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Disaster Risk Assessment in Lebanon

A Comprehensive Country Situation Analysis

Acknowledgements: This report presents the results of the implementation of a comprehensive Country Situation Analysis (CSA) for Lebanon using the GRIP-developed Systematic Inventory and Evaluation for Risk Assessment (SIERA) methodology. The work was carried out jointly by the Disaster Risk Reduction Project at the Office of the Prime Minister and the UNDP Country Office in Lebanon and with technical support from GRIP. The enthusiastic contributions of many organizations and individuals that provided the required information and data needed to complete the assessment are gratefully acknowledged.

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This publication is available at:

Global Risk Identification Programme (GRIP)
Bureau for Crisis Prevention and Recovery (BCPR)
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A Comprehensive Country Situation Analysis

November 2010

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Executive Summary

A prerequisite to the development of a national disaster risk assessment to support disaster risk management and a disaster risk reduction strategy in any country is the evaluation of current practice within the country regarding risk assessment in terms of 1. Methodologies used for risk assessment; 2. The available basic and intermediate data related to risk assessment; 3. The institutions acting as data providers; 4. Professional expertise and skills related to risk assessment; and 5. Risk assessment studies being carried out; 6. Disaster risk management strategies, policies, frameworks, action plans, regulations and executive procedures.

This publication presents the results of the project which was commissioned in order to identify the current status; main challenges and issues; areas of strengths and weaknesses; and the external support needs of the country in all the six dimensions of disaster risk management identified above.

The Global Risk Identification Program (GRIP) within the Bureau for Crisis Prevention and Recovery (BCPR) of the United Nations Development Programme (UNDP) has developed a comprehensive Systematic Inventory and Evaluation for Risk Assessment (SIERA) methodology for Country Situation Analysis (CSA). The methodology adopted in this study relied on the guidelines provided by the SIERA-CSA methodology. To achieve the objectives of the study an extensive programme of interviews with various officials and stakeholders in line ministries and non-governmental organizations was carried out. Furthermore, relevant documentation on risk assessment studies and practices as developed by various bodies together with the relevant laws, decrees, mandates and codes was collated and reviewed to produce a picture of risk assessment practices and disaster risk management practices within the country. In this manner it was possible to draw conclusions on areas of strengths and weaknesses and to identify directions where future efforts should be directed.

The report starts by providing background information on the project (Chapter 1). Chapter 2 provides a detailed analysis of the profile of disaster risk management within Lebanon including the institutional and legislative frameworks. The main findings of the study are presented in Chapter 3, with special emphasis on available data and corresponding gaps in information required for risk assessment; detailed information (capacities, needs and mandates) on the institutions working in disaster risk management; and identification of gaps in professional expertise and skills. Chapter 4 provides and overall review and evaluation of disaster risk management within the country. Finally recommendations where future effort should be directed are provided in Chapter 5.

The information collected by the project is presented in the Annexes. It is envisaged that this information will eventually be integrated and made available to end users through an e-library to be designed in collaboration with the GRIP Coordination Team.

This project has identified the areas of strengths and weaknesses in Disaster Risk Assessment within the country. The findings demonstrate that Lebanon already has many of the necessary information and elements to delineate and implement an evidence-based Disaster Risk Reduction strategy that will contribute to undergoing efforts for sustainable development within the country.

Acronyms and Abbreviations

AFDC	Association for Forests, Development & Conservation
AUB	American University of Beirut
BCPR	Bureau for Crisis Prevention and Recovery
CAS	Central Administration of Statistics
CBRN	Chemical, biological, radiological or nuclear
CDR	Council for Development and Reconstruction, Lebanon
CNRS	Council for National Scientific Research
CSA	Country Situation Analysis
CSTB	Centre Scientifique et Technique du Bâtiment, France
CTA	Chief Technical Advisor
DRR	Disaster Risk Reduction
DRM	Disaster Risk Management
EMME	Earthquake Model of the Middle East Region
GRIP	Global Risk Identification Programme
GTZ	German Technical Cooperation
HRC	High Relief Committee
ICARDA	Internatinal Center for Agricultural Research in the Dry Areas
ISO	International Standards Organization
LARI	Lebanese Agriculture Research Institute
LIBNOR	The Lebanese Standards Institution
NAC	National Advisory Committee
NRA	National Risk Assessment
SIERA	Systematic Inventory and Evaluation for Risk Assessment

TAC	Technical Advisory Committee
UNDP	United Nations Development Program
UNHCR	Office of the United Nations High Commissioner for Refugees
WHO	World Health Organization

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1. Introduction

1.1 Objectives

The aim of this project is the country situation analysis (CSA) for risk assessments in Lebanon. More specifically, the objectives of the work are:

- To produce a comprehensive inventory of existing risk assessment studies and projects, publications and reports on risk assessment, data sources, organizations and institutions related to risk assessment as well as key professional expertise and skills available in Lebanon;
- To identify needs, gaps, and required support;
- To identify information needs and requirements from stakeholders; and
- To make recommendations regarding the proposed scope and context for the national risk assessment.

1.2 Expected outputs

The expected outputs of the project are:

- Catalogues of risk assessment studies/projects, publications and reports on risk assessment, data sources (carriers), intermediate and basic data, organizations and institutions related to risk assessment as well as existing key professional expertise and skills
- A comprehensive summary of risk assessment needs and requirements.
- Key institutions and agencies engaged in disaster risk management, in view of the National Risk Assessment;
- Suggestions and recommendations for the implementation of the National Risk Assessment, including in relation to the establishment of a national coordination mechanism.

1.3 Layout

The remainder of this report is divided into five chapters. Chapter 2 briefly summarizes the current Lebanese disaster risk management profile. Chapter 3 presents the main findings of the country situation analysis on risk assessment, regarding risk assessment projects, skills, and the availability of basic and intermediate data. Chapter 4 provides an overall review and evaluation of the national situation. Finally Chapter 5 summarizes the main recommendations and suggestions for the next steps.

1.4 Methodology

The methodology within the current project follows the GRIP methodology which is both thorough and rigorous, having seven categories of CSA for inventorying as shown in Figure 1 below, and is based on the notion that the assessment is an ongoing process.

This study is a first step towards achieving a comprehensive country situation analysis. Furthermore, it is limited in its scope based on the time constraint of the project as well as other challenges. Therefore, a combined methodology was used, adopting as much as possible the GRIP methodology while taking into account above challenges.

The methodology for the CSA consists of three main phases as outlined in the Guidelines developed by GRIP.[1]

- Phase 1: Preliminary Identification and inventory of existing risk studies, methodologies, data and their sources and national capacity. Interviews will be held with relevant stakeholders. The interviews held to

1 Better Risk Information for Sound Decision Making, Country Situation Analysis for National Risk Assessment – Methodology and Guideline (Version 2.1), GRIP-BCPR/UNDP, Geneva Switzerland, December 2009.

Figure 1: Categories for inventorying within a country situation analysis

date are summarized in Table 1. The data from these interviews have been analyzed and the findings are presented in later sections of this report.

- Phase 2: Refining the preliminary inventory and carrying out a detailed evaluation of identified data, methodologies, expertise and skills, and institutional capacities that can be used in a national risk assessment. In this case interviews with key Informants may be carried out. The key informants will be identified based on findings and interviews of Phase I above.

- Phase 3: Report writing. The results of the study will be summarized in a report.

1.5 Challenges in implementation

The following challenges were faced when carrying out this study, which in turn limited the depth and breadth of the analysis:

- Lack of transparency and/or ability within some institutions to provide studies on risk assessments. In many cases this may be attributed (at least partly) to the lack of networking mechanisms through which this data exchange may take place.

- Limitation in the number of risk assessment studies which were eventually reviewed which is to a certain extent a reflection on the number of risk assessment studies being carried out. The scarcity of such studies is due mainly to the focus on response efforts in the disaster management philosophy practices in Lebanon.

- Lack of clarity and understanding in the use of terminology, where in many cases risk assessments are not well understood and are confused with other aspects of disaster risk management and reduction (DRM/R).

As the visibility of DRM/R national projects within the country improves, and as the CSA stages continue, it is envisaged that the process of the collation of the data will become easier going both ways.

Table 1: List of meetings carried out

No.	Name	Body/Authority	Location
1	Ariane Elmas	Civil Defense Project- UNDP	Grand Serail – DRM office
2	General Eid	LAF	Grand Serail
3	Sawsan Bou Fakherdine and Fadi Abu Ali	Association for Forests, Development & Conservation (AFDC)	Grand Serail – DRM office
4	Vahakn Kabakian	Climate change - UNDP	MOE (7th floor room 7-44)
5	Rita Delage	SDC	Grand Serail – DRM office
6	Pierre Khoury	LCECP - UNDP	Grand Serail – DRM office
7	Hassan Koraytem	Beirut Port	Beirut Port
8	George Bou Moussa	Civil Defense	Grand Serail – DRM office
9	Alexander Sorsok	Council for National Scientific Research (CNRS)	CNRS- Bhaness
10	Sawsan Mahdi / Jacopo Monzini	Italian Corporation	Grand Serail – DRM office
11	Ata Elias	American University of Beirut (AUB)	Grand Serail – DRM office
12	Hamdi Chawk	Civil Aviation	Civil Aviation
13	Charbel Rizq	Ministry of Agriculture - UNDP	Grand Serail
14	Ibrahim Chahrour	CDR	CDR
15	Michel Frem	(Ministry Of Agriculture – Agricultural Research Center)	Bekaa
16	Habib Ghaziri	LIBNOR and Solidere	Solidere
17	Alissar Radi	WHO	WHO
18	Samar Ramadan:	Urban Planning	Urban Planning
19	Rola Cheikh	Ministry Of Environment	Ministry Of Environment
20	Mohammad Harajli	AUB	AUB
21	George Kettani	LRC	Grand Serail
22	Antoine Rihani	Lebanese Army	Grand Serail
23	Imad Shehade; Mr. Antoine Faisal	Industrial Research Institute	Industrial Research Institute
24	Fadi Jaara	USJ	USJ

2. Lebanon Disaster Risk Management Profile

A previous study undertaken by the author on behalf of the UNDP and the Government of Lebanon has summarized the needs and capacities of Lebanon in the field of disaster risk management[2]. For the sake of completion, and based on the request of the project sponsors, this chapter will provide a summary of the earlier report, with additional elaborations summarizing the main developments since then.

2.1 Introduction

Risk assessment directly contributes to DRM/R.

However, in Lebanon, as in most developing countries, most resources are often directed to response efforts and not enough emphasis is placed on prevention, reduction, mitigation and control measures that can reduce the impacts of a disaster. This phenomenon, which is prevalent in developing countries that are often indebted and in need of sound financial management, is extremely inefficient as a dollar spent in prevention efforts is several orders of times more effective than a dollar spent in response efforts.

The degree to which prevention, reduction and control measures are given prominence can be determined by examining and reviewing the concept and practice of disaster management and disaster risk reduction measures which must be abided by as prescribed by Lebanese law; and the challenges faced by the implementation of such laws. A recent study[2] has concluded that indeed most efforts are directed at response and not sufficiently at prevention or even preparedness.

However, with the establishment of Disaster Risk Reduction Project at the Office of the Prime Minister, it is hoped that this situation will improve and that the main DRR institutions will be strengthened to empower them to effectively carryout out their prevention as well as response (and preparedness to respond) roles.

2.2 Milestones of institutional framework for disaster risk management

2.2.1 Framework for disaster risk management (High Relief Committee)

The main body responsible for disaster risk management including both prevention and response is the High Relief Committee (HRC). The following are the main milestones for disaster risk management (as specified by the role of the HRC) in the country:

1. In 1976 the High Relief Committee was formed under law number 35/1 dated 17/12/1976. In the second article of the law, the responsibilities and functions of the Committee were defined as:

- Accepting donations (food and material) given to the Lebanese state for the affected population provided by the council of ministers;
- Setting the appropriate procedures for receiving and distributing the above materials;
- Related administrative and financial tasks;
- Preparatory and logistical tasks such as receiving, transportation and storage of donations;
- The distribution of donations;
- Carrying out surveys and gathering in formation;
- Securing the necessary funds for carrying out the work;
- Developing financial procedures for the work of the Committee;
- Asking for assistance for public institutions and directorates general.

2 Primary Needs Assessment Report – Disaster Risk Management, Prepared by Dr Fadi Hamdan, February 2008.

2. Law 30, issued in 1993, modified the first item of the second article of Law 35, 1976 to read as follows:

Accepting donations of all kinds given to the Lebanese state by international, regional, national and local countries, organizations and individuals for the affected population provided by the council of ministers.

It thus became possible for the HRC to accept financial donations as a result of the modification to its mandate, as introduced by this Law.

3. Law 4, issued in 1997, modified Article 3 of Law 35, 1976 to read as follows:

In addition to the tasks specified in Article 2 above, the higher relief commission will carry out the following tasks:

- Manage all tasks related to disasters;
- All issues with a relief nature referred to it from the council of ministers;
- The agency can assign the appropriate line ministry or directorate general to implement the specific tasks. In addition it can seek the help of the various public and private institutions to carry out the overall relief works.

The HRC thus, in the year 1997, became responsible for both prevention and response phases of disaster management as a result of the modification to its mandate, as introduced by this Law. However, it should be recognized that to date, the HRC has not carried out any prevention work, and its role has effectively been the distribution of relief material to the affected population as a results of various disastrous events (both natural and man-made).

It should be noted that the current HRC framework is currently being reviewed as part of a DRR strengthening project located within the Office of the Prime Minister of the Government of Lebanon.

2.2.2 Framework for standards and codes (LIBNOR – The Lebanese Standards Institution)

LIBNOR (The Lebanese National Standards body) started in 1962, when it was established by a law dated 23/7/1962 as the sole authority mandated to prepare national standards, covering all products and practices except medicine. LIBNOR is a public institution attached to the Ministry of Industry, but with administrative and financial independence. More specifically, for the purpose of this report, it is worthwhile to note the following regarding the tasks of LIBNOR:

Optional versus Mandatory Standards

- LIBNOR Develops optional standards for all commodities used in the Lebanese market including agro-foods, chemicals, electrical, electronics, clothing, information technology and communication, as well as metrology, technical dictionary, methods of testing, codes of practice, and structural rules for buildings. Even if the LIBNOR standards are optional, they remain mandatory for public administrations and public institutions and none of these public bodies can opt for adopting non-Lebanese standards without getting prior agreement from LIBNOR;

- LIBNOR is the only body allowed to produce standards that are mandatory for the public or private sector;

- The law now allows the board of management of LIBNOR to develop mandatory standards related to public safety. The mandatory characteristic of any such standard is effected through a decree issued by the council of ministers through the recommendation of the Minister of Industry.

Brief History of Activities Before and After Civil War

- The institution embarked on implementing its tasks gradually. It ceased working from 1975 till 1998 when the Presidency of the Council of Ministers re-established a new board of management with a new director general;

- Its first activity after it was reactivated was to sign a protocol with France to provide assistance in producing basic standards related to construction. The CSTB (Centre Scientifique et Technique du Bâtiment) organization was appointed to delegate French experts to provide assistance to Lebanese experts in the field of standards for construction. The first of these standards was related to steel bars which are to be used for construction (namely for reinforced concrete), together with standards for aggregate and cement. This was later followed by standards for fire protection and seismic design for buildings and factories.

Enforcement Mechanisms

- A large number of standards have been issued, and some of these (such as the public safety decree) should be mandatory. However, up to now there are no enforcement mechanisms. Monitoring of application of standards is not the duty of LIBNOR but rather the duty of the relevant line ministries. However there is an exception concerning the standards which set the characteristics of steel to be used in construction. These standards are mandatory, and they are properly enforced through the centre for industrial research which takes samples from each shipment for testing before providing any certificates mandatory for entering the Lebanese market.

Process for Standard Development

- Committees are setup with members from international and national experts, consultants, verifiers and universities. The committees assess the possibility of adopting European standards and/or American standards (American, British and French);

- In the very first meeting for any such committee, the reference codes for international countries are listed, and members opinions are canvassed regarding which of these should act as the basis. The government bodies usually prefer to start with the International Standards Organization (ISO), followed by EU or USA codes, followed by regional codes. If there are no regional codes, LIBNOR then develops a Lebanese code;

- Voting takes place after the code is developed (or adopted with a national application document), where a consensus is required. In case of disagreement prior to signature, the Director General is asked to meet with those opposed to adopting the code where members will have an opportunity to put their case across. If the reasoning for the objection is deemed not important then the code is adopted as a national standard, which is optional, but mandatory for public institutions. Alternatively, if the argument is deemed strong, then the code is sent back for review. It is not clear what additional written criteria, if any, are used in this decision making process.

2.2.3 Framework for managing environmental hazards and ensuring sustainable development

Law number 216 issued in April 1993 legislated for the development and organization of the Ministry of the Environment was modified by Law 667 issued in December 1997 which was later superseded by Law 690 issued in August 2005. However, it is useful to review some of the main pillars of the law which remain unchanged till today.

