

SEA for Petroleum Activities

In Lebanese Waters

## 2011/2012

# Vol. 4 Gap Analysis

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### 1. PURPOSE

The purpose of this volume is to provide an overview of the present availability of environmental and socio-economic data and information in Lebanon. A Strategic Environmental Assessment (SEA) has a focus on high level and overall effects of the proposed oil and gas activities, however, part of the remit is to initiate the Scoping exercise of the Environmental and Social Impact Assessment (ESIA) process. This entails collating existing information and assessing any data deficiencies between the information that is held and that which would be required for a comprehensive ESIA of a standard that is consistent with Industry Best Practice.

This document covers the following issues:

- An overview of the requirements of a typical ESIA and how the ESIA elements relate to the developmental sequence of the oil and gas industry. It is envisaged that a series of ESIAs will be carried out, both by operators working in the Licensing Blocks as well as those commissioned by the Lebanese authorities. The range of methods and techniques for field surveys is covered in an accompanying document Field Survey Instruction Manual (2197-PRC-ALL-0002).
- The full Table of Contents for a typical Environment and Social Impact Assessment Report.
- An Overview of the Oil and Gas industry; the process of exploration, extraction and transportation; techniques and equipment employed; and a high level description of potential impacts.
- An initial Gap Analysis for each of the main areas of concern within the context of the oil and gas development in Lebanon. Data and Information acquired has been recorded in a Data Acquisition Register (Volume 6), which acts as a library catalogue, so rather than a bibliographic reference a number prefixed by 'DA' has been allocated to re ferenced texts. This refers to the Data Acquisition Register intake number.

### 2. SCOPE

The Zone of Influence for the proposed oil and gas development has been identified as the whole Exclusive Economic Zone (EEZ) and the coastal littoral extending inland to the 200m contour. This is indicated in the map below (as is the proposed on-shore pipeline route).



### 3. SEA and ESIA

As the contents of this document lie at the interface between the SEA and future ESIAs it may be pertinent at this juncture to define the difference between an EIA (or an ESIA as it is now called) and an SEA. The Sourcebook of EU Environmental Law states:

### Relationship between EIA and Strategic Environmental Assessment (SEA)

In addition to the EIA procedure described in this chapter, Directive 2001/42/ECs on the assessment of the effects of certain plans and programmes on the environment (hereafter the SEA Directive) has also introduced a separate, strategic environmental assessment (SEA) procedure. Both procedures differ in their scope. The SEA Directive applies to plans and programmes, whereas the EIA Directive applies only to projects. The EIA Directive covers both public and private projects, whereas the SEA Directive applies to plans and programmes which are subject to preparation and/or adoption by public authorities or which are required by legislative, regulatory or administrative provisions. Consequently the SEA covers in general only public plans and programmes even if it might in some cases apply to privatised utilities. There is also a functional link between the EIA and SEA Directives. The SEA Directive requires that an environmental assessment shall be carried out for all plans and programmes, which are prepared for certain sectors "and which set the framework for future development consent of projects listed in Annexes I and II" of the EIA Directive. The possible overlap between the EIA and the SEA Directives is discussed in Article 11(1) and (2) of the SEA Directive. In these cases Article 11(1) states that other Community law requirements, such as the EIA Directive, relating to an environmental assessment of plans and programmes apply concurrently with the SEA Directive. These could be cases where plans and programmes provide for several projects to which the EIA Directive applies. Article 11(2) deals with the avoidance of a duplication of assessment in situations where the plan or programme comprises the development consent for a project. In these cases the Directive suggests a coordinated approach covering the aspects of both the EIA and the SEA Directives. Plans and programmes are not defined in the SEA Directive. The guidance by DG Environment on the SEA Directive gives examples of what might be thought of as a plan in some Member States or as a programme in others. The guidance recognises that it is not possible to provide a rigorous distinction between the two and that the name alone will not be a sufficiently reliable guides. Consequently the hierarchical structure between policies (not covered by SEA), plans, programmes (covered by SEA) and projects (covered by EIA) is not as clear as it could be. In any case the norm is that in strategic decision-making the hierarchy between tiers moves down from plans to programmes to projects, but not always. Sometimes this top-down model can be reversed as in certain large scale projects subject to EIA, such as those for harbours or nuclear installations, which might begin to drive plans and programmes that require an SEA.

As can be seen from the excerpt above, the boundary between the SEA and EIA process is not well defined. However, what is well defined is the geographic, temporal and subject scope of the EIA. Although Lebanon is not governed by EU law it would be advisable in the context of a new and developing oil and gas industry with international perspectives to assess the developmental history of EU Law, International Conventions, guidelines and protocols as they

relate to the oil and gas industry. Lebanon is in an enviable position of being able to benefit from 'Lessons Learnt' and from the intense debates and research that have taken place post-Macondo; which is particularly relevant given the deep water nature of Lebanon's offshore. A strong regulatory framework now exists for the international oil and gas industry which includes due consideration for environmental and socio-economic issues as well as a company's international reputation. A comprehensive Environmental and Social Impact Assessment is now an integral part of all aspects of this industry, and the recommendations arising from the results of baseline surveys have proved cost-effective to the projects as a whole time and time again.

### 4. ESIA Schedule and Content

Assessment is a process, not a discrete, well defined piece of work that can be 'ticked-off'. SEA typically involves a broader scale that considers the larger scale setting rather than project specific ESIAs which focus on site specific issues within defined boundaries. Information from an SEA will help direct the subsequent ESIAs.

The table below lists the broad elements of an ESIA, starting with an SEA Report and continuing through the process to environmental management and monitoring. These elements are listed vertically, while on the horizontal axis are the life cycle phase of licensing the Blocks, through exploratory drilling to production and ultimate abandonment.

The table shows the coordination that is necessary for the two work streams and how important it is to initiate the ESIA in the early stages of a project to ensure effective management of the potential impacts.

	Pre-exploration	Licensing	Seismic Survey	Exploration Drilling	Appraisal	Infrastructur Feasibility	Design	Construction / Development	Production/ Transportation	Abandonment
SEA Report			1							
Stakeholder Engagement Strategy		)								
Stakeholder Consultations										
Legal Register										
Stakeholder Register										
Consultation Register										
Data Acquisition Register				1						
Impact Register										
Commitment Register										
GIS set up										
GIS maintenance										
ESIA Desk Study										
ESIA Scoping										
Sensitive Location Register										
ESIA Baseline Surveys										
Consents and Permits Register										
Public Consultaion and Disclosure Plan										
Community Engagement										
ESIA Report								1		
Environmental Management										
Monitoring										

An abbreviated Table of Contents for a typical Environmental and Social Impact Assessment Report is illustrated below.

TYPICAL ESIA CONTENTS						
Non-technical Summary						
Regulatory, Policy and Institutional Framework						
Project Justification and Review of Alternatives						
Project Description						
ESIA Overview						
Impact Assessment Methodology						
Anticipated Impacts and their effects during each phase from all Project related activities onshore and offshore						
Baseline Data						
Assessment of Physical Environment – Onshore/Offshore						
Assessment of Biological Environment – Onshore/Offshore						
Assessment of Socio-Economic Environment						
Environment and Social Management Plans						
Conclusion						
References and Appendices						

### 5. DATA GAP ANALYSIS CONCLUSIONS

Many excellent surveys have taken place in Lebanon with a focus on environmental and socioeconomic aspects. In the context of the SEA it is the World Bank, FAO East Med and UNDP, partnered with Lebanese institutions, who have been most involved with relevant surveys.

However, despite the existence of these surveys, the overwhelming conclusion is that there is a serious data deficiency, and this is alarming in the context of a developing oil and gas industry. Surveys of the bio-physical and socio-economic baseline conditions that record the conditions existing prior to any influence from the oil and gas industry are essential. The oil and gas industry carry out these surveys to mitigate their risks and liability; and in a climate where the 'Polluter Pays' these can be considerable. Conversely, it is also imperative that the Lebanese authorities are in a position to control and manage the companies who do not comply with agreed best practice; and for this, a sound knowledge of what exists is needed.

An ESIA is typically assigned a year to complete the initial baseline surveys, so accommodate seasonality of sampling, and then a further six months to write up and coordinate the reports. In Lebanon where there is such a paucity of systematically acquired data, it is especially important that surveys include sufficient detail and are of high quality.

Although the information is sparse and poorly recorded at present, the indications are that Lebanon's offshore ecology is extremely rich and diverse, but the Biodiversity goals of a 1998

agreement are not being implemented and there is inadequate habitat and species protection. The coastal littoral is compromised, probably beyond repair, by urban sprawl, habitat fragmentation and industry pollution.

These concerns are discussed in more detail in the main SEA Report, Volume 1.



# OIL & GAS

### 1 Oil and Gas

The oil and gas industry comprises two parts: 'upstream'— the exploration and production sector of the industry; and 'downstream'-the sector which deals with refining and processing of crude oil and gas products, their distribution and marketing. Companies operating in the industry may be regarded as fully integrated, (i.e. have both upstream and downstream interests), or may concentrate on a particular sector, such as exploration and production (commonly known as an E&P company) or just on refining and marketing (an R&M company). Many large companies operate globally and are described as 'multi-nationals', whilst other smaller companies concentrate on specific areas of the world and are often referred to as 'independents'. Frequently, a specific country has vested its interests in oil and gas in a national company, with its name often reflecting its national parenthood. In the upstream sector, much reliance is placed upon service and upon contractor companies who provide specialist technical services to the industry, ranging from geophysical surveys, drilling and cementing, to catering and hotel services in support of operations. This relationship between contractors and the oil companies has fostered a close partnership, and increasingly, contractors are fully integrated with the structure and culture of their clients.

Activity	Potential requirements						
Desk study: identifies area with favorable geological conditions	• None						
Aerial survey: if favorable features reveled, then	Low-flying aircraft over study area						
Seismic survey: provides detailed information on geology	<ul> <li>Access to onshore sites and marine resource areas Possible onshore extension of marine seismic area. Onshore navigational beacons</li> <li>Onshore seismic</li> <li>Seismic operation camps (onshore) or vessel (offshore)</li> </ul>						
Exploratory drilling: verifies the presence or absence of a hydrocarbon reservoir and quantifies the reserves	<ul> <li>Access for drilling unit and supply units Storage facilities</li> <li>Waste disposal facilities</li> <li>Testing capabilities</li> <li>Accommodation</li> </ul>						
Appraisal drilling: determines if the reservoir is economically feasible to develop	<ul> <li>Additional drill sites</li> <li>Additional access for drilling units and supply units Additional waste disposal and storage facilities</li> </ul>						
Development and production: produces oil and gas from the reservoir through formation pressure, artificial lift, and possibly advanced recovery techniques, until economically feasible reserves are depleted	<ul> <li>Improved access, storage and waste disposal facilities Wellheads</li> <li>Separation/treatment facilities</li> <li>Increased oil storage Facilities to export product Flares</li> <li>Gas production plant Accommodation, infrastructure</li> <li>Transport equipment</li> </ul>						
Decommissioning and rehabilitation may occur	<ul> <li>Equipment to plug wells</li> <li>Equipment to demolish and remove installations</li> <li>Equipment to restore site</li> </ul>						

Table 1.1. Summary of exploration and production process

### 1.1 Exploration

### 1.1.1 Surveying

The first stage in the search for hydrocarbon-bearing rock formations is to undertake a desk study. This will include the study of geological maps to identify major sedimentary basins. The study may also include the review of existing well data from nearby areas (known as offset data) and aerial photography to help identify potentially promising landscape formations such as faults or anticlines. If onshore, a field geological assessment is then undertaken to gather more detailed data.

Once a general area has been determined the desk study will be followed by the gathering of subsurface information using one of three main survey methods: magnetic, gravimetric and seismic.

### **Magnetic Method**

This depends upon measuring the variations in intensity of the magnetic field which reflects the magnetic character of the various rocks present (*DA: 257*).

### **Gravimetric Method**

The gravimetric method involves the measurements of small variations in the gravitational field at the surface of the earth. Measurements are made, on land and at sea, using an aircraft or a survey ship respectively (*DA*: 257).

### Seismic survey

This is the most frequent assessment method and is often the first field activity undertaken. In offshore seismic surveys, compressed-gas air guns are used to make sound waves that travel into the ocean floor: Dynamite was once widely used as the energy source, but environmental considerations now generally favour lower-energy sources such as vibroseis on land (composed of a generator that hydraulically transmits vibrations into the earth) and the aforementioned air gun in offshore exploration.

A ship tows an array of sensitive receivers called hydrophones located within neutrally buoyant "streamers" which are typically three to eight kilometres long. These receivers record the sound waves that are reflected back from the various rock layers beneath the ocean floor. In most cases, the streamer is towed behind the seismic vessel at a depth of about 10 metres below the surface, but in shallow waters the hydrophones may be laid directly on the seabed. The process is illustrated in Figure 1.1 (*DA: 258*).

The data from a single line of hydrophones gives a two-dimensional (or 2D) view. Where multiple streamers are deployed from the same ship (eight are commonly used) the closeness of the lines allows the creation of a three dimensional image of the subsurface instead of a single slice. This is commonly known as 3D seismic, which although being more expensive provides far more detailed and reliable information. For this reason it is most often undertaken in small areas where detailed information is required – for example to gather additional information on a known potential hydrocarbon reservoir.

A new four-dimensional or 4D technique involves conducting a 3D seismic survey in exactly the same location at different times – perhaps months or years apart. This monitors changes as crude oil or natural gas is drawn out of the reservoir, and identifies locations where crude oil or natural gas could remain.

By using specialist computer software, Geophysicists can filter and enhance the data to produce much clearer images of the subsurface and help ensure that geologic structures seen on the data are actually located where they appear to be. Geophysicists and geologists work as a team to make maps of underground layers that may contain oil and gas and thereby recommend lands for purchase and ultimately drilling locations.

Significant improvements in the gathering, processing and display of seismic data in recent years have made it possible for geophysicists to pinpoint promising geological formations much more accurately. However, the only way to determine what the rock layers actually contain is to drill a well.





- The seismic vessel moves into the survey area (1) and deploys the seismic streamer (or streamers in the case of 3D). (2)
- The vessel motors along the survey lines firing the airguns at regular intervals (every 10 to 20 seconds). (3)
- The echoes returning from sedimentary layers thousands of metres below the seabed are detected by the hydrophones and transmitted through the streamer(s) to recording instruments on the ship. (4)
- The result is a series of lines of recorded seismic data (5) that together yield a graphic 3D representation of subsurface geologic structure, enabling interpreters to decide where to drill for oil or gas.

### 1.1.2 Exploration Drilling

The exploitation of hydrocarbons requires the construction of a conduit between the surface and the reservoir. This is achieved by the drilling process. Offshore wells are typically drilled by mobile drilling units of which there are three broad designs currently in use: drill ship, semisubmersible drilling rig and jack-up drilling rig – (See Section 1.4).

There are three main well types. All are drilled broadly in the same way but have different functions:

• Exploration well

- Appraisal well
- Development well

### 1.1.3 Exploration wells

Once a prospective geological structure has been identified, the only way to confirm the presence of hydrocarbons, the reservoir thickness and internal pressure of a reservoir is to drill exploratory boreholes or wells. All wells that are drilled to discover the presence or absence of hydrocarbons are called 'exploration' wells.

Once a suitable well location has been identified, usually directly above the prospective reservoir, a drilling rig can be brought into position (The types of rig / installation that might be employed are covered in section 1.4) to begin the drilling operation. To support the drilling operation, the following systems and services are usually located on a rig:

- Bulk storage is provided for fuel oil, bulk mud and cement, liquid mud, drill water and potable water;
- Pipe and materials storage covered storage is provided for sacked material, drilling equipment, spares, etc. and deck storage for drill pipe and casing;
- Helideck normally rated for a Sikorsky S-61 helicopter or equivalent;
- Craneage two cranes provided for loading/off loading equipment / supplies from supply vessels;
- Emergency systems this includes life saving appliances, fire detection and protection equipment, combustible gas detection systems and life vessels; and
- Environmental protection sewage treatment unit, blow-out preventer (BOP) system, cuttings cleaning equipment and hazardous and non-hazardous drainage systems, which collect rainwater and/or any minor spills to a drains tank for treatment prior to discharge to sea, or allow transfer to tote tanks for shipment to shore and disposal by licensed waste disposal contractors.

### 1.1.4 Closed Hole or Riser Drilling

Drilling is the process of establishing a borehole. Closed system drilling is also known as riser drilling. This technology is used in shallow to intermediate water depths, by the offshore oil industry to explore for and produce oil and gas.

Riser drilling uses two pipes: a drill pipe similar to that used for open hole drilling and a wider diameter riser pipe that surrounds the drill pipe and is cemented into the seafloor (Figure 1.2). The system is closed because drill fluid (seawater and additives) is pumped down the drillpipe (to lubricate the bit and flush rock cuttings away from the bit) and then returned to the ship via the riser.

With riser drilling, the drill fluid density can be varied and borehole pressure can be monitored and controlled, thus overcoming the two limitations of open hole drilling. The single limitation of riser drilling is water depth. The current water depth limit of riser technology is approximately 3 km. This water depth limit occurs because the riser, filled with drill fluid and cuttings, puts a large amount of pressure on the rock. This pressure is greater than the strength of the rock; thus, the rock breaks apart under the riser pressure, causing the drilling system to fail (*DA: 249*).



Figure 1.2. Diagram of a Closed Hole or Riser Drilling



### 1.1.5 Open Hole or Non-riser Drilling

The open hole method uses a single drill pipe that hangs from the drilling rig / ship's derrick; a tall framework positioned over the drill hole used to support the drill pipe. The drill pipe is rotated using drilling systems, specifically a hydraulically powered top drive located above the drill floor of the ship (*See DA: 249*). Surface sea water is flushed through the center of the pipe to lubricate the rotating bit that cuts the rock and then flushes sediment and rock cuttings away to the seafloor (Figure 1.3). Open hole refers to the resulting borehole which remains open to the ocean during drilling. This method is also called a riserless drilling system. Important parts of the deep-water drilling system are a drilling derrick that is large and strong enough to hang a long length of drill pipe reaching deep ocean and subseafloor depths (up to 8 km); a system that rotates the drill pipe; a motion compensator that isolates the ship's motion from the drill pipe; and a pump that flushes sea water through the drill pipe.

Open hole methods are successfully used in all of the Earth's oceans. Using this method it is possible to drill in very deep water (6km) and to >2km below the seafloor. In an open hole, there is no way to control the drilling fluid pressure. In locations where oil and gas may exist, the formations are frequently overpressured. If these formations were to be punctured with an open hole system, the drill pipe would act like a straw that connects

this overpressured zone in the rock to the ocean and the ship. This type of puncture is called a 'blow-out' and is a serious drilling hazard. The explosion as gases are vented through the 'straw' to the ship's drill floor could cause serious damage, or worse yet, the change in the density of the seawater as the gas bubbles are released into the overlying ocean could cause the ship to sink. Without a system to control the pressure in the borehole, there is no way to prevent a blow-out.

### 1.1.6 Drilling Mud

During drilling operations a fluid known as drilling mud is pumped through the drill string down to the drilling bit and once a conductor tube or riser is set is place, is returned to the rig, in the space (or annulus) between the drill string and the casing (Figure 1.4). Drilling mud is essential to the operation. It performs the following functions:

- The hydrostatic pressure generated by the mud's weight controls the downhole pressure and prevents formation fluids from entering the well bore;
- It removes the rock cuttings from the bottom of the hole and carries them to the surface and when circulation is interrupted it suspends the drill cuttings in the hole;
- It lubricates and cools the drill bit and string; and
- It deposits an impermeable cake on the wall of the well bore effectively sealing and stabilising the formations being drilled.

The mud is recycled and maintained in good condition throughout the operation. The mud and suspended cuttings are processed on the rig through screens called "shale shakers" to maximize recovery of the mud. The recovered mud is then passed through a desander to remove sand particles and, if necessary, subsequent treatment is provided by a centrifuge or desilter. This additional equipment removes the fine colloidal solids, the particles too small to be removed by the conventional equipment, which if allowed to build up can make the mud too viscous. Three major types of mud are typically used in offshore drilling:

- Water based mud (WBM) water forms the continuous phase of the mud (up to 90 percent by volume);
- Low toxicity oil based mud (LTOBM) base oils, refined from crude oil, form the continuous phase of the mud; and
- Synthetic based mud (SBM) the continuous phase is refined from a number of organic compounds chosen because they act like base oil but are selected to be more biodegradable.

The base muds form a viscous gel to which a variety of additives may be added for various reasons, including:

- Fluid loss control. The layer of mud on the wall of the wellbore retards the passage of liquid into the surrounding rock formation. Bentonite is the principal material for fluid loss control although additional additives such as starch and cellulose, both naturally occurring substances, are also used.
- Lost circulation. Naturally occurring fibrous, filamentous, granular or flake materials are used to stop lost circulation when the drill bit enters a porous or fractured formation. Typical materials include ground nut shells and mica.
- Lubricity. Normally the drilling mud alone is sufficient to adequately lubricate and cool the bit. However, under extreme loading, other lubricants are added to prevent

the drill string from becoming stuck. No oil based chemicals will be required for the drilling of the wells.

- pH control. Caustic and lime are used to control the alkalinity of the mud to a pH of 9 to 10. This ensures the optimum performance of the polymers in the mud and controls bacterial activity.
- Pressure control. Barite is generally used as a weighting agent to control downhole pressure.

Once drilling commences, drilling fluid or mud is continuously circulated down the drill pipe and back to the surface equipment (illustrated in Figure 1.4). Its purpose is to balance underground hydrostatic pressure, cool the drilling bit and flush out rock cuttings. The risk of an uncontrolled flow from the reservoir to the surface is greatly reduced by using blowout preventers—a series of hydraulically actuated steel rams that can close quickly around the drill string or casing to seal off a well. Steel casing is run into completed sections of the borehole and cemented into place. The casing provides structural support to maintain the integrity of the borehole and isolates underground formations.

Where a hydrocarbon formation is found, initial well tests are conducted. The initial exploration well tests will aim to confirm the presence of hydrocarbons, predict a first production forecast and establish certain reservoir properties. Longer (appraisal) testing can be conducted to refine the preliminary interpretations and to establish flow rates and formation pressure. These tests may generate oil, gas and formation water —each of which needs to be disposed of.

After drilling and initial testing, the rig is usually prepared for demobilization and moved to the next site. If the exploratory drilling has discovered commercial quantities of hydrocarbons, a wellhead valve assembly may be installed on the seabed. If the well does not contain commercial quantities of hydrocarbon, the site is decommissioned to a safe and stable condition and restored to its original state or an agreed after use. Open rock formations are sealed with cement plugs to prevent upward migration of wellbore fluids. The casing wellhead and the top joint of the casings are cut below the ground level and capped with a cement plug.



Figure 1.4. Drilling rig setup and fluid return system

### 1.2 Appraisal

Following on from a successful exploration well, further wells are drilled to determine the size and the extent of the discovered field. Wells drilled to quantify the hydrocarbon reserves found are called 'appraisal' wells. The appraisal stage aims to:

- Evaluate the size and nature of the reservoir;
- Determine the number of confirming or appraisal wells required, and
- Determine whether any further seismic work is necessary.

The drilling techniques used to drill appraisal wells are the same as those employed for exploration wells, and the description provided in section 1.1 applies equally to appraisal operations. Several wells may be drilled from a single location, of these, only one well will be vertical will all of the others being drilled at an angle. This type if well is called a deviated or directional well. (*DA: 257*).

### 1.3 Development or Production wells

Having established the size of the oil field, the subsequent wells drilled are called 'development' or 'production' wells. It may be possible to develop a small reservoir using one or more of the appraisal wells. A larger reservoir will require the drilling of additional production wells. Multiple production wells are often drilled from one installation to reduce the overall infrastructure cost. The number of wells required to exploit the hydrocarbon reservoir varies with the size of the reservoir and its geology. Large oilfields can require a hundred or more wells to be drilled, whereas smaller fields may only require ten or so. The drilling procedure involves similar techniques to those described for exploration; however, with a larger number of wells being drilled, the level of activity obviously increases in proportion. The well sites will be occupied for longer, and support services— water supply, waste management, logistic demands and other services—will increase correspondingly.

### 1.4 Completion

Once a development well has been drilled, or if an appraisal well is going to be developed, it needs to be prepared for long term production. Crude oil and natural gas wells are prepared for production through a process called completion.

Initially an additional lining, called a production casing is cemented inside the well bore. This casing – tubular steel pipe connected by threads and couplings – lines the total length of the well bore and has the purpose of ensuring:

- safe control of the crude oil and natural gas,
- prevention of water entering the well bore and
- that rock formations are kept from entering the well bore.

Once the cement has set, a specialized pipe called production tubing is inserted into the well, all the way down to the bottom of the reservoir. Production tubing is high quality steel pipe of a smaller diameter than the production casing.

The production tubing is lowered into the casing and hangs from a sea floor installation called the wellhead. The wellhead has remotely operated valves and chokes that allow the production crew to regulate the flow of oil and natural gas.

Once all of the production tubing has been inserted and tested, the final stage is to start the flow of production fluids (oil and gas) from the well. This is achieved by 'perforating' the well. Specially shaped explosives are inserted into the reservoir section of the well in calculated positions and set off. This perforates the production tubing and allows oil and gas to enter the well from the reservoir.

### 1.5 Development and Production

There are many different types of facilities from which offshore drilling and production operations take place. These may include;

- Mobile drilling rigs (section1.6)
- Fixed installations (section 1.6)
- Drillships (section 1.6)
- Pipelines (section 1.7)
- Floating production systems (section 1.6)

• Mooring systems (section 1.6)

Initially, commercial oil and gas wells are usually free flowing i.e. the underground pressures drive the liquid and gas up the well bore to the surface. This is called 'primary recovery'. The rate of flow depends on a number of factors such as the properties of the reservoir rock, the underground pressures, the viscosity of the oil, and the oil/gas ratio. These factors vary throughout the commercial life of a well.

