by the Water Resources Department:
 - A total of 65 gauging stations located throughout the country in sixteen river basins are regularly monitored; fifteen of these stations are in the Litani river basin: ten on the Litani river and subsidiaries in the area upstream of the Qaraoun Dam and five on the Litani river downstream of the dam. Discharge measures are done weekly at each site.
 - The validity of the rating curves is questionable since LRA staff only measures low flow discharges by wading with a manual flow meter and is thus not equipped nor trained to measure discharges when flow levels pass 0.5 m.
 - Multi-stations are being procured by the EC-funded MOTGE project.
 - **LRA water quality monitoring activities** mostly focus on the Upper Litani River Basin. They are handled mostly by the Environmental Unit (EU), and also by the Water Resources Department and the Irrigation Project Department, with minimal coordination between them.
 - The EU monitors a total of 14 sites located throughout the river basin: eleven of these on the Litani river and subsidiaries upstream of the Qaraoun Dam (including one well) and three on the Litani river downstream of the dam. Twelve parameters are included in the measures carried out monthly.

- Most water quality monitoring equipment was procured under the USAID-funded BAMAS activity (2005).
- The only water database currently used is HYDATA (for flow measurements) and is an ancient DOS-based version which is not user-friendly; other water data and notably water quality data or dam monitoring data is recorded and stored under Excel spreadsheets which are ill-adapted for this purpose.
- Three separate Geographical Information Systems (GIS) were developed at different times by different departments or staff within LRA; most of the staff trained to develop these GIS were not permanent and have now left LRA.
- Overall, data is of uncertain quality and is not widely disseminated nor accessible ,moreover its use by decision makers seems limited.

3.2.2. PROPOSED FIRST YEAR ACTIVITIES

Based on these considerations, LRBMS technical assistance will focus during year 1 on:

- Redefining the water monitoring network in collaboration with LRA;
- Procuring and installing the water monitoring equipment to be procured to ensure a comprehensive coverage of both quantity and quality monitoring in the entire Litani River Basin (both groundwater and surface water).
- Identifying and installing computer hardware and software to support proper water databases for the routine quality control, storage, and analysis of water data.
- Merging all existing GIS and rebuilding GIS capacity within LRA.
- Clarifying water monitoring roles and responsibilities for the Litani River Basin within LRA.
- Improving LRA water monitoring procedures and practices by:
 - Streamlining data collection, quality control and analysis procedures; and
 - Preparing corresponding guidelines.
- Defining and carrying out corresponding formal and “on-the-job” capacity building activities.
- Identifying main pollution sources both point and diffuse.
- Engaging Litani River Basin stakeholders (water users and residents) to promote better behaviors to preserve water resources.

3.3. COMPONENT 3: INTEGRATED IRRIGATION MANAGEMENT

The objectives of this component are to address issues regarding the sustainability of irrigation in the Litani River basin. These include:

- Over-abstraction of groundwater resources;
- Over-use of water and lack of effective drainage systems at farm level which induce waterlogging, worsen flood impacts, and thus negatively affect yields, cropping pattern choices, use of heavy agricultural machinery and even access to the fields;
- Over-application of fertilizers and pesticides which contaminate groundwater resources (e.g. nitrate concentrations); and
- Widespread use of raw sewage for irrigation, with obvious contamination hazards from pathogens, chemicals, and metals.

3.3.1. FINDINGS

Based on the expert report of Dr Robert Hill and other USU specialists assisted by Said Bitar and Joseph Serhal (see annexes):

- The mandate of LRA specifically involves the task of studying new irrigation projects and managing them in all of Southern Lebanon and South Bekaa.
- About 75,000 hectares are agricultural lands in the Litani River Basin.
- Smallholding farmers (less than 0.5 ha) are often owners of their lands with large holdings (more than 5 ha) usually being leased lands for limited periods of time and practice intensive and often unsustainable practices (over-application leads to soil salinization).
- The main cropping patterns involve winter wheat and potato; some farmers practice a double (spring and fall).potato crop (intensive and short-lived because it is detrimental to soil quality).
- Orchards (apples, pears, etc.) and vineyards are present in the foothills (mostly western foothill).
- Some vegetables are cultivated in rotation with potatoes, and greenhouses are used north of the Damascus highway and around Joub Jenine.
- 62,000 hectares are irrigated from the Litani waters (one third being outside of the river basin mostly in the south and along the coast from Saida to Tyre); most are irrigated from groundwater, only about 16,000 hectares are irrigated from surface water networks (somewhat managed by the LRA);
- Farmers tend to over-irrigate, even those using drip and sprinkler irrigation, as they have limited, if any, notion of irrigation scheduling.
- Relationships between farmers and governmental employees are at best distrustful (LRA possibly having a better image than other agencies).
- Few farmers are members of cooperatives and these do not seem very effective; the recent (1994-01) World Bank experience for establishing 27 WUAs throughout Lebanon was a failure.