Jurisdiction of the Ministry of the Environment – Laws 216 and 667

The Jurisdiction of the Ministry of the environment was first set out in Law 216 in 1993 and then superseded by Law 667 in 1997. The latter law states that the Ministry of the Environment liaises with other line ministries and administrative authorities to perform the following tasks:

1. Set public policies and long and medium term projects and plans in all issues related to the environment and the use of natural resources as well as suggesting steps for implementation and monitoring of the above plans and projects;

2. Develop plans which should be abided by to preserve the environment and controlling and reducing the pollution from all sources including garbage, wastewater, air pollutants, and leakage of harmful substances into ground water and drinking and irrigation waters;

3. Prepare legislation and propose codes and regulations required for the safety of the environment and for reducing environmental risks arising from agriculture and industry as well as the various forms of urban expansion;

4. Specify the environmental prerequisites for providing permits for the establishment of industrial plants and factories, industrial areas, agriculture areas, quarries, etc.;

5. Specify the condition for use of sea and river coastal areas in order to protect the environment;

6. Specify the use of the various public lands and assess whether this use may harm the environment;

7. Specify the types of birds which can be hunted as well as the locations and time of the hunting seasons;

8. Develop and raise awareness on the concept of environmental education in liaison with stakeholders in the public and private sectors, in particular the ministries of the education and higher education, sport and youth, media, culture, Lebanese university and other private educational bodies;

9. Organize conferences and exhibits related to the environment, participate in international conferences and report on main findings to the relevant ministries;

10. Participate in the development of international agreements and treaties regarding the environment;

11. Encourage individual and collective initiatives aimed at improving the environment;

12. Classify scenic routes and landscapes, identify areas where natural reserves should be developed and propose legislation and regulations related to the management and protection of such locations;

13. Participate in the development of prevention plans for disasters, damage and pollution, which may arise from natural events (such as floods) and man-made events (wars);

14. Propose the establishment of gardens, parks and public beaches on public or private land owned by the government, municipalities or other bodies;

15. Contribute to the development of national safety plans and other sustainable development plans in liaison with various public and private sector stakeholders;

16. Carry out laboratory testing to identify the degree of pollution in the air, soil, domestic water, irrigation water, sea water, rivers and lakes; and develop and follow up the various procedures adopted by the relevant authorities;

17. Participate in the board of Lebanese norms and standards organizations.

Jurisdiction of the Ministry of the Environment – Law 690

The Jurisdiction of the Ministry of the environment was later modified and developed by Law 690 in 2005. The main modifications to the jurisdiction of the Ministry of the Environment included the addition of the following tasks to those discussed in the above Section:

- Prepare legislation to provide financial incentives in the environmental protection sector in liaison with relevant authorities.;

- Prepare legislation to identify responsibilities, liabilities and penal action for activities that are harmful to the environment or harmful to the sustainability of the natural resources, in collaboration with the relevant authorities;

- Participate in all committees and boards of the public sector which has activities related to the environment;

- Supervise the management and implementation of regional and international projects which are carried out in partnership with the Ministry of the Environment;

- Develop plans and strategies to meet the objectives of the general environmental policy based on concepts of awareness and guidance;

- Help civil society organizations to prepare plans related to the safety of the environment and the sustainability of natural resources;

- Develop media and advertising plans to help achieve the objectives and aims of the environmental policy of the Ministry of the Environment;

- Develop strategies and plans to manage hazardous and non-hazardous solid waste and liquid waste arising from domestic and industrial outlets and supervise the implementation of such plans;

- Develop strategies and plans to maintain the balance of ecological systems and for the sustainable development of natural resources;

- Identify environmental conditions for land use planning;

- Identify the chemical materials which pose a threat to the environment and to the sustainability of natural resources, and develop conditions for the importing, use and decommissioning of such substances in collaboration with the relevant authorities;

- Develop plans and strategies to incorporate environmental management to various development sectors;

- Make it mandatory for public and private sector to assess the environmental impact of all types of projects mentioned in this section; and review these assessments and provide approval only once environmental concerns in terms of protection of the environment and sustainability of natural resources are met;

Administrative Organization of the Ministry of the Environment

The Ministry of the Environment is organized into a series of divisions tasked with overseeing the achievement of the above tasks. The Division of Environmental Technology is tasked with supervising and monitoring the chemical safety including hazardous materials and medical and industrial wastes and air pollutants. It is also tasked with analyzing through laboratory tests samples from the environment.

2.3 Milestones of legislative framework for disaster risk management

Regarding laws for the design and construction of infrastructure to resist earthquakes and other hazards, the following developments summarize the main developments within the country:

1. Construction Law and Appendices Law 646, Issued in 2004, states in Article 13, item 2, that in the case of buildings with a height above 10m (or three floors) the Seismic Zone Parameter, which is used in the design and analysis of buildings, should not be less than 0.2g (i.e. equivalent of Zone 2B of the UBC code). The return period and acceptance criteria for scenarios with different return periods are not mentioned in the above Law. The above article was subsequently superseded when the Public Safety Decree 14293 was issued in 2005;

2. Public Safety Decree 14293, which is applicable to the design of both buildings and industrial facilities and factories against earthquakes and fires. It is immediately applicable to buildings and facilities that have not yet obtained a planning permit. For existing facilities and buildings, and for those currently under construction, it is necessary to obtain a certificate

of compliance from a reputable Bureau of Verifiers. However it must be stressed that the decree was passed in 2005 but is yet to be implemented – which is indicative of the challenges facing Lebanon in terms of enforcement as well as in terms of the lack of any implementation guidelines and executive procedures for the implementation of such codes;

3. Environment Protection Law 444, 2002, which is related to the protection of the environment and the duties and responsibilities of the Ministry of the Environment in managing the environmental risks arising from a variety of commercial and industrial activities.

2.3.1 Seismic prevention legislation

Regarding earthquakes, the minimum horizontal earthquake motion is taken as 0.2g. The return period corresponding to the above earthquake motion is not provided. The acceptance criteria for various damage limit states corresponding to events with various return periods is also not provided; furthermore, it differs with the type of international code being used. The code is characterized by several fundamental challenges some applicable to earthquake engineering protection in general (and therefore also applicable to hazardous facilities) and others applicable to the earthquake protection of hazardous facilities in particular. These challenges have been identified in the earlier study and are reproduced and refined below for the sake of completion.

2.3.2 Fires and explosions prevention legislation

Regarding fires and explosions, the decree addresses the case of fires and states that adequate fire protection should be provided and provides mitigation suggestions such as minimum thicknesses for doors to prevent / delay the spread of fires. The return period for fire events and the acceptance criteria for different types of fires are not provided. The Decree does not allow for the possibility of an explosion preceding or subsequent to a fire, particularly in industrial facilities where a leak may form a gas cloud which may either catch fire or explode. In addition, the Decree does not address the other loading scenarios corresponding to other hazards.

Box 1: Challenges of code in protection against earthquakes in general

1. The degree and frequency content of the vertical earthquake motion is not provided. It should be recognized that vertical earthquake motion has been recorded in excess of horizontal earthquake motion in some recent earthquakes in California USA (Northridge) and in Japan (Kobe). This may be particularly important for special structures such as dams, pipelines, pressure vessels and tank farms on industrial facilities. Indeed some tank failures during past earthquakes have been attributed to the fact that large vertical ground motion was ignored in the earthquake design.
2. The non-synchronous nature of the earthquake motion (the fact that the earthquake ground motion will vary from one point to another and that it is modified as it passes through the ground) is also not addressed. This may be particularly important to long structures such as dams, pipelines and bridges.
3. The return period of the earthquake is not specified which creates serious inconsistencies with any later regulations to be for a consistent hazard management philosophy.
4. The joint probability of occurrence of various loading and how this joint probability may reduce the loading from each individual event is not taken into account.
5. Scenarios of two or more hazards occurring simultaneously or consecutively are not taken into account (e.g. the case of fires and explosions breaking out in the immediate aftermath of an earthquake).
6. Acceptance criteria for various failure types is not developed or specified (such as acceptance criteria for differential displacement).
7. Prevention and importance of intervention at early stages within the life cycle are not addressed.
8. A method for the prioritization and implementation of risk reduction measures, taking into account cost benefit analysis is not provided or addressed.

Box 2: Challenges of code in protection of hazardous and critical facilities against earthquakes

1. Special attention should be directed at facilities containing hazardous materials which should be protected to a higher degree of protection against earthquakes; which is usually achieved by designing them to a more severe earthquake (higher return period) event.
2. Special attention should be directed at adopting specific acceptance criteria for the containment of hazardous material in case of an earthquake.
3. The degree and frequency content of the vertical earthquake motion is not provided. It should be recognized that vertical earthquake motion has been recorded in excess of horizontal earthquake motion in some recent earthquakes in California USA (Northridge) and in Japan (Kobe). Vertical ground acceleration is particularly important for pressure vessels and tanks where the vertical acceleration is transformed through gravity to a hydrodynamic force acting laterally on the structure and contributing to possibility of overturning.
4. The non-synchronous nature of the earthquake motion (the fact that the earthquake ground motion will vary from one point to another and that it is modified as it passes through the ground) is also not addressed. This may be particularly important to long structures such as pipelines on industrial facilities where conflicting trends make the design very complicated and require special attention. For example these pipelines should be fixed to avoid excessive lateral movement and lateral torsional buckling; however, excessive support implies they will be subjected to addition forces due to differential displacements.
5. The return period of the earthquake is not specified which creates serious inconsistencies with regulations to be adopted for the protection of facilities.
6. The joint probability of occurrence of various loading and how this joint probability may reduce the loading from each individual event is not taken into account, while most regulations rely on a probability based return period for various scenarios.
7. Scenarios of two or more hazards occurring simultaneously or in consequence are not taken into account (e.g. the case of fires and explosions breaking out in the immediate aftermath of an earthquake). This is particularly important on hazardous facilities where the leakage from pipes may lead to the break out of fires and explosions on equipment which have already been damaged due to the earthquake which in turn may lead to complete catastrophic failure and escalation in reaction to milder earthquake over shocks. The above scenario shows the importance of a consistent approach which relies on a joint probability of occurrence methodology and where one of the aims is to prevent escalation.
8. Special attention should also be directed at facilities which are critical because of their function including schools, hospitals, and various government buildings and ports and airports.

Furthermore, the code suffers from several fundamental shortcomings some applicable to fire protection in general (and therefore also applicable to hazardous facilities) and others applicable to the fire protection of hazardous facilities in particular. These challenges have been identified in the earlier study[2] and are reproduced and refined below for the sake of completion.

2.3.3 Environmental disaster prevention legislation

Environment Protection Law 444, 2002 which mandates the national council for the environment with the responsibility for setting the objectives and priorities for environment protection. The salient features of the Environment Protection Law 444, issued in 2002 are summarized below:

- Chapter 2, Article 6 states that the national council for the environment has the responsibility for setting the objectives and priorities for environment protection.
- Chapter 5 titled Facilities, Article 42 states that each facility should have available an environmental assessment and monitoring procedures with the aim of regular measurements of its polluting activities and their outcome on the environment.
- Chapter 6 is on hazardous and non-hazardous chemical materials. Article 44 states that the importation, production, mining, manufacturing, transportation, marketing, possession and use of hazardous or damaging chemical material (especially poisonous and radiological material) is subject to a special permit to be awarded according to condition set by a Decree taken by the council of ministers.
- Chapter 9 Article 50 states that a national disaster plan will be put in place with an environmental administration which will define the preventive measures that should be implemented to mitigate against environmental disaster due to natural causes, incidents or war acts.

Box 3: Challenges of code in protection against fires in general

1. For residential buildings a cellulosic fire curve may be used to obtain the severity of any expected fire. However special studies are required to determine the spread and severity of fires within special buildings including hospitals and emergency command centers and within factories and industrial facilities. These are not addressed in the Decree.
2. The return period for fire events and the acceptance criteria for different types of fires are not provided.
3. Hazardous materials which may catch fire may often also leak (e.g. to form a cloud in cases of gaseous substances) which may subsequently find an ignition source and explode. However, explosions are not considered in the code – neither for both residential buildings and facilities. While this may be acceptable to residential buildings with no central gas system it is certainly un-conservative and unsafe for residential buildings with central gas systems, as exists in some location in the Capital Beirut.
4. Fire risk reduction measures such as increased confinement and the use of water sprays and deluge may have a negative effect on the risk of an explosion. Therefore, fire and explosion hazards are usually considered simultaneously to avoid a situation arising where the risk from fire has been reduced but the overall risk has increased.
5. The decree does not differentiate or prioritize risk reduction measures in an inherently safe way from prevention to control, mitigation and then emergency evacuation and rescue.

Box 4: Challenges of code in protection of hazardous and critical facilities against fires and explosions

1. For industrial facilities, the most advanced and modern regulations adopt a goal based approach for the protection of industrial facilities against fires and explosions. Such approaches take into account the probability and return period of several factors (such as wind, dispersion, size of leak, ignition source and location, product composition, etc) occurring simultaneously to reach a particular fire load with a specific return period of occurrence. These are not addressed in the Decree.
2. The return period for fire and explosion events and the acceptance criteria for different types of fires are not provided.
3. The code does not differentiate between the different types of fire and explosions which may occur in industrial facilities.
4. Hazardous materials in factories which may catch fire may often also leak to form a cloud which may subsequently find an ignition source and explode. However, explosions are not considered in the code – for both residential buildings and facilities. While this may be acceptable to residential buildings with no central gas system it is certainly un-conservative and unsafe for residential buildings with central gas systems.
5. The fire risk reduction measures such as increased confinement and the use of water sprays and deluge may have a negative effect on the risk of an explosion. Therefore, fire and explosion hazards are usually considered simultaneously to avoid a situation arising where the risk from fire has been reduced but the overall risk has increased.
6. The decree does not differentiate or prioritize risk reduction measures in an inherently safe way from prevention to control, mitigation and then emergency evacuation and rescue.
7. Special guidance and attention is required for piping systems and pressure vessels which if designed properly will prevent escalation and if not properly designed may lead to domino effects.
8. Critical facilities such as hospitals, malls, schools, hotels, ports, airports and other facilities also need special attention and protection against fires and explosions. This should include a higher and more refined degree of both prevention measures and detailed response plans.

- The main challenges related to the Environmental Protection Law are not related to the technical issues of the law itself, as much as they are directly related to the lack of sufficient staff to be able to impose the law. Even if and when such staff are secured, another issue related to lack of enforcement of laws nationally will remain a significant challenge.

2.3.4 National land use master plan for the Lebanese territory

The National Master Plan for the Lebanese Territory (NPMPLT)[3] provides recommendations for land-use and hazard maps for the following hazards that Lebanon may be subjected to:

- Landslides;
- Floods;
- Desertification;
- Earthquakes.

3 NPMPLT National Physical Master Plan for the Lebanese Territory, Final Report, Council for Development and Reconstruction in collaboration with the General Directorate of Urban Planning, December 2005.

2.4 Knowledge and capacity enhancement for disaster risk management

Based on the gaps in risk management and risk assessment practices which have been identified earlier, there is a need for capacity enhancement in the following areas:

- Strengthening of the hazard management philosophy practice in terms of setting levels of tolerable risk;
- Strengthening LIBNOR for carrying out its duties in the development of various standards and codes related to hazard and disaster risk reduction;
- Strengthening the Ministry of the Environment to empower it to carry out its duties;
- Strengthening the Council for Development and Reconstruction (CDR) to be able to review the technical content of projects in terms of risk assessments;
- Strengthening other public institutions in their own domain including all line ministries and research centers.

The following subsections provide some additional details regarding the challenges facing some of the institutions outlined above.

2.4.1 LIBNOR

The need for the prioritization of the work after the civil war forced the organization upon resumption of its activities to focus on two main priority areas, namely standards for food industry and standards for reinforcing bars to be sued for reinforced concrete in construction.

While LIBNOR is developing 200-300 standards per year; there is a significant lag to compensate for. In other countries there are around 25000 to 30000 national standards. If prevention aspects of disaster risk reduction is seen as a government priority, LIBNOR should be empowered (through funding for both extra staff and expertise) to produce more standards regarding this topic (i.e. more codes and standards on prevention coupled with executive procedures for the smooth implementation of these codes and standards).

2.4.2 Tolerable risk

Disaster risk reduction philosophy including concepts of tolerable risk must be introduced and legislated for within the Lebanese public administration. The main weakness within the country is not the lack of risk management expertise but the lack of technical expertise. To this end, the risk management expertise should be enhanced within the public administration in order to be able to effectively implement and monitor any risk management legislation which could be developed with the help of external advisors. However for any such legislation to succeed the public administration must feel "ownership" of its objectives – something which can only be achieved provided the risk management capacities of the personnel within the public administration is enhanced.

2.4.3 Ministry of the Environment

The lack of staff within the Ministry of the Environment is combined with a lack of action on behalf of both the executive and legislative institutions in pushing for the adoption of laws and action plans being developed by the Ministry of the Environment. Several examples serve to demonstrate the challenges currently faced in this regard:

National Plan for Combating Desertification

- There is a United Nations convention to combat desertification; one of the commitments is to develop a national action plan. The plan was completed in 2003; it is now seven years old, and it is yet to be endorsed. It was the first such plan, sponsored by the German Technical Cooperation (GTZ) and UNDP. The number of personnel (within the Ministry of the Environment) following up the national action plan is two people.

Staff Shortages

- There are 40 personnel within the ministry, which clearly falls short of the required number of staff to enable the ministry to fulfill its duties;

- There is a law for having regional directorates for the ministry of the environment; however there is shortage of staff and resources; which in turn implies that there are no functioning regional directorates.

Lack of National Plans and Strategies

- There is no National Environmental Strategy;

- There is no National Environmental Contingency Plan.

Environmental Impact Assessment Law

- The Environmental Impact Assessment (EIA) Law has not been enacted by the parliament;

- Regarding environmental impact assessments, industries are grouped under five categories the most dangerous category 1 includes chemicals, while the least dangerous is category 5 such as sewing. Categories 1 and 2 need EIA.

Environmental Audit

- There are procedures for environmental audit on existing facilities. The Ministry staff are supposed to do periodic visits to existing facilities but there are only four people within the Ministry for visiting thousands of industrial facilities;

- For industrial and other sites, there is no monitoring unit;

- Monitoring data at critical and other sites should be done every six months but industrial sites do not provide data; furthermore, in case they send relevant data the Ministry staff are overstretched and unable to dedicate time to review any such incoming data;

- There are audit manuals, guidelines on good environmental management within factories and audit guidelines; including a national guideline for environmental audit, with software;

- There are 29000 industrial institutions, 28100 of which are without a license. Due to staff shortages the audit is currently only prompted by complaints. The situation is further complicated by the fact that there is no presence for the Ministry of the Environment within the governorates. Furthermore, there are no data to compare between before and after a particular complaint.

2.5 Disaster preparedness and recovery

2.5.1 HRC response plan

The disaster response plan, as set by the High Relief Committee has been reviewed in detail in an earlier study[2], where a critical discussion was provided on its scope; objectives; policies and principles; definitions and terminology; and distribution of committees, roles and responsibilities. It will not be reviewed in this document due to three main reasons:

- The HRC response plan is not adopted by the lead agency responsible for response and the other participating response teams on the ground;

- The entire setup of the HRC is under review and strengthening, which includes a review of the national response plan;

- A skeleton for a National Response Plan is currently being developed. Once this is compete, it may form the back-bone of the National Response Plan;

2.5.2 Army plan

The army has also developed a comprehensive response plan in case of large disasters. The plan specifies in detail the role and responsibilities of the army in case of different disasters. This plan is also undergoing a significant review and as such will not be reviewed in this section. More details of the existing plan can be obtained from an earlier document.

2.5.3 Response plans of other bodies

A report[2] prepared for the UNDP and the Government of Lebanon also did review the response plans prepared by various UN agen-

cies; which may have changed since the preparation and the publication of the report in 2008. These plans are listed below, while

more details may be obtained from the corresponding agencies and organizations:

- UN Interagency Contingency Plan and UN Country Office Coordination Issues and Plans Red Cross Plan;
- World Health Organization (WHO) Plan;
- Office of the United Nations High Commissioner for Refugees (UNHCR) Plan;
- Strengths and Weaknesses Weakness in Prevention.