When a well reaches the stage when the oil and gas cannot reach the surface unaided, some form of artificial lift needs to be provided, such as through a pumping mechanism or the injection of gas or water to maintain reservoir pressures. It is now considered a standard operation to inject gas, water, or steam into the reservoir at the start of the field's life in order to maintain pressures and optimize production rates and the ultimate recovery potential of oil and gas. This in turn may require the drilling of additional wells, called injection wells. Other methods of stimulating production can be used, such as hydraulic fracturing of the hydrocarbon bearing formation, and acid treatment to increase and enlarge flow channels.

### Processing

Once the hydrocarbon reaches the surface, it is routed to a production facility which gathers and separates the produced fluids (oil, gas and water). The size and type of the installation will depend on the nature of the reservoir, the volume and nature of produced fluids, and the export option selected (*DA: 257*).

Since the production operation is a long-term development, the short term facilities used in exploration are replaced by permanent facilities and are subject to detailed planning, design, engineering and construction. The temporary workforce associated with exploration activity is replaced by a permanent workforce, located on a purpose built production platform. In offshore production developments, permanent structures are necessary to support the required facilities, since typical exploration units are not designed for full scale production operations. Normally, a steel platform is installed to serve as the gathering and processing centre and more than 40 wells may be drilled directionally from this platform. Concrete platforms are sometimes used. If the field is large enough, additional 'satellite' platforms may be needed, linked by subsea flowlines to the central facility. In shallow water areas, typically a central processing facility is supported by a number of smaller wellhead platforms. Technological developments, aimed at optimizing operations, include remotely operated subsea systems which remove the requirement for satellite platforms. This technology is also being used in deep water where platforms are unsuitable, and for marginal fields where platforms would be uneconomic. In these cases, floating systems — ships and semi-submersibles — 'service' the subsea wells on a regular basis.

Advances in horizontal drilling have enhanced directional drilling as a means of concentrating operations at one site (Figure 1.5) and the number of platforms offshore. The technology now enables access to a reservoir, kilometres from the drill rig, while technology is developing to permit even wider range. This further minimizes the 'footprint' by reducing the need for satellite wells. It also allows for more flexibility in selecting a drill site, particularly where environmental concerns are raised.





The production facility processes the hydrocarbon fluids and separates oil, gas and water. The oil must usually be free of dissolved gas before export. Similarly, the gas must be stabilized and free of liquids and unwanted components such as hydrogen sulphide and carbon dioxide. Any water produced is treated before disposal. A schematic representation of a typical crude oil processing facility is shown in Figure 1.6.

### Figure 1.6. Crude oil processing example



The operator will only be able to extract a portion of the oil present using 'primary' recovery (i.e. natural pressure and simple pumping) but a range of additional recovery methods are available as discussed above. For example, secondary recovery uses water or gas injection and tertiary methods utilising chemicals, gases or heat to increase the efficiency of oil recovery.

### **1.6 Marine Installations**

Offshore installation have many uses including oil exploration and production, navigation, ship loading and unloading, and to support bridges and causeways. Offshore structures must function safely for design lifetimes of twenty-five years or more and are subject to very harsh marine environments, so it is important to select the most applicable design for a given purpose and location (water depth in particular).

### 1.6.1 Drilling facilities

There are a number of different types of mobile offshore drilling rig - and the type used will depend on the well location and water depth (*DA: 254*).

### **Drilling barges**

Drilling barges are used mostly for inland, shallow water drilling. This typically takes place in lakes, swamps, rivers, and canals. Drilling barges are large, floating platforms, which must be towed by tugboat from location to location. Suitable for still, shallow waters, drilling barges are not able to withstand the water movement experienced in large open water situations.

### Figure 1.7. Drilling barge



Source: International Drilling Rig Builders and Brokers

### Jack-up platforms/rigs

Jack-up rigs are similar to drilling barges, with one difference. Once a jack-up rig is towed to the drilling site, three or four 'legs' are lowered until they rest on the sea bottom. This allows the working platform to rest above the surface of the water, as opposed to a floating barge. However, jack-up rigs are suitable only for shallower waters, as extending these legs down too deeply would be impractical. This rig type can only operate to water depths of up to about 150 metres. These rigs are typically safer to operate than drilling barges, as their working platform is elevated above the water level.

Figure 1.8. Jack-up rig



Source: Maersk

### Submersible platforms/rigs

Submersible rigs, also suitable for shallow water are similar to jack-up rigs in that they come in contact with the ocean or lake floor. These rigs consist of platforms with two hulls positioned on top of one another. The upper hull contains the living quarters for the crew, as well as the drilling platform. The lower hull is similar to a submarine – when

the platform is being moved from one place to another, the lower hull is filled with air – making the entire rig buoyant. When the rig is positioned over the drill site, the air is let out of the lower hull, and the rig submerges to the sea or lake floor. This type of rig has the advantage of mobility in the water but only in very limited water depths;





Source: Offshore Industry

### Semi-submersible platforms/rigs

Semi submersibles are required to float in deep water and provide a stable platform to allow drilling into the sea floor. Semi submersibles are designed to reduce 'heave', the vertical motion of a vessel in response to the action of waves. This is done by reducing the area of the hull in contact with the water to a minimum. Two, three or four vertical circular sectioned columns are fitted beneath the deck at each side, terminating in underwater pontoon hulls containing large tanks for ballast, fuel and fresh water. The columns and pontoons provide the buoyancy to keep the vessel afloat and some of the tanks can be flooded to lower the vessel to a sufficient depth in the water to maximise stability and minimise wave movements whilst drilling.

A typical deep sea semi-submersible drilling rig has dimensions of approximately 90 metres x 80 metres, with a draught of about 30 metres. Semi-submersible rigs are capable of operating in water depths well in excess of that to be encountered at the potential drilling location and can drill to depths in excess of 7,500 metres.

They carry a crew of up to 100 personnel and include offices, crew cabins, mess halls, recreation area, sickbay and control room.

Semi-submersible rigs are generally anchored by cable anchors during drilling operations, though they can also be kept in place by dynamic positioning. Semi-

submersible rigs can also be kept in place by the use of dynamic positioning. Semisubmersibles can be used in depths from 600 up to 35,000 feet (180 to more than 10,600 m). This type of rig platform will drill a hole in the seabed and can be quickly moved to new locations.

Figure 1.10. Semi-submersible rig



Source: RPS library

### Drillships

Drillships are ships designed to carry out drilling operations. These vessels are specially designed drilling platforms for deep-sea well locations. A typical drillship will have, in addition to all of the equipment normally found on a large ocean going vessel, a derrick, drilling platform and associated equipment located on the middle of its deck. Drilling operations are undertaken through a hole in the centre of the vessel called a "moonpool" This allows the drill string to extend through the vessel, down into the water.

Drillships are not anchored to the seabed but remain in position using 'dynamic positioning' systems. This is a complicated system of electrically driven propellers call 'thrusters' located on the underside of the vessel which can move the ship in any direction. These motors are integrated into the ships computer system, which uses satellite positioning technology, in conjunction with sensors located on the drilling template, to ensure that the ship is directly above the drill site at all times.

### Figure 1.11. Drillship



Source: Nautic Expo.

### 1.6.2 Fixed platforms

Primarily fixed installations are used as production facilities and although many do contain drilling facilities, this is usually only used for development drilling operations.

In certain instances, in shallow water (i.e. in continental shelf water depth of up to ca, 250m), it is possible to physically attach a platform to the sea floor. This is what is known as a fixed platform. The base is constructed of concrete or steel, sometimes called a 'jacket'. This is installed on to the seabed and fixed in place with piles. The platform facilities are then installed onto the jacket or concrete base. With some concrete structures, the weight of the legs and seafloor platform is so great, that they do not have to be physically attached to the seafloor, but instead simply rest on their own mass, these are called 'gravity platforms'. There are many possible designs for these fixed, permanent platforms and their main advantage is their stability; as they are attached to the sea floor, there is limited exposure to movement due to wind and water forces. Different types of fixed offshore platforms are shown in Figure 1.12.





Source: Mining and Minerals Service

### **Compliant Towers (Tower platforms)**

Compliant towers are much like fixed platforms. They consist of a narrow tower, attached to a foundation on the seafloor and extending up to the platform. This tower is flexible, as opposed to the relatively rigid legs of a fixed platform. This flexibility allows it to operate in much deeper water, as it can 'absorb' much of the pressure exerted on it by the wind and sea. Despite its flexibility, the compliant tower system is strong enough to withstand hurricane conditions.





Source: OffshoreTechnology.com

### Floating production systems

A floating production, storage and offloading (FPSO) unit is a floating vessel used for the processing of hydrocarbons and for storage of oil. A FPSO vessel is designed to receive hydrocarbons produced from nearby platforms or subsea template, process them, and store the processed hydrocarbon until it can be offloaded onto a tanker or transported through a pipeline. FPSOs are preferred in frontier offshore regions as they are easy to install, and do not require a local pipeline infrastructure to export oil. FPSOs can be a

conversion of an oil tanker or can be a vessel built specially for the application. A vessel used only to store oil (without processing it) is referred to as a floating storage and offloading vessel (FSO).

Oil produced from offshore production platforms can be transported to the mainland either by pipeline or by tanker.



When a tanker is chosen to transport the oil, it is necessary to accumulate oil in some form of storage tank such that the oil tanker is only needed once sufficient oil has been produced to fill the tanker. At this point the transport tanker connects to the stern of the storage unit and offloads oil. The choice of FPSO design will depend on the area of operation. In benign waters the FPSO may have a simple box shape or it may be a converted tanker.



While most FPSOs are ship-shaped, some FPSOs have a semi-submersible type hull with storage, or have a cylindrical hull. An FPSO has the capability to carry out some form of hydrocarbon separation process. If the unit does not have such facilities, it is generally referred to as a Floating Storage and Offloading unit (see below), and would be operated in conjunction with a production platform. The process plant on an FPSO is a core component and forms a key part of production process.

Floating production, storage and offloading vessels are particularly effective in remote or deepwater locations where seabed pipelines are not cost effective. FPSOs eliminate the need to lay expensive long-distance pipelines from the oil well to an onshore terminal. They can also be used economically in smaller oil fields which can be exhausted in a few years and do not justify the expense of installing a pipeline. Once the field is depleted, the FPSO can be moved to a new location.

A floating storage and offloading unit (FSO) is a floating storage device, which is a simplified FPSO without the capability for oil or gas processing.

Most FSOs are old single hull super tankers that have been converted.

Where exported natural gas is brought back to ambient temperature and pressure, ships may also be used as floating storage and re-gasification units (FSRUs). A liquefied natural gas (LNG) FSRU is a floating storage and regasification system, which receives (LNG) from offloading LNG carriers, and the onboard re-gasification system provides natural gas send-out through flexible risers and pipeline to shore.





Source: Deepwater offshore

### **Tension leg and Seastar platforms**

A Tension-leg platform or Extended Tension Leg Platform (ETLP) is a vertically moored floating structure normally used for the offshore production of oil or gas, and is particularly suited for water depths greater than 300 metres and less than 1500 meters.

The platform is permanently moored by means of tethers or tendons grouped at each of the structure's corners. A group of tethers is called a tension leg. A feature of the design of the tethers is that they have relatively high axial stiffness (low elasticity), such that virtually all vertical motion of the platform is eliminated. This allows the platform to have the production wellheads on deck (connected directly to the subsea wells by rigid risers), instead of on the seafloor. This allows a simpler well completion and gives better control over the production from the oil or gas reservoir.

Seastar platforms comprises of a floating installation, very similar to the semisubmersible design previously discussed. A lower hull is filled with water when operating, which increases platform stability against wind and water movement. In addition to the platform design Seastar platforms also incorporate a tension leg system employed in larger platforms (see below). Tension legs are long, hollow tendons that extend from the seafloor to the floating platform. These legs are kept under constant tension, and do not allow for any up or down movement of the platform. However, their flexibility does allow for side-to-side motion, which allows the platform to withstand the force of the ocean and wind, without breaking the legs off. Seastar platforms are typically used for smaller deep-water reservoirs, when it is not economical to build a larger platform. They can operate in water depths of up to 3,500 feet.

Figure 1.15. Tension leg platform

Figure 1.16. Seastar platform

Source: ISI Engenharia

Source: Brighthub

### Subsea system

Subsea production systems are wells located on the sea floor, as opposed to on a fixed or floating installation. As with in a floating production system, the petroleum is extracted at the seafloor, and then can be 'tied-back' to an already existing production platform. The well can be drilled by a moveable rig and instead of building a production platform for that well, the extracted oil and natural gas can be transported by a riser or even undersea pipeline to a nearby production platform. This allows one strategically placed production platform to service many wells over a reasonably large area. Subsea systems are typically in use at depths of 7,000 feet or more, and do not have the ability to drill, only to extract and transport.





Source: Malaysia Marine and Heavy Engineering (MMHE)

### Figure 1.18. Spar platform

### **Spar Platforms**

Spar platforms are among the largest offshore platforms in use. These huge platforms consist of a large cylinder supporting a typical fixed rig platform. The cylinder, however, does not extend all the way to the seafloor, but instead is tethered to the bottom by a series of cables and lines. The large cylinder serves to stabilize the platform in the water, and allows for movement to absorb the force of potential hurricanes.



Source: OffshoreTechnology.com

### 1.6.3 Summary of Offshore Construction Project stages

An offshore platform construction project includes the following phases:

- Investment feasibility studies
- Construction site survey including diving inspections of installation locations
- Conceptual, basic and detailed design
- Platform element strength calculations
- Design approval by the regulating authorities
- Procurement
- Fabrication of steel structures
- Preparation of platform elements transportation and offshore installation procedures
- Loadout, transportation and installation operations
- Commissioning.

Usually, fabrication of steel structures for such facilities as offshore platforms is carried out at locations significantly remote from the installation site. Transportation of such large-sized elements is a complicated operation requiring a special design, with structural strength calculations for the transportation conditions.

### **1.7** Hydrocarbon transportation

As an oil or gas discovery moves into the development phase, decisions are made regarding transportation of the product to market. Export options include transportation by tanker or subsea pipeline. Each option has several alternatives in design and implementation (considering variables such as climate, location, water depth, environmental impact and financial feasibility) with various advantages and disadvantages (*DA: 266*).

### 1.7.1 Tankers

A specialized ship designed to transport oil from offshore oil fields to onshore refineries is referred to as a shuttle tanker (shown in figure 1.19). Shuttle tankers are often used as an alternative to pipelines in harsh climates, remote locations or deepwater.

The value of using a shuttle tanker instead of pipelines has spread worldwide since its their first appearance in the 1970's. Operators have recognized the flexibility of loading oil and transporting it to any destination they want as opposed to pipelines that are fixed to one receiving terminal.

Operators also favour the ability of shuttle tankers to segregate the oil. Pipelines often blend crude from various fields. Shuttle tankers are also easier to maintain and have a back-up-system in place if they require maintenance. If a pipeline requires maintenance, the whole network is likely to be shut in.

An offshore loading system transfers oil from a FPSO in most sea states and weather conditions. The offshore platform will have a field export system that connects to the loading system on the shuttle tanker. The type of export system onboard varies based on safety, weather conditions, water depth, seabed conditions and cost.



Figure 1.19. Shuttle tanker

Source: Ship-technology.com

### The single point mooring system (SPM)

This is an offshore loading buoy where tankers can connect to load and offload oil. SPMs can handle any size ship. The body of the buoy, mooring and anchoring elements, product transfer system and other components make up an SPM (figure 1.20). Together, these parts allow shuttle tanker operators to favourably position the vessel around the mooring point so it is less affected by weather conditions. A hose from the export system is then connected to the loading system on the vessel. The Ugland Kongsberg Offshore Loading System is a less expensive option than a SPM, but can only be used with dynamically positioned shuttle tankers.





Source: oilspillsolutions.org

### Submerged Turret Loading System (STL)

The Submerged Turret Loading (STL) system (figure 1.21) has a submerged buoy that comes through a cone-shaped turret on the keel of the shuttle tanker. The STL systems operating today are installed in water depth from 85 to 350 metres with significant wave heights of 6.2 metres. Verification systems and feasibility tests have shown that STL mooring systems could be applied in depths from 40 to 900 metres.





Source: Portmeridan.com
#### Single Anchor Loading system

The Single Anchor Loading (SAL) system is used primarily in shallow water and in good weather conditions (figure 1.22). The SAL is a simple, cost effective alternative to the STL. This system is suitable for extended well tests (EWTs), early production phases (EPPs) and also for supporting offshore loading.





Source: Oilspillsolutions.org

#### 1.7.2 Pipelines

Laying pipe on the seafloor can pose a number of challenges, especially if the water is deep. There are three main ways that subsea pipe is laid -- S-lay, J-lay and tow-in (figure 1.23).

#### Figure 1.23. Pipe laying methods



#### **Pipeline Installation**

The pipeline installation process can begin once the appropriate route has been determined and the design requirements (*i..*, size and materials specifications, etc) completed. Various methods may be used to install pipelines. In deeper water, the pipe lay vessel may use a dynamic positioning system, consisting of a surface navigation system and subsea acoustic positioning system integrated with the vessel's propulsion and thrusters to maintain course and speed over the route. In shallow water, the pipe lay vessel may employ a system of anchors and winches to move the barge along the route. Anchor handling support vessels continuously lift and deploy the anchors as the lay barge travels along the route. The anchors and anchor cables are in contact with a large area of the seabed on either side of the pipeline route. Buoyancy affects the pipelay process, both in positive and negative ways. In the water, the pipe has increased buoyancy if it is filled with air, which puts less stress on the pipelay barge. But once in place on the sea bed, the pipe requires a downward force to remain in place. This can be provided by the weight of the oil passing through the pipeline, but gas does not weigh enough to keep the pipe from drifting across the seafloor. In shallow-water scenarios, a concrete saddle or rock armour is placed over the pipe to keep it in place, while in deepwater situations, the amount of insulation and the thickness required to ward of hydrostatic pressure may be enough to keep the line in place (DA: 265). In some coastal areas, fishing activities on the seabed may take place in water depths over 80 metres. It is sometimes necessary to bury pipelines even at these depths to avoid contact or interference with fishing and Navigation routes. Burial of the pipeline (where necessary) requires that a trench is excavated out of the seabed into which the pipeline is placed. The trench can then be infilled or left to infill through natural processes. In deeper water, trenching is used to ensure that the pipeline is in continuous contact with the seabed and that there are no areas where the pipeline is suspended free of the seabed (spanning).

Jetting using high pressure water may also be used to excavate pipeline trenches. A system of high pressure water jets can remove sediment from beneath the pipeline. The use of this method is subject to the type of sediment along the route.

## 1.8 Land facilities

#### Ports

An offshore drilling rig or platform will require regular supplies (food, potable water, equipment, etc.) that must be transported from onshore. To this end it is necessary to have suitable port facilities, capable of birthing supply vessels within manageable range of the offshore operations.

#### **Pipeline - Landfall**

Landfall is considered to be the point at which an offshore pipeline makes contact with the coastline. This can be the site of a considerable amount of infrastructure, which may include any of the following:

- Above Ground Installation (AGI)
- Compressor stations
- Pipelines
- Liquid Natural Gas (LNG) plant

- Onshore processing facilities
- Metering stations
- Control rooms

The focus of this overview is the offshore aspects of the oil and gas industry. As such a more in depth overview of these and other onshore facilities is beyond the scope of this report.

# **1.9** Decommissioning and abandonment

Decommissioning is the process by which the operator of an oil or natural gas installation will plan, gain approval and implement the removal, disposal or re-use of an installation when it is no longer needed for its current purpose.

Decommissioning is often a complex and risky operation. The five key considerations are:

- The potential impact on the environment;
- Potential impact on human health and safety;
- Technical feasibility;
- Costs of the plan and;
- Public acceptability.

There are several pathways to decommissioning, depending on the facilities type and the location.

National governments play an extensive role in assessing and licensing decommissioning options and most countries which have offshore oil and natural gas installations have laws governing decommissioning.

The prime global authority is the International Maritime Organisation (IMO), who set the standards and guidelines for the removal of offshore installations. The guidelines specify that installations in less than 75 metres of water and with substructures weighing less than 4000 tons are to be completely removed from the site. Those in deeper water must be removed to a depth of 55 metres below the surface so that there is no hazard to navigation. In some countries the depth to which structures have to be removed has already been extended to 100 metres.

The planning of decommissioning activities involves extensive periods of consultations with the relevant authorities and interested parties, such as fishing and environmental groups to ensure a suitable and comprehensive decommissioning programme is developed.

The basic aim of a decommissioning programme is to render all wells permanently safe and remove most, if not all, surface (or seabed) signs of production activity. How completely a site should be returned to its 'green field' state, is a subject for discussion between government, operator and the public (*DA: 204*).

The decommissioning of onshore production installations at the end of their commercial life, typically 20–40 years, may involve removal of buildings and equipment, restoration of the site to environmentally-sound conditions and continued monitoring of the site after closure. Planning for decommissioning is an integral part of the overall management process and should be considered at the beginning of the development during design, and is equally applicable to both onshore and offshore operations.

By their nature, most exploration wells will be unsuccessful and will be decommissioned after the initial one-to-three months of activity. It is, therefore, prudent to plan for this from the outset, and ensure minimal environmental disruption. Decommissioning and rehabilitation will, subsequently, be simplified (*DA: 257*).

#### 1.9.1 Well abandonment

Whether offshore or on land, an effective well abandonment programme should address the following concerns:

- isolation of all hydrocarbon bearing intervals
- containment of all overpressured zones
- protection of overlying aquifers
- removal of wellhead equipment.

A traditional abandonment process begins with a well killing operation in which produced fluids are circulated out of the well, or pushed (bull headed) into the formation, and replaced by drilling fluids heavy enough to contain any open formation pressures. Once the well has been killed the Christmas tree is removed and replaced by a blowout preventer, through which the production tubing can be removed.

Cement is then placed across the open perforations and partially squeezed into the formation to seal off all production zones. Depending on the well configuration it is normal to set a series of cement and wireline plugs in both the liner and production casing (see Figure 1.24), to a depth level with the top of cement behind the production casing.





The production casing is cut and removed above the top of the cement, and a cement plug positioned over the casing stub to isolate the annulus and any formation which may

Source: Developments in Petroleum Science, Volume 55, 2008

still be open below the intermediate casing shoe. The remaining casing strings may be cut and removed close to surface and a cement plug set across the casing stubs.

## 1.9.2 Pipelines

All pipelines will be circulated clean and those that are buried, or on the seabed, left filled with water or cement. Surface piping will normally be cut up and removed. Flexible subsea pipelines may be 'reeled-in' onto a lay barge and disposed of onshore.

## 1.9.3 Offshore facilities

There are currently more than 6,500 oil and gas installations located on the continental shelves of some 53 countries. About 4,000 of these are in the US Gulf of Mexico, 950 in Asia, 700 in the Middle East and 400 in Europe.

Each of the main facility types, for example steel jacket, gravity structure, tension leg and floating platform, have different options for decommissioning. The main factors which need to be considered and which will impact on costs are type of construction, size, distance from shore, weather conditions and the complexity of the removal, including all safety aspects. Figure 1.25 shows the options available.

## Figure 1.25. Decommissioning options



#### Source: Developments in Petroleum Science, Volume 55, 2008

Tension leg and floating platforms can easily be released and towed away for service elsewhere. In the case of the fixed platforms, the topside modules are removed by lift barge and taken to shore for disposal. Gravity-based structures can in theory be deballasted and floated away to be reemployed or sunk in the deep ocean, and steel jackets cut and removed at an agreed depth below sea level. In some areas jackets are cleaned and placed as artificial reefs on the seabed.

Subsea facilities are easily decommissioned as they are relatively small and easy to lift. However, subsea manifolds and templates can weigh in excess of 1000 tons and will require heavy lift barges for removal.

# 1.10 Regularity Framework

This subject is covered in section 2 of this report. The RPS Legal Register (Volume 2: Registers) also provides comprehensive coverage of all relevant Lebanese regulations pertaining to the aspects of an oil and gas industry.

# 1.11 Strategy and Future Plans

It is the intention of the Lebanese government to develop an offshore oil and gas industry within Lebanon. Although a strategy document has not yet been produced by the government, groundwork towards this goal has been underway for some time. Some of the key developments to date are listed in table 1.2.

Table 1.2. Summary of key actions towards developing an offshore hydrocarbon industry in
Lebanon to date

Date	Action			
2000	Spectrum company carried out 2D seismic survey of Lebanon's Exclusive Economic Zone (EEZ) as part of a regional speculative survey conducted over the east Mediterranean region.			
2001	Southampton Oceanographic Center was asked to carry out boundaries delimitation for the Lebanese Exclusive Economic Zone (EEZ).			
2001	AT Energy was asked to advise the government on exploration licensing process (report submitted in 2002).			
2002	Spectrum company carried out 2D seismic survey for Lebanon's territorial waters			
2002	TGS- NOPEC carried out a 2D seismic survey of Lebanon's Exclusive Economic Zone, as part of a regional speculative survey conducted over the eastern Mediterranean region.			
Jan 2007	Lebanon and Norway launched the Oil for Development Cooperation Programme.			
Jan 2007	Lebanon and Cyprus signed an agreement on the delimitation of the Exclusive Economic Zone (EEZ).			
Jan 2007	Cooperation agreement with Norway (Oil for Development program).			
Feb 2007	Conducted Multi client 3D geophysical survey (2350 Km <sup>2</sup> ).			
Oct 2007	Petroleum policy for oil and gas exploration offshore Lebanon was endorsed by the Council of Ministers.			
Feb 2009	PGS acquired 4900km of new 2D data and signed an agreement to merge and manage all existing seismic data.			
May 2009	The report on the delimitation of the Exclusive Economic Zone (EEZ) of Lebanon endorsed by the CoM			
Aug 2010	The Offshore Petroleum Resources Law was ratified by the Parliament			
Feb 2011	PGS acquiring additional 3800 Km 2D and 1400 km <sup>2</sup> of 3D seismic data			
June 2011	The first international forum dedicated for oil and gas exploration in Lebanon was held			
July 2011	The resource base assessment report was accomplished by Beicip Franlab			
Oct 2011	Work on the Strategic Environmental Assessment (SEA) is initiated with RPS Energy			
Source: DA: 1.	24			

Moving forward into 2012 there are more key milestones to be achieved, culminating in the launching of 1<sup>st</sup> licensing round for offshore Lebanon:

- Appointment of the board members of the Petroleum Administration
- Accomplishing the Petroleum Activities Regulations( PAR) and the model contract
- Finalizing the Strategic Environmental Assessment
- Finalizing the resource base assessment and prospect evaluation report
- Ratifying the delimitation agreement with the Republic of Cyprus by the Lebanese Parliament
- Signing a general framework agreement with Cyprus and the delimitation and framework agreements with Syria
- Training and capacity building of Lebanese Civil servants
- Promotion of the licensing round
- Launching the 1st Licensing round offshore Lebanon (anticipated for the first quarter of 2012).