- Banks rarely lend money to farmers and do so only with collateral (usually in the form of a land title). Most farmers receive fertilizers, pesticides, and other inputs from agricultural dealers who encourage over-application and get reimbursed by receiving a part or the entirety of the crop at discounted prices.
- LRA manages the Conveyor 900 main canal to deliver pressurized irrigation water to a 2000-hectare Pilot Project area around Joub Jenine. Sprinkler (on wheat, potatoes, and forage corn) and drip (vegetables) are the LRA-mandated irrigation methods. Only 700 ha are currently irrigated from the canal, reasons mentioned being over-irrigation and reluctance from farmers to use canal water because they consider it polluted, unreliable, and more expensive than groundwater pumping.
- A couple of other small irrigated schemes are also managed by the LRA along the coast, but most farmers irrigate on their own.
- A new, sophisticated and fully functional soil and water analytical laboratory was provided by the EC-funded IRWA project to LRA Kherbet Kanafar Extension and Service Center. Unfortunately it is not operating and has been awaiting administrative approval for some time.

3.3.2. PROPOSED FIRST YEAR ACTIVITIES

Based on these considerations, LRBMS technical assistance will focus during year 1 on:

- Designing and constructing the infrastructure necessary to provide supplemental irrigation water from Lake Qaraoun to farmers currently using raw sewage in the Machgharra plain.
- Further documenting the various irrigated areas in the Litani river basin by assessing current irrigation management and agricultural practices.
- Selecting one pilot demonstration area within the West Bekaa Irrigation Management project to demonstrate better irrigation management and agricultural practices and improve farm incomes.

This will include:

- Improving water delivery practices and promoting water use efficiency (through irrigation scheduling based on crop water requirements);
- Strengthening WUAs and agriculture extension services; and
- Improving agricultural practices and mitigating pollution of water resources (through rational use of fertilizers and pesticides and modern crop production).
- Improving farmer access to seeds, fertilizers, pesticides and other agricultural inputs.
- Defining and carrying out corresponding formal and “on-the-job” capacity building activities.

3.4. COMPONENT 4A: RISK MANAGEMENT (MONITORING OF QARAOUN DAM)

The goal here is to minimize the risk of failure of Qaraoun Dam and to improve its sustainability as the main asset of the LRA, in terms of providing a steady income (through energy production) that ensures LRA's financial autonomy, and in terms of managing the flow of the Litani River for the benefit and welfare of farmers and residents in the river basin.

Other risks should also be considered, with appropriate contingency/emergency plans (and possibly warning systems) for their mitigation: drought, accidental pollution, dam failure, etc.

3.4.1. FINDINGS

Based on the expert reports of Dr John Smart and Wael Sabra (see annexes):

- It appears that the dam is performing satisfactorily under normal operations; this conclusion is based primarily on the apparent absence of increasing trends in flows from the dam, embankment deformations, or sediment transport.
- A comprehensive dam safety program for Qaraoun Dam would include:
 - Monitoring and ongoing maintenance;
 - Periodic dam safety examinations (an annual detailed examination of the dam by an engineer who is not involved in the day-to-day monitoring of the dam);
 - Periodic dam safety reviews (a comprehensive engineering review of all technical issues including a review results of the ongoing monitoring and maintenance, approximately every 5 years);
 - An exercised emergency response plan (dam- break modeling for inundation mapping is the tool that is typically used to guide the assessment of those effects).
- Regarding seismic vulnerability, Qaraoun Dam presents:
 - Features that would make it resistant to failure during an earthquake, such as proper cleanup of the foundation at the time of construction, use of average quality rockfill (limestone); and
 - Factors that make it vulnerable, such as : strong seismic potential in the area, rockfill dumping (instead of placement and compaction), steepness of the slopes ;

Based on these considerations, a quantitative assessment of the vulnerability of the dam to seismic loading could be considered; it would require a site specific seismic hazard assessment and a deformation analysis of the dam.