2.6 Strengths and weaknesses

2.6.1 Weakness in prevention

Weaknesses in prevention can be best summarized under the following main headlines:

1. Lack of a coherent and uniform disaster risk reduction strategy, which would be informed by risk assessment studies to inform decision makers in their quest to reach a rational methodology for the allocation of resources. This would inevitably include procedures and guidelines for tolerable risk, risk assessment and acceptance criteria, and prioritization of risk reduction measures along scientific inherently safe principles;

2. The lack of links between government priorities in disaster risk reduction, research centers, funding bodies, private and public universities leads to a situation where opportunities for improvement are being missed and possibilities of cooperating within regional and international research efforts for disaster risk reduction are also being missed. This point will be elaborated further in the national evaluation assessment, which will provide both examples of missed opportunities and recommendations for strengthening existing links and developing new ones;

3. Lack of enforcement of codes which are meant to prevent against disasters such as earthquakes, where for example the public safety decree has been issued in 2005 but its implementation has not started yet. Furthermore, there is a lack of implementation procedures for the execution of the codes, which poses a challenge that does not seem to be recognized;

4. Some of the available codes do not take into account the more recent advances in various fields of disaster risk reduction.

2.6.2 Weaknesses in response

The plan that has been developed by the HRC in 1996 has not been widely circulated and is not the one that is adopted by the main bodies that intervene in case of disasters (i.e. the Lebanese Army assisted by the other bodies). However, the army being the main body of response and intervention has its own plan. This plan is currently being improved for chemical, biological, radiological or nuclear (CBRN) events and its structure may inform the process of the overall structure of the national response plan.

2.6.3 Strength in response

The challenges in the prevention institutions and in the weak role of the state in prevention has lead to a strength in the response expertise of individual bodies (as opposed to expertise in developing effective, tested and functional liaison mechanisms) due to the fact that Lebanon has been subjected to several disasters (albeit man-made) during its short modern history. Lebanon benefits from a significantly active, and experienced civil society and NGO sector which has in the past intervened promptly and effectively in various humanitarian disasters to affect the country, including the 2006 war with Israel.

3. Main Findings of Country Situation Analysis

3.1 Current practice on risk assessment studies

For the sake of this report, and following the UNDP GRIP terminology, the risk assessment process may be subdivided into three broad steps:

Step 1: Hazard mapping which includes:

- Hazard prone area maps, which act as an indicative measure of which areas may be prone to a particular hazard but does not include any information on the probability and the corresponding intensity of the particular hazard under consideration;

- Hazard intensity maps, which show the spatial distribution of the intensity of a particular hazard corresponding to a predefined annual probability of exceedance;

- Hazard zoning maps which uses hazard intensity maps corresponding to several hazards in order to produce hazard zoning maps to contribute to the decision making process of producing land-use maps.

Step 2: Exposure mapping which includes data on the exposed elements in terms of people, critical natural resources, critical infrastructure, and housing.

Step 3: Vulnerability assessment to define the vulnerability of the various exposed elements identified in Step 2 above.

In the absence of any national framework for risk management and disaster risk reduction, it is expected that risk assessment studies (related to the three steps identified above) will be scarce and will vary significantly in both the degree of complexity and in the tolerable risk criteria that are being used. Indeed this is the general picture of risk assessment in the country – a picture which has emerged after meetings with various officials in different institutions.

Several risk assessment studies have been identified. However they are mainly focused on generating maps for hazard prone areas and may be categorized under hazard mapping activities (albeit they are often referred to as risk studies and risk maps thereby demonstrating the confusion prevalent within various stakeholders on between hazard and risk). In particular, the following studies have been identified from previous reports[4]:

- Flood mitigation project in the Bekaa Valley, UNDP;
- Flood Risk Mapping for Lebanon, GTZ;
- Fire Risk Assessment of Beirut Airport, French Embassy;
- Flood Hazard/Exposure Mapping, High Relief Committee.

However, during the course of this project the following studies were identified:

- Flood Risk Management – Arsal, Bekaa;
- Forest Fire Project.

3.2 Main challenges

The main challenges facing current practice are summarized below:

3.2.1 Earthquake hazards

Hazard Maps for the Country

Earthquake hazard maps are currently being produced by various institutions. For example, the CDR has produced its own seismic prone hazard area maps. The Geophysical Research Center within CNRS has also produced its own maps. Other universities (in particular the American University of Beirut are also working

4 Mission Report on Implementing National Risk Assessment in Lebanon, Dr Carlos Villacis and Dr. Jianping Yan, GRIP, BCPR-UNDP, March 2010.

in this domain). The methodologies adopted by the different institutions need to be unified. As a first step there needs to be an agreement on the historical seismic events within Lebanon, an issue which is currently a stimulating scientific debate.

Seismic Risk Assessment Practices within Individual Projects

On an individual project level, the earthquake hazard is being dealt with by following certain international codes. The main challenge is that different codes may adopt different return periods and may take different aspects of response and loading into account, which implies that there is no consistency within the country.

Usually for large infrastructure projects, feasibility studies are carried out and part of the feasibility study would be a risk assessment corresponding to the hazards which may afflict the critical infrastructure element.

One such large infrastructure project was reviewed, namely the feasibility study for the Damour dam. The code followed was the "International Commission on Large Dams" (1989) which recommends three earthquakes for which a dam should be designed:

- The Operating Basis Earthquake (OBE), the largest reasonably conceivable earthquake that appears possible along a recognized fault or within a geographically defined tectonic province, under the presently known or presumed tectonic framework. The MCE is generally defined as an upper bound of expected magnitude;

- The Maximum Design Earthquake (MDE), The MDE will produce the maximum level of ground motion for which the dam should be designed or analyzed. The dam should stay "fail safe". It is commonly accepted that the probability of occurring of the MDE should be about 10% during the service life (about 100 years); and

- The Maximum Credible Earthquake (MCE), The OBE represents the level of ground motion at dam site at which only minor damage is acceptable. The dam structures and equipment should remain functional and damage easily repairable, from the occurrence of earthquake shaking not exceeding the OBE. Typically, the probability of occurring of the OBE should be about 50% during the service life (about 100 years).

While careful consideration has been given to the maximum loading magnitude of the earthquake hazard – including the vertical earthquake component; there are three main challenges within the adopted methodology:

1. The lack of available time history earthquake records which are needed for carrying out the time history analysis for the dam. Response spectra are provided but these are useful assuming that the response of the dam remains within the linear range. For the MDE, the design must allow for fail safe conditions and this implies carrying out nonlinear analysis which require the development of time history earthquake ground motion records near the site of the dam;

2. The lack of any quantification of non-synchronous motion effects;

3. Not enough consideration is given to the response side. This includes the possibility of the separation between the concrete face and the rock-fill which may have a detrimental effect on the stresses on the dam, as demonstrated in earlier studies on both the Litani and the Cogoti dams[5]. It also includes taking into account the effects of fluid structure interaction on the development of stresses within the concrete face and the rock-fill;

4. It is not known how risk reduction measures are being reduced to ensure that the response of the dam will remain within the fail safe zone referred to above.

5 Sarma S K and Hamdan F H; Seismic Response of Concrete Face Rock-fill-Dams, International Conference on the Rehabilitation and Development of Civil Engineering Infrastructure Systems, Beirut, Lebanon, 9 - 11 June 1997; and Hamdan F H and Sarma S K; Seismic Response of Concrete Face Rock-fill Dams with Particular Application to the Cogoti Dam, The 11th European Conference on Earthquake Engineering, 6 - 11 September 1998, Paris, France.

3.2.2 Tsunami hazards

The tsunami hazards are not being considered for any of the major infrastructure projects along the Lebanese coast, all of which is prone to Tsunamis. It is stated that the runway of the Beirut Rafiq Hariri International airport has a barrier against a 4-meter wave. However it is not clear how this number has been derived and whether it corresponds to a particular tolerable risk, and whether this risk is compatible with the tolerable risk and return period of the earthquake which might produce such a tsunami.

3.2.3 Forest fires

Forest fire predictions are currently being carried out by different bodies using different methodologies. For example, the Italian corporation is funding a program with the civil defense for the prediction of forest fires; however these predictions does not take into account the soil type, trees and use of forests (i.e. agricultural vs. forest/woods), due to the lack of data that would allow the modeling of the effects of these variables. The AFDC, an independent NGO, also produced fire risk maps. Finally, LARI (Lebanese Agricultural Research Institute) also produces fire indices. It is necessary that the methodologies adopted in these three approaches be carefully reviewed in order to identify any inconsistencies.

3.3 Evaluation of basic and intermediate data

3.3.1 Base maps

There are base data within various ministries and centers related to exposed elements. For example, the Geophysical Center within the Lebanese Army has datasets and maps of Lebanon showing:

- Topographic data;
- Orographic data;
- Administrative boundaries;
- Buildings;
- Transportation routes;
- Telecommunication lines;
- Energy lines;
- Hydrology data;
- School Data;
- Vegetation and land cover.

Topographic maps and aerial photos do not provide very accurate land-use maps. One of the main challenges, however, is for these maps to be validated and assessed on the ground. Towards this end, there is data in the various line ministries; however this data needs collation and validation. Therefore, even for the validation of the base maps, some data collation and validation is first necessary. Figure 2 below shows the population density distribution across the Lebanese territory.

An additional challenge related to collation and validation is the ownership of the data. Even when government subcontractors develop information and maps, this becomes the property of the private firm which carried out the development. This constitutes a challenge against the various government institutions making use of the gathered data in other aspects of the available databases.

3.3.2 Hazard prone area maps and hazard intensity maps

The following hazard prone area maps are available:

- Earthquake hazard map;
- Landslide susceptibility map;
- Flood map;
- Desertification;
- Fire susceptibility maps.

However, they are still in the process of development and not all information is updated or available. Furthermore, the maps are based on a coarse scale and cannot be used for detailed hazard identification and subsequent risk assessment (e.g. such as required for urban risk assessment against a variety of hazards).

There are hazard intensity maps produced by several institutions including the geophysical research centre within the CNRS and AUB. However there is no consensus regarding these maps. There are no hazard intensity maps for the other hazards considered within this study. Table 2 summarizes the hazard map situation

Figure 2: Map showing population distribution in the Lebanese territory

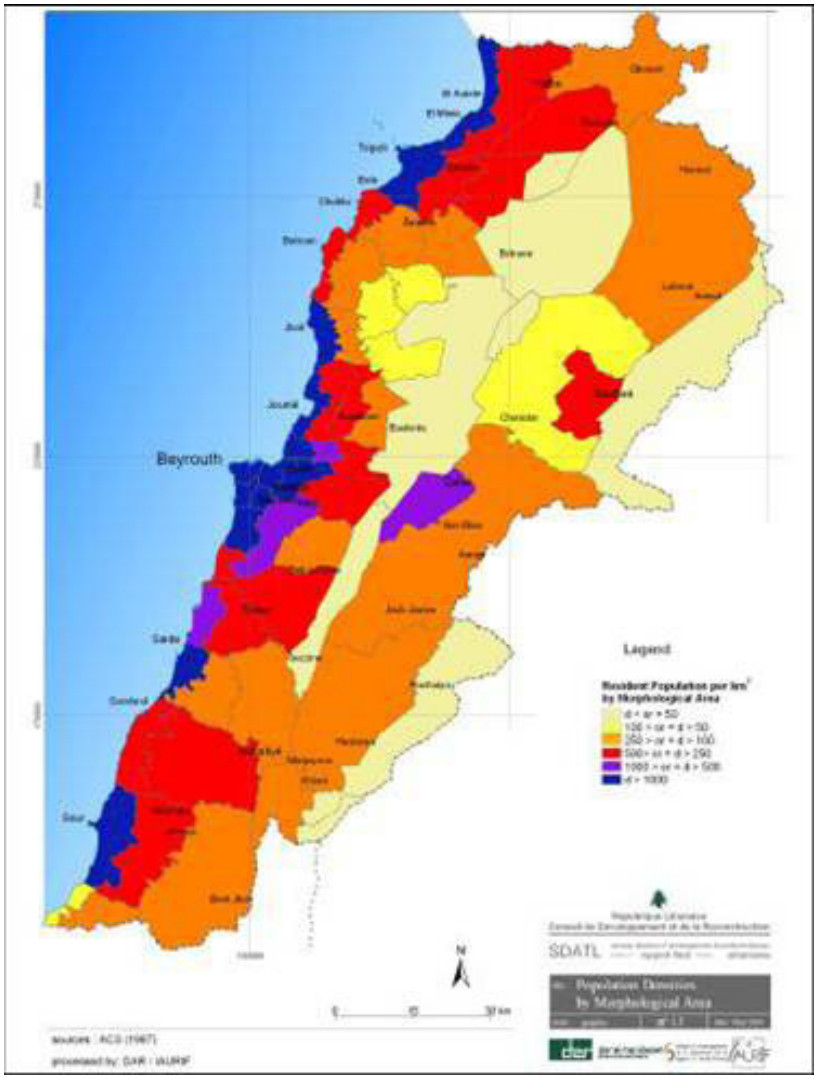


Table 2: Hazard map inventory

Hazard / Map	Earthquakes	Floods	Fires
Hazard Prone Areas	yes	yes	yes
Hazard Intensity Maps	yes	no	no
Hazard Zonation Maps	no	no	no

for the main hazards affecting the country or certain regions within it.

Figures 3 and 4 provide examples of the available hazard prone area maps, where Figure 3 shows the flood hazard prone area map, while Figure 4 shows the seismic hazard prone area map. The mistake is apparent in the use of the word "Risk" to denote the type of map being shown.

3.3.3 Earthquakes

Basic data: Information on basic data is relatively acceptable (from the point of view of fault mechanisms); however, due to the fact that Lebanon has isolated mountains with deep valleys this complicates the evaluation of the geophysical risk. Furthermore the reason for the uplift of the crust remains unknown. Further basic data that is lacking includes:

- The zones that will be isolated for a relatively long time due to various earthquake scenarios;

- Landslides as a result of the earthquakes, especially landslides in the vicinity of Beirut. There is a need to determine which scenarios are more likely and the manner in which the scenario events may unfold;

- More data is required on the coherence of the Lebanese soil, which in turn would allow for more accurate estimation of site-effects (intermediate data) and also landslide probabilities. In addition, within the context of landslides, more data is required on soil shear velocity and strength;

- The above uncertainties further complicate the risk picture because it is expected that

Figure 3: Flood hazard prone area map

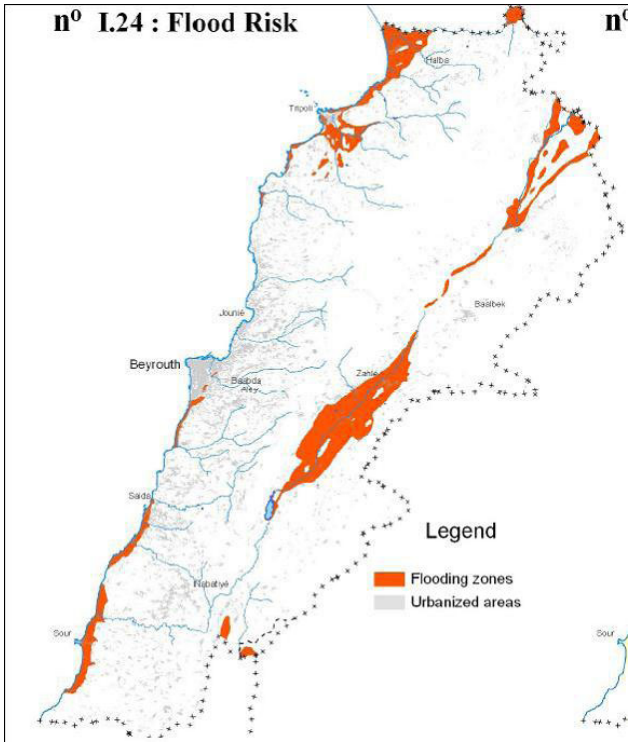
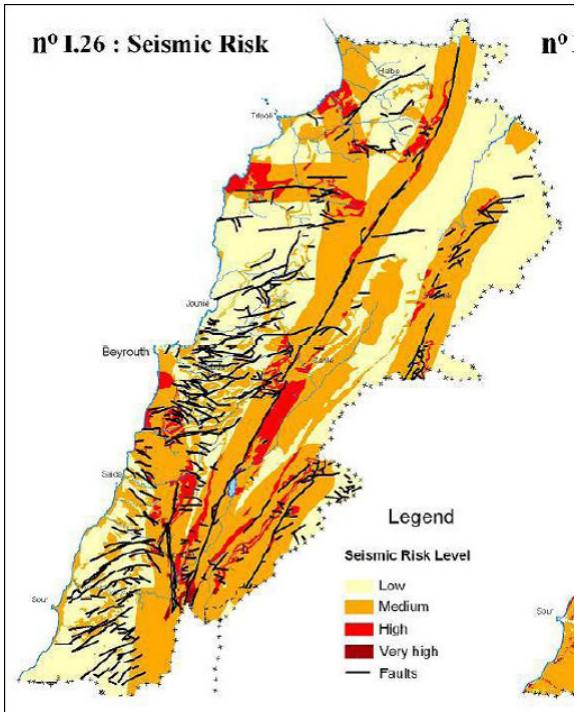


Figure 4: Seismic hazard prone area map



in urban areas the ground motion will be highly variable;

- There is a need to agree on a catalogue of historical earthquakes (there is diverging points of view at the moment).

Intermediate data: It is possible to generate artificial records if more work is carried out. However, there must be a clear demand for this by the engineering community and this is not yet the case. Furthermore, for many critical infrastructure elements such as dams it is necessary to have (both horizontal and vertical) accelerograms, this is currently not available. For other critical infrastructure elements such as bridges, pipelines and dams which span relatively large distances it is necessary to assess their risk using accelerogram records that take into account non-synchronous motion effects this data is also currently not available.

3.3.4 Tsunamis

Basic data: There is a need for additional data (both basic and intermediate data) regarding the Tsunami hazard. In particular, the following points can be made:

- Regarding return periods, there is a need to determine the source of tsunamis. Tsunamis

  as far as Greece can reach Lebanon; as happened for the Santorini earthquake.

- To determine the run-up, the following data needs to be determined:
  1. The bathymetry, especially the shallow water bathymetry;
  2. The above is required especially for areas of high population concentration and low sea level such as the Mina in Tripoli, the north and south suburbs of Beirut, Sidon and Dammour. In addition, attention should be given to valleys near the shore where there are urban dwellings. Finally, attention should be given to main infrastructure such as ports, Zouk electric plant, baddawi refinery, zahrani refinery and airport.

Intermediate data: There is a need for additional intermediate data on tsunamis. Regarding tsunamis the intermediate data could be the wave run-up distributed along the Lebanese shore and corresponding to various return periods. Such data should exist for both tsunamis originating from faults near the Lebanese shores and other further away in the Mediterranean sea (e.g. near Greece, where there is evidence in ancient history that Beirut has been affected by Tsunamis from earthquakes originating in Offshore Greece).