Beyond this, there are plans by the Ministry of Energy and Water to develop and construct a new buried 36" natural gas transmission pipeline from North Lebanon (Tripoli) to South Lebanon (Tyr). The new pipeline will pass through onshore and offshore predetermined localities (*DA: 249*).

# 1.12 Impact from Development of Petroleum Activities

## 1.12.1 Human, socio-economic and cultural impacts

This subject is covered in sections 11, 12 and 13 of this report. The RPS Legal Register (Volume 2: Registers) also provides comprehensive coverage of all relevant Lebanese regulations pertaining to the impact on this area by the aspects of an oil and gas industry.

## 1.12.2 Atmospheric impacts

This subject is covered in section 7 and 8 of this report. The RPS Legal Register (Volume 2: Registers) also provides comprehensive coverage of all relevant Lebanese regulations pertaining to the impact on this area by the aspects of an oil and gas industry.

## 1.12.3 Aquatic impacts

This subject is covered in sections 4, 6 and 8 of this report. The RPS Legal Register (Volume 2: Registers) also provides comprehensive coverage of all relevant Lebanese regulations pertaining to the impact on this area by the aspects of an oil and gas industry.

## 1.12.4 Terrestrial impacts

This subject is covered in sections 3 and 8 of this report. The RPS Legal Register (Volume 2: Registers) also provides comprehensive coverage of all relevant Lebanese regulations pertaining to the impact on this area by the aspects of an oil and gas industry.

# **1.13 Possible Implications**

The anticipated interactions and impacts of an offshore oil and gas industry (from initial surveys through to production) are detailed in table 3.

# Table 1.3. Summary of potential offshore industry environmental impacts

(H = Human, socio-economic and cultural; T = Terrestrial; Aq = Aquatic; At = Atmospheric; B = Biosphere)

Activity	Source	Potential Impact	Component Affected	Comments
Aerial survey	Aircraft	Noise	H/At/B	Low-level flights, disturbance to humans and wildlife (consider seasonality). Short-term, transient.
Seismic operations (offshore)	Seismic equipment	Noise	В	Acoustic sources, disturbance to marine organisms (may need to avoid sensitive areas and consider seasonality). Short-term and transient.
	Vessel operations	Emissions and discharges	At/Aq/T	Atmospheric emissions from vessel engines; discharges to ocean: bilges, sewage; spillages; waste and garbage disposal to shore. Low-level, short-term, transient.
		Interference	Н	Interaction with other resource users (e.g. fishing). Short-term, transient.
Exploratory and appraisal drilling (offshore)	Site Selection	Interactions	H/B/Aq	Consider sensitivities in relation to biota, resource use, cultural importance, seasonality. Secondary impacts related to support and supply requirements and potential impact on local ports
	Operations	Discharges Emissions Wastes	H/At/B/Aq/T	Discharges to ocean—muds, cuttings, wash water, drainage, sewage, sanitary and kitchen wastes, spillages and leakages. Emissions from plant equipment; noise and light; solid waste disposal onshore and impact on local infrastructure. Disturbance to benthic and pelagic organisms, marine birds. Changes in sediment, water and air quality. Loss of access and disturbance to other marine resource users. Emissions and discharges from well test operations, produced water discharges, burning and flare, additional noise and light impact. Short-term and transient. Effects of vessel and helicopter movements on human and wildlife.
	Decommissi oning	Footprint	B/Aq	Proper controls during operations and careful decommissioning should effectively remove risk of long-term impact. Improper controls can result in sediment

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Activity	Source	Potential Impact	Component Affected	Comments
				and water contamination, damage to benthic and pelagic habitats, organisms, biodiversity. Onshore in terms of solid waste disposal, infrastructure and resource conflicts.
Development and Production (onshore)	Roads	Access	H/Aq/B/T	Long-term occupation of sites requires access to facilities. Long-term loss of habitat and land use, possible barriers to wildlife movement; increased exposure to immigration and secondary effects; long-term effects from vegetation clearance, erosion, changes to surface hydrology, introduction of barriers to wildlife movement.
				Increased disturbance from transportation, traffic volumes, density, impact on local infrastructure, disturbance to local population and wildlife. Long-term effects require proper planning and consultation.
	Site Preparation	Footprint	H/At/Aq/B/T	Long-term occupation of sites requires permanent facilities. Long-term loss of habitat and land use. Permanent facilities require increased size of site, increased footprint, more intensive construction methods. Long-term effects from vegetation clearance, erosion, changes in surface hydrology. Larger scale, construction activities, noise, vibration, emissions related to earth works. Aesthetic and visual intrusion. Proper site selection to avoid socio-economic, cultural impacts and due consideration of local/indigenous populations. Possible requirement for pipelines— construction, access, long- term occupation of land resource, introduction of barriers to wildlife movement.
	Transportati on pipeline	Footprint Interactio ns	H/At/B/T	Consider sensitivities in relation to biota, resource use, cultural importance, seasonality. Secondary impacts related to Potential impact on local infrastructure. Long-term occupation of sites requires permanent facilities. Long-term loss of habitat and land use. Permanent facilities require increased size of site, increased footprint, more intensive construction methods. Long-term effects from vegetation clearance, erosion, changes in surface hydrology. Larger scale

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Activity	Source	Potential Impact	Component Affected	Comments
				construction activities, noise, vibration, emissions related to earth works. Aesthetic and visual intrusion. Proper site selection to avoid socio-economic, cultural impacts and due consideration of local/indigenous populations. Possible requirement for pipelines— construction, access, long-term occupation of land resource, introduction of barriers to wildlife movement.
	Operations	Discharges Wastes Emissions	H/At/Aq/B/T	Long-term occupation of sites and permanent production facilities lead to long-term and increased potential for impact. Increased demand on local infrastructure water supply, sewage, solid waste disposal. Increased discharges and emissions from: production processes (waste water, produced water, sewerage and sanitary wastes, drainage); and power and process plant (waste gases, flaring, noise, vibration, light). Potential effects on biota, wildlife disturbance, habitats, biodiversity, water, soil and air quality. Increased risks of soil and water contamination from spillage and leakage.
		Socio-economic Cultural	н	Long-term permanent presence of facilities and workforce; increased demand on local infrastructure, socio-economic and cultural impacts (labour force, employment, education, medical and other services, local economy, effects on indigenous populations. Land-use conflicts. Visual and aesthetic intrusion.
Development and production (offshore)	Site selection	Interactions	H/B/Aq	Long-term site selection based upon biological and socio- economic sensitivities and minimum disturbance. Risk of impact to sensitive species, commercially important species, resource conflict, access. Long-term support and supply base requirement and impacts on local port infrastructure.
	Transportati on pipeline	Footprint Interactio ns	H/B/Aq/T	Long-term site selection based upon biological and socio- economic sensitivities and minimum disturbance. Risk of impact to sensitive species,

Activity	Source	Potential Impact	Component Affected	Comments
				commercially important species, resource
				conflict, access. Long-term support and supply base requirement.
	Operations	Discharges Emissions Waste	H/At/B/Aq/T	Long-term, chronic effects of discharges on benthic and pelagic biota; sediment and water quality. Impact of drill cuttings and mud discharges, produced water, drainage, sewage, sanitary and kitchen wastes, spillage and leakage.
				Emissions from power and process plant and impact on air quality. Noise and light impact from facilities and flaring. Solid waste disposal and impact on onshore infrastructure. Increased vessel and helicopter movements.
		Socio-economic Cultural	н	Loss of access and resource use interactions. Local port, harbour and community interactions related to supply and support functions.

# 1.14 ESIA Data Requirements

The purpose of this section has been to provide an overview of the international oil and gas industry. The assessments of ESIA data requirements relating to an oil and gas industry for Lebanon are detailed within other sections of this report. The relevant section for each impact receptor is given in table 1.4.

Impact Receptor	Report section/s
Human, socio-economic and cultural impacts	The data requirements for the production of an ESIA relating to this subject are covered in sections 11, 12, 13 and 14 of this report.
Atmospheric impacts	The data requirements for the production of an ESIA relating to this subject are covered in section 7 and 9 of this report.
Aquatic impacts	The data requirements for the production of an ESIA relating to this subject are covered in sections 4, 6 and 9 of this report.
Terrestrial impacts	The data requirements for the production of an ESIA relating to this subject are covered in sections 3, 8 and 9 of this report.
Unplanned pollution incidents	The data requirements for the production of an ESIA relating to this subject are covered in section 9 of this report.

Table 1.4. Location of ESIA data requirements for each impact receptor within this report

# 1.15 Description of Data Status

There is an abundance of high quality data relating to all aspects of the oil and gas industry on an international scale. Information can be obtained at all levels from high level conceptual understanding to very detailed technical documents relating to the latest technologies. There is a vast array of journals, forums and conferences to enable parties to keep their knowledge up to date in their particular field/s of interest.

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As of yet, there is very little data specific to Lebanon relating to an oil and gas industry. The new Offshore Petroleum Resources Law has been ratified, but is not yet enforced (reviewed in section 2 of this report). There are several seismic survey reports in circulation, but their application is highly specific.

It is anticipated that as Lebanon's offshore oil and gas industry grows, so too will the country specific data available.





# 2. Environmental Law

## 2.1 Environmental Law

Environment issues and environmental protection is slowly gaining greater credibility in Lebanon, largely due to the work of committed individuals and pressure from international agencies and funding organisations. A number of laws, decrees, and ministerial decisions govern environmental

management in Lebanon; chief among them are the laws and decrees establishing the Ministry of Environment itself and defining its mandate.

The fundamental framework law for the environment is the Protection of the Environment Law No. 444, and because of its importance it has been copied at the en<sup>-4</sup> of this Gap Analysis chapter. Decrees are the mechanism for implementation, and the Protection of the Environment Law will require 36 decrees for it to function in its entirety. To date, the majority of these decrees, although drafted, have not bee officially passed. With regard to the potential development of an in-country oil and gaJ industry, the most important decree is the MoE drafted Decree for Environmental Impact Assessment (EIA), which is currently under review by the Council of Ministers. Once passed, this will require all significant offshore and onshore oil and gas operation to be the subject of a mandatory EIA process.

The EIA Decree, strongly and comprehensively enforced, is absolutely essential for environmental protection in Lebanon in the face of economic development. The EL procedure needs to be allied to an efficient environmental legislative framework, quality control of the EIA reports and removal of political constraints that hinder its implementation. EIAs are not an obstacle to investment and economic development but promote a sustainable and equable use of resources; as the developed world ha discovered. Indeed, as international oil and gas operators have found, a comprehensive EIA process undertaken at an early stage of project planning and design, can prove to b an invaluable tool in the management of their operations, often resulting in significant cost savings, e.g. in energy usage or waste management. For this reason many international operators have an internal management system requirement to undertake the EIA process as a part of all projects. This internal requirement is a positive step forward, however, for Lebanon to have full control over the EIA process, e.g. to ensure comparable standards for all licence holders, there also needs to be an external legar requirement.

The system of prerogatives allocated to all Ministries, while in principle facilitating a democratic and robust approach, in practice is producing a stalemate and a lack of positive direction and progress. In addition, there are 735 legislative texts in Lebanon , many confusing and contradictory. The law on Liability, an old concept in Lebanon originating with the concerns of Phoenician traders, links pollution events with intention. International law uses the' Polluter Pays Principle', and the concepts of

Responsibility and Accountability, so it will be interesting to witness the play between the two when international oil and gas companies operate in Lebanon.

## 2.2 Environmental Aspects - Legal Status and Inconsistencies

The following text depends heavily on the publication 'Strengthening the Environmental Legislation Development and Application System in Lebanon (SELDAS) 2004.' This is a seminal work and although it is dated from 2004 it is worth quoting extensively in this Gap Analysis as it is only written in Arabic and, although changes have occurred in the Lebanese legislature, the concerns, shortfalls and inconsistencies are still very much present.

Aspects 1. Biodiversity 2. Water Air 3. 4. Soil 5. Land Use 6. Agriculture 7. Energy 8. Industry 9. Construction 10. Transportation 11. Noise 12. Solid Waste Management 13. Tourism 14. **Oil and Gas Activities** 

The following environmental aspects are discussed:

#### 2.2.1 Biodiversity

The legislative texts that make reference to biological diversity in Lebanon are old and lack the required legislative framework and implementation procedures due to the pyramid structure in Lebanon. This structure whereby the dominant laws on the top level, followed by legislative decrees and then ministerial decisions has lead to a weakness in the ability to apply laws, due to a lack of cooperation and participation between ministries.

There is also a lack of awareness on the importance of environmental issues among decision-makers and thus do not contribute to the modernisation and application of many laws. Despite recent plans and strategies that have been prepared for the management of natural resources and biodiversity, often these plans remain to be applied. This is important for building the foundations for devising new policies for biodiversity management and demonstrates the obstacle facing the protection and management of nature reserves compounded by the inability to secure financial sustainability, and threatening Lebanon's obligation to international conventions.

There is, in addition, a lack of definitions and vocabulary of technical terms, such as habitat types and classifications of protected areas, in legal texts, as well as definitions of the value of fauna and flora, along with the absence of regulations protecting endangered species.

The Ministry of Agriculture took the lead in planning, management and licensing associated with biodiversity, while the Ministry of Environment was only seldom mentioned in these

legal texts. This gave rise to conflicts of the roles and responsibilities of the two ministries, particularly with regard to placement of conditions, fishing regulations, and the establishment and management of nature reserves and reforestation. This has lead to disruption of the legal framework governing protected areas where some laws and decisions are governed by the MoE and while other are governed by the MoA.

Finally, there is a lack of financial aspects in legal texts referring to sponsorship and compensation for biodiversity, which is particularly important for the nature reserve management. The most significant gaps in Lebanese laws are the implementation of protected areas, environmental impact assessment, and texts that refer to conviction of violations against natural resources, as well as the mechanisms for adherence to obligations under international conventions which Lebanon has acceded to. In addition to this, there is a lack of legislative decrees that refer to monitoring mechanisms to convict violators and the likely penalties they face, as well as the qualified human resources and equipment required to carry these procedures out.

#### 2.2.2 Water

There is a critical absence of an official government policy governing the water sector in Lebanon, and the current legal framework does not give the MoEW or any other public institution policy development and formulation powers, despite the MoEW having a central role in management and control of the water sector in Lebanon.

The current legal system governing the water sector in Lebanon is significantly archaic in comparison to the advanced system of regulations in Europe, especially in terms of integrated water management.

The MoEW has only recently put more focus on attempting to properly manage the water sector. The only clear policy on water is Law No. 221/2000 that defined the role and competencies of the MoEW and reorganises the sector into 4 Regional Water Establishments (RWEs) and amended through Law No. 337/2001 that included sanitation responsibilities of the RWEs and MoEW. However, investment planning and execution rights have not been fully handed over to the RWEs but remain with the MoEW and CDR. Moreover, the regulatory framework to enforce and impose technical, fiscal or environmental standards and conditions are either non-existent or very ineffective such as the control of domestic and industrial discharges and uncontrolled groundwater extraction.

It is crucial that the National Water Sector Strategy be approved by the Council of Ministers to resolve the issues plaguing this sector. If properly implemented in coordination with other institutions, this strategy has the potential to mainstream environmental concerns and incorporate recent initiatives such as the Water Code, and CDR's wastewater programme, while eliminating institutional overlap and inefficiencies within the sector.

#### 2.2.3 Air

The laws related to air quality exhibit essential gaps and some of the most important text on protection of air pollution in Lebanon is inadequate and incomplete. For example, the texts do not address the issue of Lebanese procedures for emergency management making it difficult to control air pollution in the event of accidents and disasters. The texts also

struggle to distinguish between environment in general and the issue of air pollution in particular making it very inaccurate. In addition, sources of pollution are not specified or classified clearly, which has thus legal texts have neglected air pollution produced from the energy sector and air and maritime transportation.

There are also many gaps related to environmental standards and conditions while lacking in comprehensiveness. Necessary criteria for fixed sources of pollution, such as specifications for fuel type and height of chimneys have also been neglected from legal texts which are highly important in curbing air pollution. In addition, the standards do not have clear demarcation of minimum and maximum acceptable emission levels making them inaccurate.

The conditions of licensing for polluters also neglects environmental aspects especially related to air pollution. Although the Environmental Protection Law No. 444 stipulates that EIAs should be conducted on new potentially polluting projects, there is a lack of texts that determine the quality of information that is required from these studies. As for sources of fixed pollution, the texts do not distinguish between the conditions for permitting for construction and those for operation, which led to the legislation to neglect the defining concepts of international emissions permits. The texts also do not address the ban on import of substances harmful to the ozone layer despite the Montreal Protocol necessitating this completely.

Despite the imposition of special conditions on the import of vehicles and fuel, the legal texts have also neglected environmental factors with regard to determining the conditions for vehicle registration.

The major weaknesses at the executive level include the lack of environmental planning for pollution control, the necessary executive legal texts, and the necessary human resources and expertise compounded by a lack of equipment to carry out monitoring and inspection of emissions, as well as specialised judges in environment.

## 2.2.4 Soil

There are fundamental gaps in the laws related to soils in terms of protection from erosion and contamination, and existing laws for its protection are inadequate and incomplete. This is due to the fact that Lebanon is not essentially considered an industrialised country as such and since cost of management of this sector is high and so lacks the required planning.

There are no legal texts that directly associated with soil erosion, but instead the subject is mentioned in other laws that are related to issues such as laws against logging, grazing, the organisation and use of quarries, and agriculture etc. Moreover, these laws are spread across different ministries without defining appropriate strategies for application of

Permitting procedures do contain some mechanisms for the prevention of soil erosion however these are not concise and require means for their enforcement. There are even some requirements to compensate for lost vegetative cover due to construction through reforestation and land rehabilitation, but there are no specifications on how much land needs to be rehabilitated as found in other countries and often not applied. There is also a lack of legal provisions in environmental planning to suppress and control soil contamination as well as for the remediation of contaminated lands and the development of strategies for the management of risks associated with contaminated land. There's also a lack of environmental standards and conditions for activities that may result in land contamination, and a lack of criteria for the classification of contaminated sites and standards for remediating and testing the land.

Moreover, there's a lack of financial incentives to for environment friendly pollution control from various sectors, and many laws don't give protection of soils enough importance in terms of submitting of complaints and monitoring activities.

#### 2.2.5 Land Use

There are many legal texts in Lebanese legislation that address land management and zoning and in particular cover the following main areas:

- Land, cities, villages, and countryside planning
- Facilities Planning
- Construction and infrastructure planning
- Planning of natural area
- Planning of archaeological sites
- Management of public property and private state property
- Planning the use of natural resources

In comparison to international legislation there are many gaps in legal texts related to land use management and in particular those referring to the protection and safety of the environment.

- 1. Lebanese legislation does not clearly or explicitly set the provisions for taking into account safety and environmental protection in land use planning and land management, as opposed to other countries that give much importance to such matters. The few cases where they have been addressed are very general. Therefore it is necessary to determine clear environmental conditions and standards that should be taken into account when preparing land use plans and regional guidance plans. This should include consideration for protection of green cover and water resources, as well as public needs such as solid waste and wastewater management, transportation, and energy and water usage.
- There is a lack of essential and basic environmental concepts in land use and land cover planning such as the importance of public participation, a process which has become absolutely necessary in other countries. This not only makes a more acceptable scheme for public involvement in the planning process but can significantly enhance environmental protection.
- There is often overlap of roles and responsibilities between various public administrations.
   For example, overlap can occur in setting industrial zoning between the Ministry of Public
   Works and Transportation (Directorate General of Urban Planning) and the Ministry of

Industry (Department of Licensing) and the Ministry of Environment in relation to identifying industrial sites and conditions of licensing, investment and operation and development.

- 4. With the exception of the Higher Council for Urban Planning, which includes several administrations involved with land use planning including the Ministry of Environment, legal texts do not clearly indicate the necessity for coordination between relevant administrations involved in land use and land cover planning and the MoE. Moreover, there are no guidelines on how proper coordination with the MoE should be carries out. This is due to the fact that many legal documents pre-date the formation of the MoE in 1993.
- 5. Environmental protection and safety in land use and land cover planning cannot be fully implemented without the ratification and proper implementation of the Environmental Impact Assessment Decree.

#### 2.2.6 Agriculture

Many of the legislative texts relating to the agricultural sector have not been made to keep up with the developments in the application of ago-ecological practices. Most of the laws in force in this sector are old and in need of modernisation due to changes in data management and nomenclature, since many date back pre-1970s and to the French mandate.

As with most sectors, many environmental concepts are absent from legal texts relating to agriculture, or any reference to the principles of sustainable agriculture or organic farming, or the concepts of integrated pest management, and exercising best-practice techniques. Most of the laws deal with farming issues, such as herding and grazing and use of agricultural chemicals on the basis of public health and safety only without directly addressing the environmental issues such as soil quality, biodiversity, and vegetation.

These laws also did not encourage the rehabilitation of damage agricultural land or forests prone to indiscriminate grazing. However, the guideline decrees do encourage increasing vegetative cover in the absence of conditions and environmental standards and clear licensing and monitoring.

There is an urgent need to issue decrees that determine the application of environmental laws that are currently in force, for example, it is legally required to specify the environmental conditions of harmful substances and hazardous chemicals. However, the decree that determines the details for such a law has not been issued. Moreover, Lebanon is also committed to complying with international conventions such as the Montreal Protocol and Stockholm Convention amongst others that stipulate the use of agricultural alternatives, but the necessary enacting decrees have not been ratified or are currently in the process such as the phase-out of methyl-bromide.

In addition to the lack of regulatory decrees, other texts lack the necessary legal supplements, such as the Decision No. 94/1 dated 20/05/1998 that banned the use of several substances, however did not determine the penalties when it is breached.

There is an urgent need for Lebanon to keep up with the evolution of environmental legislation in the international arena and to integrate environmental concepts into the agricultural sector through:

- Identifying and clarifying the definitions and terminology used in the sector and the addition of basic environmental concepts such as organic farming, integrated pest management, alternative crops, and supporting sustainable agricultural enterprises
- Updating legal text that define and clarify the roles, responsibilities, and coordination mechanisms among stakeholders (especially the ministry of agriculture, environment, and public health)
- Developing a classification system for all agricultural establishments (vegetative and livestock)
- Introducing the concept of Strategic Environmental Assessment in the development of policies, plans, and programmes for the sector
- Develop programmes and action plans that address land degradation and exploitation of water resources, and agricultural pest control
- Strengthening the presence and quality of environmental standards and conditions that must govern agricultural practices in terms of land use (terracing mountainous areas), water consumption, pesticides and fertilisers, and waste management
- Developing a licensing system to include clear environmental conditions based on EIA studies.
- Issuance of implementing decrees from Law No. 444 that would provide financial incentives for investment in environment friendly agriculture, and concessions for building the foundations for integrate environmental management of the sector though certificates etc.
- Regulation of water consumption in the sector through the creation of water user associations and impose fees for the rate of consumption
- Indentifying administrative and judicial mechanisms (procedures and the principles of offenses and penalties) which should include deterrence of encroachment on environment and natural resources.
- Encouraging local initiatives to develop research and studies on sustainable agriculture such as irrigation techniques and crop selection, as well as develop awareness and training programmes for farmers

## 2.2.7 Energy

It's fair to say that the legal texts relating to energy sources in Lebanon are outdated and have not been modernised in parallel to the development of new technologies. It is clear that Lebanese laws related to this sector needs to be directed more towards ensuring environmental protection while maintaining sustainability for future generations. The actual implementation of such concepts is almost impossible due to conflicting legal texts which are not based of clear foundations and without clear strategies. The effectiveness of environmental protection is this sector depends on clear understanding of the "polluter pays principle" and therefore it is necessary to set standards and conditions and monitoring its proper application as well as enforcement by penalising and fining polluters. However,

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incentives must be provided to promote the sustainable energy production to prevent pollution.

In the context of management and implementation, it is clear that the Government is unable to bear the burden of intervening in controlling the oil and gas market and the development of trade under administrative supervision and its direct control to effectively apply the conditions imposed on oil and gas distributers and storage areas as well as the relationship between the state and the direct production and sale of electricity. The Government understands this problem and passed several laws that will allow it to monitor these operations, giving it a margin of freedom for intervention, and ensures the provision of necessary data for this intervention. Among the most important laws in this regard is the law regulating the energy sector, which is moving towards privatisation, and establishing the National Council for Accreditation which allows the private sector to conduct inspection and monitoring operations, without any political and administrative intervention.