3.4.2. PROPOSED FIRST YEAR ACTIVITIES

Based on these considerations, LRBMS technical assistance will focus during year 1 on:

- Carrying out a failure mode analysis to tailor the dam monitoring equipment and procedures to the specificities of Qaraoun Dam and its area; potential failure modes of the dam, foundation, abutments, and appurtenant structures such as breach, leakage/seepage, overtopping, and extreme flood events will be considered;
- Procuring and installing the corresponding equipment;
- Defining with LRA and implementing formal procedures to monitor the dam and record the observations;
- Propose techniques to carry out regular maintenance and repair (e.g. joints);
- Conducting a formal and comprehensive engineering review of the safety of the dam.
- Investigating the cost and usefulness of analyses and/or equipment to lower Qaraoun Dam vulnerability to earthquakes.
- Defining and carrying out corresponding formal and “on-the-job” capacity building activities.

3.5. COMPONENT 4B: RISK MANAGEMENT (FLOOD MANAGEMENT)

The goal here is to mitigate damage due to flooding in the Litani River Basin by delineating risk areas, defining and promoting better urban development and agricultural practices to reduce the extent of the floods and their impacts.

3.5.1. FINDINGS

Based on the expert report of Dr Geert Prinsen assisted by Robert Bou Nahed and other members of the LRBMS Team (see annexes):

- The flood of February 2003 seems to be the largest flood in recent memory (50 years or so): the Damascus highway was flooded and not passable by traffic near Bar-Elias during several days, along with some buildings and urban areas and several hundred hectares of agricultural lands;
- Previous floods are still being identified (years mentioned: 1962, 1968, 1975, 1993, 1998) but it remains to be confirmed if:
 - The 2003 flood is really the largest in terms of actual river discharge or is perceived as such because:
 - It is the most recent;
 - It was magnified by riverbed infringements (e.g. pump sumps from farmers) and obstructions such as low bridges;
 - Many constructions have been built in floodable areas and thus are more sensitive to damage.

- All of the floods mentioned are due to large flows of the Litani River and subsidiaries or simply persistent rains that saturate the clayey soils in the valley and leave extended areas waterlogged for days or even weeks.
- One previous flood model has been identified; it was developed recently by the IRWA project using HEC-RAS but is very basic since it is not based on any actual topography nor field survey; it may have been sufficient to identify bottlenecks and define corresponding structural enlargements and river bed recalibration works that were carried out in 2005-7.
- Several of the new bridges built recently (or rebuilt after the 2006 bombings) on the Litani river and subsidiaries do not obviously have the necessary discharge capacity to transit floods and will create new overflowing issues.
- A 1-D and 2-D flood model will have to be developed:
 - A 1-D model is usually simple enough for rivers the size of the Litani River; it could be built, calibrated and used by LRA staff with some technical assistance and would suffice to describe floods and assess flood mitigation structures and strategies; while
 - A 2-D model may allow better flood description and evaluation of flood mitigation measures but at the cost of additional complexity in terms of model construction, calibration, and use (it is doubtful LRA staff will be able to operate such a model, which is rarely used for small rivers like the Litani).

3.5.2. PROPOSED FIRST YEAR ACTIVITIES

Based on these considerations, LRBMS technical assistance will focus during year 1 on:

- Identifying and documenting, through a field survey, past flooding events in the Litani river basin, in terms of duration, extent, damages.
- Assessing urban development and agricultural practices that impact flooding patterns and damages.
- Defining and supervising the topographical survey necessary to determine past flood levels, characteristics of water structures and bridges, and cross-sections of the riverbed and the floodplains;
- Building a flood model to produce a mapping of floodable areas and to test flood mitigation scenarios.
- Defining and carrying out corresponding formal and “on-the-job” capacity building activities.

4. ONGOING ACTIVITIES

Besides continuing the assessment of LRA capacities and needs, the LRBMS team is already carrying out the activities described hereafter per component.

4.1. PROJECT SETUP AND COORDINATION

4.1.1. PROJECT SETUP

LRBMS is working on:

- Getting properly registered in Lebanon;
- Opening a bank account;
- Finalizing all office procedures;
- Finalizing the identification and mobilization of Lebanese technical specialists.
- Preparation and submission to USAID of first year work plan, first quarterly report, training and procurement plans, and Performance Monitoring Plan.