3.3.5 Floods

Basic data: There is data in the form of rainfall per day. However for hydrological modeling to be used in risk assessments there is a need to know rainfall per hour and also in some instances rainfall per second. Currently these are obtained from the rainfall per day through the use of approximate methods which implies that the accuracy of the risk assessment becomes impaired. There is no data on the shear wave velocity within soils. In order to assess damages and the vulnerability of humans to flood events, it is necessary to collate additional data on population density and exposed elements to be added as layers within existing databases.

Intermediate data: Most of the available data on flooding is related to the region of Ras Baalbeck, Fakha and Irsal; where most of the data goes back to the period ranging from 1964 to 1970. For carrying out cost benefit analysis which is necessary in risk management studies when various risk reduction options are being examined and the merits of each are weighed, it is necessary to take indirect costs into account; however this is not possible due to the need of additional data on the state of the flooded areas before and after the disaster. It is not possible to assess the effect of flooding on soil erosion since there is a need for additional data before and after the flooding events. There is a need for a climatological station in the region and for a house to protect this station. Finally, additional data is required to examine the underlying causes of flash flooding.

3.3.6 Landslides

Intermediate data: There is a need for the availability of additional data on the possibility of land-slides around large cities within Lebanon and the most likely scenarios.

3.3.7 Climate change, drought and desertification

Basic data: There are currently forty four stations measuring solar radiation, precipitation (total), wind direction and speed, air temperature, relative humidity, soil temperature, dew point, air pressure. In order to have complete coverage of Lebanon, there is a need to extend the network to include at least 75 networks to include all Lebanese territory.

Intermediate data: There is currently data on indirect indicators for drought and desertification including:
- New types of diseases and pests affecting for crops;
- Shorter, more intense periods of rain;
- Large temperature variation between day and night, which is a strong indicator for climate change and desertification.

However, additional data is required on the effects of drought and desertification including:
- Geographic distribution of people, where many farmers have either changed crops or actually moved to other jobs which inevitable implies relocating;
- Pastures and associated livestock;
- Biodiversity; and
- State of ground water and water table.

3.3.8 Forest fires

Basic data: As a first step, data collation from archives of civil defense and agriculture ministry should be carried out in order to determine historic locations of fires. This was carried out between the years of 1993 and 2004. For this period the fire data is automatically added to the data set. However, the gathering of additional data faces several challenges and gaps:
- Geographical extension of forest is needed;
- Existing conditions in the vicinity of the forest;
- The scale and quality of the maps are not adequate;
- Existing information is available but is scattered in many institutions;
- Even if government subcontractors develop information and maps, it becomes the property of the private firm which developed them;
- Topographic maps and aerial photos are not very accurate for producing land-use maps. These must be checked on the ground.

Intermediate data: Fire index maps are now available, but additional data is required to improve quality of predictions and warning. In the Chouf reserves, soil sensors have been placed in critical spots to provide more accurate data on the composition of the ground. However this must be extended to include additional data (see comments below) as well as other forests and reserves. More accurate data that is required includes:
- The composition of the ground;
- The type of the forest;
- Buffer zone utilization;
- State of the forest (used or not used, maintained or not);
- The status of the forest (e.g. protected, natural reserve, etc);
- Information on mines and people;
- Current data is on maps with a scale of 1:100000 or 1:200000. There is a need to use a finer scale of 1:50000 or even less. Furthermore, it is not clear whether this data can be transported into maps from other databases based on more refined scales.

3.3.9 Epidemics

Basic data: As a result of various studies carried out in the past five years, there is currently GIS mapping of all hospitals and health centers (including services offered). Data on capacity of border points in terms of both surveillance equipment and human resources to respond to cross-border disasters and health emergencies (including early warning and response systems) has also been gathered. The following data needs development and/or collation:

- Data on the root causes of cancer (i.e. is it dietary, air exposure, asbestos, etc) to be able to use such data in further assessment studies to determine the effects of various climate- change related phenomena on the rate of cancer development;

- Data on mortality and morbidity rates which implies to enable medical researchers to carry out risk assessment to determine quality adjusted life years and the burden of disease;

- Data to act as a benchmark regarding the distribution of the number of death per year across various disease types.

Intermediate data: There is currently available data on the following issues:
- Data on heavy metals in water;
- Data on the health state of public schools (health and safety indices), including sanitation and fire escapes;
- Data on risk spots of avian flu;
- Data on interventions for the recovery of the health sector after the 2006 war;
- Data on emerging diseases as a result of climate change, including Malaria;
- Data on effects of floods and ponds on diseases;

However, there is a need to collate data on the following issues:
- Tobacco related diseases;
- Utilization of hospital beds.

3.4 Evaluation of main institutional capacities

3.4.1 CNRS- Geophysics Centre

Mandate: The mandate of the centre is to carryout research in fundamental geophysics topics and is not related to developing intermediate data to be used by engineers in earthquake analysis. There seems to be both ambiguity and lack of awareness (by other stakeholders) regarding the mission and mandate of the centre.

Expertise and Skills: There are skills within the centre to carryout fundamental basic research on earthquake faults. In addition there are skills in developing intermediate data to be used by engineers in any necessary advanced nonlinear time domain analysis, as is for example required in the case of critical infrastructure elements.

Experience: There is practical experience.

Resources: There are limitations in terms of human resources and also in terms of financial resources. This is causing pressure on the center which may also partly explain the cause for not participating in some of the regional initiatives such as the Earthquake Model of the Middle East Region (EMME).

Data information and sharing: There are several challenges in data sharing and dissemination, typical of all public institutions within Lebanon.

Networking: Networking takes place between the director of the centre and various other individuals within various institutions. There is also networking on a particular specific project. There is a lack of networking frameworks between the centre and other key players in earthquake, tsunami and landslide hazards, all of which are relevant to the work of the centre and its expertise.

3.4.2 Lebanese Agriculture Research Institute (LARI)

Mandate: LARI (Lebanese Agriculture Research Institute) has 420 employees, with financial and administrative independence- but under the auspices of the ministry of the agriculture. It is mandated with carrying out tests to assess pest and disease situation and issue warnings and mitigations measures for pest and disease for all crops accordingly; including assessing the effect of climate change on both agriculture and the environment. It is also tasked with carrying out awareness raising activities for both citizens and farmers to adapt to climate change.

Expertise and Skills: In addition to expertise and skills necessary for carrying out its duties, LARI acts as a host for the Internatinal Center for Agricultural Research in the Dry Areas (ICARDA), an international organization for

climate change and desertification. More skills are needed to assess the effects of climate change on pastures and to propose mitigation measures (e.g. some initiatives have started in North Bekaa where small dams are being adopted to help planning of fodder which can act as pastures).

Experience: The centre has experience in carrying out tests for food control, including tests for various poisonous materials, residual medicinal treatments and heavy metals. The centre also has experience in carrying out tests for trans-boundary diseases between animals and humans including testing for pig influenza, bird influenza, Maltese fever and foot and mouth disease. The centre also has experience in collation and storage (in conjunction with Kew Gardens – London; UK) of Lebanon's botanical resources, together with seeds of these sources, as part of a wider campaign to fulfill Lebanon's obligations regarding the International Treaty for Genetic Resources (both animal and botanical).

Resources: More resources are required to increase the stations from 44 to 75, thereby securing coverage throughout Lebanon.

Data information and sharing: Early warning information related to floods, fires and storms is disseminated through mobile text messages, websites, radio broadcasts, advertisements and official bureaus. However, LARI also gathers data from 44 stations for data collection; relying on Austrian equipment and Dutch modeling. The availability of this data is subject to the same challenges that are faced when attempting to acquire other data within public administrations. On the other hand, the centre offers free testing of water for both potable and irrigation use.

Networking: There are no official forums for networking with other stakeholders working on the same hazards including fires, floods, disease and storms.

3.4.3 Ministry of Agriculture

Mandate: The mandate of the Ministry of Agriculture is related to flooding as far as it is a cause of land degradation. However, strictly speaking the mandate of flooding also lies within the Ministry of water and Energy. This causes ambiguity which needs to be clarified.

Expertise and Skills: There is expertise in quantification of watershed water. More expertise and skills in urban planning are required. Also more expertise is needed for integrated flood management.

Experience: There is experience in developing mitigation measures in terms of structures.

Resources: Like most line ministries there are limited human and financial resources.

Data information and sharing: Data sharing within the ministry is rather restricted. There is the need for strengthening existing mechanisms and developing new ones for acquiring such data, particularly if needed by researchers within universities. This can hinder assessments of the actual situation in order to identify the challenges and address them in a scientific manner. This is particularly true when universities are being called upon by various other stakeholders to play a more prominent role in contextualizing the various models used for flood assessments.

Networking: Networking may take place within the council of Ministers with other ministers. Nevertheless, there are few opportunities to network on issues related to risk assessment and risk reduction since these remain limited to private and/or individual projects and as such are not reflected by government policy which does not allocate any time or other resources to achieving them. This is particularly important since universities are being called upon to play a more prominent role in flood management; which in turn requires the establishment of official networking forums where all stakeholders are represented and can air their views.

3.4.4 Council for Development and Reconstruction

Mandate: The council is mandated with overseeing the implementation of various projects related to infrastructure and reconstruction. It

does not set codes nor does it set terms of reference or technical specifications.

Expertise and Skills: Expertise and skills exist within the council in carrying out simplified risk assessment for most hazards. However, very little experience exists in hazard management and in risk reduction.

Experience: The council has experience in risk assessment as part of the preliminary assessment often carried out within feasibility studies.

Resources: The council, in general, is better equipped in terms of both staff and financial resources than line ministries and other public institutions.

Data information and sharing: The council is relatively more cooperative in the sharing of information due to its close liaison with various outside bodies. However, it remains part of the public institutions and as such shares the same challenges in this regard.

Networking: The centre can play a prominent role in networking and in facilitating networking forums due to the nature of its functions which spans several ministries, which in turn gives its staff the ability to have good working relationships with personnel from these ministries.

3.4.5 Ministry of Public Works and Transportation

Mandate: The directorate of roads and buildings is tasked with:

- Inspecting bridges, walls, sewage systems;
- Assess the relationship of road networks to urban development, taking into account existing and future economic development plans;
- Carry out feasibility studies (including safety assessment) for road networks (including bridges and tunnels) and government and administrative buildings;
- Prepare terms of reference and technical specifications for carrying out all tasks related to road network design and development including auditing and inspection;
- Prepare terms of reference and technical specifications for carrying out all tasks related to government and administrative buildings including auditing and inspection;
- Prepare guidelines related to all stages in the lifecycle of road networks and government and administrative buildings;
- Prepare training strategy for internal staff;
- Preparation of technical design studies for all aspects of road networks including bridges, and sewage systems;
- Preparation of technical design studies for all aspects of government and administrative buildings;
- Carry out laboratory testing to assess the integrity of the various components comprising the road networks;
- Carry out laboratory testing to assess the integrity of government and administrative buildings;

Expertise and Skills: The Ministry suffers from severe shortage in expertise and skills due to lack of human resources, which in turn is due to lack of funds and related low salaries.

Experience: The experience of the ministry does not include risk assessment but is limited to the most basic of design procedures and setting of specifications.

Resources: Like all other line ministries there are severe shortages in staff and financial resources.

Data information and sharing: Data sharing within the ministry is rather restricted; with the need for strengthening existing mechanisms and developing new ones for acquiring such data; particularly if need by researchers within universities. This is turn can be a hindrance that does not permit carrying out assessments

reflecting the actual situation in order to identify the challenges and address them in a scientific manner.

Networking: Networking may take place within the council of Ministers with other ministers; but there are few opportunities to network on issues related to risk assessment and risk reduction since these remain limited to private and/or individual projects and as such are not reflected by government policy which does not allocate any time or other resources to achieving them.

3.4.6 Ministry of Water and Energy

Mandate: The mandate of the Ministry of Water and Energy includes:

- Designing all components of irrigation and electricity generation systems including bridges and dams;
- Preparing technical details and specification booklets for the above facilities;
- Assess existing facilities to propose maintenance, audit and any necessary modification and strengthening schemes.

Expertise and Skills: The experience of the ministry does not include risk assessment but is limited to the most basic of design procedures and setting of specifications.

Experience: The experience of the ministry does not include risk assessment but is limited to the most basic of design procedures and setting of specifications. Even on large projects such as construction of new dams many activities are subcontracted process to the private companies who even decide which code to follow in the design of such dams.

Resources: Like all other line ministries there are severe shortages in staff and financial resources.

Data information and sharing: Data sharing within the ministry is rather restricted, with a clear need for strengthening existing mechanisms and developing new ones for acquiring such data, particularly by researchers within universities. This in turn can hinder carrying out assessments reflecting the actual situation in order to identify the challenges and address them in a scientific manner.

Networking: Networking may take place within the council of Ministers with other ministers; but there are few opportunities to network on issues related to risk assessment and risk reduction since these remain limited to private and/or individual projects and as such are not reflected by government policy which does not allocate any time or other resources to achieving them.

3.4.7 Ministry of Industry

Mandate: The mandate of the Ministry of Industry includes the following tasks:

- Providing licenses to industrial installations, including those to be established within industrial facilities;
- Providing an informed opinion on all matters related to the projects, plans and designs within industrial cities;
- Monitor the safety conditions within existing industrial facilities;
- Contribute to rising technical skills in all matters related to industrial engineering;
- Providing due attention to industrial legislation including the preparation of international agreements related to industry.

Expertise and Skills: The experience of the ministry does not include risk assessment but is limited to the most basic of design procedures and setting of specifications.

Experience: The experience of the ministry does not include risk assessment but is limited to the most basic of design procedures and setting of specifications. Even on large projects such as the design of large chemical facilities, many activities are subcontracted to the private companies.

Resources: Like all other line ministries there are severe shortages in staff and financial resources.

Data information and sharing: Data sharing within the ministry is rather restricted, with the need for strengthening existing mechanisms and developing new ones for acquiring such data, particularly by researchers within universities. This in turn can hinder carrying out assessments reflecting the actual situation in order to identify the challenges and address them in a scientific manner.

Networking: Networking may take place within the council of Ministers with other ministers; but there are few opportunities to network on issues related to risk assessment and risk reduction since these remain limited to private and/or individual projects and as such are not reflected by government policy which does not allocate any time or other resources to achieving them.

3.4.8 Other important institutions

The situation within the Ministry of the Environment and the High Relief Committee has been described in detail in previous chapters. Furthermore, both these institutions are undergoing major strengthening and reorganization initiatives; and as such must be revisited once these initiatives are complete.

3.4.9 Summary of DRR institutions including data providers

Table 3 summarizes the institutions that have as part of their mandate the generation and/or provision of data related to risk assessment.

Table 4 summarizes that main institutions carrying out activities related to the main hazards in Lebanon which include earthquakes and tsunamis, floods, drought, landslides and fires.

3.5 Evaluation of professional expertise and skills

3.5.1 Disaster risk management

On the organizational level, skills are required for setting strategies and frameworks for disaster risk reduction, developing policies for delivering these strategies and actions plans for the implementation of such policies.

On the framework level, skills are required within the public administration for setting levels of tolerable risks, setting mechanisms for

Table 3: Data providers

Institution	Data
CDR	Hazard prone area maps; Socio-economic data of Lebanon
Lebanese Army	Base maps for Lebanon covering entire country
Centre for Agricultural Research – LARI	Climatological data including Solar radiation, precipitation (total), wind direction and speed, air temperature, relative humidity, soil temperature, dew point, air pressure.
Civil Aviation Authority – Department of Meteorology	Climate data
KSARA	Climatological Station, rainfall per day

Table 4: Summary of the various institutions working in DRR

Hazard / Institution type	Earthquakes / Tsunamis	Floods	Drought	Landslides	Fires
Data Providers (Base maps),	CDR, Geographical Information Directorate in Lebanese Army				
Data Providers (hazard specific data)	AUB, CNRS	LARI, MoA, Unis, KSARA	LARI	AUB, CNRS	AFDC, CD
Risk Assessments	Unis, CNRS,	Unis	Unis	Unis	Unis
End users	CDR, UPD, Muni, DN, NGOs	MoA, Muni, DN, NGOs	MoA, DN, Muni, NGOs	UPD, CDR, Muni, DN, NGOs	LA, CD, DN, Muni, NGOs

Unis: AUB, LAU, NDU, USJ; LARI: ; CD: Civil Defense; MoA: Ministry of Agriculture; UPD: Urban Planning Directorate; LA: Lebanese Army; CDR: Council for Development and Reconstruction; Muni: various municipalities and local authorities; DN: Various donors

prioritizing risk reduction measures and setting procedures for carrying out cost benefit analysis to determine when further risk reduction becomes disproportionate to benefit. This inevitably must include putting a monetary value to damages to the environment and to the value of saving a life.

On the legislative level, skills are required to review and modify mandates to successfully audit and enforce these policies and action plans. It also requires the development of specific laws and decrees to reflect the latest scientific advances in disaster risk reduction, including risk assessment. Finally it involves developing skills to develop implementation procedures for the laws and decrees.

In all the above levels there is a need to strengthen available skills. Furthermore, and due to the lack of disaster risk management practices and frameworks within the country, there is virtually no experience within this field within the country, except for those personnel (whether nationals or expatriates) who have worked abroad in this field in the past and are now residing within the country.

3.5.2 Geophysical hazard and risk mapping

There is a major shortage of skills and experiences in geophysical hazards and to a certain degree less corresponding shortages of skills and experiences in assessment of risks arising from geophysical hazards. This shortage of skills can be attributed to two main factors:

1. Only one of the universities in Lebanon (AUB) has an undergraduate and/or post graduate course in Geology;

2. The mandates of the various institutions (including the Geophysical research centre) does not include the detailed assessment of geophysical hazards and risk, which leads to a lack of incentive to develop whatever existing skills further.

The lack of clear mandates, combined with the lack of courses within educational institutions and the lack of disaster risk management practices agglomerate and lead to a situation where the experiences in this field are very limited.

3.5.3 Hydro-meteorological hazards and risks

Existing skills and experiences are deemed adequate for assessing watershed and mitigation measures in terms of structures.

There are skills shortages in the following areas:
- Assessing the causes and consequences of flash floods;
- Integrated flood management;
- Adopting international flooding models and software to the Lebanese context;
- Development of early warning systems for flooding.

3.5.4 Structural engineers

There are many structural engineering skills within the country, both at the private sector level and at the academic level. Within the public sector, more expertise is concentrated within the CDR due to the lack of adequate resources in the other public sector institutions (i.e. line ministries). However most structural engineering skills seem to be focused on the design of buildings against regular operating loads which leads to three main challenges:

- There are limited skills in the seismic design of buildings, where current practice often relies on increasing the number of reinforcing bars within the concrete as a means of improving ductility. Other equally important aspects of dynamic design and protection of buildings against earthquakes are ignored;

- Due to the fact that most of the urban centers within Lebanon are almost at sea level, and due to the fact that high rise buildings (i.e. tens of floors) have only recently become more in use, there is very limited experience and skills in the design against lateral loadings (i.e. earthquakes and wind loading);

- There are limited skills in the dynamic design of critical infrastructure elements such as lifelines, bridges, pipelines, liquid stor-

age tanks against earthquakes (and also fires and explosions where these hazards are applicable such as in the case of chemical plants and refineries).