Lebanon has not been able to keep up with the rapid and continuous development of new technologies and not only has it not been able to benefit from this but is not prepared for dangers from the introduction of such new technologies. The absence of the enacting decree for Environmental Impact Assessment prevents the proper assessment of risks associated with these new technologies. Moreover, the absence of conditions and standards in turn prevents the proper assessment of these health and environmental risks. There is no information on underground storage tanks and no set requirements for these tanks. There are also no statistic on the impacts of transmission lines and standards for their establishment. The reports from the World Health Organisation on electromagnetic fields have not found a place in Lebanese legal system, and the Government does not contribute to these reports like other member states do.

#### 2.2.8 Industry

Law No. 444 on Environmental Protection emphasises the need to adopt the "precautionary principle" which would in turn require the adoption of effective and appropriate based on modern scientific information, and promote the use of best available clean technologies designed to lessen the threat of potential environmental damage.

Although many of the legal text in the industrial sector are very old and date back to 1932, they are apparently somewhat comparable to contemporary texts. For the legislations that were passed during this period of Lebanon's life established the entire judicial system in Lebanon, and were ahead of their time, and introduced a revolution of concepts. During this period Lebanon was transformed from Ottoman rule, with its feudal superstructure, to a constitutional republic. The royal decrees and mandates of the Ottoman Empire that were not based on any justification were thus replaced with legislative texts based on democracy and the constitution.

The legislative decree 21/L 1932, for example, provided a key role for local authorities as stated in the amended reports on roles of decentralised authorities represented by Governors and sub-Governors (Qaimaqam), and sixty years before the reference document of national reconciliation on administrative decentralisation.

Many Countries still rely on the same classification adopted by the legislative decree mentioned in terms of the three categories of organisations and the necessity to keep them at a safe distance away from residential buildings. However, the powerful structure of these texts and the precision in the legislation as well as the vision which characterised it did not make it modern. For the year and the technological advancement that characterised the twentieth century made most of these texts lose their effectiveness and requires updating to keep up the pace.

In an effort to rectify this situation law No. 742 – 1996 was issued and its enacting decree 8018 – 2002, that both transferred the normative authority of governors and sub-governors to the Minister of Industry, and like-wise the decentralised decisions to a decision by the central authority, unlike international and scientific directives.

The development of laws governing classifying organisations that would require environmental licenses was overlooked as well as other licenses such as those for the use of natural resources of licenses for emissions and discharge of liquid and solid wastes whose discharges amounts should be measured and charged under the application of the "polluter pays principle". Lebanon has therefore ended up with a licensing system for industries that does not guarantee environmental protection and environmental issues remain as secondary concerns vested in the Ministry of Environment alone. The Ministry of Environment has however attempted within its capacity to pass decisions associated with greening industry such as setting standards and conditions however these are scattered and inconsistent. The effectiveness of these decisions imposed on licensors and manufacturers also remains uncertain due to the weakness as a mandatory ministerial decision that require ratification by the Council of Ministers.

New legal texts have not managed to reduce administrative routines or increase the effectiveness of environmental monitoring and control of violations. The gaps in these texts have contributed to the weakness in their implementation especially when issuing environmental and health licenses, and specifically for conducting EIAs, whose enacting decree has not been ratified yet.

Many legal texts are lacking since they have not been submitted for approval by the administrative court, because the issuance of ministerial decisions cannot be issued before the approval of specialised decrees that relate to every part of the production process, from the management of raw materials to waste management to emissions control and so on.

Even if legislative texts that protect the environment from industrial processes are passed, there is a clear lack of institutional capacity and qualified human resources that are experienced with environmental and health legislation and its application as well as monitoring techniques.

In the absence of decrees regulating essential aspects of the industrial sector such as management of industrial solid and liquid wastes and emissions, in addition to the EIA Decree, the environmentally technical face of Lebanese law has many incomplete elements.

A significant disadvantage in Lebanon is the lack of coordination between administrative departments, and the many contradicting and conflicting legal texts governing the functioning of these various departments.

#### 2.2.9 Construction

The use of quarries in Lebanon poses a significantly large impact on the natural environment in Lebanon. However, their management is often very poor and politically intertwined. In 2002 the National Council for Quarries was established and represents all the ministries associated with this sector including the Governor. The Council was formed following much debate over designation of power to issue licenses to open quarries between ministries and the Governor. The functioning of the Council, however, is obstructed by the lack of an official master plan that has only been issued in 2009 and is yet to be fully implemented. Despite the fact that some legal texts contain important environmental matters such as restoring and rehabilitating quarries the effectiveness of the licensing mechanism requires further supporting environmental regulations such as the management of waste generated from quarries, of which the Ministry of Environment has prepared a draft Decision tackling this issue.

Legal texts associated with quarries also lack mention of self-monitoring, although the Environment Protection Law No. 444 stipulated the importance of this process in ameliorating pollution control and environmental degradation, there is a lack of qualified human resources to carry out such procedures.

There are very few legal texts that deal with environmental impacts arising from the organisation of the construction sector and are scattered in various different laws, decrees, and decisions, and mostly refer to the protection of green spaces and the provision of public sanitary services such as public water supply to buildings, and ignore the actual impacts of pollution from construction.

Despite the Decisions issued by the Ministry of Environment, including the Law #444 that refer to standards and environmental conditions for construction sites, materials, equipment, and management of construction waste there is a lack of integration of environmental concepts in construction laws and regulations in particular. There is clear weakness in setting modernised best-practice standards and environmental requirements, a lack of any mention of green buildings and environmentally sound construction methods, as well as conditions restricting emissions from works and machinery and noise limitations. Even when these texts exist, there is poor capacity for monitoring and enforcement, in addition to a lack of clarity on roles and responsibilities of relevant parties.

Without sound legal environmental grounds for the construction sector, the mechanisms for control, enforcement, and incentives to build an environmentally friendly sector are lost, and it is necessary to update the existing laws and regulations to integrate environmental standards, conditions, and guidelines, which are necessary to regulate licensing mechanisms and control as well as other legislative aspects.

#### 2.2.10 Transportation

The legal texts governing the transport sector in Lebanon make little reference to environmental pressures arising from the sector in terms of air pollution, noise, waste, land degradation etc.. This is mainly due to the fact that transportation laws in Lebanon are old and obsolete, and are not in line with modern environmental legislation. The weakness in the planning and management can be highlighted by the poor joint management of the sector that could contribute to emissions reduction in major cities.

Legal texts that do make reference to environmental issues mainly focus on land transportation while texts relating to maritime and air transport are very few and weak. However, Lebanon has signed up to several international conventions mainly referring to shipping but is lacking the mechanisms for their implementation.

Moreover, there is often weakness or inaccuracy in definitions and vocabulary of technical terms, such as determining emissions from exhaust (e.g. toxic smoke), and a shortage of technical charts defining environmental standards for emissions and pollutants (gaseous, liquid, and noise).

On the management side, there is also a clear lack of coordination between concerned authorities (such as the Ministry of Public Works and Transport, the Ministry of Interior and Municipalities, the Ministry of Environment, and local authorities) in planning, legislation, implementation and monitoring. Despite the existence of a Higher Council for Land Transportation it has not proven its effectiveness as focal point for coordination, especially since it was established before the creation of the Ministry of Environment, and was not amended to include it among its members, noting that the MoE has a key coordinating role for issues relating to environment that involve more than one ministry, as indicated in Decree No. 5591 dated 1994, and the need to identify the way to address these issues by a joint order from the Minister of Environment and other concerned Ministry so as to ensure coordination and its integrated implementation.

Most legal texts also do not provide financial incentives to support and promote environment friendly transportation from infrastructure to vehicles, except supporting the phase-out of leaded petrol and the incentive to place conditions on the import and registration of new vehicles. However, in reality the latter remains inadequately implemented and requires reform. Moreover, the absence of insurance for environmental accidents does not allow the effective implementation of the "polluter pays principle" that was adopted in the Environmental Protection Law No. 444 dated 2002.

With regards to implementation, the greatest gap remains the lack of implementing procedures for most of the principles stipulated in Lebanese law, especially what is due for carrying out environmental impact assessments for projects and the environmental legislations that manages environmental impacts from the transport sector such as emissions and pollutants, management of wastes resulting from transport from oil to used tires, and the conditions for construction of facilities and infrastructure for the transport sector. Along with the lack of implementation procedures, the shortage of qualified human resources and equipments in relevant authorities (such as the Ministry of Public Works and Transportation and the Ministry of Interior and Municipalities) prevents the effective application of laws in terms of monitoring mechanisms for examination and inspection, and control violations, as well as shortage of specialist in environmental planning. A lack of awareness by decision-makers also contributes to the application of many laws especially those associated with environmental issues.

#### 2.2.11 Noise

There is an absence of any clear definitions of the terms noise and noise nuisance areas in legal texts in Lebanon. However, some texts include a number of standards (measured in decibels) that determine the maximum allowable levels of noise in the workplace, factories, and workshops, as well as limits to noise in residential, commercial, and industrial areas amongst others. Although the existence of these standards is a good starting point for noise management, there are many other scientific standards that define permissible noise limits for the sectors such as transportation, construction, machines that are not found in Lebanese legal texts.

There are various different players that can have direct or indirect role in the management of noise. The MoE for example has specific roles in setting the scientific criteria to determine the permissible levels and intensity of noise outdoors and indoors, as well as levels of machinery, engines, vehicles, and others. On the other hand, the Ministry of public Works and Transportation has an important role in controlling levels of noise through: zoning and land use management, through the Directorate General of Urban Planning; management and organisation of the road network, through the Directorate General of Roads and Buildings; management of land and maritime transport through the Directorate General Directorate of Civil Aviation.

The Ministry of Industry has an important role in controlling noise through the permitting process of industrial enterprises and through the establishment of industrial zones. The Ministry of Interior and Municipalities have responsibilities of ensuring the proper application of these standards through the Internal Security Forces and the Municipality police.

However, it is clear that legal provisions could be strengthened through the Environmental Protection Law No.444 that ensures environmental protection of all types of pollution. This law specifically stipulates the importance of conducting the environmental impact assessments on proposed projects, whereby appropriate mitigation measures could be implemented that would include the impacts arise from noise pollution. The law also includes a set of standards and conditions particularly related to noise as well as several incentives to mitigate noise pollution. However, the effectiveness of this law depends on the ratification and implementation of supplementing decrees.

It is clear that the urban planning and land management are an important means to control noise. For example, guidelines and regulations detail the need for industrial zoning schemes to separate these areas from residential areas to avoid nuisance from noise to the general public. However, this remains to be properly effectively applied on the ground.

In the road transportation sector there is a lack of standards for noise altogether. However, the laws governing road vehicles (cars and motorcycles) have legal provisions related to regulating noise generated from horns and their proper use to prevent nuisance. However, this is with absence of standards that determine maximum levels of noise from engines and horns. The maritime and air transport sectors are completely lacking any environmental standards relating to infrastructure (ports and airports) or vehicles (ships and aircraft),

noting that international legislations gives much importance to noise levels from such sources.

There are several legislations concerned with noise produced form the industrial sector, both direct and indirect. These range from zoning of industrial areas to permitting procedures for establishing and operating these industrial installations. There are also several more direct legislations to reduce noise levels in industry such as the necessity to use soundproof walls in production departments, and the need to provide machines and engines with silencing cases. Despite the large number of text governing noise productions the standards that define the permissible limits of noise are absent from all the texts.

Quarries in Lebanon are also bound by some legislative texts related to noise. For example, for license application it is necessary to submit an EIA that reflects the impacts of noise on the surrounding environment. In addition, legislation sets the minimum distances between quarries. Again, standards of permissible limits of noise are absent.

Legal requirements also exist for residential areas, whereby the increase in private generators in the country has called for the use of silencers, but not indication of what technical specifications and standards these silencers need to be. Moreover, there is not a clear and scientific definition of the term "nuisance" in these texts.

#### 2.2.12 Solid Waste Management

Lebanese legislation associated with solid waste management (SWM) is often outdated and incomplete. There is a weakness in the definition and vocabulary of technical terms and also the distinction between the types of waste according to their sources and their nature. Although Decree No.8006 – 2002 classified health wastes and its dangers, it lacked the clear classification of other types of waste such as industrial waste. Recognising the importance of defining industrial waste for its adequate management, the MoE set a number of conditions for license for several types of establishments and activities, however there are many types of industries that need specific technical definitions of solid waste established in the ungratified decisions of the MoE.

Several texts do not address solid waste directly but are found embedded in other public issues including the protection of public health, natural sites, and the sea. Other texts have been enacted spontaneously with little regard for the implementation, such as Decree No. 9093 – 2002 that offers financial incentives for municipalities that accommodate SWM facilities, including landfills, however is impossible to implement.

There is also often a lack of clarity in powers associated with SWM and poor coordination between authorities (such as the MoE, Ministry of Interior and Municipalities, the Ministry of Public Health, and local authorities) in planning, legislating, implementing and controlling. Decree No. 5591 – 1994 however gives the MoE a fundamental role of coordination when addressing issues that involve more than one ministry. Although this law recognises the MoE's responsibilities in pollution control and protection of the natural environment, this was not back up with implementing decrees giving it executive powers. Therefore, the administrative framework does not accommodate adequate mechanisms for licensing and clear control over establishing solid waste treatment facilities.

There remains a large gap in implementation decrees for fundamental principles in Lebanese law, especially that of EIA of projects for solid waste treatment facilities and the environmental conditions that regulate the impact of this sector on the environment, such as emission, pollutants, industrial waste management, hazardous waste management and special conditions for establishing processing facilities and drainage. A lack of qualified human resources with experience in environmental planning and with the use of technical equipment for monitoring purposes is another impeding factor along with awareness of critical decision-makers on environmental issues who are important in implementing laws. It should also be noted that the privatisation of the SWM sector has reduced the roles of municipal councils and limited the effectiveness of these legal provisions.

#### 2.2.13 Tourism

The laws surrounding the tourism sector are like many sectors out-dated and have not kept up with the development of the tourism sector towards concepts such as eco-tourism and the environmental management of the tourism enterprises. This is due to the fact that many texts were passed before the creation of the Ministry of Environment and thus ignores its current roles in terms of controlling investments by tourism establishments and even in providing an opinion on licensing of tourism enterprises. This does not coincide with the fact that most of the decrees that are related to licensing of tourism enterprises require an EIA and compliance with environmental requirements. This demonstrates the conflicting nature of the legal system and lack of coordination in Lebanon.

Optimistically, some legal texts ensure that the legal provisions concerned with the organisation of the tourism sector on the protection of the maritime domain are in place, but strongly indicates the lack of its application.

The interdependence between the tourism and environment sectors is, however, robust since most of the laws related to environmental protection attempted to protect the tourism sector and work towards its sustainable development, while many of the provisions that deal with the protection of the tourism sector clearly seek to preserve the environment especially in recent laws and decisions.

#### 2.2.14 Oil and Gas Activities

A completely new Petroleum Activity Law and accompanying Regulations is currently being drafted with guidance from Petrad, Norway. This law will be the instrument that will control and regulate oil and gas activities in Lebanon.

The content also includes provision for SEA and EIA Reports as a mandatory requirement for oil and gas projects.

# 2.3 Considerations

The original intention was to tabulate the prerogatives and responsibilities for various Lebanese government ministries and agencies and delineate the environmental roles and responsibilities for each. In the event such a matrix would not have aided clarification, particularly as there appears to be a common situation whereby several different ministries with rights have been assigned equal responsibilities against the same environmental issue,

and conversely some environmental issues were not assigned to any ministry or government body. This situation effectively stalls any progress on implementation and creating an effective regulatory framework.

Due to the above, the Ministry of Environment does not have an effective and clear mandate to promote environmental protection. The presumption is that the EIA Decree will be passed for use in the near future, and this will increase pressure on the MoE staff responsible for ensuring implementation and quality control.

In this context, it is important to note that Article 4 of Law 216 called for the creation of an "Environmental Advisory Council," a group of no more than 12 environmental specialists designated by the Minister of Environment. While the Advisory Council was never put in place, the amended Law 667/97 (Article 3) calls instead for establishing the National Environmental Council. The Environmental Council would be charged with formulating proposals and recommendations for a comprehensive and integrated environmental policy as well as suggesting implementation plans, which would become binding upon their approval by the Council of Ministers. Membership of the National Environmental Council is to be evenly divided among representatives of concerned ministries and those of civil society (NGOs, private sector, academia).

This proposal requires the fullest support in preparation for managing the much increased work load associated with Environment and Social Impact Assessments conducted by the oil and gas operators.

It is possible that clarification will be required concerning the contents and responsibilities of the EIA Decree and those of the new Petroleum Activity Law. Both have provisions for the production of EIAs; the Petroleum Activity Law cites SEAs and EIAs in relation to oil and gas activities, whereas the EIA Decree has a broader scope and is also concerned with subsequent management of the identified impacts. Potentially, environmental impact assessments could be seen as conflicting with rapid economic development, so it is important that EIAs are evaluated using established and internationally accepted environmental criteria by competent and qualified staff. The creation of a National Environmental Council could have a significant contribution to make.

# Protection of the environment Law No. 444 -

# issued on 29/7/2002

House of Representatives passed, President of the Republic and published the following law:

A single article - ratified the draft law laid down in Decree No. 8171 aimed at protecting the environment as amended by the Administration and Justice Committee. This law upon its publication in the Official Gazette. Baabda, July 29, 2002 Signature: Emile Lahoud Issued by the President of the Republic Prime Minister Signature: Rafik Hariri Prime Minister Signature: Rafik Hariri

# **Environmental Protection Act**

## **Section I - Basic Principles and General Provisions**

**Article 1** - This law defines the general legal framework for the implementation of national environment protection policy in order to prevent all forms of degradation, pollution and damage and suppression and the promotion of sustainable use of natural resources and life insurance under the environmentally sound and stable.

Article 2 - For the purposes of this Act, Definitions:

A - Environment: the natural environment (i.e. physical, chemical and biological) and social beings who live in all living systems and the interaction within the environment and within organisms and between organisms and the ocean.

B - Initial environmental examination: a preliminary study aims to identify potential environmental impacts of a project to determine the need for environmental impact assessment study for the project.

C - Environmental Impact Assessment: Identify, assess and evaluate the effects of a project on the environment and set the necessary measures to mitigate the negative impacts and increase positive impacts on the environment and natural resources, before giving the decision to approve or reject the project.

D - Environmental Management Plan: A set of mitigation measures and means of monitoring, control and institutional measures taken during the creation, operation or dismantling of the project, which would cancel the negative environmental impacts or mitigate to acceptable levels locally, if any, except in accordance with United Nations standards.

The "environmental management plan" an integral part of the report "Environmental Impact Assessment" report, "the initial environmental examination."

E - Biodiversity: the variability among living organisms from all sources including, inter alia, terrestrial ecosystems, marine and aquatic ecosystems that are part of this includes diversity within species, diversity between species and of ecosystems.

F - Natural Resources: The following elements of the environment: air, water, earth and living organisms.

G - the ecosystem: Ecosystem complex vital for the groups of organisms of plant and animal interacts with the environment of non-living because they represent the functional unit.

**Article 3** - Everyone has the right sound and stable environment, it is the duty of every citizen to ensure the protection of the environment and ensuring the needs of present generations without compromising the rights of future generations

**Article 4** - in the context of environmental protection and natural resource management, all natural or legal person, public or private should adhere to the following principles:

A - the precautionary principle, which requires the adoption of effective and appropriate measures based on scientific information and the best available clean technologies designed to prevent any threat of damage potential and not subject to correct damage to the environment.

B - the principle of preventive action for all damages caused to the environment, through the use of best available techniques.

C - the principle of "polluter - pays" which stipulates that the polluter bears the costs of preventive measures, pollution control and reduced.

D - the principle of conservation of biological diversity, which requires that all activities to avoid injuring the various components of biodiversity damage.

E - the principle of avoiding degradation of natural resources, which stipulates that all activities to avoid causing any damage cannot be correct for the natural resources like water, air, soil, forests, rivers and the sea, and others. And - the judge that the principle of participation:

1 - Every citizen shall have the right to obtain information relating to the environment, according to the laws and regulations in force.

2 - ensures each natural person or legal entity, public or private, for the safety of the environment, and contributes to the protection and to report any danger that might threaten them.

G - the principle of cooperation, which requires public authorities to cooperate and local citizens to protect the environment at all levels.

H - the principle of the importance of standard customary in rural areas, the requirement that the introduction of this custom in the absence of the text.

I - the principle of pollution control, which aims to prevent and control pollution in all environmental media of water, air, soil and plant and waste treatment so as not to cause pollution in the environment of pollution to move to the center of another, or to influence him.

J - the principle of relying on economic incentives as a tool of control and regulation in order to get rid of all sources of pollution and / or mitigation and promote sustainable development policy.

K - the principle of environmental impact assessment as a means of planning and management in order to combat sources of pollution and degradation of natural resources, curtailment or reduction in size to a minimum.

# Part II - Organization of Environmental Protection

# **Chapter I - Environmental Planning**

# Article 5 -

1 - For the purposes of application of this law, puts the Minister of Environment Basic Plan for the Protection of the Environment on a proposal of the National Council for the Environment, the plan recognizes the decree adopted by the Council of Ministers upon the proposal of the Minister of Environment.

2 - Environmental Protection Plan is subject to periodic review of the basic carried out by the Minister of the Environment every two years on the proposal of the National Council for the Environment, adopt amendments to the decree adopted by the Council of Ministers upon the proposal of the Minister of Environment.

3 - take the audit conducted every two years into account the particular activities that are held for the environment, as damage affecting the environment and the risks that are identified as to the progress in scientific research and technological development.

# **Chapter II - National Council for the Environment**

**Article 6** - The Council shall be established a national environment of fourteen members. Is written by the National Council for the Environment and the way it works under the decree of the Council of Ministers upon the proposal of the Minister of the Environment, to be divided equally between the representation of ministries concerned with the environment and stakeholders from the private sector (environmental associations and environmental experts and members of trade unions liberal professions).

**Article 7** - The National Council for the Environment, in addition to the tasks entrusted to him under the law of creation of the Ministry of Environment, the following advisory functions:

A - recommendation identifying environmental goals and priorities, and propose amendments to the environmental policies.

B - Evaluation of the environmental consequences of each activity with a relationship to natural resources and make the necessary recommendations.

C - Coordinate orientations institutions, departments and ministries concerned with the protection of the environment.

D - Recommendation to amend the laws, regulations, specifications and standards of quality and standards of national environmental protection and principles.

# **Chapter III - the financing of environmental protection**

**Article 8** - is the establishment of a national fund for the environment has a legal personality and financial and administrative Balastqlalin and is subject to the control of the Audit Bureau stern tutelage and the Minister of Environment.

Article 9 - The Fund shall be vested in the National Environment following duties and powers:

A - contribute to the funding procedures for monitoring and supervising the application of this law and its provisions applied.

B - conditions for granting loans recommendation referred to in this article.

- C the recommendation to grant incentive measures referred to in Article (20) of the Act.
- D Support the development of research and technological progress in matters of environmental protection.

E - To support and encourage activities and sustainable development projects aimed at protecting the environment and combating desertification, deforestation, soil erosion and protect biodiversity.

And - support initiatives and activities undertaken by associations and non-official.

G - to contribute to the preventive activities that have an impact on the environment in general.

H - granting loans defined by a decree of the Council of Ministers upon the proposal of the Ministers of Environment and Finance, each of the active charge would improve the quality of the environment.

# Article 10 -

1) - made up of imports of the National Fund of Environment:

A - annual financial contribution seen in the laws of the general budget and determined according to its needs.

B - charges for the protection of the environment imposed under this Act or by special laws.

C - subsidies, grants, gifts, bequests, which give it a particular bodies of national and foreign public and private in order to protect the environment and development.

D - Fines and damages awarded or agreed on the damages caused to the environment pursuant to the provisions of this law and reconciliations taking place on them.

E - the proceeds and revenues and the benefits of his money.

2) The balance of the Fund and special funds are public funds.

3) allocate the Fund's resources in order to achieve its objectives.

4) are produced and imports from the proceeds and benefits of funds of the Fund shall be deposited in a special account at the Bank of Lebanon, according to the assets specified in the Regulations of the Fund.

**Article 11** - How the organization of the National Fund for the Environment and the assets of its functions to be determined by decree of the Council of Ministers upon the proposal of the ministers of environment, finance, and in the same manner may amend the Fund's assets and its functions.

# **Chapter IV - Environmental pollution control mechanisms**

# Article 12 -

1 - in order to achieve integrated control of pollution, defined by a decree of the Council of Ministers upon the proposal of the Minister of Environment, the national environmental quality standards and methods as granting the necessary permits, and monitoring its implementation and assess the status of assets and protect the environment.
2 - can the Ministry of Environment, for this purpose, employ an expert in any national or international in the process of determining the national standards which are periodically reviewed. And that taking into account the development of scientific knowledge and technological advances and the internationally accepted standards.

**Article 13** - includes assessing the status of the environment and protection programs of environmental management carried out by institutions classified and other institutions that carries out contaminated, and programs of self-censorship or environmental audit, in order to objectively evaluate and periodically the effectiveness of measures taken in the field of pollution control or reduce it and inform the public the results of these measures.

# Part III - Environmental Information System and participation in environmental management and protection

# **Chapter I - Environmental Information System**

# Article 14 -

1) put an information management system relating to the environment and methods of protection, applied under the supervision of the Ministry of Environment, to identify ways of organizing environmental information management decree adopted by the Council of Ministers upon the proposal of the Minister of Environment and consult the National Council for the Environment.

2) any natural person or legal entity on environmental management and sustainable development, and the right of access to environmental information management system, in accordance with the provisions of this law and its provisions applied. Everyone has to get objective information concerning the status of the environment, with the exception of information relating to national security or professional secrecy.

Should be given this information within one month, and all refused to give the required information must be justified.

**Article 15** - Ministry of the Environment shall ensure the application of information systems, consulting and warning, as set forth in international and regional treaties on the environment and to which Lebanon or join them.