4.1.2. COORDINATION WITH LRA

Coordination with LRA is excellent. LRA staff is overall competent and willing to collaborate even if, because of understaffing, they are very occupied by their current responsibilities.

Four “component” groups have been formed and meet on a regular basis (every two weeks or so). These groups involve appointed staff from LRA and members of the LRBMS TA team.

4.1.3. DONOR COORDINATION

The LRBMS has started collaborating with UNESCWA/BGR: and their upcoming transboundary water monitoring activity and is investigating the potential development by UNEP of a flood model for the Litani River.

4.2. COMPONENT I: BUILDING CAPACITY OF LITANI RIVER AUTHORITY TOWARDS INTEGRATED RIVER BASIN MANAGEMENT

The LRBMS Team is now:

- Assessing the financial, accounting, and budgeting practices of LRA
- Evaluating the annual reporting process of LRA and defining how to improve it.
- Defining the process that will be followed to prepare the River Basin management Plan.

- Defining the process that will allow the identification and involvement of representatives of stakeholders (water users and residents).
- Preparing to developing awareness materials regarding the LRBMS program (brochure, website, specific communication and outreach materials, etc.), and to assist LRA with its communication strategy.
- Defining related capacity building activities.

4.3. COMPONENT 2: WATER MONITORING

The LRBMS Team is now engaged in:

- Redefining the water monitoring network in collaboration with LRA;
- Building close collaboration between the LRA Environmental Unit (responsible for quality monitoring) and the Water Resource Department (responsible for quantity monitoring);
- Defining the water monitoring equipment to be procured to ensure a comprehensive coverage of both quantity and quality monitoring in the entire Litani River Basin.
- Providing an update version of the HYDATA water database (for flow measurements) and identifying other water databases for the routine quality control, storage, and analysis of water data.
- Assessing the three separate Geographical Information Systems (GIS) and evaluating how to merge them and rebuild GIS capacity within LRA.
- Defining related capacity building activities.

4.4. COMPONENT 3: MACHGHARRA PLAIN

Having located the site where farmers divert raw sewage and engaged the municipality of Machgharra, the LRBMS Team is now:

- Defining the flow capacity that is needed to replace the sewage flow and to provide farmers with supplemental irrigation in summer months.
- Identifying the course for the installation of the pipeline, and assessing the ownership of lands where works will occur.
- Defining the characteristics of the pipe (length, diameter, type) to ensure sustainable delivery of the necessary irrigation flow.
- Defining the work requirements to properly procure and install the pipeline.

There is reasonable hope that the pipeline can be built before June-July when the need for supplemental irrigation water forces farmers to divert raw sewage into their canals.

4.5. COMPONENT 4A: QARAOUN DAM MONITORING

The LRBMS Team is currently engaged in:

- Defining a standard dam monitoring equipment package for rockfill dams such as Qaraoun Dam;
- Preparing more detailed analyses such as the failure mode analysis, which will investigate potential failure scenarios for Qaraoun Dam and their early warning signs and thus guide a more tailored dam monitoring equipment package;
- Defining related capacity building activities;
- Investigating specific maintenance methods to repair joints in the front facing of the dam;
- Investigating how to setup an emergency closure process for the forced pipe supplying the Markaba, Awali and Joun hydropower plants in case of earthquake or structural failure.

4.6. COMPONENT 4B: FLOOD MANAGEMENT

The LRBMS Team is currently engaged in:

- Carrying out an extensive field survey to identify the extent of the February 2003 flood in terms of magnitude, flood levels, risk areas and damage, and to define the topographical survey that will be the basis for the flood model;
- Selecting qualified surveyors to carry out the topographical survey and estimating the cost of the survey;
- Assessing which modeling software would be best suitable for the Litani River ;
- Defining related capacity building activities.

5. SPECIALIST REPORTS

The following specialist reports are annexed hereafter:

- Legal and institutional review (Dr Carl Bruch)
- Water quality and water quality monitoring (Pascal Boderie)
- Water quantity and water quantity monitoring (Dr Mark Saadeh)
- Water monitoring databases (Dr Tom Sheng)
- Irrigation management (Dr Robert Hill supported by colleagues from USU)
- Dam monitoring (Dr John Smart)
- Flood management (Geert Prinsen)

These specialist reports represent the views of their individual authors. They may somewhat differ from the findings and recommendations presented above which were the results of discussions within the LRBMS Team and with LRA.

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