The above problem is further complicated by the fact the Order of Engineers within Lebanon is not being able to address these challenges due to a variety of reasons including:

- It is perceived often as a political institution where elections take place with representatives from the various political; parties and factions; and where its role in providing social security and medical care for its members is perceived as the most important one. Indeed it is felt in many quarters that less emphasis is placed on improving the skills and needs of the engineering professions than on dealing with the above two issues;

- The existing laws on earthquake engineering are simple and do not require a detailed risk assessment. Furthermore existing laws are not being enforced and hence there is a lack of strong incentives to develop such skills.

The order of engineers has a very important role to play in risk assessment and it must be empowered to do so through a variety of means, including perhaps a review and if necessary modifications to its mandate.

3.5.5 Socio-economic experts

On the one hand there are many existing socio-economic experts and institutions. On the other hand their work is more focused on mainstream socio-economics, economics and social work, with little work on issues related to disaster risk management and disaster risk reduction.

For example, past attempts to assess the level of damages due to disasters have not followed internationally defined standards and procedures, and indeed would not pass the scrutiny of such procedures. In the aftermath of the Israeli war in 2006 there were various exercises and initiatives to assess damages arising from the heavy Israeli aerial bombardment and the war in general. The debate was quickly politicized and until now, five years later, there is no consensus on what should be included within this damage assessment exercise and how it should be carried out and indeed no agreement on the final total sum of the damages of the war. While future natural disasters might not be as politicized they certainly will become so to a certain extent. Hence, there is a need to predefine damage assessment criteria prior to any disaster taking place.

There is also a lack of skills and experiences in assessing the indirect costs of disasters including cost to livelihoods, various economic sectors, the environment, the economy in general and the reputation of the country at large. There is also a corresponding lack of expertise and experience in defining the recovery cost. This is further complicated by the fact that recovery must be considered as an opportunity to build more resilient structures and cities and there are skills shortages also in determining the added cost for achieving this objective.

Finally there are skills shortages in devising methods for assessing the various risk reduction methods from a cost benefit point of view, including the determination of the value of saving a life, environmental damages, damages to the economy and to production, and setting interest rates to be used in the calculation of net present values for the various DRR options. This is not necessarily the specialty of economists, such as the case in Europe and in the USA where it is often carried out by engineers acting as projects managers or by DRR specialists. However, for the purpose of this assessment it is included under this broad heading.

3.5.6 GIS specialists

There is an increasing number GIS specialists within the country, and their skills and experiences is continuously improving due to their continued and increased exposure to the various applications of GIS to the fields of disaster and risk management. Notwithstanding the above positive trends; expertise and experience in GIS is currently focused on having base maps and having maps for forest fires. In this, GIS is seen as a novel method to collate

and present data and not yet widely perceived and understood as a tool for disaster risk management to inform decision makers in taking scientific rational decision based on the prioritization of the risks. To this end, there are skills shortages in the application of GIS technology for mapping out all components of exposed and vulnerable elements against a wide variety of hazards; as well as a lack of expertise in mapping the possible damages arising from hazardous scenarios.

3.5.7 Interdisciplinary skills

Even when the above skills shortages have been addressed, a new set of skills shortages will emerge, namely the lack of interdisciplinary skills between various fields which is a necessity for many disaster risk reduction practices. As an example, few such interdisciplinary skills are listed below:

- Structures and earthquakes, where more emphasis should be placed on training structural engineers in some of the more complex phenomena of earthquake loading including frequency content and scaling, scaling of accelerograms, vertical excitation, and non-synchronous motion effects.
- Urban planning and hazards, while there is recognition that urban planning has a major role in disaster risk reduction; there is a need to develop more specific training modules which will strengthen and build interdisciplinary skills and will demonstrate the role of urban planning in reducing risks of various hazards. The design of such training modules however, requires skills in understanding and demonstrating the manner in which development itself can either detrimentally affect or mitigate against disasters.
- Architecture and hazards, where currently more emphasis is often placed on the role of engineers and urban designers in disaster risk reduction efforts, while not enough attention is paid to the crucial role of architects in this regard.
- The effect of climate change on other hazards, including desertification, droughts and floods.

3.5.8 Summary of professional expertise and skills

Table 5 below provides a summary of the main challenges within the various categories of professional expertise and skills related to DRR in Lebanon.

Table 5: Summary of challenges of main categories of skills related to DRR

Expertise type	Comments
DRM	Until very recently has not been required.
Geological Hazard	Additional expertise is required within academic, public and private sectors.
Hydro-Met Hazar	Additional expertise is required particularly for integrated flood management and flash floods.
Structural	Expertise available within academic and private sector. Additional expertise may be required within the public sector.
Soil	Expertise available within academic and private sector. Additional expertise may be required within the public sector.
Economics	Additional expertise required in assessing damage due to disasters.
Sociologists	Additional expertise required in assessing damage due to disasters.

4. Overall Review and Evaluation

4.1 Methodologies adopted in risk assessment studies

Based on the description provided in earlier Chapters, Table 6 provides a summary of current status regarding methodologies adopted for risk assessment within Lebanon.

4.2 Data for risk assessment

Table 7 provides a summary of Status of Data for Risk Assessment within Lebanon.

4.3 Institution capacity of organizations working in DRR/DRM

Table 8 provides a summary of Institution Capacity of Organizations working in DRR/DRM within Lebanon.

4.4 Professional expertise and skills

Table 9 provides a summary of professional expertise and skills in Disaster Risk Management/Reduction in Lebanon.

Table 6: Status of methodologies adopted for risk assessment in Lebanon

Factor	Description
Current Status	Risk assessment studies are being carried out within various institutions and research centers. Government needs are scattered within individual ministries. There is a desire in the research activities of individual researchers to collaborate with scientific universities and research centers abroad. The practice of risk assessment within Lebanon is yet to reach a stage where such studies are being carried out along predefined and agreed upon methodologies, in response to policies and frameworks set at the national level. This in turn explain the fact that these studies are often concerned with assessing the risk rather than reducing it, in the absence of predefined levels at the national level of tolerable risks within the various sectors.
Issues and Challenges	There is a need for clearly reporting on the methodologies adopted for carrying out risk assessment and quantifying risks, which in turn would allow future studies to build on existing ones. There is a need to ensure agreement on the acceptable methodologies to be used in risk assessment studies, which leads to the production, for example, of conflicting hazard prone area maps and hazard intensity maps for earthquakes. A similar trend is seen for the other main hazards including floods and forest fires.
Strengths and Weaknesses	There are expertise within the private and the public academic sectors in Lebanon which can play a bigger role in carrying out a multitude of risk assessments studies and in developing a consensus on scientifically sound risk assessment methodologies, in conjunction with various relevant professional bodies and research centers. The main hurdle facing the achievement of the above is the need for close cooperation and linkages between the above identified stakeholders, which is proving difficult to achieve in the absence of national strategies and a functioning DRR/DRM unit. It is hoped that this situation will change once the DRR unit becomes functional.
External Support Needs	There is a need to strengthen government expertise in specifying (at least to a detail sufficient for writing technical specifications) the acceptable methodologies to be used in various risk assessment studies; and in reviewing methodologies used in risk assessment studies.

Table 7: Status of data for risk assessment in Lebanon

Factor	Description
Current Status	Base maps exist for various parameters including hazard prone areas, topographic, soil, agricultural, irrigation, and water resource. Furthermore, exposure maps on population densities, critical infrastructure, schools, etc also do exist. In addition, hazard prone area maps for most hazards do exist. Additional work is required to produce hazard intensity maps, and hazard zoning maps.
Issues and Challenges	There is an urgent need for the validation and assessment of the above base maps based on ground data. In many instances the scale adopted in these maps needs refinement. Regarding the ownership of the data, an important issue is the need to ensure that the data generated from studies funded by the government remain the property of the government, or at a minimum can be used by other institutions both public and private for risk assessment and risk reduction purposes. A related issue is the necessity to strengthen data sharing mechanisms. Finally, one of the most important challenge is to establish mechanisms for linkages between government priorities and private and public research institutions to ensure that data gaps are being addressed in a gradual, efficient and accurate manner.
Strengths and Weaknesses	Additional data regarding base maps does exist in various ministries; however, it is scattered and also needs collation and validation. Furthermore there is a need for a systematic approach to identify and address gaps within data. Once a clear policy and methodologies are adopted, it is possible to rely on the strong academic sector within the country to aid in efforts for producing hazard maps including hazard intensity maps and hazard zoning maps.
External Support Needs	Additional support is required for the generation of base maps intended for use in producing risk information to aid and inform the decision making process. Support is also required for strengthening expertise within the public sector for developing and encouraging linkages and data sharing mechanisms.

Table 8: Status of institution capacity of organizations working in DRR/DRM in Lebanon

Factor	Description
Current Status	There are several centers of expertise (both public research centers and private academic institutions) within the country for most hazards. These centers carry out multiple activities related to the hazards they are concerned with. However in some cases there is neither a direct nor a full mapping between the activities of these centers and the range of needs of the country regarding risk assessment.
Issues and Challenges	An important issue is related to the mandates of the various public institutions regarding DRM and DRR, which needs both reviewing and refinement. In some cases, there is an overlap in mandates; while in other cases important tasks related to risk assessment is not clearly allocated to any of the public bodies.
Strengths and Weaknesses	There is a need to strengthen linkages between research centers, universities, professional bodies and national policies. Due to the dynamic nature of both the private and public academic sectors within the country, as well as the dynamic nature of several professional bodies, it is envisaged that once national policies and linkages are put in place it will become possible to rely on these elements of strength within the country to advance the practice of DRM/DRR.
External Support Needs	Some of the public institutions need strengthening to enable them to carry out their duties related to DRM/DRR. Furthermore other institutions need strengthening to enable them to carry out additional duties which this report proposes they carry out. For example, LIBNOR and the Ministry of the Environment needs strengthening in terms of staff and resources to fulfill their DRM/DRR related mandates. While the CDR needs strengthening to be able to fulfill its additional duty, proposed in this report, to act as a reviewer of the risk assessment studies which may be carried out as part of the feasibility studies of large infrastructure projects.

Table 9: Status of professional expertise and skills in DRM/R in Lebanon

Factor	Description
Current Status	Theoretical capacities do exist at University level and within various public sector institutions. However, due to the relative novelty of the DRM field within the country, the existing capacities are often not coupled with significant experience in the field.
Issues and Challenges	DRM/R (and therefore risk assessment) is only very recently beginning to gain more visibility; therefore currently experience is lagging behind.
Strengths and Weaknesses	Regarding risk assessment, the main capacity shortage is in geology where only one university provides geology degrees at the undergraduate or post graduate levels. Within the larger picture of DRM, the main capacity shortage is in capacities of the public sector employees in setting strategies, policies, plans, laws, decrees and executive procedures for DRM/R related matters. It is envisaged that once there national strategy is in place, the dynamic public and private academic sector can be encouraged with sufficient incentives to address the shortage in capacity. This, however, must be an iterative process, since the current national strategy is being developed with limited national capacities especially within the public sector.
External Support Needs	External support is required for strengthening of capacities in DRM, integrated flood management, generation of hazard intensity and zoning maps.

4.5 Disaster risk management practice(s)

4.5.1 Current status

Often in many third world countries such as Lebanon, intervention is limited to recovery efforts after a disaster has taken place and very little if any preventative measures are put in place to prevent the disaster from occurring and/or mitigate against its consequences in a controlled scientific manner. Furthermore, even when control, reduction or mitigation measures are adopted in third world countries, they are often done in an arbitrary manner and not according to any scientific prioritization scheme which should prefer and promote, for example, passive mitigation measures over active ones due to the inherent safety of the former. If we look at DRM practices in more detail, we can see that it can be comprised of three main stages namely:

- Prevention, which includes mitigating measures to reduce the effect of the disasters;
- Response, which can further be subdivided into preparing to respond and responding including emergency evacuation and rescue efforts; and
- Recovery which includes recovering livelihoods, and rehabilitating infrastructure and residential buildings.

Prevention efforts in their broadest term as defined above rely on risk assessment studies to select the most appropriate risk reduction measure; while response efforts involve much less , if any, risk assessment studies. Recovery should be seen as an "opportunity" to build safer structures and more resilient cities. However, the extent to which this has been achieved in Lebanon remains to be determined. The focus on response and recovery efforts within the country implies that there is few risk assessment studies carried out within the country. Those carried out are usually at the feasibility stage within the project; and usually carried out to satisfy the scope and the terms of reference of the project which set the codes and standards that must be followed. Whatever risk assessment practices are carried out in this context, the situation is complicated by the absence of a disaster risk reduction unit which sets codes and standards to ensure a unified methodology for risk assessment is being carried out.

Risk assessment practices as a tool to inform decision makers within the public sector (and the private sector for large critical infrastructure elements such as refineries and plants) is non-existent. In addition, risk management practices as a tool to select the most appropriate risk reduction measure is also non-existent. Furthermore, risk management as a participatory approach which involves all stakeholders within society to set levels of tolerable risk in a scientific manner which will make rational

tradeoffs between benefits and risks is non-existent. Cost benefit analysis practices which places a monetary value on saving a life and on damages to the environment as part of a rationale to decide at which stage risk reduction becomes disproportionate to benefit is also non-existent.

The absence of the above strategies for disaster risk management obviously implies the absence of any corresponding frameworks and policies, action plans and regulations to guide the delivery and implementation of these strategies.

4.5.2 Issues and challenges

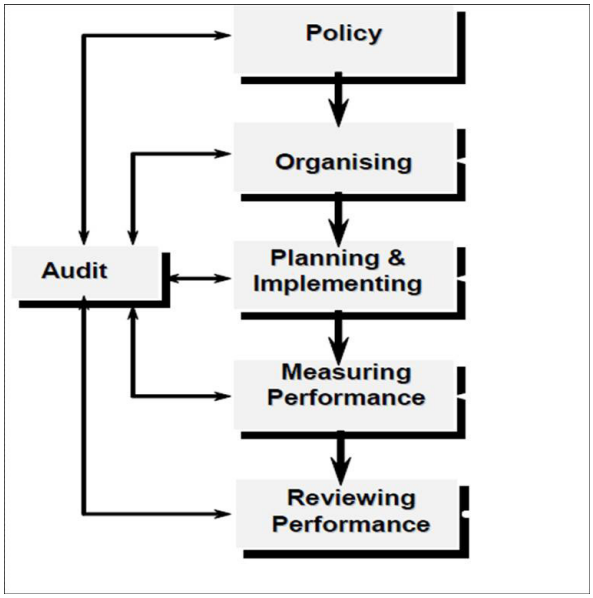
The main challenge is the lack of a functioning body that is actively managing all disaster risk reduction efforts within the country. This body is currently being setup and is in the process of becoming functional. The main duties of this body should include developing a unified strategy for disaster risk reduction and a set of policies to set a clear direction for the various public sector agencies and private sector organizations to follow regarding disaster risk reduction. This body should also develop an effective management structure and ensure arrangements are in place for delivering the policy; it should also develop an action plan to ensure a planned and systematic approach is in existence to implementing the disaster risk reduction policy through an effective management system. Performance should be measured against agreed standards to reveal when and where improvements are needed. Finally, processes should be in place to ensure that the organization learns from all relevant experience and applies the lessons. Figure 5 below illustrates the various steps outlined above.

In the meantime, and until such a body is fully functioning work can proceed on two main issues which if addressed properly will have an immediate impact on disaster risk reduction efforts within the country; namely, the development of better linkages mechanisms and the review and refinement of mandates for the various public institutions. These will be discussed further.

4.5.3 Strengths and weaknesses

Since its independence, there has been a golden period in the fifties and sixties (which also was interrupted with the threat of civil war in 1958), and after that Lebanon has been marred by fractious and sectarian politics leading to a weak government vis-à-vis a group of feudal-sectarian lords. The break out of the Civil War in 1975 led to the emergence of feudal war lords and the end of the war in 1990, meant that the feudal war lords took their position within the Government, which lead to its weakening to even greater extents. This situation has been further complicated, and the government further weakened, and to greater

Figure 5: Generic steps and tasks of a disaster risk reduction body



extents by a number of Israeli invasions and wars (1978, 1982 and 2006) as well as a number of Israeli strikes on main critical infrastructure facilities and civilians (e.g. 1996). These damages arising from these wars together with the efforts which went towards the construction of the infrastructure after the civil war meant that there is a scarcity of resources which was allocated towards the reconstruction effort without sufficient attention being given to disaster risk reduction and prevention. Furthermore, in a country marred by so many wars in such a short period of time, the natural progress of events forced the government and various public and private institutions to place more emphasis on response rather than prevention efforts. Therefore, regarding response abilities there is significant experience within each of the main response bodies for response (Army, Police, Fire, Civil Defense and Red Cross). However there are gaps in coordination mechanisms and these are being currently addressed.

The main weaknesses within the country are related mainly to disaster risk management skills, in particular:

1. Skills for setting policies at the strategic level;

2. Skills for setting tolerable levels of risks;

3. Skills for developing mechanisms for the prioritizing risk reduction efforts;

4. Skills for developing risk reduction mechanisms targeted at different stages within the disaster risk reduction cycle, i.e. targeted at preventing the disaster from occurring, reducing its likelihood, and/or controlling its size.

5. Skills for developing and adopting codes and standards including ensuring the various codes adopted reflect a consistent methodology for dealing with risk and that this consistent methodology is what the government is trying to achieve.

6. Skills to develop executive procedures for planning the smooth implementation of the codes and standards related to public safety and disaster risk reduction.

7. Skills regarding the refinement of the tools and methodologies used in the assessment of risks arising from various hazards. However these can be addressed in an easier manner within resources in the country once strategies and policies identified above have been developed.

4.5.4 Areas where external support may be required

Out of the weaknesses listed above, the first six are critical. The existing national public institutions need external support to improve the required skills. This delivery can be best achieved by the development of detailed strategy of capacity building to meet and rectify skills shortages within the DRR unit (and the HRC unit) and the various public sector institutions (including all line ministries) which will also have a role in the implementation of the policies to be developed by this unit.

4.5.5 Summary of status of disaster risk management practices within Lebanon

Based on the description provided in earlier subsections, Table 10 provides a summary of disaster risk management practices within the country.