# Article 16 -

1 - Each educational institution, elementary, middle, secondary, university, whether public or private, and every other academic institution, that fall within the curriculum, educational programs concerning the environment.
2 - under the programs listed in item I of this article are subject to the approval of the Ministry of the Environment in accordance with the conditions determined by decree of the Council of Ministers upon the proposal of the Minister of Environment and the ministers concerned.

**Article 17** - the public and private institutions working in the fields of education, training, education and research, information and culture, to cooperate with the Ministry of Environment and relevant ministries, the development of information campaigns and awareness campaigns on the protection of environmental media and natural resources and the application of prevention techniques.

# Chapter II - System participation in the management of the environment

Article 18 - believe in citizen participation in environmental management and protection through:

1 - free access to environmental information in accordance with the laws and regulations in force.

2 - Develop consultative mechanisms at the national and local associations of citizens and caring for the environment.

3 - Development of environmental education in the national educational system.

4 - awareness campaigns and information to citizens about environmental issues.

5 - the organization of activities of general interest in the context of environmental protection.

6 - Developing technologies for recycling and collection centers, sorting and disposal of waste, particularly at the local level.

7 - Prepare guidelines for the use of technologies and alternative energy and materials and maintain the natural resources and follow-up to encourage the development of indicators of pollution prevention and reduction and control.

8 - Everyone has a duty to inform the Ministry of Environment for all damage which may affects the environment.

**Article 19** - set by decree taken in the Council of Ministers upon the proposal of the Minister of Environment, after consultation with the relevant ministries, the origins of the implementation of the participation of citizens mentioned in Article XVIII of the Act.

# **Chapter III - stimulus measures**

# Article 20 -

 each of the used equipment and technologies allow the avoidance or reduction or elimination of all forms of pollution as waste treatment and recycling and the use, benefit from discounts on customs duties due on such equipment and technologies, by 50% (fifty percent) maximum under the conditions and assets that determine the decree adopted by the Council of Ministers upon the proposal of the Ministers of Environment and Finance.
 any natural person or legal entity based activities preserve the environment will benefit from a tax cut that deal with these activities, by 50% (fifty percent) maximum under the conditions and assets that are defined by a decree of the Council of Ministers upon the proposal of the Ministers of Environment and Finance.

3) of the Council of Ministers upon the proposal of the Ministers of Environment and Finance and the competent Minister approved every measure of economic incentive or other financial.

# Part IV - Evaluation of environmental impact

**Article 21** - the stakeholders in the public and private studies environmental screening or initial assessment of the environmental impact of projects that may threaten the environment, because of their size or nature or effect or activities. Decline in the Ministry of Environment of these studies and approved after confirmation of their relevance to the safety conditions of the environment and sustainable natural resources.

## Article 22 -

1) The word "project" means:

A - implementation of building works or other construction.

B - Any intervention in the natural environment, including those involving acts of extraction or addition of natural resources.

C - any suggestion program, study or invest or regulation affects the Lebanese full activity or sector as a whole. D - any modification, addition, expansion, rehabilitation or closure of the activities referred to in paragraphs (a), (b), and (c) of this item.

2) Prepare the initial examination or study of the environmental impact assessment at the expense of the entrepreneur and his account. As well as all expenses and costs of surveillance.

**Article 23** - determine how to implement this section and put the list of projects subject to study the environmental screening of principle and a list of projects subject to environmental impact assessment study and determine the fees and the cost of the review referred to in article twenty-one decree adopted by the Council of Ministers upon the proposal of the Ministers of Environment and Finance.

# Part V - Protection of environmental media

# Chapter I - Protection and control of the air smells annoying

# Article 24 -

 Every natural or legal person, public or private, in the exercise of his activity, that is committed to non-emission or leakage of air pollutants, including odors disturbing or harmful, are prohibited under this law and its provisions applied and all other laws in force, or beyond the limits allowed and determined by the national standards for the quality of the environment, taking into consideration the text of paragraph (d) of Article II of this Act.
 prohibits the possession, use or investing machines, engines or vehicles produced by the emission or leakage of air pollutants, including odors disturbing or harmful prohibited under this law and its provisions applied and all other laws in force, or beyond the limits permitted and specified by national standards for quality environment, taking into consideration the text of paragraph (d) of Article II of this Act.

# Article 25 -

1) must when burning any type of fuel or fuel or other purposes, whether in industry or power generation or any other purpose, to keep emissions of all types within the maximum limits allowed.

2) determine the specifications of chimneys and other means of emissions control on the different types leaks from the combustion process in accordance with national standards of environmental quality in addition to the maximum limits allowed.

**Article 26** - all natural or legal person, public or private, especially when the use of machines, engines or equipment or vehicles or when using horns or loudspeakers, to commit to not exceed the maximum limits allowed for the intensity of noise and determined by the national standards for environmental quality, with taking into consideration the text of paragraph (d) of Article II of this Act.

**Article 27** - Every natural or legal person violates the provisions of Articles 24, 25 and 26 of this Law, foreshadowing by the competent local authority, which shall inform the Ministry of Environment and relevant ministries or departments for a warning.

If the violator does not comply with the content of warning within the time limit specified therein, as well as in case of emergency, the Minister of Environment to take all legal measures designed to stop the activity of the polluted air environment after select it.

**Article 28** - Decree provided for in Article XII of this Law, the assets of monitoring the implementation of the provisions of Articles 24, 25, 26 and 27 of this Law.

# Chapter II - Protection of the coast and marine environment from pollution

# Article 29 -

1) aimed at protecting the marine environment from pollution to achieve the following purposes:

A - Protecting the shores of the Republic of Lebanon and its natural resources and ports of the risk of pollution in all its forms and manifestations.

B - Protection of Lebanese territorial waters and non-living natural organisms, the risk of pollution in all its forms and manifestations.

2) The Ministry of Environment in coordination with the Ministry of Public Works and Transportation departments and competent authorities, each in his respective capacity, to achieve the objectives mentioned in item (1) of this Article, including plans to manage and protect the beaches.

# Article 30 -

1) Subject to the provisions of international and regional treaties to which Lebanon is strictly prohibited all drainage or flooding or burning in Lebanese territorial waters of each substance that is directly or indirectly, to:

A - affect human health and marine natural resources.

B - activities and harm marine organisms, including navigation, fishing, plants and algae.

C - spoil the quality of marine waters

D - reduce the recreational value and tourism potential of the sea and the shores of Lebanon.

2) defined by a decree of the Council of Ministers upon the proposal of the Ministers of Environment and Public Works and Transport is the list of substances referred to in item I of this article.

# Article 31 -

1) to the Minister of Public Works and Transport, based on a study testing the initial environmental or environmental impact assessment study conducted in accordance with the provisions of this law and its provisions applied to authorize drainage and flood or burning in the territorial waters and the underground sea in the territorial waters, the materials do not produce caveats mentioned in article thirty of this Act, under conditions that prevent unauthorized operations cause harm to the marine environment.

2) The decree mentioned in the item «1» of article thirty of this Act, the conditions and procedures for granting the statements set forth in item «1» of this article and control procedures as conditions for the application of these provisions on the operations of drainage and flooding, and landfill and incineration.

**Article 32** - Subject to the provisions of laws and regulations and international and regional treaties to which Lebanon, Decree mentioned in item «2» of article thirty, the measures necessary for the prevention of all marine pollution caused by ships or tankers freely, vehicles or facilities in Lebanese territorial waters .

**Article 33** - Subject to the provisions in force relating to manned public property, preventing works on public property sea or river that impede the free access to the coast and sandy beaches or lead to erosion of the site or to deteriorate or cause a threat to the interests mentioned in the item «1» of Article XXIX.
**Article 34** - subject areas, wetlands and ecosystems of special protection of renewal decree adopted by the Council of Ministers upon the proposal of the Minister of the Environment, and take into consideration the role of these regions and their importance in preserving marine biodiversity and / or river and the ecological balances coastal overall.

## Chapter III - Protection of the aquatic environment from pollution

## Article 35 -

1) Subject to the legal provisions in force concerning the maintenance and water and use of public property, subject to this water protection measures stipulated in this law and its provisions applied, taking into consideration the national environmental standards, in order to:

A - Protection of surface water and groundwater pollution on the risk of its forms and to reset the quality of these waters.

B - balances environmental protection and wetland sites and their ecosystems.

C - the development and protection of natural resources and evaluation of resources as an economic and secure distribution of the various uses.

2) defines a joint decision issued by the Ministers of Energy, Water and Environment each measure or policy aimed at developing an integrated management of natural resources on the environment.

3) apply the measures referred to in item 2 / / of this Article on each discharge or dumping or throw or deposit, directly or indirectly, to materials that could cause pollution of surface water or groundwater, or further degrade the quality of modifying their physical properties or chemical, biological or bacteriological.

**Article 36** - defined by a decree of the Council of Ministers upon the proposal of the Minister of Environment and the competent minister, within the time limits specified by this Decree:

A - asset inventory of public to measure the level of contamination of water, springs and rivers and their courses and their banks, lakes, ponds and Searat, marshes, reservoirs and distribution networks for drinking water and irrigation canals, to be reconsidered in this inventory the public whenever the need arises.

B - national standards, chemical, biological, bacteriological, which should be available in the water, springs and rivers burst their banks and their courses and lakes and ponds, swamps and Searat and reservoirs and distribution networks of drinking water and irrigation canals.

C - national standards of quality that should be available in the water intended for human consumption and other uses.

D - Methods of analysis and control of physical properties and chemical, biological and bacteriological quality of water.

H - Procedures for drainage and landfill and dumping, throwing, deposit, direct or indirect, to materials that could cause pollution of surface water or groundwater, or further degrade the quality of modifying their physical properties, chemical, or biological, bacteriological, and procedures for monitoring these processes.

And - Special protection measures that may be the Ministry of Environment or the competent authorities to impose a view to preventing or reducing all damage to the aquatic environment.

G - the assets of existing facilities subject to the provisions of this law and its provisions applied.

**Article 37** - Subject to the laws and regulations in force, each facility shall be subject of water treatment license prior to the initiation of work issued by the Minister of Environment. Determine the decrees of this law limits the assets and facilities subject to the provisions of this Article.

## Chapter IV - Environmental protection of terrestrial and underground

**Article 38** - defined by a decree of the Council of Ministers upon the proposal of the Minister of Environment and the ministers concerned:

A - Conditions of the special protection which aims to reduce soil degradation and erosion and combat desertification and pollution of ground and underground, and their natural resources, and loss of arable land.

B - measures aimed at promoting the rational use of land or underground, and their natural resources.

C - a list of activities that by their nature or their importance or their results, may cause pollution of ground and underground, and their natural resources.

D - assets subject to the above-mentioned activities of the prior authorization of the Ministry of Environment.

E - the list of fertilizers, pesticides and diseases that allows use in order to protect the environment and underground of all damage that may infect.

And - monitoring assets and measures that can be imposed to ensure the protection of the environment and the inner ground floor of all damage that may infect.

**Article 39** - defined by a decree of the Council of Ministers upon the proposal of the Minister of Environment and the ministers concerned:

A - Terms of locating and establishing centers of purification and waste dumps, the various, and conditions of its investment and technical standards to be followed in these centers and landfill waste and determine the fate of the neglected and control procedures of these provisions.

B - the assets of the supervision of the Ministry of the Environment on the procedures for full treatment of the waste pursuant to the provisions of this Law and Law No. 64/88 dated 12/08/1988 (preservation of the environment against pollution from hazardous waste and hazardous materials) and the law of creation of the Ministry of Environment, as amended.

**Article 40** - Subject to the provisions of Law No. 64/88 Date 12/8/1988, defined by a decree of the Council of Ministers upon the proposal of the Minister of Environment:

A - List of hazardous waste or harmful and which contain substances hazardous to public health and safety which prevents imported or entered into or discharged or stored or used, traded or transferred over the Lebanese territory, or where.

B - a list of permitted imported waste and disposal, storage, use and trade and transfer across the Lebanese territory and where.

C - Methods and conditions for the import of materials or products of the waste generated, and entered and disposal, possession, use and trade and transfer across the Lebanese territory and where.

**Article 41** - Subject to the provisions of Part VI of this Act, subject to the affected areas as a result of the work being carried out without compliance with the legal provisions and regulatory window, and places contaminated by landfills or wild landfill is not permitted, measures to eliminate pollution and to correct the environment, and at the expense of responsible for these places in order to return them as much as possible to the same origin as determined by the Ministry of Environment.

Determine the application of this Article minutes in the decrees issued by the Council of Ministers pursuant to the provisions of this law.

## **Chapter V - Installations**

### Article 42 -

1 - on each facility, that have the potential of environmental review and monitoring in order to measure selfregulating contaminated publications and the results of their activities on the environment.

2 - under each facility to permit pre-investment that sets the limits for all kinds of versions contaminated, including those related to the treatment of wastes, and other outcomes of the activities of the facility on the environment, as well as the conditions of implementation of environmental auditing and self-monitoring referred to in clause (1) of this Article.

3 - defined by a decree of the Council of Ministers upon the proposal of the Minister of Environment and the competent ministers, national standards for each category of facilities, and minutes application of this Article and the fundamentals of the application of provisions of the existing structures on the enforcement of this law, the terms of the cease or close or cancel each facility, when These established a threat to the environment could not be observed for the measures in this law avoided.

**Article 43** - When the investment one of the establishments classified as a source of damage to one of the elements of the environment on the local authority to take the Ministry of Environment informed the matter to the investigation required, and warn the local authority investor should take all necessary measures to prevent such danger or to get rid of it and that at his own expense. In the absence of investor commitment to the content of warning within the time limit specified therein, it shall apply the measures and sanctions provided for in laws and regulations in force.

The Minister of the immediate environment of an investigation designed to control the reflection of the establishment activity on the environment. Has, after warning the investor and without warning in case of emergency, to take the necessary measures to protect the environment, at the expense of the investor.

Impose costs and get the investigation, surveillance and measures taken in accordance with legal public accounting and collection of direct taxes and fees.

Subject the persons responsible for monitoring the installations classified for professional mystery.

## Chapter VI - chemicals, harmful and / or hazardous

## Article 44 -

1 - Subject to the provisions of laws and regulations in force, in particular Law No. 64/88 dated 12 August 1988 subject to the import, production or extraction, transformation or marketing or transfer, possession, use or destruction of harmful chemicals and / or dangerous, which because of its composition nature and effects, particularly toxic or radioactive, or quantity, constitute or may constitute a danger to public health and safety and the environment in general, for the permission granted under the conditions determined by decree of the Council of Ministers upon the proposal of the Minister of Environment and the ministers concerned, and to monitor the Ministry of Environment.

2 - The provisions of this law and its provisions applied to marketed formulations made from the materials mentioned in item «1» of this article.

3 - The present Decree:

A - List of substances of which the import or production or extraction, conversion, marketing, possession, use or destruction of, or transferred over the Lebanese territory is prohibited or subject to prior authorization.

B - Conditions, procedures and deadlines granted prior authorization.

C - Terms of discharges and procedures for each group of products.

D - the conditions of production, storage, packaging, classification, transport, marketing and recycling of materials the subject of this chapter.

E - control procedures and measures that can be imposed to ensure the protection of the environment, particularly in case of emergency.

And - the original application of the provisions of this chapter on harmful chemicals and / or dangerous on the Lebanese territory on the date of this Act.

4 - for the application of the decree mentioned in the item «1» of this article, are taken into consideration the guidance and technical standards harmonized at international level by specialized institutions.

## Article 45 -

1 - Subject to the provisions of the Penal Code, the provisions of Law No. 64/88 dated 12 August 1988 in violation of the provisions of this chapter, set the criminal and materials can be set as a means of transport and closure of the institution temporarily.

2 - Contrary to the provisions of Part VI of this law, when these materials are a real threat and danger, the competent local authorities shall destroy or cancel their effects at the expense of the owner of these materials and that under the supervision of the Ministry of Environment.

Impose and receive expenses in accordance with legal public accounting and collection of direct taxes and fees.

## Chapter VII - acoustic and noise damage

**Article 46** - defined by a decree of the Council of Ministers upon the proposal, and the ministers concerned Zeralbaih:

1 - conditions for the organization each version of the noise or sounds, may be harmful to human health or may cause excessive disturbance or affect the environment, particularly that caused by installations, vehicles and others.
2 - measures that can be imposed, especially in cases of emergency, to prevent injury and acoustic noise or limit the negative consequences.

## Chapter VIII - natural resource management and biodiversity conservation

**Article 47** - is one of the public interest nature protection and the prevention and control of desertification and the preservation of animal and plant species and their homes and on the balance of biological and ecosystems and biodiversity, in the face of all the causes of degradation and pollution and the risk of disappearing.

## Article 48 -

1 - based natural resource management and conservation of biodiversity in Lebanon:

A - Develop an inventory of races of animals and plants that exist, especially those at risk of disappearing.

B - subjecting each activity that would prejudice the environment to inform the Ministry of Environment in advance.

C - Proposed plans to protect dwelling animal and plant species and conditions of protection and development.

D - the proposal to establish national parks and nature reserves and protected areas and to propose terms of protection of sites and landscapes.

H - Develop a monitoring system to enter the biological resources and bio-genetic and their uses in accordance with agreements and treaties entered into by or entered into Lebanon, in agreement with the concerned ministries. And - participation of citizens and public and private institutions in biodiversity conservation and sustainable use of natural resources.

2 - determined by decree taken in the Council of Ministers upon the proposal of the Minister of Environment and the ministers concerned, minutes, application of the provisions of this article.

## Chapter IX - the risks and natural disasters

**Article 49** - is managed shared resources with other countries in a sustainable and based on cooperation, information and mutual consultation, in accordance with the provisions of international treaties and regional agreements between countries that share with them to Lebanon, the listed resources.

## Chapter IX - the risks and natural disasters

**Article 50** - be a national plan for disaster management and natural hazards for each region of Lebanon, including an environmental management plan be attended by the Ministry of Environment in collaboration with relevant ministries. And identify preventive measures that must be taken to face all serious environmental pollution caused by natural disasters or by war or otherwise, and the powers of the departments and the competent authorities in the implementation of these measures taken by decree in Council of Ministers upon the proposal of the Minister of Environment and the ministers concerned.

## Part VI - responsibilities and sanctions

## **Chapter I - Responsibilities**

**Article 51** - Subject to the provisions of the Code of Obligations and Contracts and the Penal Code, each violation of the environment, damage to persons or the environment does it ask for compensation Almtojb. And the State, represented by the Ministry of Environment, the claim for damages resulting from damage to the environment.

## Article 52 -

1 - Those responsible for any damage that affects the environment due to work done without a permit or in violation of the provisions of the legal and regulatory window, particularly those related to studies testing the initial environmental or environmental impact assessment, are obliged to take all measures that lead to the removal of the damage, at their own expense.

2 - The expenses resulting from measures taken by the competent authorities to prevent all damage affects the environment, are the responsibility of responsible for this damage.

**Article 53** - at each of the invested enterprise classified or used chemicals, harmful and / or dangerous as defined by this law and its provisions applied, or sign a contract insurance against all risks to the environment.

## **Chapter II - Adjust misdemeanors**

## Article 54 -

1 - set the violations of the provisions of this law and its provisions applied under lecturer control organized by the members of the judicial police, in accordance with the laws;

2 - to adjust irregularities and monitor compliance with this law and its provisions applied to members of the judicial police and observers of the Ministry of the Environment in accordance with the laws in force.

A - Access to campus buildings and facilities and institutions covered by the provisions of this law.

B - Inspection on the campus and buildings and construction, equipment and storage facilities and institutions

mentioned above.

C - access to all documents relating to the conditions and procedures for environmental work for enterprises and institutions covered by the provisions of this law, or of its activities.

D - Sampling and analysis of the amounts necessary.

3 - required for the exercise of law enforcement personnel and their function in other places suspected activities or the exercise of the existence of materials, to the detriment of the environment to obtain the prior written consent of the Attorney General and the use of members of the internal security forces whenever the need arises.

**Article 55** - shall be transmitted with the records of seizure of documents and statements and all information relating thereto, to the Attorney General of a copy to the Ministry of Environment.

**Article 56** - seen in the exact offenses, in accordance with the provisions of this law and its provisions applied, judges soloists specialists in the province where the offense occurred, and applied on the violations of due process memorable summary of crimes, and their judgments are subject to Asttinav only.

## **Chapter III - administrative measures**

**Article 57** - The application of penal sanctions does not preclude the validity of the departments and the competent authorities, after a written warning informing him the way to the offender management, the right to take all or some of the following administrative measures:

A - the imposition of special conditions to allow for monitoring the implementation of a particular activity, as well as preventive measures and self-monitoring and environmental audit, on an ongoing basis, and the suspension of the license revenue for this activity until compliance with the special conditions and the measures mentioned.

B - prevent a particular activity because of the serious risks posed to the environment, and return him to revoke the license and the closure of the institution.

C - repair work such as removing pollution, reforestation and maintenance of premises, at the expense of the violator.

D - commitments that the imposition of fines.

E - all other measure aimed at preventing or reducing all damage to the environment.

## **Chapter IV - Sanctions**

## Article 58 -

1 - shall be punished by imprisonment from one month to one year and a fine of fifteen hundred million to a million Lebanese pounds, or either, of the following:

- Implemented a project requires an initial environmental examination of the study or environmental impact assessment without conducting the study in advance or be subject to control of the Ministry of Environment and relevant ministries and departments.

- Implemented a project requires an initial environmental examination of the study or environmental impact assessment study, in contrast to the content submitted by it and which have won the approval of the Ministry of Environment and relevant ministries and departments.

- Implemented a project does not require an initial environmental examination of the study or environmental impact assessment and non-identical and national standards.

- Oppose or impede the monitoring and inspection procedures and tests set forth in this law and / or texts are applied.

2 - In case of repeated violation the penalty is doubled.

**Article 59** - Subject to the provisions of Law No. 64/88 Date 12/8/1988, shall be punished by imprisonment of one month a year and a fine boiled than two million to ten million Lebanese pounds, or either of them, anyone who violates the provisions of this law and its provisions applied for the protection of the environment air or sea water or ground and underground.

Redundancy in the event the penalty is doubled.

**Article 60** - shall be punished with imprisonment of one month to one year and fined two million to ten million Lebanese pounds, or either of them, anyone who violates the provisions of this law and applied its provisions relating to institutions listed.

Redundancy in the event the penalty is doubled.

**Article 61** - Subject to the provisions of Law No. 64/88 Date 12/8/1988 on preserving the environment against pollution from hazardous waste and hazardous materials, raise the fines provided for in the Act: ten million to one hundred million Lebanese pounds.

## Article 62 -

1 - punishable by a fine from one million to ten million Lebanese pounds, anyone who violates the provisions of this law and its provisions applied on waste other than those specified in Article sixty-one of this law.
2 - In case of repeated violation the penalty is doubled.

## Article 63 -

1 - All other contravention of the provisions of this law and its provisions applied, shall be punished by a fine of five hundred thousand to five million Lebanese pounds.

2 - In case of repeated violation the penalty is doubled.

**Article 64** - The penalties provided for in this law does not prevent the application of penalties stipulated in the Penal Code and other penal laws, and measures and administrative sanctions or undue compensation by virtue of civil liability.

**Article 65** - Contrary to the provisions of the Forest Act, issued on January 7, 1949, especially Article 98, the total return of fines and compensation res judicata pursuant to the provisions of this law and its provisions applied to the National Fund for the Environment.

## Part VII - FINAL PROVISIONS

**Article 66** - The Minister of Environment for reconciliation on the fines and damages awarded on the damages caused to the environment, pursuant to the provisions of this law and its provisions applied, provided it does not address the settlement of more than half the value of the fine or compensation.

Article 67 - All provisions contrary to this law or that is inconsistent with the content.

Article 68 - This Law shall become effective upon its publication in the Official Gazette.







# 3 Onshore Ecology

## 3.1 Topic

This section on Onshore Ecology summarises the available data on the following topics: Coastal & Lowland Habitats; Vegetation; Birds; Mammals; Reptiles & Amphibians; Terrestrial Invertebrates; Fish; and Sensitive Areas.

The scope of this study only considers areas located less than 200m above Mean Sea Level (MSL). This covers the coastal plains and lowlands, applicable to potential oil and gas industry infrastructure that may be developed in the future.

## 3.2 Regulatory Framework

Current laws and regulations concerning the onshore ecology of Lebanon are listed below. Some of these have direct application to the oil and gas industry:-

- 444 The Lebanese Environment Law calls for protection of biodiversity, nature and genetic heritage from any influencing activity. It follows the polluter pays principle, whereby hydrocarbon importers will assume full responsibility in the case of an oil spill. It also strictly forbids all discharges, immersions or burning in the Lebanese territorial waters of any material that may directly or indirectly affect the health of human beings or natural marine resources and / or negatively impact on important tourist locations around the Lebanese coast.
- 4809 1966 establishes the procedure pertaining to the exploitation of the public maritime domain.
- 17614 1964 determines the procedure to be followed for obtaining a permit to exploit the public maritime domain. The Ministry of Environment (MoE) has an indirect role in permitting process through the Higher Council for Urban Planning.
- 3899 1993 regulates the extraction of sand and other materials from the public maritime domain.
- 549 2003 allows the Government to tender for and contract on the designing, financing, development, rehabilitation, and operation of the Tripoli and Zahrani refineries; including the construction of an import / export terminal for LNG and the establishment of networks to sell and distribute natural gas (i.e. pipelines).
- The Forests Law of 1949 prevents the establishment of fuel depots within the forest.

Between 1997 and 1998 Lebanon passed many regulations protecting coastal wetlands. Notably, Decision #980 dated 16 April 1999 declared seven nature reserves and four RAMSAR sites (not mutually exclusive).

Lebanon is also a signatory or contracting party of the following relevant conventions, which are either at the stage of being ratified or accessed.

 London Convention (1972): Prevention of Pollution by Dumping of Wastes and Other Matter.