4.6 Importance of linkages

The main issue is not skills or adopting wrong methodologies; as much as the need for a coherent strategy for disaster risk reduction which sets policies, priorities and action plans to achieve these priorities. This section provides several examples on how the lack of linkages may be detrimentally affecting the overall national situation regarding risk assessment as part of risk reduction efforts.

4.6.1 Gaps in teaching courses

The lack of linkages is leading to gaps in training since there are no links between the needs of the country in terms of disaster risk reduction and risk assessment, the prioritization of such needs, and the resources and skills required

Table 10: Status of disaster risk management in Lebanon

Factor	Description
Current Status	Disaster risk management is a relatively new topic within public administration. This implies that the few risk assessment studies which are carried out, often do not inform the decision making process. This is mainly because the links between risk assessment and the decision making process need strengthening and/or development.
Issues and Challenges	An important challenge is the prevalence of differences in understanding of concepts of risks and hazards within various public and private institutions. This challenge is further compounded by the fact that DRM efforts require interdisciplinary skills and mandates; and their success is dependent on a successful multi-stakeholder, multi- agency participatory approach. This in turn requires the establishment and operation of a functioning disaster risk management body to oversee and coordinate the multi-disciplinary, multi-stakeholder and multi-agency DRM efforts. An important issue to recognize is that such a body is in the process of being developed and strengthened within Lebanon.
Strengths and Weaknesses	On the prevention side, there is an urgent need to strengthen links between national strategies, policies that set direction for organizations to follow, management structures for delivering the policies, and planning the implementation of the policies. The strength of DRM within Lebanon is mainly on the response side, and the experience gained in responding to various disasters that have affected Lebanon in its recent history.
External Support Needs	There is a need to strengthen capacities in setting national strategies, frameworks and policies for DRM and the links between them.

to achieve these needs. Perhaps this is most clearly manifested in the lack of geology and geophysics undergraduate or M.Sc. courses exept in one university (namely the American University of Beirut). Such a discipline is very necessary for the assessment of the nature and severity of many of the main hazards of Lebanon including earthquakes, tsunamis, and landslides.

4.6.2 Lack of participation in some international and regional initiatives

There are two initiatives which if Lebanon joins, then the country and the engineering practice is envisaged to benefit from the availability of a higher quality of data. One initiative is called the Global Earthquake Model (GEM) and the second is termed the EMME. The current situation now is that the official body which should be tasked with the follow up of such an initiative (National Centre for Geophysical Research) does not seem to be carrying it thorough quoting lack of interests from the Order of Engineers and the engineering profession in general; while researchers and academics within some quarters feel that this is extremely useful but lack the official status to manage or participate in such an initiative.

4.6.3 Lack of efforts in the development of necessary intermediate data

There is a lack of efforts in the development of necessary intermediate data required in the risk assessment procedures of many hazards including earthquakes, tsunamis, landslides and floods. This lack of intermediate data, combined with the lack of fundamental skills required to generate such data, implies that personnel from the "wrong" disciplines are taking it upon themselves to develop such data. This creates a dire situation where data necessary for risk assessments is being developed by personnel (albeit researchers and university lecturers) whose main area of expertise lies elsewhere. One example is the case of earthquake hazard maps and earthquake ground motions and acceleration time histories. Structural engineers are often quoted as doing the geologist job because the lack of linkages implies that most of geologists working in Lebanon have no time available to dedicate for such tasks. This in turn is reflecting on the ability of the various Lebanese professions to base their respective risk assessments on accurate data which could be obtained from hazard assessments which ideally in most cases should be carried out by the geology and the geophysics discipline.

4.6.4 Lack of efforts in the collation of necessary basic data

There is a lack of effort in the collation of the necessary data required for base maps in many hazards. In addition there is a need for the collation of necessary data to be included in the fire risk maps including vegetation and tree coves, use of forests, etc. In many cases such data may exist in a scattered format within various public administrations but may need collation, validation and unification.

4.6.5 Lack of mechanisms to enforce availability of data to researchers and members of public

There is a need to develop new mechanisms and develop existing ones to ensure that any available data on hazards and risk assessments may be obtained from members of the public or via the websites, as is customary in all countries which have set disaster risk reduction as one of their priorities and as is implied in the Hyogo Framework for Action. This complicates efforts of analysts and researchers in their risk assessment exercises.

4.7 Mandates

In general within the government institutions in Lebanon there is a need to review and refine mandates within each of the ministries and the official bodies to ensure clarity regarding roles and responsibilities for DRM/R. It is envisaged that development would help address challenges which are manifesting themselves in two main currents:

- A lack of clarity or sometimes absence of executive procedures required for the implementation of the tasks which the official public body is required to perform. Indeed, in most cases executive procedures are nonexistent which creates room for interpretation and misunderstanding leading in many cases to the tasks under consideration not being performed.

- A lack of clarity on where the authority and jurisdiction of one body ends and where the role of another body comes into play. This is particularly challenging for these tasks which by their very nature are multi-disciplinary and require a task force of a multiple of agencies for their implementation.

- The above two challenges are further complicated by the fact that Lebanon does not yet have a disaster risk reduction strategy and therefore many of the tasks comprising disaster risk reduction efforts may not have been identified as the responsibility of any of the official bodies.

Once a disaster risk reduction strategy is put in place, one of its main duties must be reviewing all the tasks which should be carried out in this process and ensuring that these tasks have been allocated to the proper agencies, as reflected in their revised mandates together with corresponding implementation procedures. Special and careful consideration should be given to these tasks which are multi-disciplinary and which require the collaboration of multiple agencies. In reality, most of the tasks of disaster risk reduction would fit into this category.

5. Recommendations and Suggestions

5.1 Development of national risk assessment framework

Any National Risk Assessment (NRA) must necessarily be a multi-disciplinary process. Furthermore, in the absence of a functioning agency that is tasked with Disaster Risk Reduction, the NRA will also have to be a multi-agency exercise, in the sense that it will have to rely on the expertise, experience and data from a variety of agencies. In the remainder of this section the main activities and the main components comprising the implementation team of the NRA, as recommended by GRIP[1], will be reviewed from the perspective of their applicability to the Lebanese context.

Urban Risk Assessment (URA) for the main cities within Lebanon are an area of priority for disaster risk reduction and are directly linked to the concept of resilient cities currently being promoted by various international bodies. However, they are not considered part of the NRA but rather form a separate component termed URA, with its own GRIP guidelines[7] regarding recommended main activities and implementation programmes. Critiquing these guidelines within the Lebanese context can form, if necessary, one of the first tasks of the NRA.

5.1.1 Main activities of the NRA

The main activities of the NRA include:

- Comprehensive country situation assessment which is the subject of this document;
- Hazard assessment where a comprehensive profile of the hazards is obtained, hazard prone areas identified, plausible hazard and event scenarios are developed and hazard maps are developed at different scales.
  Lebanese context: Raw data exists on some hazards such as forest fires, earthquakes and floods; with less available data on other hazards such as tsunamis and landslides. Furthermore, in many cases this data has been derived as part of a very simplified probabilistic hazard assessment – based on a worst case or most likely case scenario. Therefore there are no hazard maps corresponding to different return periods; this fact complicates the achievement of the activities outlined in Section 5.2 below, which recommend the development of event scenarios corresponding to different acceptance criteria and tolerable risk levels. In addition, it is not clear which probabilistic methodology, if any, was adopted in the derivation of many of the existing hazard maps. Finally, there is a need to refine the scale (and the accuracy) of the base maps on top of which the various hazards are going to be super-imposed;
- Exposure assessment where elements at risk are identified and categorized, in terms of the country situation; where possible geospatial surface models are built for relevant elements at risk; and the exposure level of elements at risk (e.g. population, buildings, critical facilities, livelihoods, infrastructure) are identified.
  Lebanese Context: Detailed data on the exposure of the population is unavailable due to the lack of reliable data on population demographics and distribution of citizens. This is mainly because Lebanon has a sectarian system of government; and the main apprehension is that documented changes in population demographics might be used as a rallying call for change (albeit along sectarian lines as indeed has happened in the recent past) of the division of the politi-

7 GRIP – Global Risk Identification Programme – better information for sound decision making – service package, UNDP-GRIP, 2009.

cal roles within government. This exercise can be in-formed by the UNDP studies on data on livelihoods and living conditions; and by studies from the Central Administration of Statistics (CAS) and the Council for Development and Reconstruction (CDR) on buildings, critical facilities and infrastructure;

- Damage state assessment where a comprehensive set of vulnerability functions are developed for the relevant elements at risk; and where the damage state of the targeted elements at risk are assessed.
  Lebanese Context: This task must be related to the levels of tolerable risk and the different damage states which should be defined within this process. For example, it is perfectly acceptable to have a large infrastructure element be damaged during a very rate seismic event (e.g. with a return period of 1000 return years) but it would be unacceptable for such a facility/element to experience any damage during a much milder event (e.g. return period of 50 years). Hence this exercise must start, and culminate in predefined acceptance criteria and damage state definitions corresponding to various return period scenarios. Another issue requiring attention under this item is the degree of accuracy in the assessment process of the state of the targeted elements. Critical infrastructure elements must be assessed to a higher degree of accuracy or alternatively accept that with more simplified methods the results will be more conservative and may indicate an unrealistic high degree of damage corresponding to the scenarios under consideration, which in turn might result in overly expensive risk reduction schemes. Furthermore, it might also result in a flawed process of prioritization of risk reduction resources based on a non-uniform approach of risk assessment methodologies;

- Risk estimation and profiling where potential losses are estimated in a unified unit; where the socio-economic impacts of the risks are analyzed; and where the results are presented in an easily disseminated and assimilated manner.
  Lebanese Context: Adopting a unified unit for potential losses will inevitably mean attaching a monetary value on environmental damages as a result of disasters. This also, perhaps more controversially, implies attaching a monetary value of the worth of a life saved (or otherwise). These decisions are necessary to inform the disaster risk reduction strategy which should be considered as an integral part of the NRA process (shown as the last activity in this subsection);

- Identification of high risk areas where high-risk areas are identified in terms of different criteria, i.e. by hazard and sector; and where possible risk reduction measures for each of the high-risk areas are identified.
  Lebanese Context: High earthquake risk areas will inevitably include large urban population centers such as Beirut, Tyre, Sidon and Tripoli – cities which may also be high tsunami risk areas depending on the bathymetry of the coast. Based on tolerable risk levels, it is necessary to form a picture of aggregate risk before risk reduction measures are developed and prioritized. This must form part or at least inform urban risk reduction measures. Regarding the latter issue, there are many regions with in the cities named above where a combination of factors agglomerate to render certain zones high risk zones (e.g. overcrowded neighborhoods, small streets with no infrastructure services, low quality construction, etc);

- Formulation or revision of national risk reduction strategy where priorities for risk reduction are defined; available resources are allocated; and DRR programs are initiated.
  Lebanese Context: There is currently no disaster risk reduction strategy in Lebanon. A disaster risk reduction strategy must necessarily first set levels of tolerable risk, the steps of which will be discussed. Next it should develop a methodology for selecting the most suitable risk reduction measure according to inherently safe principles (i.e. in the order of priority of preventive

DRR measures, followed by likelihood reduction measures, then control measures, followed by mitigation and finally emergency, evacuation and response measures). The disaster risk reduction strategy should also develop methodologies on how to judge that a risk has become tolerable taking into account the benefit of reducing the risk further (e.g. in terms of saving lives and reducing damage to property and the environment) versus the cost of further risk reduction measures.

5.1.2 Implementation team for the NRA

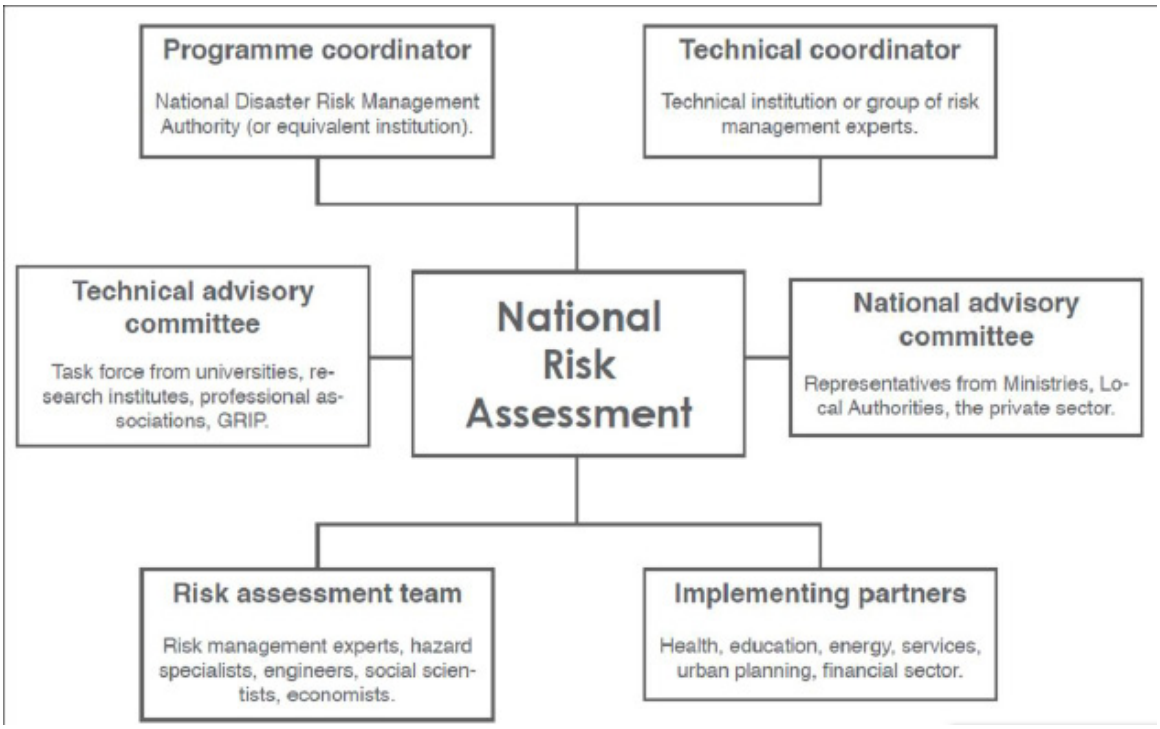
The key players in the NRA team are identified in the GRIP guidelines and shown in Figure 6, where it can be seen that these are composed of decision/policy makers, who ought to be the most immediate users of the risk assessment results. In terms of the role and relevant duties in the process, the GRIP guidelines recommend that the implementation team of a national risk assessment can generally be divided into four types of working groups:

- Coordination team composed of a program coordinator and a technical coordinator at minimum. It is recommended that this team should be in charge of overall project implementation. It can be a prestigious national technical institution or a group of experts dealing with disaster risk management.
  Lebanese Context: Within the Lebanese context, the coordination team may be formed from the UNDP and the DRR unit at the office of the Prime Minister. However, a technical coordinator would be required to provide advice on risk assessment strategies and methodologies. There is a clear need for a Chief Technical Advisor (CTA) to play a linking role, through technical advice, to the overall programme;

- Advisory Committee composed of Technical Advisory Committee (TAC) and National Advisory Committee (NAC). TAC provides technical advice on risk assessment and its applications and revise the project for technical accuracy. In general, TAC is composed of task force universities, research institutes, and professional association. NAC provides overall guidance and advice on long-term project planning, project priorities, visibility to the project and ownership promotion, functioning as a program steering committee as well. Members of NAC include representatives from relevant ministries, local authorities, civil society, and industries can be the members.
  Lebanese Context: Due to the complex tasks involved in the NRA for Lebanon, and since this kind of process has not been carried out before, what is required is a steering committee from all the relevant line ministries and bodies. This steering committee must include high ranking representatives who can secure the help of their respective agencies in anything which the project requires. In this context, it is recommended that the steering committee takes the place of the NAC referred to above. On some occasions different representatives will be required for the TAC. Alternatively different subcommittees of the TAC may need to be formed. The number and constitution of these subcommittees may be decided once the project starts and the NAC and the TAC meet for the first time;

- Risk Assessment Team comprised of a group of disaster risk management experts, hazard specialists, structural engineers, economists, social scientists, and information analysts, it is responsible for the implementation of all project activities. To ensure the sustainability of national risk assessment, it is highly recommended that the implementing team be built with a long-term vision.
  Lebanese Context: Careful consideration should be given as to whether a new body (e.g. a public institution) should be formed to carry out such an assessment or whether an existing body should be strengthened to empower it to carry out such an assessment. Having a long term view inevitably means that such a team must have some kind of a permanent characteristic since it should be mandated with updating and refining the National Risk Assessment (or components of it as the need arise. Furthermore, it is envisaged that as disaster

Figure 6: GRIP guidelines regarding the implementation team for national risk assessment



risk reduction measures are being implemented the NRA will necessarily need to be refined in order to reflect the lower degree of risk within some elements; which inevitably will imply that there is a need to update the prioritization of the remaining risk reduction measures in order to maintain an up-to-date picture on the aggregate risk within the country and the critical infrastructure within it. To this end, it is recommended that a new unit be formed within the Council for Development and Reconstruction (who is one of the most well resourced institutions within the Lebanese public administration) to take the lead role in developing and maintaining the NRA even if some of the NRA tasks are subcontracted to outside sources. This in turn will help ensure continuity in the long term;

- Implementing Partners composed of public sectors such as health, education, energy, services (water, power, and telecommunications), industry, urban planning, and the financial sector; they are an indispensable component of the implementation team. They are generally sources and providers of the data and information required in the risk assessment. They also play a key role in the review and validation of the results, the calibration of methodologies, and the application and presentation of the results. Lebanese Context: Within the Lebanese context, previous experience has shown the significant challenges in obtaining the relevant data from the various public and private institutions. This demonstrates the importance of the presence of a steering committee with high ranking officials from the relevant line ministries and institutions. It is envisaged that this will resolve the issues of having access to data and the issue of securing the cooperation of all those concerned. The constitution of the steering committee should be such that new members may be added if necessary and existing members may also be replaced if they prove unable to provide the required assistance.

5.2 Recommendations for work of committee on setting tolerable risks

5.2.1 Definition

Within societies, levels of tolerable risk may differ depending on the needs, capacities and resources of the society under consideration.

Lebanon is no different in this regard, in the sense that levels of tolerable risk within the country must be set taking into account the specificities of the Lebanese situation in terms of its natural resources, wealth, and human resources and skills.

5.2.2 Important tasks

The important main steps required in order to arrive at different levels of tolerable risk include the following activities and steps:

Step 1: Identify all stakeholders who have a role to play in the determination of levels of tolerable risk.

Step 2: Review the process of implicit decision making (if it exists and it is possible to identify) regarding the levels of tolerable risk for earthquake disaster. Repeat this exercise for risks arising from other hazards.

Step 3: Identify common elements of the above processes or develop a new methodology for determination of levels of tolerable skills to be based on a participatory approach where all relevant stakeholders within Lebanese society contribute to the consultative process.

Step 4: Develop a unified methodology for defining levels of tolerable risks for a variety of risks arising from different hazards. The methodology should set levels of tolerable risks and propose a scientific approach to reduce risks to tolerable levels based on inherently safe design principles which prioritizes risk reduction measures according to their inherent safety.

5.2.3 Key stakeholders

It is envisaged that key stakeholders for this task, which should be represented within the committee include but are not restricted to the following:

- Order of engineers;
- Relevant line ministries including Ministry Public Works, Ministry of Water and Energy, Ministry of Environment, Ministry of Health, WHO, Ministry of Industry, Ministry of Agriculture;
- Lebanese Atomic Energy Center.

It should be recognized that the above stakeholders may be expanded at the beginning of this exercise as a result of step 1 which will be based on an all inclusive consultation exercise with all Ministries and Public Administrations.

5.3 Recommendations for earthquake risk assessment

5.3.1 Important tasks

The important main steps required in order to carry out a methodological earthquake risk assessment, and to produce logical and well thought of earthquake disaster risk reduction recommendations, include the following activities and steps:

Step 1: Identify all stakeholders who have a role to play in earthquake disaster risk assessment and earthquake disaster risk reduction.

Step 2: Review the process of implicit decision making (if it exists and it is possible to identify) regarding the levels of tolerable risk for earthquake disaster for both regular buildings and critical infrastructure. In this step two levels of earthquake events should be considered.

Step 3: Using simplified analysis procedures categorize critical infrastructure elements into high level, medium level and low level risk categories. Based on the concept of proportionality, reanalyze those critical infrastructure elements. If the risk determined using more advanced methods is still seen to be unacceptable, review available risk reduction measures and recommend based on inherently safe design principles.

Step 4: For urban areas identify zones where earthquake risk may be excessively high. This conclusion may be arrived at in a simplified manner. However, careful consideration should also be given to zones within the various cities where several detrimental factors agglomerate to produce high urban risk. Categorize building and zones into high, medium and low level risk categories. Recommend risk reduction measures based on inherently safe design principles.

5.3.2 Key stakeholders

It is envisaged that key stakeholders for this task, which should be represented within the committee include but are not restricted to the following:

- Order of engineers;
- Relevant line ministries including Ministry Public Works, Ministry of Water and Energy, Ministry of Environment, Ministry of Health, Ministry of Industry, Ministry of Education;
- WHO;
- National Center for Geophysical Research;
- Council for Development and Reconstruction;
- LIBNOR;
- Center for Industrial Research, Lebanese University.

It should be recognized that the above stakeholders may be expanded at the beginning of this exercise as a result of step 1 which will be based on an all inclusive consultation exercise with all Ministries and Public Administrations.

5.4 Recommendations for flood risk assessment and reduction

5.4.1 Important tasks

The important main steps required in order to carry out a flooding risk assessment, and to produce logical and well thought of flood risk reduction recommendations, include the following activities and steps:

Step 1: Identify all stakeholders who have a role to play in flood risk assessment and reduction.

Step 2: Review the process of implicit decision making (if it exists and it is possible to identify) regarding the levels of tolerable risk for flood disaster for critical infrastructure, environment and livelihoods. Along similar lines to what was carried out for the earthquake hazard, two levels of flooding events should be specified.

Step 3: Using simplified analysis procedures categorize risk to critical infrastructure elements, environment and livelihoods into high level, medium level and low level risk categories. Based on the concept of proportionality, reanalyze those critical infrastructure elements categorized under medium and high level risk categories. If the risk determined using more advanced methods is still seen to be unacceptable, review available risk reduction measures and recommend based on inherently safe design principles.

5.4.2 Key stakeholders

It is envisaged that key stakeholders for this task, which should be represented within the committee include but are not restricted to the following:

- Order of engineers;
- Relevant line ministries including Ministry Public Works, Ministry of Water and Energy, Ministry of Environment, Ministry of Agriculture, Ministry of Health;
- WHO;
- Center for Agricultural Research;
- Center for Industrial Research;
- Council for Development and Reconstruction;
- LIBNOR.

It should be recognized that the above stakeholders may be expanded at the beginning of this exercise as a result of step 1 which will be based on an all inclusive consultation exercise with all Ministries and Public Administrations.

5.5 Needs and requirements for capacity building

Capacity building requirements may be divided under two broad categories:

- Training and capacity building to enhance existing fundamental skills which can then be oriented towards disaster risk reduction efforts. In the course of this chapter this will be referred to Capacity Building (i.e. building on existing knowledge);

- Filling gaps in basic knowledge through the provision of both undergraduate and post graduate courses in topics which are critical to disaster risk reduction efforts. In

the course of this chapter this will be referred to as Development of Fundamental Knowledge.

5.5.1 Capacity building

Continued professional development and training can be achieved using two basic methods:

1. By placing more emphasis on them in undergraduate degrees within the undergraduate courses;

2. By providing short courses (e.g. up to one week) for practicing professionals and fresh graduates such courses can be located both at university premises and at the premises of the relevant professional institutions.

The subsections below provide brief suggestions for some topics corresponding to some of the hazards; however, it should be stressed that these requirements should be further developed and elaborated as a result of a rigorous study in order to become part of a comprehensive national training strategy for disaster risk reduction.

Earthquakes

- General dynamic behavior: Capacity building in dynamic behavior, ductile response and pseudostatic analysis;

- Earthquake Motion: Capacity building in deriving artificial earthquake records, scaling methods for earthquake motion, modeling vertical excitation, modeling non-synchronous effects on long structures;

- Analysis of Critical Infrastructure: Capacity building in fluid structure interaction and dynamic analysis to be able to model behavior of dams, liquid storage tanks, pipelines and bridges.

Fires and Explosions

Fires and explosions on industrial facilities and factories are particularly important since they may arise as a result of industrial accidents or in the aftermath of an earthquake. Indeed, ground shaking almost never kill people. Falling debris and collapse of structures is one cause of death. Another cause of death is fires and/or explosions resulting from broken gas or power lines which constitute a major danger during an earthquake. Spills of hazardous chemicals are also a concern during an earthquake. The latter two causes are treated in this subsection.

- General Hazard Management Philosophy: Introduce concepts of inherently safe design principles, prioritization of risk reduction measures, developing acceptance criteria and performance measures. It should be noted that this module is applicable to disaster risk management in general and is not restricted to fire and explosion risk;

- Fire Loading: Development of fire loading scenarios (including types of fires and corresponding heat fluxes and component temperatures and associated probabilities) using both simplified and advanced methods taking into account a variety of complex phenomena;

- Fire Response: Determination of response of structures to fires and protection against fires taking into account the drop in strength and stiffness, changes in failure modes, active and passive fire protection methods and general fire response and protection philosophy;

- Explosion Loading: Development of explosion loading scenarios (including types of explosions, overpressure and blast waves, associated drag and overpressure and corresponding probabilities) using both simplified and advanced methods;

- Explosion Response: Determination of response taking into account change of material behavior due to strain rate effects, ductility requirements, design against blast and dynamic amplification and reduction factors;

Landslides

- Climate Change Effects: Quantification of the effects of lower amounts of rainfall and more intense rainfall (i.e. falling in shorter periods of time) on probability of

landslides; taking into account saturation in aquifers and corresponding changes in shear velocity and strength;

- Probable Scenarios: Determination of most probable scenarios for occurrence of land slides as a result of various earthquake scenarios, taking into account effects such as coherence of the soil.

Tsunamis

- Determination of basic data related to bathymetry: Methods for the determination of the variation of the water depth along the Lebanese shoreline;

- Probable Scenarios: Methods for the determination of the wave heights corresponding to tsunamis arising from different locations and with different associated return periods;

- Response and Protection: Methods for the determination of the response of the various critical infrastructure elements to the tsunamis taking into account the effects of various available protection measures.

Floods

- Flash Floods: Acquiring knowledge, and tools for modeling flashfloods and analyzing the reasons for their occurrence;

- Floods: Hydrological modeling of floods and their extent and effect on neighboring environments, taking into account how models should be developed to take into account specificities of the Lebanese environment;

- Urban Planning issues: Development of urban planning skills as one of the most effective prevention and mitigation methods to fight flooding disasters.

- Integrated flood management:
  - Methods to take advantage of floods such as having pools to feed aquifers, etc.;
  - Development of early warning systems;
  - Development of assurance financial instruments to offer insurance against flood damage.

5.5.2 Development of fundamental knowledge

Basic fundamental knowledge is unavailable in geology and in geophysics. This is attenuated by the fact that there is only one university department which offers geology degrees at the undergraduate or M.Sc. levels within the country, namely AUB. This poses a critical problem since geologists are required to develop basic data for the assessment of risks arising from several hazards including landslides, earthquakes and tsunamis. As part of a wider interdisciplinary team including engineers, urban designers, and architects, geologists and geophysicists are also required to play an important role in the development of intermediate data for the assessment of the risks arising from landslides, earthquakes and tsunamis hazards.

Therefore it is essential the more effort is directed at improving knowledge and educational courses in the field of geology. This can only be effectively achieved if it is considered a government priority and as such reflected in support for research centers and universities in carrying out teaching and research activities in this field.

6. Annexes

A. Inventory of risk assessment studies/projects

Hazard Type: Earthquakes

Table 11: Contribution to Seismic Hazard Assessment in Lebanon project

Project Name: Contribution to Seismic Hazard Assessment in Lebanon (Beirut)	
Purpose and Objectives	To grasp the seismic risk in three main aspects, namely: Hazard, Physical Vulnerability and Social Vulnerability.
Scope and Context	Earthquake, Seismic hazard mapping
Geographical Coverage	The Capital of Lebanon, Beirut
Description	The tectonic setting of Lebanon is characterized by three important fault systems. Inland, the two left-lateral strike-slip Yammouneh Fault and Rachaiya -Serghaya Faults. The third is a large thrust fault system located offshore Lebanon. So far the knowledge of the fault systems inland is restricted to a few places along the Yammouneh fault and along the Serghaya Fault. The knowledge of the offshore thrust system is limited to one survey. The project aims at filling these gaps through work on hazard studies, an assessment of physical vulnerabilities and a first order probabilistic seismic hazard analysis for Lebanon.
Key Activities	- Task 1: identification of active faults and past ruptures - Task 2: Instantaneous fault kinematics and present-day fault monitoring - Task 3: Crustal tomography and fault monitoring - Task 4: Site effects and strong ground motion prediction - Task 5: Issues related to probabilistic seismic hazard assessment in Beirut - Task 6: Identify vulnerabilities (vulnerable elements of population, infrastructure, environment)
Methodology Used	- Assess timing and sequence of ruptures on the major faults - Examine and assess the deformation field, present-day and quaternary slip-rates and space-slip rate variations - Fault identification, crustal structure and fault interaction ad depth - Fault monitoring and detection of potential transient deformation - Assess subsidence as a proxy for site effects evaluation in Beirut - Integrate side effects in probabilistic seismic hazard analysis - Preliminary assessment of physical and societal vulnerabilities
Expected Outcomes	Seismic microzonation map for Beirut
Duration	4 years, beginning 2009
Implementing Organization	Lebanese Side: 1. CNRS- Centre of Geophysical Research leading a consortium composed of 2. AUB , 3. USJ (Beirut), French Side: 1. Laboratoire de Geophysique Interne & Tectonophysique, 2. Institut de Physique du Globe (Paris), 3. Centre d'Etudes Techniques de l,Environnements Mediterranee; 4. Environnements, Dynamiques et Territoires de la Montagne,
Funding Agency	EU
Status	Ongoing
Available Reports	None
Remarks	As will be discussed in more detail in the data sheet, the project will not produce data that can be used by engineers in the assessment of the seismic risk of critical infra-structure elements. The production of this data required a closer cooperation between the government (to set priorities), the CNRS, the order of engineers and the universities.

Hazard Type: Tsunamis

There is a clear and complete gap on no risk assessment studies and no risk projects on the tsunamis hazard. This is particularly dangerous the following reasons:

1. Lebanese shores in many places have steep slopes which imply that the run-up of the wave can be well above 6 meters.

2. The main critical infrastructure elements lie, unprotected, along the shores; including Beirut airport, port, Zouk plant, Jiyyeh fuel tank farm, baddawi refinery, the coastal highway, etc.

3. It is very challenging to carry out any tsunami risk assessment in the current state of knowledge, due to our lack of knowledge of basic data on bathymetry, especially shallow water bathymetry.

B. Inventory of intermediate data, basic data and base maps

Intermediate data

Hazard Type: Earthquakes

Table 12: CNRS Centre for Geophysical Research dataset (intermediate data)

Dataset Name	CNRS Centre for Geophysical Research
Compiled / Maintained by (Contact Person)	Mr. Sursok
Address	Bhannes - Metn, Lebanon - P.O.Box 165432, Ashrafieh, 1100-2040, Beirut, Lebanon
Phone	t: + 961.4. 981 885; t: + 961.6. 981 886; e-mail: geophys@cnrs.edu.lb
Format	Not known
Period Covered (date)	One accelerogram record from 1982,
Description	The GPA is approximately 0.16g; taken from Bhanes in hard rock- record corresponds to a rather mild earthquake.
Availability	From CNRS
Acquisition	
Published reference	
Other related databases or sources	Not available
Other comments	It is possible to generate artificial records if more work is carried out. However, there must be a clear demand for this by the engineering community and this is not yet the case. Furthermore, for many critical infrastructure elements such as dams it is necessary to have accelerogram of both horizontal and vertical earthquake excitation, this is currently not available. For other critical infrastructure elements such as bridges, pipelines and dams which span relatively large distances it is necessary to assess their risk using accelerogram records that take into account no-synchronous motion effects- this is also currently not available.

Hazard Type: Tsunamis

No data is available on tsunamis. Regarding Tsunamis the intermediate data could be the wave run-up distributed along the Lebanese shore and corresponding to various return periods. Such data should exist for both Tsunamis originating from faults near the Lebanese shores and other further away in the Mediterranean sea (e.g. near Greece, where there is evidence in ancient history that Beirut has been affected by Tsunamis from earthquakes originating in Offshore Greece).

Hazard Type: Landslides

There is no data available on the possibility of land-slides around large cities within Lebanon and the most likely scenarios.

Hazard Type: Floods

Table 13: UNDP- Ministry of Agriculture dataset (intermediate data)

Dataset Name	UNDP- Ministry of Agriculture
Compiled/Maintained by (Contact Person)	Charbel Rizq
Address	Ministry of Agriculture
Phone	
Format	Digital
Period Covered (date)	Most of the available data on flooding is related to the region of Ras Baalbeck, Fakha and Irsal; where most of the data goes back to the period ranging from 1964 to 1970.
Description	For carrying out cost benefit analysis which is necessary in risk management studies when various risk reduction options are being examined and the merits of each are weighed, it is necessary to take indirect costs into account; but this is not possible because of the lack of data on the state of the flooded areas before and after the disaster. It is not possible to assess the effect of flooding on soil erosion since there is no data before and after the flooding events.
Availability	
Acquisition	
Published reference	
Other related databases or sources	
Other comments	There is a need for a climatological station in the region and for a house to protect it. More data is required to examine the underlying causes of flash flooding.

Table 14: LARI dataset (intermediate data)

Dataset Name	LARI
Compiled/Maintained by (Contact Person)	Michel Frem
Address	Zahle, Riyak
Phone	t: 9618901575/6
Format	Soft copy
Period Covered (date)	Last five years
Description	The centre also collates indirect indicators for drought and desertification including: - New types of diseases and pests affecting for crops; - Shorter, more intense periods of rain - Large temperature variation between day and night, which is a strong indicator for climate change and desertification
Availability	Available to relevant stakeholders within the public sector
Acquisition	On a case by case basis
Published reference	On website www.lari.gov.lbt
Other related databases or sources	N/A
Other comments	More data is required on the effects of drought and desertification including: - geographic distribution of people, where many farmers have either changed crops or actually moved to other jobs which inevitable implies relocating pastures and - associated livestock - biodiversity - state of ground water and water table

Hazard Type: Forest Fires

Table 15: AFDC Fire Index dataset (intermediate data)

Dataset Name	AFDC Fire Index
Compiled/Maintained by (Contact Person)	Sawsan Fakhreddine
Address	AFDC, Sagesse St. 7, Bldg 26, 1st floor, Jdiedeh, Lebanon
Phone	t: 9611898475
Format	Soft copy
Period Covered (date)	2008
Description	Fire index maps are now available, but additional data is required to improve quality of predictions and warning. In the Chouf reserves, soil sensors have been placed in critical spots to provide more accurate data on the composition of the ground. However this must be extended to include additional data (see comments below) as well as other forests and reserves.
Availability	On the website
Acquisition	On a case by case basis
Published reference	On website www.AFDC.org.lb
Other related databases or sources	LARI

Other comments	- More accurate data that is required includes:
	  - The composition of the ground
	  - The type of the forest
	  - Buffer zone utilization
	  - State of the forest (used or not used, maintained or not)
	  - The status of the forest (e.g. protected, natural reserve, etc)
	  - Information on mines and people, not sure where mines still exist
	- Current data is on maps with a scale of 1:100000 or 1:200000. Need to use a finer scale of 1:50000 or even less.