- Barcelona Convention (1980): Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources.
- Barcelona Convention (1982): Protocol concerning Mediterranean Specially Protected Areas and Biodiversity in the Mediterranean.
- Barcelona Convention (1976): Protocol concerning Co-operation in Combating Pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency.
- Basel Convention (1989): Control of Transboundary Movements of Hazardous Waste and their Disposal.
- Rio Earth Summit (1992): Convention on Biological Diversity.
- Bonn Convention (1979): Not ratified, however its following two conventions are: The Agreement on the Conservation of African Eurasian Migratory Waterbirds (AEWA) and the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic (ACCOBAMS).

For further laws and conventions see the Legal Register (*Volume 6: Registers*). Note: There is also an Integrated Coastal Zone Management (ICZM) plan pending and also the National Contingency Plan (NCP) for Lebanon which will prepare services for emergency response to any hydrocarbon incident.

## 3.3 Strategy and Future Plans

In November 1998 the Lebanese Ministry of Environment, in collaboration with the United Nations Development Programme (UNDP) and the Global Environment Fund (GEF), finalised the development of a National Biodiversity Study and Action Plan (NBSAP) to fulfil the requirements of the Convention on Biological Diversity (CBD) In particular, article 6 outlines nine biodiversity goals (*DA: 152*). Of these, six are relevant to the conservation and management of the onshore ecology in Lebanon:

- To conserve fresh water biodiversity, manage and use fresh water resources sustainably;
- To protect Lebanon's coastal [and marine] biodiversity and develop their resources in a sustainable way;
- To establish a national biodiversity database for documentation and monitoring of biodiversity;
- To conserve biodiversity under natural conditions and establish a balanced ecosystem where plants and animals evolve naturally;
- To conserve Biodiversity ex-situ and utilising existing capacities;
- To share knowledge, costs and benefits with individuals and communities.

## 3.4 Impact from Development of Petroleum Activities

The development of petroleum activities in Lebanon (including pipeline installation and the construction of Liquefied Natural Gas (LNG) plants as well as any Onshore Processing Facility (OPF)) will likely have a limited impact on the onshore ecology of Lebanon if developments remain inside the set study area of up to 200m elevation above sea level. This is due to the substantial effect urbanisation has already had along the coast and lowlands of Lebanon, heavily compromising the natural onshore ecology of the study area. This assumes avoidance of all areas recognised as being environmentally sensitive or protected.

#### **Onshore Pipeline Construction**

*Physical Presence & Land take* – A considerable impact would be caused by physical presence and land take during the construction phase of a pipeline. During this phase, an

installation corridor for laying equipment and a construction camp for workers will both be required. As well as adding to the land take area, the extra population of workers in the vicinity may lead to increased footpath erosion along the main



tracks and possible wildlife disturbance.

*Noise* – The effects of noise will be temporary and centred around construction operations. Use of machinery and construction workers will add to the background level of noise currently emitted in the coastal urbanised areas. Noise will be also emitted during the operation of LNG plants or OPFs, as well as by any associated transportation.

*Waste Management* – The construction of a pipeline will create both hazardous and nonhazardous waste. As Lebanon does not currently have the facilities to effectively treat

hazardous waste, any hazardous waste generated would have to be exported. The construction workers camp will also create waste, including; sewage, garbage, food waste and grey water.

*Light* – In areas around the pipeline and construction camp for workers, lights have the potential to disturb nocturnal species, particularly bats which are expected along the proposed pipeline route. Light pollution will be more significant away from the main towns where ambient light pollution is lower. Light can also bother marine turtles nesting on the coast.

*Water* – Hydrotesting of a pipeline can require significant amounts of water. The testing of the onshore sections is conducted using freshwater. Although this could potentially



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place a high demand on Lebanese water supplies, any saltwater and associated chemicals used instead would need to be treated on task completion. This would require facilities that Lebanon does not yet have. Water extraction for hydrotests and for use at the construction camp will need to be timed appropriately so as to reduce strain on the available water supply.

*Traffic* – Traffic from associated construction activities will require management so that local and regional traffic flows are not interrupted. Routes for heavy goods vehicles should be planned in advance to avoid compromising road stability or interfering with domestic traffic.

*Energy Demand* – The construction camp will require electricity and it is anticipated that the camp will have a generator to meet this demand. The generator will likely be serviced by trucks with the associated traffic related impacts mentioned above.

Atmospheric – The effects of atmospheric emissions (including particulates) will be largely temporary and centred around construction operations. Use of machinery will add to the background level of atmospheric pollution currently emitted in the coastal urbanised areas. Atmospheric outputs will also be emitted during the operation of LNG plants or OPFs, as well as by any associated transportation.

#### **Construction of Oil and Gas Supporting Infrastructure**

*Physical Presence & Land take* –The construction of oil and gas infrastructure would result in additional land take and present a long term impact. Other physical presence or land take to be considered would be the additional infrastructure required to support the industry (e.g. logistical developments).

*Noise* – Noise will be emitted during both the construction and operation of LNG plants or OPFs, and from the vehicles associated with the construction phase. After the initial construction phase, noise generated from the running of the plant can be expected to reduce, but will persist at some level for as long as the site related site is in operation.

*Waste Management* – The construction of oil and gas infrastructure facilities will create both hazardous and non-hazardous waste. As Lebanon does not currently have the facilities to effectively treat hazardous waste, any hazardous waste generated would have to be exported. Accommodating the construction workforce will also create waste, including; sewage, garbage, food waste and grey water.

Light – Building lighting as well as lights for security around buildings and construction



camps will add to the light pollution in the lowlands of Lebanon. The location of the site will determine the extent of the impact against background light levels. Light can also bother marine turtles nesting on the coast.

*Water* – Will be required in the construction process and for day to day consumption thereafter. It would be misleading to estimate consumption requirements at this stage as there are too many unknown variables. Water availability will need to be considered to ensure the resource is managed efficiently at all stages.

*Traffic* – Traffic from associated construction activities will require management so that local and regional traffic flows are not interrupted. Routes for heavy goods vehicles should be planned in advance to avoid compromising road stability or interfering with domestic traffic. Local and regional traffic flows will be affected in the long term by the work force commuting to the facilities once they are operational.

*Energy Demand* – Any building sites (and possibly construction camps) will require electricity and it is anticipated that generators will be used to meet this demand. The generators are likely to be serviced by trucks with the associated impacts mentioned above. Once the facilities are operational there will be an ongoing demand for electricity potentially for the lifespan of the building / plant.

Atmospheric – The effects of atmospheric emissions (including particulates) will be largely temporary and centred around construction operations. Use of machinery will add to the background level of atmospheric pollution currently emitted in the coastal urbanised areas. Atmospheric outputs will be also emitted during the operation of LNG plants or OPFs (or similar infrastructure) as well as by any associated transportation.

## 3.5 **Possible Development Options**

Lebanon's extensive offshore territory and the deficiency of environmental data - especially for the deep offshore areas - is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration there. A lesson learnt from that situation is that it takes time to acquire and collate data, and this data gathering phase happens piecemeal rather than in a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline Surveys being carried out as part the Environmental and Social Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of contract and a legal requirement in Lebanon. In these circumstances Baseline Surveys are an insurance necessity to guard against future liabilities.

To maximise the value of the surveys Lebanon would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that might accrue due to operator proposed mitigation measures, Lebanon needs to be fully cognisant of best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

It is also worth noting that further research is could be backed backed in Lebanon by international organisations, for example through UN initiatives. Good relationships with any the organisations behind such initiatives and strong communication will hopefully lead to compatible data being gathered by all parties, creating a more complete picture of the subject matter in question.

## 3.6 ESIA Data Requirements

Producing a comprehensive ESIA for a project impacting on onshore ecology in the Lebanese coastal and lowland region would require the availability of good data relating to the following subject areas:

Habitat – The physical environment in which a group of organisms may be found. The habitats found along the coastal and lowland region of Lebanon include: Foreshore; Vermetid Platform; Rocky Shore; Rocky Headland; Estuary; Dune Grassland; Mediterranean Scrub; and Pine Forest.

Birds – Coastal and lowland inhabiting birds, of both migratory and resident status.

*Freshwater & Estuarine Fish* – Aquatic vertebrate with gills living in rivers, lakes or estuaries.

*Mammals* – Vertebrate animals with mammary glands and a double occipital condyle. Relatively few non domesticated mammals are still found inhabiting the Lebanese coast and lowlands.

*Reptiles & Amphibians* – Amphibians are vertebrate animals that inhabit both land and water. Reptiles are ectothermic vertebrates distinguished by their laying of shelled eggs. Seven species of amphibians have been identified in Lebanon and around forty species of reptiles have been observed on the Lebanese coast.

Terrestrial Invertebrates – Land residing heterotrophs that lack a backbone.

Aquatic Invertebrates – Freshwater inhabiting heterotrophs without a backbone.

*Vegetation* – Plants providing ground cover. These are the primary producers that form the foundations of ecosystems.

*Sensitive Areas* – identification of both recognised protected areas and sites recommended for protection in the literature.

## 3.7 Description of Existing Data

#### Habitat

The topography in Lebanon is extremely This has resulted diverse. in the "microemergence of several environments" within the country that are each home to a wide range of flora and fauna. The project "area" encompasses the entire coastal zone and is contained within the "thermodediterranean" phytoassociation zone (DA: 232).



Increased, and often uncontrolled,

urbanisation in Lebanon has had a detrimental impact on the natural environment. The principle cause of this is irreversible change to the Lebanese coastal zone, including an increase in the utilisation of water resources for activities such as agriculture. Furthermore, water quality has been impeded via the release of sewage and effluents into rivers. This has resulted in a decrease in water availability and quality, culminating in a reduction in biodiversity (*DA: 232*).

#### Biodiversity

The only national flora and fauna studies or species inventories in Lebanon date back to 1996 (Biodiversity Country Study), all other more recent species studies are either in form of checklists limited to protected areas or specific studies conducted in some sites by single researchers. Despite the fact that the protection of the globally threatened species is considered in the Lebanese legislation, there are no studies of status and trends of the taxa at national level nor do the habitats in which the restoration of species is an integral part of conservation represent all types of ecological areas of the country. Moreover, trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socioeconomic importance are in need to be identified whilst the indicators to monitor trends are far from being nationally completed. In addition, there is a major lack in studies related to alien species and alien invasive species in addition to proper mechanism for their control and monitoring and lack in alien species management plans (*DA: 252*).

#### Birds

Birdlife International lists 297 bird species known to occur in Lebanon. Within the designated project area, 24 of these species have been recorded and are of concern to the IUCN. Six are categorised as "vulnerable" (VU), six as "endangered" (EN), and twelve as "near threatened" (*DA: 81*).

There are 15 Important Bird Areas (IBAs) in Lebanon, all but one of these are located in mountainous areas outside of the project area. There is one IBA located on the Palm Islands nature reserve offshore Lebanon. This is discussed further in the "offshore ecology" section.

During spring and autumn bird migrations occur across Lebanon. In spring these predominantly occur in land, above the 200 MSL threshold. In autumn, however, birds migrating south have been recorded in coastal regions in and around Jounieh.

### Freshwater and Estuarine Biodiversity

A wide variety of organisms inhabit Lebanon's freshwater ecosystems, including invertebrates, molluscs, fish and others. The most recent comprehensive study (conducted in 1996) states that the faunal species in freshwater represent 16% of the total fauna biodiversity of the country and the floral species represent 6% of the flora species only. Five percent of the country's freshwater fauna are threatened and 1.3 percent endemic. The only endemic freshwater fish to Lebanon *Phoxinellus libani* has been observed in Yammouneh Lake, Litani River and Qaraoun Lake at least as recently as 2001. Many have been exterminated from particular river systems due to overfishing.

There are extensive pressures on Lebanon's inland aquatic ecosystems: water pumping, rivers channelling and pollution of various origin. Their impact on the ichtyofauna is high

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mortality during the drought season and abandon of preferred spawning areas (Cyprinidae, Cyprinodontidae and Cobitidae).

Protected areas in Lebanon have been designed to conserve watersheds and freshwater biodiversity. The only inland true freshwater swamp in Lebanon (Aammiq) is a privately owned marshy area but protected under the umbrella of the Shouf Biosphere Reserve and by personal initiative of the landowners, the site was one of the two sites that were previously managed under the MedWet Coast project executed by MoE with the support of UNDP/FFEM. On the other side, most of the rivers and river valleys are declared natural sites under the protection of the Ministry of Environment through decisions issued by the Minister of Environment, however there is a need to enhance the enforcement of such decisions (DA: 152).

#### Mammals

Terrestrial mammals found in Lebanon include; bats, porcupines, hedgehogs, jackals, foxes, hyaenas and boars. Despite a ban on hunting coming into force in 1996, mammal species in Lebanon are still at risk from illegal, uncontrolled and indiscriminate hunting (*DA: 402*). Observational data exists for the mammals of Lebanon, but their numbers and range are not well known.

#### **Reptiles and Amphibians**



The level of Lebanese herpetofauna (reptiles and amphibians) species diversity is high. During a review of studies of herpetofauna distribution and abundance in Lebanon, 5 amphibian and 44 reptilian species were recorded (*DA: 396*). Of these, the IUCN has categorised 4 as "endangered", 1 as "vulnerable", and 1 as "near threatened". All species of concern to the IUCN are found in mountainous areas above the 200m above MSL threshold, and are therefore not relevant to this project.

#### Invertebrates

Following a study in 1996, 3835 species of invertebrate were described in Lebanon, 656 of which were aquatic invertebrates (*DA: 252*).

In Lebanon, very little work has been done on the study of invertebrates, apart from a few isolated small scale studies (for example the invertebrate study conducted in the Aammiq marsh). In introducing its publication on national biological diversity in Lebanon, the Lebanese Ministry of Agriculture stated that "the lists



included in this work are no longer up to date; there is an urgent need to undertake new studies in order to have complete information on the current state of the Lebanese freshwater fauna." The result is that although the importance of some locations (such as the Aammiq marsh) for aquatic invertebrate biodiversity in the Lebanon is assumed to be high, exactly how high remains unknown.



Invertebrates unique to Lebanon include a grasshopper Chorthippus lebanicus, the longhorned beetles Pogonocherus ehdenensis and Callidium libani, a scarab Melontha excisicauda, a plant bug Psallus jeitensis, a cave-dwelling centipede Lithobius libanicus, the amphipod crustaceans Nipharaus altagahizi and Echinogammarus berytensis ,and several freshwater

snails: Gyraulus bekaensis, Pseudobithynia amiqensis, Pseudobithynia levantica, and Pseudobithynia kathrini.

#### Vegetation

The project "area" encompasses the entire Lebanese coast. This is contained within the "Thermomediterranean" zone and is characterised by the presence of endemic plant species such as *Ceraonia, Pistacia, Pinus* and *Myrthus*. In general, Lebanon has a high percentage (12%) of endemic plant species, although this is mostly contained within mountainous regions. Forest fires occur frequently in Lebanon and have caused significant damage to the flora along the coastline (MoE, 2009).

A report into the ecosystem of the Tyre Beach nature reserve on the south east coast of Lebanon was also produced by the Ministry of Environment (*DA: 402*). Table 3.4. shows plant species found in this nature reserve that the team regarded to be of special significance from a management perspective. It is important to note that this study covers a limited geographical area and as such does not represent the entire study area.

#### **Sensitive Areas**

There are three designated Ramsar sites within the project area. Details of these are given below.

#### Deir el Nouriyeh cliffs of Ras Chekaa

This site is located on the Lebanese coast between Beirut and Tripoli. It has been described as "a mosaic of woodland and olive groves". The site acts as an important site for migrating Middle Eastern bird species, notably the white pelican (*Pelecanus onocrotalus*) and purple heron (*Ardea purpurea*). Biodiversity in surrounding waters is also thought to be enhanced due to the presence of submarine freshwater springs off the coast at Ras Chekaa (*DA: 405*).

#### Palm Islands Nature Reserve

Consists of a group of three flat rocky islands of eroded limestone that rise a maximum of 12m above the sea and are located approximately 5.5km northwest of Tripoli. These islands and the waters around them support several species of concern to the IUCN. This

includes breeding and nesting loggerhead turtles (Caretta caretta) (classified as "endangered"). The "critically endangered" green turtle (Chelonia mydas) also occurs in surrounding seas, as does the "endangered" Mediterranean monk seal (Monachus monachus). The caves on the islands also support spawning fish species and around 42 species of migratory birds (including 6 that are included in the IUCN Red List) (DA: 405).



#### Tyre Beach



This site is located within one of the best preserved sandy coastlines of southern Lebanon. It is listed for its rich biodiversity, but is threatened by its proximity to the city of Tyre and the Rachidieh refugee camp. The artesian wells provide a good freshwater habitat for a range of species, although these are used to irrigate vegetable, citrus and palm trees within the reserve. Beach vegetation consists mainly

of sea spurge and cotton weed. The hillocks are dominated by grasses, shrubs and rush species. The beaches are also thought to be an important nesting site for the green and loggerhead turtles (*DA: 405*).

#### El Aabbassiye and El-Bourgheliye beaches

The El Aabbassiye and El-Bourgheliye beaches are situated North of Tyre. These beaches have no protected status, yet are deemed to be highly significant turtle breeding beaches for the IUCN 'critically endangered' green turtle (*Chelonia mydas*) and 'endangered' loggerhead turtle (*Caretta caretta*) (*DA: 327*).

#### **Climate Change**

The change in climatic conditions being experienced across the globe as a result of the increased concentration of greenhouse gases in the atmosphere since the industrial revolution also affects biodiversity. Climatic changes will most likely favour vegetation that includes more drought resistant species to be better established and to be more abundant than other native species. Warmer climates would lead to an increase in rodents (field mice, house mice, rats, etc.) throughout the Lebanese territories. This increase will then be matched by an increase in animals that prey on rodents such as jackals, foxes, stone martins, etc. Marginal mammals will become extinct due to the loss of habitat. This is especially true for otters (such as those in the Aammiq wetlands) and other mammals that rely on waterbodies whose habitat will be severely reduced and disrupted due to the reduction in water resources. Due to the increase of warm days during the year, insect pests and vectors will be active for a longer period of time. This

will enable them to reproduce more and thus to increase their populations. Climate change will probably cause bioclimatic zones to shift to higher altitudes. Various reptiles and amphibians will be impacted by such a change. Climate changes affect the physiology, the distribution, phenology and adaptation of birds. Trends and routes of migration of birds will also see changes. Moreover, bird communities whose distribution is limited by cold temperatures will expand beyond their natural number with warmer, more clement temperatures. Establishment of several new semi-desertic bird species in Lebanon is likely to occur (*DA: 152*).

## 3.8 Missing Data

From analysing the existing data available for the onshore ecology of Lebanon, the following gaps identified will need to be addressed in order to produce a comprehensive SEA for Lebanon:

#### Habitat

- Classification of current Lebanese habitat types;
- Up to date habitat type distribution map for Lebanon;
- Species list by habitat type;
- Community prediction tool.

#### Birds

- Coastal and lowland bird community data;
- Identify status of bird species present: resident, migrant etc. and if not resident record month(s) in which the species may be found in onshore Lebanon (seasonal variation);
- Identify species specific migratory route, where applicable;
- Identify nesting sites and record the month(s) in which these take place;
- Seasonal sensitivity to disturbance for each species;
- Record density per map grid square;
- Highlight rare / endangered species and consider protection of critical habitat.

#### Freshwater & Estuarine Fish

- Fish community data;
- Identify any spawning and nursery areas in Lebanon along with seasonal variation;
- Seasonal sensitivity period for each species;
- Differentiate between freshwater and estuarine species;
- Highlight rare / endangered species and consider protection of critical habitat.

#### Reptiles & Amphibians

- Reptile and amphibian community data;
- Identify status of reptile and amphibian species recorded: resident, migrant etc. and if not resident record month(s) in which the species may be found in Lebanese waters and coastal and lowland regions;
- Identify up to date breeding and nesting areas and record the month(s) in which these take place;
- Seasonal sensitivity period for each species;
- Record density by licence block or per map grid square when on land;
- Highlight rare / endangered species and consider protection of critical habitat.

#### **Terrestrial Invertebrates**

- Terrestrial invertebrate community data;
- Identify mating sites and record the month(s) in which these take place;
- Seasonal sensitivity period for each species;
- Record density per map grid square;
- Highlight rare / endangered species and consider protection of critical habitat.

#### Aquatic Invertebrates

- Acquire comprehensive aquatic invertebrate community data;
- Identify mating sites and record the month(s) in which these take place;
- Seasonal sensitivity to oiling for keystone species;
- Record density per map grid square or water body;
- Highlight rare / endangered species and consider protection of critical habitat.

#### Vegetation

- Determine vegetation assemblage and plant community structure;
- Classify these within Lebanese habitat types;
- Record density per map grid square;
- Record soil type where species is located;
- Community prediction tool;
- Identify pollinating season for keystone species;
- Highlight rare / endangered species and consider protection of critical habitat.

#### **Sensitive Areas**

- Identify sensitive areas critically in need of protection. Use criteria set out in EU Habitat Directive 92/43/EEC and EU Birds Directive 79/409/EEC;
- Collect baseline environmental data (based on criteria above) for each sensitive area.

## 3.9 Discussion

Following analysis of the data currently available regarding the ecology of Lebanon's coastal and lowland region it is clear that there are some major omissions.

The laws governing the management and protection of onshore ecology in Lebanon appear to focus on particular themes and so the onshore ecology topics outlined above have received uneven levels of attention.



The ecology of the coastal and lowland region of Lebanon has suffered under the extensive urban sprawl that now stretches much of the length of Lebanon's coastline and extends sporadically back up past this study's limit of 200m above MSL elevation. To prevent this situation worsening due to the addition of oil and gas industry infrastructure, improved management and planning should be implemented as soon as possible to protect areas at risk. For example, the El Aabbassiye and El-Bourgheliye beaches North of Tyre. These beaches have no protected status, yet are deemed to be highly significant turtle breeding beaches for the internationally protected Green and Loggerhead Turtle species (*DA: 327*). The pending legislation on Coastal Zone Management (CZM) and the Environmental Impact Assessment (EIA) Decree needs to be implemented so that the environmental costs of large developments can be properly considered.

Lebanon is home to a variety of birds, mammals, reptiles and amphibians. The greatest challenge is recording exactly which species inhabit the coast and lowlands of Lebanon, how many are here, and which habitats should be preserved. The current data deficiency regarding terrestrial and aquatic invertebrates and freshwater and estuarine fish should also be addressed by collecting the data suggested. Once this data has been recorded and effective monitoring programmes have been set up, the Lebanese government can work together with the oil and gas industry to maintain Lebanon's unique ecological heritage.

The main difficulties facing Lebanon are the lack of financial resources and up-to-date information, as well as the lack of specialists and opportunities for their training.

Although important legislation has been drafted and/or issued, the difficulty consists in the lengthy process of law endorsement as well as proper enforcement of existing legislation. The cooperation between sectors needs to be reinforced. There is also a lack of efficient coordination of both research and nature protection activities.

The introduction of an oil and gas industry presents Lebanon with the opportunity to improve its coastal and inland ecosystem management. With effective legislation and guidance in place the impact on the environment can be effectively managed to ensure that negative impacts are minimal and significant ecologies are preserved / protected. Revenue generated from oil and gas exploration could also be directed into conservation projects with the aim to amend any environmental damage that has already occurred.





# 4.1 Offshore Ecology

## 4.2 Topic

This section on offshore ecology summarises the available data regarding the distribution and abundance of the following; benthic and planktonic species, demersal and pelagic fish, marine mammals and reptiles.

## 4.3 Regulatory Framework

Current laws and regulations concerning the offshore ecology of Lebanon are listed below, some of these have direct application to the oil and gas industry:

- 444 The Lebanese Environment Law calls for protection of biodiversity, nature and genetic heritage from any influencing activity. It follows the polluter pays principle, whereby hydrocarbon importers will assume full responsibility in the case of an oil spill. It also strictly forbids all discharges, immersions or burning in the Lebanese territorial waters of every material that may directly or indirectly affect the health of human beings or natural marine resources and / or reduce the entertainment value and tourism possibilities of the sea and the Lebanese coast.
- 4809 1966 establishes the procedure pertaining to the exploitation of the public maritime domain.
- 17614 1964 determines the procedure to be followed for obtaining a permit to exploit the public maritime domain. The Ministry of Environment (MoE) has an indirect role in permitting process through the Higher Council for Urban Planning
- 3899 1993 regulates of the extraction of sand and other materials from the public maritime domain.
- 549 2003 allows the Government to tender for and contract on the designing, financing, development, rehabilitation, and operation of the Tripoli and Zahrani refineries; including the construction of an import / export terminal for LNG and the establishment of networks to sell and distribute natural gas (i.e. pipelines).

Between 1997 and 1998 Lebanon passed many regulations protecting coastal wetlands. Notably, Decision #980 dated 16 April 1999 declared seven nature reserves and four RAMSAR sites (not mutually exclusive).

Lebanon is also a signatory or contracting party of the following relevant conventions, which are either at the stage of being ratified or accessed.

- London Convention (1972): Prevention of Pollution by Dumping of Wastes and Other Matter
- Barcelona Convention (1980): Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources
- Barcelona Convention (1982): Protocol concerning Mediterranean Specially Protected Areas and Biodiversity in the Mediterranean
- Barcelona Convention (1976): Protocol concerning Co-operation in Combating Pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency
- Basel Convention (1989): Control of Transboundary Movements of Hazardous Waste and their Disposal

- Rio Earth Summit (1992): Convention on Biological Diversity
- Bonn Convention (1979): The Agreement on the Conservation of African Eurasian Migratory Waterbirds (AEWA)

For further laws and conventions see the Volume 6: Registers.

Note: There is also an Integrated Coastal Zone Management (ICZM) plan pending, which should address coastal habitat degradation and urban sprawl, and also the National Contingency Plan (NCP) for Lebanon which will prepare services for emergency response to any hydrocarbon incident.