Hazard Type: Epidemics

Table 16: WHO Dataset (intermediate data)

Dataset Name	WHO Dataset
Compiled / Maintained by (Contact Person)	Dr. Alissar Radi
Address	Museum Square Bldg, 4th Floor
Phone	t: 9611612970
Format	Soft copy
Period Covered (date)	Last five years
Description	Data on heavy metals in water Data on health state of public schools (health and safety indices), including sanitation and fire escapes Data on risk spots of avian flu Data on interventions for the recovery of the health sector after the 2006 war Data on emerging diseases as a result of climate change, including Malaria Data on effects of floods and ponds on diseases
Availability	From website www.leb.emro.who.int
Acquisition	On a case by case basis
Published reference	Reports on website
Other related databases or sources	Ministry of Health.
Other comments	- Lack of sufficient data on tobacco related diseases - Lack of data on utilization of hospital beds

Basic data

Hazard Type: Earthquakes

Table 17: CNRS Centre for Geophysical Research dataset (basic data)

Dataset Name	CNRS Centre for Geophysical Research
Compiled/Maintained by (Contact Person)	Mr. Sursok
Address	Bhannes - Metn, Lebanon - P.O.Box 165432, Ashrafieh, 1100-2040, Beirut, Lebanon
Phone	t: + 961.4. 981 885; t: + 961.6. 981 886; e-mail: geophys@cnrs.edu.lb
Format	
Period Covered (date)	
Description	Information on Basic data is relatively acceptable (from the point of view of fault mechanisms); however, due to the fact that Lebanon has isolated mountains with deep valleys this complicates the evaluation of the geophysical risk. Furthermore the reason for the uplift of the crust remains unknown.
Availability	
Acquisition	
Published reference	
Other related databases or sources	There are two initiatives which if Lebanon joins, then the country and the engineering practice is envisaged to benefit from the availability of a higher quality of data. One initiative is called the Global Earthquake Model and the second is termed EMME. The centre was approached to participate in these models but has not done so to date due to the said lack of interest by engineers.
Other comments	Further basic data that is lacking includes: - The zones that will be isolated for a relatively long time due to various earthquake scenarios - Landslides as a result of the earthquakes, especially landslides in the vicinity of Beirut. There is a need to determine which scenarios are more likely and the manner in which the scenario events may unfold. - More data is required on the coherence of the Lebanese soil, which in turn would allow for more accurate estimation of site-effects (intermediate data) and also landslide probabilities. In addition, within the context of landslides, more data is required soil shear velocity and strength. - The above uncertainties further complicate the risk picture because it is expected that in urban areas the ground motion will be highly variable. - There is a need to agree on a catalogue of historical earthquakes (there is diverging points of view at the moment)

Hazard Type: Tsunamis

There is a lack of both basic and intermediate data regarding the Tsunami hazard. In particular, the following points can be made:

- When we speak of return periods we need to determine the source of the tsunami since tsunamis as far as Greece in their source can reach our shores; as happened in the Santorini earthquake which reached the Lebanese shores;

- On the same shore the run-up will be different. To determine the run-up we need to know the following:
  - Shape of the shoreline – known;
  - The bathymetry, especially the shallow water bathymetry
  - 200m known;
  - 0-200m not known and a more exact assessment is required;
  - This is required especially for areas of high population concentration and low sea level such as the Mina in Tripoli, the north and south suburbs of Beirut, Sidon and Dammour. Also attention should be given to main infrastructure such as ports, Zouk, baddawi, zahrani and airport.
- There is a role to be played by the geographic affairs within the Lebanese Army.

Hazard Type: Floods and Landslides

Table 18: UNDP- Ministry of Agriculture dataset (basic data)

Dataset Name	UNDP- Ministry of Agriculture
Compiled/Maintained by (Contact Person)	Charbel Rizq
Address	Ministry of Agriculture
Phone	
Format	Digital
Period Covered (date)	Most of the available data on flooding is related to the region of Ras Baalbeck, Fakha and Irsal; where most of the data goes back to the period ranging from 1964 to 1970.
Description	There is data in the form of rainfall per day. However for hydrological modeling to be used in risk assessments there is a need to know rainfall per hour and also in some instances rainfall per second. Currently these are obtained from the rainfall per day through the use of approximate methods which implies that the accuracy of the risk assessment becomes impaired. There is no data on the shear wave velocity within soils.
Availability	
Acquisition	
Published reference	
Other related databases or sources	
Other comments	The mandate of the agriculture ministry is related to flooding in as far as it is a cause of land degradation; however, it is strictly speaking the mandate of the Ministry of Water and Energy. In order to assess damages and flooding and the vulnerability of humans to flood events, it is necessary to collate additional data on population density and exposed elements to be added as layers within existing databases.

Hazard Type: Climate Change, Drought and Desertification

Table 19: LARI dataset (basic data)

Dataset Name	LARI
Compiled/Maintained by (Contact Person)	Michel Frem
Address	Zahle, Riyak
Phone	t: 9618901575/6
Format	Soft copy
Period Covered (date)	Last five years
Description	There are currently 44 stations measuring solar radiation, precipitation (total), wind direction and speed, air temperature, relative humidity, soil temperature, dew point, air pressure. In order to have complete coverage of Lebanon, there is a need to extend the network to include at least 75 networks to include all Lebanese territory.
Availability	Available to relevant stakeholders within the public sector
Acquisition	
Published reference	
Other related databases or sources	
Other comments	

Hazard Type: Forest Fires

Table 20: AFDC Fire Index (basic data)

Dataset Name	AFDC Fire Index
Compiled/Maintained by (Contact Person)	Sawsan Fakhreddine
Address	AFDC, Sagesse St. 7, Bldg 26, 1st floor, Jdiedeh, Lebanon
Phone	t: 9611898475
Format	Soft copy
Period Covered (date)	1993 onwards
Description	Data collation from archives of civil defense and agriculture ministry to determine historic location of fire. This was carried out between 1993 and 2004. After this period the fire data is automatically added to the data set.
Availability	Available to public sector relevant stakeholders upon request.
Acquisition	On a case by case basis
Published reference	On website www.afdc.org.lb
Other related databases or sources	LARI fire index maps
Other comments	More data is required on: - Geographical extension of forest - What is around the forest - The scale and quality of the maps not good enough - Existing information is available but is scattered into many institutions - Even if government subcontractors develop information and maps, it becomes the property of the private firm - Topographic maps and aerial photos not very accurate land-use maps. What is missing is to be checked on the ground.

Table 21: WHO Dataset (basic data)

Dataset Name	WHO Dataset
Compiled/Maintained by (Contact Person)	Dr. Alissar Radi
Address	Museum Square Bldg, 4th Floor
Phone	t: 9611612970
Format	Soft copy
Period Covered (date)	Last five years
Description	GIS mapping of all hospitals, health centers (including services offered) Data on capacity of border points in terms of both surveillance equipment and human resources to respond to cross-border disasters and health emergencies (including early warning and response systems)
Availability	May be available to stakeholders within the public sector upon request
Acquisition	
Published reference	www.leb.emro.who.int
Other related databases or sources	
Other comments	The following data is missing: - Data on the root causes of cancer (i.e. is it dietary, air exposure, asbestos, etc) to be able to use such data in further assessment studies to determine the effects of various climate-change related phenomena on the rate of cancer development - Lack of data on mortality and morbidity rates which implies it is not possible to carry out risk assessment to determine quality adjusted life years and the burden of disease - No data to act as a benchmark regarding the distribution of the number of death per year across various disease types

Hazard Type: Epidemics

Table 22: Lebanese Army, Geological Affairs Department base maps

Dataset Name	Lebanese Army, Geological Affairs Department
Compiled/Maintained by (Contact Person)	Abdallah Rihani
Address	Lebanese Army, Geological Affairs Department
Phone	
Format	Soft copy
Period Covered (date)	Up to 2000, the maps were based on data collated in the 1960s and 1970s. Since 2000, they are being updated.
Description	Most of the maps that exist are for a scale of 1:100000 or 1:200000. Base maps do exist for all of Lebanon with a scale of 1:20000, but errors become more apparent as degree of scale refinement increase. There is a need for more updated and accurate and validated maps with a scale of at least 1:25000 to help in intervention activities of response and rescue services.
Availability	Available from the Army
Acquisition	Can be purchased
Published reference	
Other related databases or sources	
Other comments	There is data in the various line ministries but it needs collation and validation. The available base data may be used to produce refined maps for the large cities with a scale of 1:5000. Even for the validation of the base maps, some data collation is first necessary. Even if government subcontractors develop information and maps, it becomes the property of the private firm Topographic maps and aerial photos do not provide very accurate land-use maps. What is missing is to be checked on the ground.

Base maps

Table 23: Fire Risk Maps - AFDC

Dataset Name	Fire Risk Maps - AFDC
Compiled/Maintained by (Contact Person)	Sawsan Fakhreddine
Address	AFDC
Phone	t: 9611898475; e: Sawsan@afdc.org.lb
Format	Soft copies
Period Covered (date)	They are still being developed and not all information is updated or available (see comments below).
Description	The existing maps, even if missing data (see comments below) are acceptable for assessing high risk fire situations.
Availability	Available to relevant stakeholders.
Acquisition	
Published reference	www.afdc.org.lb
Other related databases or sources	Fire risk maps are also produced by the directorate of Agriculture Scientific Research (Ministry of Agriculture).
Other comments	In order to manage the risk (i.e. reduce the fire risk), more types of data and more accurate data is required.

Table 24: CDR Hazard Maps

Dataset Name	CDR Hazard Maps
Compiled/Maintained by (Contact Person)	Dr Ibrahim Chahrou
Address	CDR, Tallat el Serail, Beirut
Phone	t: 9611980096
Format	Soft copies
Period Covered (date)	2004
Description	Earthquake hazard map Landslide map Flood map Desertification
Availability	Available to relevant stakeholders.
Acquisition	Soft copy
Published reference	www.cdr.gov.lb
Other related databases or sources	
Other comments	Maps for all of Lebanon using a coarse scale.

Hazard maps

Table 25: Data sources

Organization / Institution	Address	Contact Information	Data available	Format	Acquisition	Remarks
CDR	Tallat el Serail, Beirut	Dr Ibrahim Chahrour t: 9611980096 f: 9611981252	Hazard maps; Socio-economic data of Lebanon	Softcopy	At specific cost	Coarse scale
Lebanese Army	Geological Affairs Directorate	Abdallah Rihani	Base maps for Lebanon covering entire country	Softcopy	At specific cost	
Centre for Agricultural Research - LARI	Zahle, Riyak	Michel Frem, t: 9618901575 /6 f: 9618900077 e: lari@lari.gov.lb	Climatological data including Solar radiation, precipitation (total), wind direction and speed, air temperature, relative humidity, soil temperature, dew point, air pressure.	Softcopy	Sent for free for relevant public administrations.	
OMSAR-Geological Centre for Geographical	Not Operational					
Rafiq Hariri Beirut International Airport – Department of Meteorology	Rafiq Hariri Beirut International Airport	Dr Hamdi Chaouk, Director General of Civil Aviation; t: 9611628195 f: 9611629010	Climate data	Softcopy	Free for relevant public administrations	
PLASAR - KSARA	KSARA		Climatological Station, rainfall per day			

C. Inventory of data sources

D. Inventory of publications, reports and risk-related maps

Table 26: Conceptual Seismic Design for Buildings

Publication Name: Conceptual Seismic Design for Buildings	
Author	Hugh Bachmann
Year	2002
Title	Conceptual Seismic Design for Buildings
Language	Arabic , French
Publisher	Swiss Agency for Development and Cooperation
Sources	Swiss Agency for Development and Cooperation
Abstract	Provide conceptual and practical guidelines for both the design and the construction stages to be used by civil engineers, architects, real estate developers and owner, and other relevant authorities.
Remarks	Very good publication. Would be however more useful if, in collaboration with SDC, an appendix is added to put the publication within the Lebanese national context.

Table 27: National Physical Master Plan for the Lebanese Territory

Publication Name: National Physical Master Plan for the Lebanese Territory	
Author	Council for Development and Reconstruction, Lebanon
Year	2005
Title	Conceptual Seismic Design for Buildings
Language	Arabic , English, French
Publisher	Council for Development and Reconstruction
Sources	Council for Development and Reconstruction
Abstract	Provide guidelines on land-use planning including hazard maps for earthquakes, floods, landslides and desertification.
Remarks	The maps are not to a high resolution and hence while their application for land-use is acceptable in certain cases, they cannot be used for critical infrastructure elements where a more detailed map including site effects would need to be taken into account.

Table 28: Proceedings of the first conference on Disasters: Towards a National Comprehensive Prevention Policy

Publication Name: Proceedings of the first conference on Disasters: Towards a National Comprehensive Prevention Policy	
Author	National Committee for Disaster Management
Year	2009
Title	Proceedings of the first conference on Disasters: Towards a National Comprehensive Prevention Policy
Language	Arabic
Publisher	National Committee for Disaster Management, Lebanese Cultural University (Diaspora)
Sources	Various
Abstract	Presentation by representative of various relevant stakeholders in disaster response and prevention including Lebanese Army, Ministry of Environment, Other Security and police services.
Remarks	

Table 29: Hazardous Waste Management Manual - Lebanon

Publication Name: Hazardous Waste Management Manual - Lebanon	
Author	Ministry of Environment
Year	
Title	Hazardous Waste Management Manual for Lebanon
Language	English
Publisher	Ministry of Environment
Sources	Ministry of Environment
Abstract	The manual first provides an introduction to hazardous waste. Next the various options of waste management are discussed with emphasis on waste minimization and waste recovery. The next section classifies and identifies the different types of waste according to modern classification systems. Guidelines for onsite and offsite waste management are also provided. Good practices on reporting, safety and emergency procedures are finally presented and discussed
Remarks	

Table 30: Preliminary flood frequency estimates for Lebanon

Publication Name: Preliminary flood frequency estimates for Lebanon	
Author	K. J. Sene, H. A. Houghton-Carr, A. Hachache
Year	2001
Title	Preliminary flood frequency estimates for Lebanon
Language	English
Publisher	Hydrological Sciences-Journal-des Sciences Hydrology
Sources	Ministry of Environment
Abstract	The paper describes a first attempt at developing a regional flood estimation methodology for Lebanon. The analyses are based on instantaneous flood peak data for the whole country, and cover the period from the start of observations in the 1930s to the start of the civil war in the mid-1970s. Three main flood- generating zones are identified, and regional flood growth curves are derived for each zone using the Generalized Extreme Value distribution fitted by probability-weighted moments. Typical parameter values are presented, together with regression coefficients for estimating the mean annual flood. Based on this work, several recommendations are made on the future data collection and analysis requirements to develop a national flood estimation methodology for Lebanon.
Remarks	The derived frequencies do not take into account the increase in the frequency and severity of the flooding witnessed in various regions in Lebanon due to the recent phenomenon of climate change

Table 31: National Guidelines for Environmental Audit

Publication Name: National Guidelines for Environmental Audit	
Author	Ministry of Environment
Year	
Title	National Guidelines for Environmental Audit
Language	Arabic
Publisher	Ministry of Environment
Sources	Ministry of Environment
Abstract	Provides guidelines on environmental audit including environmental management practices, processes used, water consumption, wastewater generation, air quality and gaseous emissions, solid waste generation, energy consumption and occupational health and safety.
Remarks	

Table 32: National Strategy for the Management of Forest Fires in Lebanon

Publication Name: National Strategy for the Management of Forest Fires in Lebanon	
Author	Ministry of Environment, AFDC
Year	2009
Title	National Strategy for the Management of Forest Fires in Lebanon
Language	Arabic
Publisher	Ministry of Environment, AFDC
Sources	Ministry of Environment, AFDC, Ministry of Agriculture, Ministry of Interior and Municipalities, Ministry of Defense, General Directorate of Internal Security Forces, Civil Defense.
Abstract	Develops a national strategy towards preventing and reducing the likelihood and controlling forest fires in Lebanon, taking into account complex factors such as climate change, land-use. The strategy outlines recommendations together with legislative, financial, administrative and technical measures and proposals for the implementation of the recommendations.
Remarks	

E. Inventory of organizations and institutions at stake

Table 33: Organizations and institutions at stake (earthquakes)

Organization / Institution	Person in Charge	Address	Expertise and Skills	Experience
CNRS – National Center for Geophysical Research	Mr. Sursok T: + 961.4. 981 885 F: + 961.6. 981 886 E-mail: geophys@cnrs.edu.lb	Bhannes - Metn, Lebanon P.O.Box 165432, Ashrafieh, 1100-2040, Beirut, Lebanon	Geophysics, estimation of severity and probability of events	
AUB – Geology Department	Dr Ata Elias	Geology Department		
USJ – Civil Engineering Department	Professor Jaara	Civil Engineering Department	Structural & Geotechnical Engineering	
LAU – Civil Engineering Department	Dr Chatila & Dr Tabbara	Civil Engineering Department	Structural & Geotechnical Engineering	
NDU – Civil Engineering Department	Dr. Jacques Harb & Dr Elie Chakar	Civil Engineering Department	Structural & Geotechnical Engineering	

Hazard Type: Earthquakes
Hazard Type: Tsunamis

Table 34: Organizations and institutions at stake (tsunamis)

Organization / Institution	Person in Charge	Address	Expertise and Skills	Experience
CNRS – National Center for Geophysical Research	Mr. Sursok T: + 961.4. 981 885 F: + 961.6. 981 886 E-mail: geophys@cnrs.edu.lb	Bhannes - Metn, Lebanon P.O.Box 165432, Ashrafieh, 1100-2040, Beirut, Lebanon	Geophysics, estimation of severity and probability of events	
AUB – Geology Department	Dr Ata Elias	Geology Department	Geophysics, bathymetry	

Table 35: Organizations and institutions at stake (floods and landslides)

Organization / Institution	Person in Charge	Address	Expertise and Skills	Experience
UNDP- Ministry of Agriculture	Charbel Rizq		Floods, Desertification	
Directory of Agriculture Scientific Research	Michel Frem, t: 9618901575/6 f: 9618900077 e: lari@lari.gov.lb	Zahle, Riyak	Floods, Desertification	

Hazard Type: Floods and Landslides

Table 36: Organizations and institutions at stake (drought and desertification)

Organization / Institution	Person in Charge	Address	Expertise and Skills	Experience
Directory of Agriculture Scientific Research	Michel Frem, t: 9618901575/6 f: 9618900077 e: lari@lari.gov.lb	Zahle, Riyak	Floods, Desertification	
Ministry of Environment, Environmental Health	Michel Frem, t: 9618901575/6 f: 9618900077 e: lari@lari.gov.lb	Lazarieh Bldg, Beirut	Environmental Impact Assessments	

Hazard Type: Drought and Desertification

Table 37: Organizations and institutions at stake (climate change)

Organization / Institution	Person in Charge	Address	Expertise and Skills	Experience
Ministry of Environment	Vahakn Kabakian t: 9611976555 f: 9611976531 e: Vahakn@moe.gov.lb	Lazarieh Center, Beirut Central District, floor 7	Climate Change	
WHO	Dr. Alissar Radi t: 9611612970 f: 9611612973 e: radya@leb.emro.who.int	Museum Square Bldg, 4th Floor	Effect of climate change on new diseases	Plans for response, control and prevention of epidemics

Hazard Type: Climate Change

Table 38: Organizations and institutions at stake (forest fires)

Organization / Institution	Person in Charge	Address	Expertise and Skills	Experience
AFDC	Sawsan Fakhreddine t: 9611898475 e: Sawsan@afdc.org.lb	AFDC		
Civil Defense	George Bou Moussa m: 9613292988			
Lebanese Army	Abdallah Rihani	Lebanese Army	GIS	
UNDP	Arianne Elmass m: 9613680630	UNDP		

Table 39: Organizations and institutions at stake (epidemics)

Organization / Institution	Person in Charge	Address	Expertise and Skills	Experience
Ministry of Health	Walid Ammar	Ministry of Health		
WHO	Alissar Radi t: 9611612970 f: 9611612973 e: radya@leb.emro.who.int	Museum Square Bldg, 4th Floor	Effect of climate change on new diseases	Plans for response, control and prevention of epidemics
Lebanese Red Cross	Georges Kettaneh t: 9615955992 f: 9615955994	EMS headquarters, Hazmieh	Response Operations	

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