## 4.4 Strategy and Future Plans

In November 1998 the Lebanese Ministry of Environment, in collaboration with the United Nations Development Programme (UNDP) and the Global Environment Fund (GEF), finalised the development of a National Biodiversity Study and Action Plan (NBSAP) to fulfil the requirements of the Convention on Biological Diversity (CBD) In particular, article 6 outlines nine biodiversity goals (*DA: 152*). Of these, six are relevant to the conservation and management of the onshore ecology in Lebanon:

- To conserve fresh water biodiversity, manage and use fresh water resources sustainably;
- To protect Lebanon's coastal [and marine] biodiversity and develop their resources in a sustainable way;
- To establish a national biodiversity database for documentation and monitoring of biodiversity;
- To conserve biodiversity under natural conditions and establish a balanced ecosystem where plants and animals evolve naturally;
- To conserve Biodiversity ex-situ and utilising existing capacities;
- To share knowledge, costs and benefits with individuals and communities.

The CNRS has developed with the International Center for Advanced Mediterranean Agronomic Studies (CIHEAM) - particularly the Mediterranean Agronomic Institute of Bari (Italy), a project proposal on Environmental monitoring and sustainable development of the Lebanese Sea. The main objective is to support marine and environmental research over 3 years (*DA: 252*).

CIHEAM- Bari, in collaboration with specialized marine researchers in Lebanon and Italy, participated in the rehabilitation of a fishing boat and its transformation into a scientific vessel specialized on marine research. In April 2009, an agreement was signed between the CNRS and the Italian Government which secures a 2.3 million euro financial support to research.

The Scientific vessel, CANA- CNRS, will be used for a number of scientific campaigns such as monitoring: Coastal Bathymetry; physiochemical and microbiological sea parameters; primary and secondary ecological production; benthos community analysis, marine resources, Marine mammalian protection and oil pollution.

The project on Integrated Management of East Mediterranean coastlines (IMAC), has prepared the background for lacking national legislative and institutional framework for Integrated Coastal Zone management in Lebanon. Therefore the project has developed a

structural sustainable mechanism for coastal zone management in cooperation with local stakeholders.

In the long-term, the goal for coastal zone management will be to establish a national framework for integrated management of the Lebanese coast, including clear legal provisions and institutional responsibilities, as well as to strategically integrate CZM with spatial planning (*DA: 252*).

## 4.5 Impact from Development of Petroleum Activities

The development of oil and gas production activities in Lebanon (including seismic acquisition, exploration drilling, production and pipeline installation; discussed further in Section 1) could potentially have a significant effect on offshore ecology if proper risk and impact assessment is not carried out. The impacts generated by differenct aspects of the offshore industry and how they impact on offshore ecology are considered in this section.

## Seismic Data Acquisition

*Physical Presence* – Fishing activity in the immediate vicinity of the vessels may be temporarily interrupted during seismic surveying. This would be deemed to be a short term impact, only lasting for the duration of the survey.

Noise – The underwater noise and vibration created by the air guns used during offshore seismic surveys have



the potential to impact fish, sea turtles, cetaceans, pinnipeds and commercial fisheries. High pressure sounds are capable of damaging the hearing of marine mammals, turtles and fish and of damaging fish eggs and larvae. Again, this would be deemed to be a short term impact, only lasting for the duration of the survey

### **Petroleum Exploration and Production**



*Physical Presence* – Fishing activity in the immediate vicinity of the any offshore oil and gas structures may be interrupted by the structure itself and an exclusion zone setup around it. This impact will last for the duration of the structure/vessel being at a given location. Exploration equipment is usually short term in its duration at a given location, but production structures are more likely to be permanent fixtures.

Seabed Disturbance – Offshore installations may require anchors to hold them in position on the sea floor. It is possible that these anchors will crush and break benthic fauna. Care should be taken not to unnecessarily drag the anchors along the seabed or allow chain sweep, as recovery may take many years. This will impact upon benthic communities and potentially demersal fish species. Disturbance of the seabed can also cause sediment suspension. Sediment is likely to become suspended during drilling operations. This could affect the gills of fish and the filter systems of some benthic fauna. As the suspended sediment settle out benthic fauna may become smothered.

*Noise* – The underwater noise and vibration created from exploration and production drilling and the associated support vessels have the potential to impact fish, sea turtles, cetaceans, pinnipeds and commercial fisheries. High pressure sounds are capable of damaging the hearing of marine mammals, turtles and fish and of damaging fish eggs and larvae.

#### **Offshore Pipeline Construction**

*Physical Presence* – Fishing activity in the immediate vicinity of the vessels may be temporarily interrupted during pipe laying. Furthermore, following installation commercial fishermen will not be able to use trawl nets in the vicinity of the pipeline due to the risk of losing their equipment and / or damaging the pipeline. In waters shallower than 200ft it is usually recommended that the pipeline be buried.

Seabed Disturbance – Offshore pipeline installation may require a pre-lay dredge to smooth seabed topography and rock dumping or the addition of concrete mats if pipeline stability is considered an issue. The pipe laying barge may be held in position with anchors to the sea floor. It is possible that these anchors will crush and break benthic fauna. Care should be taken not to unnecessarily



drag the anchors along the seabed or allow chain sweep, as recovery may take many years. This will impact upon benthic communities and potentially demersal fish species. Disturbance of the seabed can also cause sediment suspension. This could affect the gills of fish and the filter systems of some benthic fauna. As the suspended sediment settle out benthic fauna may become smothered.

*Noise* – The underwater noise and vibration created from exploration and production drilling and the associated support vessels have the potential to impact fish, sea turtles, cetaceans, pinnipeds and commercial fisheries. High pressure sounds are capable of damaging the hearing of marine mammals, turtles and fish and of damaging fish eggs and larvae.

#### Logistical support of industry

Physical Presence - Fishing activity in the immediate vicinity of the vessels may be



temporarily interrupted during journeys to and from offshore installations. This would be deemed to be a short term impact, only lasting for the duration of the vessels presence in a particular area.

Noise – The underwater noise and vibration created from the engines and propellers are comparable to those of other sea

users of a similar size (e.g. passenger ferries). Support vessels have the potential to impact fish, sea turtles, cetaceans, pinnipeds and commercial fisheries.

#### **Onshore Support Facilities**

*Waste* – Although the activities related to an offshore oil and gas industry are predominantly found offshore, there will always be a component that is based onshore (offices, storage depots, accommodation, etc.). It would be misleading to try and approximate the scale of such facilities at this stage as so much will be defined by future actions and events, but it is a reasonable assumption that any such facilities will increase demand on the wastewater and sanitation facilities of Lebanon, which both ultimately discharge to the marine environment.

## 4.6 **Possible Development Options**

Lebanon's extensive offshore territory and the deficiency of environmental data especially for the deep offshore areas - is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration there. A lesson learnt from that situation is that it takes time to acquire and collate data, and this data gathering phase happens piecemeal rather than in a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline Surveys being carried out as part the Environmental and Social Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of contract and a legal requirement in Lebanon. In these circumstances Baseline Surveys are an insurance necessity to guard against future liabilities.

To maximise the value of the surveys Lebanon would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that might accrue due to operator proposed mitigation measures, Lebanon needs to be fully cognisant of best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

It is also worth noting that further research is could be backed in Lebanon by international organisations, for example through UN initiatives. Good relationships with any the organisations behind such initiatives and strong communication will hopefully lead to compatible data being gathered by all parties, creating a more complete picture of the subject matter in question.

## 4.7 ESIA Data Requirements

Producing a comprehensive and meaningful ESIA for offshore ecology in Lebanese waters would depend on the data available on the following subject areas:

**Benthos** – the name given to organisms that live in, on or near the bottom sediments of the ocean floor. They make up the benthic community and may be filter feeders or deposit feeders. This will include soft corals which have been recorded in Lebanese waters. Deep water vents have also been recorded in Cypriote waters. However, the full extent of both corals and vents are still unknown in Lebanon. Desirable data would include species present, their ranges and distribution.



**Plankton** – tiny animals, plants, bacteria or archaea that drift through the pelagic zone of the water column. They provide nutrition for large species of fish and cetaceans. Desirable data would include species present, their ranges and distribution.

**Cephalopods** – short lived, carnivorous invertebrates with rapid growth rates that play an important role in marine food webs. Desirable data would include species present, their ranges and distribution.

**Fish & Shellfish** – Fish are aquatic vertebrate with gills that live throughout the water column, whereas shellfish are exoskeleton bearing aquatic invertebrates and include crustaceans and molluscs. Both organism groups consume phytoplankton and zooplankton as part of their diet. Desirable data would include:

- Fish / shellfish species distribution Best indications of where species of fish (particularly those that are of commercial importance) may be found;
- Spawning grounds particularly for commercial species;
- Fishing seasons for particular species;

**Sea Turtles** – marine reptiles can be found across most of the world's oceans, except the Polar Regions. Three of the seven existing sea turtle species are classified as critically endangered by the IUCN. The endangered Loggerhead Turtle (*Caretta caretta*) and critically endangered Green Turtle (*Chelonia* mydas) both nest on the shores of Lebanon. The African Softshell Turtle (*Trionyx triunguis*) has also been recorded in Lebanese waters. Although this species is not classified as a 'turtle' by Forskål it should also be included under this section. Desirable data would include species present, their ranges and distribution.

*Marine Mammals* – a group consisting of cetaceans (whales, dolphins and porpoises), and pinnipeds. Desirable data would include species present, their ranges and distribution.

**Birds** – in the context of offshore ecology the ESIA will require information on year round and migratory pelagic birds. Desirable data would include species present (resident and migratory), their ranges and distribution.

**Sensitive Areas** – identification of both recognised protected areas and sites recommended for protection in the literature.

## 4.8 Description of Existing Data

#### **Benthos**

There are 6 species of Scleratinian coral known to occur in Lebanese waters, mostly in depths of less than 100m; *Cladocora caespitosa*, *Hoplangia durotrix*, *Madracis pharensis*, *Oculina patagonica*, *Phyllangia mouchezii* and *Polycyanthus muellerae*. Of these, only *O. patagonica* is considered an "alien" species. Although the report does provide locations of where these corals have been found in the past, the article was written in 1997 and so needs updating. Whilst most areas of present-day deep sea Mediterranean appear to depend on surface primary production to support benthic communities, it is noted that a relatively dense and diversified macrobenthic community based on chemosynthesis has been recognised at depths greater than 1100 m on the Napoli Dome mud volcano in the Olimpi area, and on the Kazan and other mud volcanoes in the Anaximander Mountains. This suggests that priority areas for macrobenthic community research are the relatively shallow areas of offshore Lebanon and the Eratosthenes seamount (*DA: 79*).





During a study of the benthos along Lebanese coast between 1996 and 1997 230 benthic species were recorded (DA: 169). The study concentrated on 6 sites, with 4 to the North of Byblos and 2 to the south. The team recorded several endemic species, noting that the specialised geographic conditions in the Levantine basin likely accounts for this. A difference in community structure was also observed in waters containing different levels of pollutants. This was particularly true of a site to the North of Beirut. Since this study was completed over 10 years ago, Lebanon has experienced an increase in urbanisation along the coast. This will have resulted in an increase of pollutants released into the sea, which may have caused a change in the composition of benthic communities along the coast. It is therefore recommended that this study be repeated. It is also recommended that this study is extended to include offshore sites to better support potential oil and gas related ESIA's in the future.

A study produced in 1984 also provides details of copepod species in the Levantine basin. However, this data is most likely obsolete as the species composition and abundance is likely to have changed since this study was completed (*DA: 156*).

Two mud volcanoes, one to the south of Turkey (Anaximander) and another off Crete (Olimpi) at depths between 1700 and 2000m were investigated from the submersible NAUTILE. This study is very useful as a starting point for researching the hydrothermal or seep areas of the eastern Mediterranean and their surrounding ecosystems. However, further investigation is required on order to establish whether similar habitats are found in Lebanese waters (e.g. around the Eratosthenes seamount and any cold seeps or vents) (*DA: 234*).

The IUCN provides an overview of deep sea marine communities in the Mediterranean. It states that the Levantine bathyal benthos appears to consist of indigenous self-sustaining populations of eurybathic species. Trawl samples from the Eratosthenes Seamount collected rich and diverse fauna, including two Scleractinian Corals (*Caryophyllia calveri* and *Desmophyllum cristagalli*), Red Shrimps of commercial interest (*Aristaeomorpha foliacea, Aristeus antennatus* and *Plesionika martia*), and a large array



of other invertebrates in higher densities than other sites of comparable depth in the Levantine basin. More data is needed to establish the extent of the corals and Red Shrimps on Eratosthenes, and the species diversity and distribution of invertebrates (*DA: 97*).

A study from 2008 concentrated on the impact of pollutants, specifically phosphogypsm, on meiofauna assemblages. Samples were taken in summer 2007 and winter 2008 at ten stations along Batroun. The study suggests that meiofauna samples close to the phosphogypsm discharge pipe showed lower community composition and density. The conclusion provides information on the sediment size classification at the sampled sites. Attention is given to meiofauna community composition and density and only names the 'most important taxa' rather than providing a full list of species (*DA: 93*).

## Plankton

Plankton consists of marine and freshwater organisms with limited swimming capabilities that drift with the prevailing currents. It represents an integral part of the marine ecosystem and provides a crucial source of food to higher trophic levels (i.e. fish and cetaceans). Plankton is divided into two broad groups: Phytoplankton (autotrophic) and Zooplankton (heterotrophic). The species and quantity of phytoplankton and zooplankton off the Lebanese coast were recorded during a 38 year study from 46 stations covering 150km of the Lebanese coastline (*DA: 61*), encompassing both coastal and offshore sites. The study reports that two annual thermal phases characterise the Levantine basin offshore Lebanon: a cold winter phase between December and March, and a warm phase between June and November. It is noted that plankton abundance peaks between April and June when hydrological conditions are optimal for growth.

### Phytoplankton

Approximately 400 phytoplankton species were recorded in Lebanese waters, including 230 dinoflagellates and 160 diatoms. Some silicoflagellates were also recorded. Good information exists as to the seasonal variation in the phytoplankton species (*DA: 61*).

As part of another study (*DA: 171*), macroalgae samples were also taken in spring and summer between 2000 and 2004 at six sites along the coast of Lebanon. At each site samples from the supralittoral, mediolittoral and infralittoral zones were collected. 243 taxa of macroalgae were found, including 25 Cyanophyta, 58 Chlorophyta, 29 Phaeophyta, 127 Rhodophyta, 3 Phanerogams and 1 Xantophyta. This study also reports a peak in phytoplankton abundance in spring and summer.

### Zooplankton

Approximately 1000 zooplankton species have been recorded off the coast of Lebanon, including all planktonic groups. 250 microplankton species were identified, including 141 Tintinnids, 25 Foraminifera, 10 Acantharia, 25 Radiolaria Spumellaria, 30 Nasselaria, 6 Phaeodaria, and 1 Helizoa. Many of these are thought to be introduced exotic species of Indo-Pacific origin. Zooplankton abundance also peaks in spring between April and June. At this time filter feeders are prevalent, including; Copepods, Appendicularia, Thaliacea, and several small larvae (*DA: 61*).

### Demersal and Pelagic Fish

Research has been conducted in the past to identify which fish species may exist in Lebanese waters. However no indication is given as to resident or migratory species, seasonal sensitivities, or habitat use (DA: 54).

An article published in Hydrobiologia (*DA: 119*) discusses mariculture in Lebanese waters between 1992 and 1997. According to this report, there has been an increase in catch for

all key Mediterranean species (sea bream. turbot and bass. sea mullet). The study makes a good contribution to understanding pelagic fish assemblages in Lebanese waters. However, this data needs to be updated as the most recent figures in this study are from 1997. It is very likely that catch rates and even the species of fish targeted have changed since this report was published.



The impact of alien fish species on resident fish assemblages in the Mediterranean has also been assessed (*DA: 116*). The study observes species living in sandy habitats and *Posidonia oceanica* meadows and records the domination of invasive species and their predation on other species. Four invasive species are described in Lebanon, including *Siganus rivulatus, Siganus luridus* and *Upeneus pori* and *Upeneus moluccensis*. In 2004 the Siganidae comprised 80% of the herbivorous fishes in the shallow coastal areas of Lebanon. This gives an indication of the significant effect invasive species can have on indigenous populations.

A list of Lessepsian species recorded by fishermen in Lebanon up to 2010 has also been produced (*DA: 113*). However it only quotes 'east Levantine' and does not indicate exactly where these species were found in Lebanon, nor the species' population size or their distribution.

The IUCN has also produced reports into the status of marine fish in the Mediterranean (*DA: 239 and 238*). In these reports, the Lebanese coast is reported to have medium species richness in comparison to the Western part of the sea. The eastern Mediterranean sea is home to cartilaginous and bony fish. These include sharks, rays and chimeras that are native to the Mediterranean. Cartilaginous species are all slow growing, late to mature, have low fecundity and productivity and long gestation times. This means that they are particularly susceptible to disturbance events. Some cartilaginous fish have a restricted range within the Mediterranean. For example, a small population of the Smalltooth Sand Tiger Shark (*Odontaspis ferox*) is listed as resident in a 'particular area off Lebanon'. There are also 442 bony fishes in the Mediterranean. Most



of these have a better capacity for population recovery, although some, such as large tunas, are also relatively long lived.

The IUCN report also notes that there are between 22 and 27 species of threatened fish in the Levantine basin along the Lebanese coast. Species targeted by fisheries offshore Lebanon include; the common guitar fish (*Rhinobatos rhinobatos*) (classified as "endangered) and the Blue Fin Tuna (*Thunnus thynnus*) (data deficient). Although

a general picture of species richness of marine fish is presented by these reports, more specific data is required in order to ascertain the location of individual species. Specifically, future studies should aim to define the extent of the *O. ferox* habitat offshore Lebanon.

The IUCN also composed a report on deep marine ecosystems (*DA: 97*). It states that the Levantine Sea has relatively low primary productivity, and reports a general scarcity of

deep-sea fish fauna in this region. However, it is noted that out of the species recorded there are several that are either rare or new to science. Studies have found that whilst the Levantine basin has a low number and low abundance of



species relative to the western Mediterranean basin, the assemblage composition is different. Among the most abundant fish species in Levantine bathyal communities are the deep-sea sharks (*Centrophorus* spp., *Etmopterus spinax* and *Hexanchus griseus*).

#### Cetaceans



A report was produced outlining the work ACCOBAMS has completed in Lebanon since Lebanon became a contracting party in 2004. Projects have included the monitoring of stranded cetaceans, whale watching, public awareness, introduction of cetacean knowledge in Universities, and the distribution of training kits. Their survey method of completing line transects on the

CANA scientific vessel (covering 665km in total) is a more systematic approach, however just 56 bottlenose dolphin (Tursiops truncatus) were sighted in small pod sizes of 1 to 6 individuals (DA: 76).IT is also important to note that only certain areas of Lebanese waters were surveyed at certain times, not providing a complete picture of cetacean distribution within Lebanese waters.

ACCOBAMS collated lists of cetacean species found in the Mediterranean, with matrixes showing whether species are residents/visitors or vagrants to particular areas. Table 4.2. shows the species reported off the Lebanese coast. This may act as useful initial data for marine mammal observers during surveys. However, the data has largely been extrapolated from existing data averaged over the whole Mediterranean and there are no density figures or species population numbers given (*DA: 197 and 198*). It is recommended that a comprehensive marine mammal survey is undertaken offshore Lebanon.

Species	Notes	Native (presence confirmed)	Native (possibly present)	Possibly Vagrant	Recorded in Israeli waters, but not Lebanese
Fin Whale (Balaenoptera physalus)		х			
Long finned pilot whale ( <i>Globicephala melas)</i>	This species has not been recorded in eastern Mediterranean, although this could partly be due to low survey effort.			х	
Risso's dolphin ( <i>Grampus griseus</i> )	Predominantly found in the western Mediterranean and is considered scarce in the east. However, this may be due to the relative lack of survey effort in this area.		X		
Common bottlenose dolphin <i>Tursiops truncates)</i>	Recorded throughout the Mediterranean.		х		
Striped dolphin ( <i>Stenella</i> <i>coeruleoalba</i> )	Recorded throughout the Mediterranean. This species is regularly spotted around the Greek Islands.		х		
Sperm Whale ( <i>Physeter macrocephalus</i> )	Recorded throughout the Mediterranean.		х		
Fin Whale ( <i>Balaenoptera physalus</i> )	Fin whales are very abundant in the Western Mediterranean. They are rare in the east, although have been spotted on occasion.		х		
Cuvier's Beaked Whale ( <i>Ziphius cavirostris</i> )	Present in deep waters throughout the Mediterranean.		х		
Common Minke Whale (Balaenoptera acutorostrata)					x
Killer Whale (Orcinus orca)					х
False Killer Whale ( <i>Pseudorca crassidens</i> )					x
Rough-toothed dolphin (Steno bredanensis)					х

# Table 4.2. Status of cetaceans recorded offshore Lebanon (DA: 197)
#### Pinnipeds

A monk seal (*Monachus monachus*) was recorded off the shore of Beirut during the ACCOBAMS survey programme between 2009 and 2010 (*DA: 41*). An un-verified source has also reported two separate sightings of *M. monachus* around the northern caves of Lebanon (*DA: 401*)



#### Sea Turtles

Two species of turtle are known to occur along the Lebanese coast; loggerhead turtles (*Caretta caretta*) and green turtles (*Chelonia mydas*). Mediterranean loggerhead turtles are classified as "endangered" by the IUCN, and nest predominantly in Turkey, Greece, Cyprus and Libya. Much lower numbers of *C. caretta* are reported along the Lebanese coast. Green turtles are classified globally as "endangered", with the Mediterranean population classed as "critically endangered" (*DA: 126*). Peak season for nesting is recognized as being between 15<sup>th</sup> and 30<sup>th</sup> June in the Eastern Mediterranean. The coralline reefs along the Lebanese coast are considered extremely important for sea turtles in the region. They have been identified offshore at most sites where turtles have been recorded nesting.

There are several international conventions to which Lebanon is a signatory that protect marine turtles;

- The Convention on the International trade in Endangered Species of Wild Fauna and Flora (CITES)
- The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)
- The Convention for the Protection of the Mediterranean Sea against pollution (Barcelona Convention)
- The Convention on the Conservation of Migratory Species of Wild Animals (CMS) (Bonn Convention)
- The Convention on Biological Diversity (CBD)
- Mediterranean Action Plan
- Revised Action Plan for the Conservation of Mediterranean Marine Turtles
- UN Convention on the Law of the Sea
- The MARPOL Convention
- The World Heritage Convention

Daily monitoring was conducted throughout the nesting season of 2005 in the Tyre Coast Nature Reserve, El Mansouri, and El Abbessiye (*DA: 38 and 126*). Both *C. caretta* and *C. mydas* were observed at these sites. The methodology used involved monitoring the tracks of turtles in sand and classifying them as either "nest" or "emergence". Results of the survey revealed that although nesting was sparsely distributed along parts of the northern Lebanese coast and scattered on several developed beaches, the southern nesting sites were found to be more important both nationally and regionally for nesting turtles. Overall, there are estimated to be between 37 - 70 *C. caretta* nests and 0 - 16 *C.* 

*mydas* nests per year on southern beaches in Lebanon. The results are discussed in more detail below.



El Mansouri is currently considered the most significant nesting rookery site in Lebanon. The location of the beach awav from human settlement and close the southern Lebanese border helps to protect the turtles here from disturbances. At this site, 51 loggerhead turtle nests and 57 emergences were observed; no green turtles emerged or nested. However, the close proximity to the Lebanese border with Israel makes monitoring

difficult. El Aabassiye boasts the only undisturbed sand dune system in Lebanon. Although this site is not currently protected, it has a high conservation priority since it is considered the second most important turtle nesting beach in Lebanon. During the survey, a total of 20 loggerhead turtle emerges were recorded, with 10 resulting in nests. One green turtle was recorded nesting at the Tyre Coast Nature reserve. This was a marked decrease in nesting effort in comparison to 2004. However, 53 hatchling tracks were recorded on the beach in the nest area. Official published studies have not been conducted since 2005 although some unofficial monitoring is still conducted by individuals. It is recommended that long term monitoring is conducted in order to estimate the spatial and temporal distribution of sea turtles. This will also help to decide what the best tagging technique to use is. A survey of fishermen was also conducted. 43 out of 59 fishermen reported seeing turtles offshore Lebanon every day. However these results should be treated with caution as it is likely that some fishermen may have exaggerated sighting numbers in order to justify damaging fishing practises (*DA: 38 and 126*).

A study conducted in 2001 aimed to provide an assessment of turtle nesting beaches along the Lebanese coast from north to south, indicating the degrees of importance for each Sites of high importance site. included: El Mansouri, Tyre Coast Nature Reserve. North Sour. Qasmiye, Mahmoudiye, Adloun, Jbail, Palm Islands (Rabbit Island), and Cheikh Zannad. The survey provides further evidence of green turtle nesting and indicates that



southern town of Sour is of particular interest. The paper proposes short and long term recommendations to secure the protection of turtle populations. It has been recommended that Marine Protected Areas (MPAs) around these sites be created (DA: 39). However, given the age of this study, it would be advisable to repeat the study to establish any changes in turtle numbers and breeding locations during the intervening period of time.

A survey conducted by the marine turtle conservation in the Mediterranean reported on surveys conducted in 2004 as part of MEDWETCOAST and MEDASSET on the Tyre Coast Nature Reserve, Abbasieh, El Mansouri, and Ras El Ain. Data collection during the survey was incomplete, and cannot provide a precise estimate of sea turtle populations or determine their status. However this report has shown that the southern Lebanese coast is important for *C. caretta* and *C. mydas* at national and regional levels. The paper advises that establishing long term monitoring programmes will provide important information that would assist in the creation of a national database and consequently apply suitable conservation measures at each site (*DA: 122*).

Further analysis of the MEDWETCOAST and MEDASSET surveys conducted in 2004 have also been undertaken (*DA: 37*). It indicates that the nest status on Palm Islands requires re-assessment and that future conservation efforts are necessary for El Aabbassiye / El bourgheliye beach. It is recommended that these should cover sea turtle nesting grounds as well as the rehabilitation of rare and endangered coastal habitats.

The following turtle species have also been reported offshore Lebanon; African Softshell Turtle (*Trionyx triunguis*), classified as "critically endangered" by the IUCN, Spur – Thighed Toirtoise (*Testudo graeca terrestris*) (vulnerable) and the western Caspian turtle (*Mauremys caspica rivulata*) (least concern). However, these records are up to 20 years old (*See DA: 396*). Repeated sightings of these species are not known to have occurred.

#### Birds

SPNL has compiled a list of bird species in Lebanon, including marine birds such as Petrels, Shearwaters, and Pelicans. However, there is no information on seasonality and habitat location. For a comprehensive SEA the marine birds should be evaluated according to oiling vulnerability and their distribution should be indicated on a habitat map.

Wild Lebanon (*DA: 48*) goes a step further to address the status of each bird (i.e. resident, visitor, migrant, vagrant, or extinct. Migration dates for some species of bird are also provided, although only a few species appear to be applicable to the offshore ecology. This will be a useful tool for establishing seasonal sensitivities (*DA: 49*). However, a habitat map is still not provided.



However, protection may cease at the shoreline, meaning it would not extend out to sea. According to the fact file there are 156 species of migratory birds, including several endangered species, which use the islands as a resting point. Endangered species present on the islands

A Rocha produced a fact file on Important Bird Areas (IBAs). The only IBA relevant to offshore ecology is the Palm Islands Nature Reserve – designated as a Marine Protected Area (MPA) and RAMSAR site.



include Audouin's Gull (*Larus audouinii*), categorised by the IUCN as "near threatened", and the Dalmatian Pelican (*Pelecanus crispus*) ("vulnerable"). The report also lists the

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Corncrake can (*Crex crex*) as "globally threatened". However, the IUCN considers this species to be of "least concern" (*DA: 47*).

The fact file indicates which significant bird species are found on Palm Islands but does not provide sufficient detail for an SEA. This document also illustrates bird migration paths across Lebanon, although it is unclear if there are any major marine migratory routes. From this document, it appears that in spring most migrations occur inshore, although in autumn birds migrating south have been recorded in and around Jounieh on the coast. Further research is required in order to establish if, where and when migrations take place over offshore Lebanese waters (*DA: 50*). A news article alludes to the fact that birds are migrating over the Palm Islands but species specific data or the timings of this are currently undocumented (*DA: 51*)

#### **Sensitive Areas**

A survey was conducted by the IUCN and partners with the aim of providing an up to date baseline to assess progress towards developing an ecologically representative and coherent network of Marine Protected Areas (MPAs) in the Mediterranean Sea (*DA: 218*). Lebanon has been listed in the report as having one MPA: the Palm Islands. It is unclear as to whether there is misuse of this term since the islands are legally listed as a Nature Reserve that does not include the surrounding waters. The survey involved a questionnaire directed towards managers of MPAs for their input based on scientific data available or on the basis of past experience.

The results of the survey indicated that the Convention on Biological Diversity target of protection of 10% is not likely to be achieved, and that that the current Mediterranean MPA system is not representative or coherent of all habitats and ecosystems. This highlights the lack of MPAs on the Southern shoreline, meaning that this area cannot be defined as an ecological network but rather an initial system upon which a coherent network should be designed. A series of recommendations to support development of a coherent network and to improve management effectiveness through regional initiatives were made. The definition of term MPA for the Palm Islands needs to be clarified and should be in line with other IUCN proposed sites for marine protection in Lebanon (DA: 218).

The GPS co-ordinates of twelve proposed marine protected areas along the Lebanese coast as well as six estuaries are shown in figure 4.1. This data was obtained from the IUCN project within the Lebanese Ministry of Environment for "Supporting the Management of Important Marine Habitats and Species in Lebanon". The habitats shown at these sites consist of; vermetid platforms, canyons, coralligeneous bottoms, and seagrass meadows. Vermetid platforms are good indicators of rising sea level, whilst seagrass meadows provide nursing habitats for commercially important fish species.





It is very important that official protection is given to critical habitats before oil and gas activities become established. These areas should be surveyed to establish the baseline environment for the designated areas and the data collected could be presented in a comprehensive GIS database (*DA: 219, 220, 235 and 237*).

The Levantine Basin is an important migratory route for bluefin tuna (*Thunnus thynnus*), and a breeding area for loggerhead turtles, green turtles and sharks. The threatened Sand Tiger Shark (*Carcharias Taurus*), Gulper Shark (*Centrophorus granulosus*) and Angel Shark (*Squatina squatina*) are also present in the area. Adjacent coastal waters contain hydrothermal vents and their associated communities. The paper proposes a total of 100 sites forming a network of Mediterranean MPAs. It includes the Beirut escarpment, Saint George Canyon, Jounieh Canyons, covering fisheries targeting pelagic species such as the endangered Common Guitarfish (*Rhinobatos rhinobatos*), and Sour Canyon, a known spawning area for bluefin tuna. However, the area was categorised as 'data deficient' by the IUCN (*DA: 239*).

This report provides a highly informative and detailed overview of the Lebanese coastal biodiversity and typical threats to wildlife. It proposes eighteen MPAs (of which six are estuaries) in line with the Greenpeace target of protecting 40% of the world's oceans. The sites were selected in accordance with IUCN criteria for protected areas, and are also in line with the MPAs proposed by other IUCN projects (*DA: 219, 220, and 271*).

#### Marine Biodiversity Threats

Extractive use of marine living resources is the major threat to marine biodiversity; with numerous species of marine fish being heavily exploited.

Many species of Lebanon's marine domain will certainly be impacted by the exotic and lessepsian species as is the case of the Brown Algae *Stypopodium zonale* which invaded large surface areas on the detriment of other species of the marine habitats (*DA: 252*).

The current manner in which the coast is exploited is clearly detrimental and destructive, both for the coast and for the future of Lebanon. The beaches are very vulnerable and there are several areas where parts of beaches and dunes are being lost. This loss is partly due to human development and partly to natural causes like erosion. Although development in itself is a necessary process to ensure economic growth it also carries risk and influences other sectors in the region. The loss of beaches can have a negative effect on tourism and fishing industries. The use of explosives destroys sea fauna, and causes other unforeseen problems. The direct outpour of sewage, industrial waste and household refuse without prior treatment and with no sanitary measures has transformed the Lebanese beaches into trash dumps and the Lebanese coast into underwater sewers. The removal of maritime accretions at low depths threatens the destruction of what is left of the beaches.

One of the threats resulting from exploitation of marine species is the issue of bycatch and incidental mortality. This occurs when non-target species like the endangered marine turtles or dolphins are killed by accident during fishing operations.

Marine resources are not extracted only for use as a source of food. Many fish are collected to be sold or used as aquarium fish and many shells are gathered by collectors or removed from certain areas to be released in others, affecting as such the equilibrium of the biocenoses. Climate change effect on marine biodiversity is not clearly approached by scientists and the open system mariculture (the mass production of marine fish for human consumption) is not yet seriously practiced in Lebanon.

In 2006, 10,000 tons of heavy fuel oil has been spilled into the Lebanese sea, causing an environmental catastrophe with severe effects on health, biodiversity and tourism. It has affected more than 140 km of both public and private rocky and sandy beaches along the Lebanese coast including public and private marinas/ports for boats/ships of fishermen. The toxic oil, which covered rocky coasts, has killed algae and other organisms that fish and turtles feed on. Consequently, fishermen have reported decreased numbers of fish harvests compared to previous years. Oil, which has sunk to the sea bed reappeared in the form of tar balls and re-contaminated sandy beaches. Moreover, oiled and dead birds are still discovered in monitored places like Palm Islands Nature Reserve (*DA: 252*).

# 4.9 Missing Data

From analysing the existing data available for the ecology offshore of Lebanon, the following gaps identified will need to be addressed in order to produce a comprehensive SEA for Lebanon:

#### **Benthos**

- Location of coral species in Lebanese waters. As a minimum, describe the habitats in which corals are expected for predictive habitat mapping;
- Macrobenthic community data;
- Meiobenthic community data;
- Phytobenthos data;
- Benthic flora community data;
- Copepod community data.

#### Plankton

- Offshore plankton community data. As a minimum take spatially distributed samples and compare with coastal plankton database provided in (*DA: 61*);
- Investigate seasonal population fluxes.

#### **Demersal and Pelagic Fish**

- Fish (including sharks and rays) community data;
- Identify status of fish species recorded: resident, migrant etc. and if not resident record month(s) in which the species may be found in Lebanese waters;
- Identify any spawning and nursery areas in Lebanon and record the month(s) in which these events take place;
- Seasonal sensitivity period for each species;
- Identify deep-sea species;
- Highlight rare / endangered species and consider protection of critical habitat.

### Cetaceans

- Cetacean community data;
- Identify status of cetacean species recorded: resident, migrant etc. and if not resident record month(s) in which the species may be found in Lebanese waters;
- Identify calving areas and record the month(s) in which these take place;
- Seasonal sensitivity period for each species;
- Record density by licence block;
- Highlight rare / endangered species and consider protection of critical habitat.

## Pinnipeds

- Pinniped community data;
- Identify status of pinniped species recorded: resident, migrant etc. and if not resident record month(s) in which the species may be found in Lebanese waters;
- Identify pupping areas and record the month(s) in which these take place;
- Seasonal sensitivity period for each species;
- Record density by licence block;
- Highlight rare / endangered species and consider protection of critical habitat.

## Sea Turtles

- Sea turtle community data;
- Identify status of sea turtle species recorded: resident, migrant etc. and if not resident record month(s) in which the specie may be found in Lebanese waters;
- Identify nesting sites and record the month(s) in which these take place;
- Seasonal sensitivity period for each species;
- Record density by licence block;

• Highlight rare / endangered species and consider protection of critical habitat.

#### Birds

- Marine bird community data;
- Identify status of bird species recorded: resident, migrant etc. and if not resident record month(s) in which the species may be found in Lebanese waters;
- Identify migratory routes, where applicable;
- Identify nesting sites and record the month(s) in which these take place;
- Seasonal sensitivity to oiling for each species;
- Record density by licence block;
- Highlight rare / endangered species and consider protection of critical habitat.

#### **Sensitive Areas**

- Identify sensitive areas critically in need of protection. Use criteria set out in EU Habitat Directive 92/43/EEC and EU Birds Directive 79/409/EEC;
- Collect baseline environmental data (based on criteria above) for each sensitive area;
- Define the extent of Palm Islands Nature Reserve / MPA and ensure boundaries of all future coastal or marine protected areas are established in writing.

## 4.10 Discussion



A critical analysis of the existing data available regarding the Lebanese offshore ecology has identified large gaps in the data relating to the Lebanese marine ecosystem.

The laws governing the management and protection of offshore ecology in Lebanon appear to focus on particular themes and so the offshore ecology topics outlined above have received uneven levels of attention.

The Lebanese waters are a rich ecological and economic fisheries

resource. In order to preserve this value for future generations it is vital that a comprehensive set of baseline data is obtained and a suitable management strategy put in place before Lebanon introduces an oil and gas industry to its makeup. This will allow the oil and gas industry to more accurately assess any potential impact derived from operations and thus minimise impact on the regional ecosystem.

Oil and gas companies are well acquainted with industry standards of best practice and will anticipate that the Lebanese Government will provide operational standards and regulations to adhere to. At present the environmental law in Lebanon is severely lacking in these forms of guidance and allowing such an industry to develop outside of an effective legal framework would be highly irresponsible. The pending EIA Decree must be enacted with provision for:

- Environmental baseline assessment;
- Description of potential impacts arising from oil and gas activities;
- Mitigation measures to manage any adverse environmental impact;
- An outline of the operator's and any contractor's Environmental Management System; and
- A summary of residual effects.

The Lebanese Government have the opportunity to raise the profile of marine ecology conservation and make good progress towards meeting its long term goals in sustainable environmental management.





# 5 Fisheries

# 5.1 Topic

Fisheries management draws on fisheries science in order to find ways to protect fishery resources so sustainable exploitation is possible. According to the Food and Agriculture Organisation (FAO), there are "no clear and generally accepted definitions of fisheries management". However, the working definition used by the FAO and much quoted elsewhere is:

"The integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and the accomplishment of other fisheries objectives."

Fisheries objectives need to be expressed in definitive management rules. In most countries fisheries management rules should be based on the internationally agreed, though non-binding, Code of Conduct for Responsible Fisheries, agreed at a meeting of the U.N.'s Food and Agriculture Organization FAO session in 1995. The precautionary approach it prescribes is typically implemented in concrete management rules as minimum spawning biomass, maximum fishing mortality rates, etc.

Other situations need additional intergovernmental coordination. For example, in the Mediterranean Sea and other relatively narrow bodies of water, EEZ of 200 nautical miles (370 km) are irrelevant. International waters beyond 12-nautical-mile (22 km) from shore require explicit agreements. Straddling fish stocks, which migrate through more than one EEZ also present challenges.

This section considers the data available on fisheries in Lebanon. Data relating to fish stock monitoring, catch data, fishing effort and the areas being fished will be assessed. Data pertaining to the fisheries infrastructure and regulation will also be considered.

# 5.2 Regulatory Framework

The Law for fisheries in Lebanon dates back to 1928. The Ministry of agriculture have coordinated efforts with the FAO since 2004 to draft a new law on basis of extensive field data collection. However, the draft law is still being discussed with fishermen and no consensus is reached yet.

The objectives of the fisheries policy are set at a national level (fishing Law 70 (1937, Monitoring of fishing practices in coastal waters (1929), Prohibiting fishing of whales, seals and marine turtles 83/1 (1983)). The current policy aims at enforcing the regulations stipulated in the different laws, decrees and ministerial decisions enacted by ministries with overlapping authorities.

Article 30 of Environmental Law 444 addresses endeavours to protect marine creatures and fisheries from harmful discharges to the marine environment.

The Ministry of agriculture has issued many decisions banning the fishing by using dynamites and trawling nets. In addition to the decision banning the fishing of marine turtles, cetaceans and monk seals issued in 1999, there was also a ban on the selling, use or trade of any derivates from the mentioned species. However the main obstacle remains the proper enforcement of legislation (*DA: 252*).

Regarding sponge fishing, the Statutory Order No 95 dated 9/5/1939 regulates Sponge Fishing in Lebanon, and No 63 dated 16/3/1993 prohibited sponge fishing for five years and afterwards the Statutory Order No 281 dated 19/11/1998 was issued and it prohibited sponge fishing for another five years (*DA: 252*).

For further laws and conventions see the Legal Register in Volume 6.

### **Roles and responsibilities**

Fisheries resources and management in Lebanon are administrated by the Department of Fisheries and Wildlife.

Fishery Law (Law 2775 of September 28, 1929 & Decree 5246 of June 20, 1994) as per Decree 5246 of June 20, 1994 covers;

- Marine & freshwater fisheries and Game hunting affairs;
- Applied research on aquaculture and establishment of training centres in different locations and at its Institute of Oceanography and Fisheries at Batroun;
- Awarding fishing licenses;
- Establishment and modernization of fishing ports and fish handling facilities in coordination with the Ministry of Transportation;
- Regulating the fishing sector by assigning fishing seasons and protected areas. Organizing and regulating diving clubs and protected areas;
- Attempts to improve the livelihood of fishermen by organizing cooperatives and syndicates;
- Carrying out applied research on aquaculture. Development and modernization of fishing techniques. Provide training on fishing boats;
- Preparation of extension programs;
- Hatching and distribution of adaptable fish species. Running trials on local and introduced fish species;
- Surveys of game species;
- Preparing general guidelines to preserve game species and regulating its hunting in coordination with the Ministry of Environment;
- Growing of game species and running trials on them;
- Enforcing fishing and game hunting laws and regulations and;
- Other pertaining matters

#### Administration

The administrative structure of entities dealing with fisheries within the Ministry of Agriculture is given in the organogram below. The part on the left shows the structure of central administration in Beirut, while the right-hand side shows the organisational structure in the governorates. The four agriculture services deal not only with fisheries, but with all issues related to the Ministry of Agriculture. These services cover four Lebanese governorates: North Lebanon, Mount Lebanon, South Lebanon, and Beqa'a. Each agriculture service has a rural development department that manages the forest and fish centres.



The Directorate of Rural Development and Natural Resources manages fisheries in the Ministry of Agriculture in Beirut. The Service of Forests and Natural Resources is part of this directorate, and controls the Fisheries and Wildlife Department. The department manages and supports four designated centres. The FAO receives fisheries data from the Chief/Head of the Fisheries & Wildlife Department, Directorate of Rural Development and Natural Resources, Ministry of Agriculture.

# 5.3 Strategy and Future Plans

A draft law is currently being formulated in order to update the fisheries management and reporting systems in accordance with the standards set forth by the FAO and the United Nation organizations and based on the Code of Conduct for Responsible Fisheries.

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The new law will replace law number 2775 in order to update fisheries management and reporting systems.

The initiative at the Marine Resources and Coastal Zone Management program (MRCZM) at the Institute of the Environment at the University of Balamand has been collecting commercial fisheries data including landings and effort in the Mohafaza of North Lebanon and Akkar on a regular basis since August 2005. The geographical coverage of the monitoring program represents approximately 30 percent of the Lebanese coast. The main goal of the initiative is to establish long-term monitoring of the landings of commercial fish species and effort spent fishing in order to develop appropriate management plans based on scientific data to sustainably benefit from the resource. Since the launching of activities, the monitoring program has been striving to meet the following objectives:

- Establish an easy to implement data collection & analysis method
- Develop & validate the socio-economic, fish catch and fishing effort surveys
- Share the collected data with the MoA
- Recommend seasons
- Raise the awareness of fishermen about the importance of managing



the resource themselves: promote ownership

• Identify the season in which targeted species will fetch the highest price

The data collection is an indirect method where data is collected twice per week all year round. The data is gathered from the four main fishing harbors and main fish markets while fishing effort is obtained from the records of the Lebanese Army that records boat activity on a daily basis. The variables currently being evaluated are:

- Fishing gear type (Nets, Lines, Pots)
- Fish species landed per gear type: Quantity (Kg)
- Average fish size (No. of fish/Kg)
- Prices (L.L./Kg)
- Fishing effort:
  - Total number of fishing boat outings during 24 hours
  - ✓ Number of fishing boats per gear type

Findings from this monitoring program have not yet been published. A compatible study to cover the remaining Lebanese coastline is planned upon completion of the study in the North.

# 5.4 Impact from Development of Petroleum Activities

The development of oil and gas production activities in Lebanon (including seismic acquisition, exploration drilling, production and pipeline installation; discussed further in Section 1) could potentially have a significant effect on the fisheries of Lebanon. These potential impacts arise from several different aspects of the oil and gas industry (some aspects are potentially more demanding of waste resources than others). These aspects are outlined below.

### **Seismic Data Acquisition**

*Physical presence* – The presence of a seismic survey will create an exclusion zone that may temporarily displace fishing efforts.

*Noise* - The conducting of a seismic survey will involve the firing of airguns, potentially creating avoidance behaviour in some fish species further impacting fishing efforts. Seismic surveys are considered to be a short term impact lasting in the order of days.



## **Petroleum Exploration and Production**

*Physical presence* – Once an installation is on site, it is best industry practice to ensure a 500 metre exclusion zone around the installation for its duration at a given location. This will potentially restrict the range of waters available for fishing activities during this time.

Seabed disturbance – During drilling operations (refer to section 1 of this document) drill cuttings may be deposited on the seabed. These deposits have the potential to smother fish eggs thus impacting fish spawning and impacting future fish stocks.

## **Offshore Pipeline Construction**

*Physical presence* – The presence of a pipe laying vessel will create an exclusion zone that may displace concurrent fishing efforts.

Seabed disturbance – During pipe laying operations (refer to section 1 of this document), the pipe may be placed upon the seabed, then covered with rock armour or concrete shielding. These activities would involve land take from the seabed, potentially disrupting fish spawning grounds and demersal fish species. A trench may also be dug to

accommodate the pipe line, putting sediments into suspension which may cause a smothering effect. These deposits have the potential to smother fish eggs thus impacting fish spawning and impacting future fish stocks.

### **Standby and Supply Vessels**

*Physical Presence* – The presence of a standby and supply vessels (both around the installation and traversing to and from it) will potentially cause disruption that could displace concurrent fishing efforts.

# 5.5 **Possible Development Options**

Lebanon's extensive offshore territory and the deficiency of environmental data especially for the deep offshore areas - is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration there. A lesson learnt from that situation is that it takes time to acquire and collate data, and this data gathering phase happens piecemeal rather than in a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline Surveys being carried out as part the Environmental and Social Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of contract and a legal requirement in Lebanon. In these circumstances Baseline Surveys are an insurance necessity to guard against future liabilities.

To maximise the value of the surveys Lebanon would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that might accrue due to operator proposed mitigation measures, Lebanon needs to be fully cognisant of best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

It is also worth noting that fisheries research is being backed in Lebanon by UN initiatives, such as the FAO East Med programme. Good relationships with the organisations behind such initiatives and strong communication will hopefully lead to compatible data being gathered by all parties, creating a more complete picture of the fisheries in question.

# 5.6 ESIA Data Requirements

A comprehensive ESIA related to oil and gas activities would require good data relating to the following areas when considering its impact on existing fisheries:

- Fish species distribution Best indications of where species of fish (particularly those that are of commercial importance) may be found;
- Spawning grounds particularly for commercial species;
- Fishing effort;
  - size of fishing fleet,

- scale of operations,
- regions fished,
- hours fished per vessel;
- Effort spent per classification (pelagic, demersal, etc)
- Equipment used
- Fishing seasons for particular species;
- Historic fish stock levels to help assess a baseline status of the fisheries industry;

# 5.7 Description of Existing Data

The demand for fish in Lebanon is high (15,000 tonne per year in 2000). Imports of fresh, chilled, and frozen fish were reported to be 9 383 tonne in 2002. The estimated potential for fish consumption in Lebanon is 35,000 tonne per year. The average per capita fish supply was estimated at 9.2 kg per year in the period 1999 - 2001 (*DA: 407*).

The fisheries of Lebanon are classified as small-scale, artisanal, and are traditionally based on bottom stationary gear (trammel nets and longlines), purse seine nets (lampara) and beach seines. Fishing operations, with the exception of longlines, are mostly carried out at depths of up to 50 meters. Most of the gillnets, beach, and purse seines have small mesh sizes (less than 2x2 cm). Because of the strict control by the military, the fishing with explosives has been in decline.



Ninety nine percent of the landings are recorded at family or higher level, leaving only the landings of Common octopus (*Octopus vulgaris*, 25 tonne) and European conger (*Conger conger*, 9 tonne) to be recorded at species level. The five most important

species-groups in 2003 were: *Clupeidae* (650 tonne), *Carangidae* (400 tonne), *Scombroidei*1 (400 tonne), *Sparidae* (370 tonne), and *Mugilidae* (365 tonne) (*DA: 407*).

During the nineties the Ministry of Tourism (MoT) implemented a program to rehabilitate 15 fishing harbors along the Lebanese coast, including 4 in North Lebanon: Al Abdeh (250 boats), El Mina (1000 boats), El Kalamoun (50 boats) and Batroun (80 boats). The Lebanese fishing fleet is made of a total of 2700 fishing boats spread all over the Lebanese coast with approximately 1000 being active in North Lebanon. Trawling is prohibited by the 1929 law #2775, while the most commonly used gear includes trammels and long-lines, roundhaul nets and beach seines. Even-though it is prohibited by law, spear fishing using scuba diving gear is widely practiced. Furthermore, fishing nets with illegal mesh sizes are widely available on the black market increasing the by-

catch of immature organisms and leading to negative impacts on recruitment rates. According to the Ministry of Agriculture (MoA), fish production averaged 2300 tons in the 1970s reaching 7500 tons in the year 2004 (data available from the MoA). The Ministry does not publish any statistics related to specific fisheries. Imports on the other hand have reached a total of 15,000 tons in 2005 at a value of 30 million USD. This information is very detailed in terms of imported species, quantities as well as prices. However, the MoA neither has a fisheries management plan nor a monitoring program, and no information is currently available on fishing effort or quantities of marine products caught off the Lebanese coast on a national scale.

#### **Fishing effort**

Seaworthiness and sailing licensing for fishing vessels is under the jurisdiction of the Ministry of Public Works & Transportation. This Ministry as of 2005 holds electronic census data of its fishing fleet. This in turn has produced a computerized Fishing Vessel Register. This register conforms to the standards set by the Food and Agriculture Organisation (FAO) and the General Fisheries Commission for the Mediterranean (GFCM) (*DA: 53*). A study was conducted on the port of Tyre in 2004, looking at catch landing statistics and the state of the fishing fleet. This study employed good methodology,

however it was of too small a scale and over too short a period of time to offer a meaningful insight to the fisheries of Southern Lebanon let alone the whole country (*DA*: 53).

#### Historic fish catch data

Fish sales in Lebanon are mainly through auctions to fishmongers / restaurants / individuals. Fish selling outside such venues is common, but its extent is unknown. There is one official Central Fish Auction Yard next to Beirut Sea Port. Moreover, there is one fish auction yard/fish stall at each fishing port which is run by the respective fishermen cooperative at that port. Some of these auction yards keep some manual



records on certain improvised ledger books, which are extremely difficult to consolidate (DA: 54).

The Ministry of Finance along with Lebanese customs maintain and publish Fish Trade data (quantities and value) according to the Harmonized System adopted in 2002. Such information is very accurate for legally imported/exported products.

High level data does exist relating to Lebanese marine fisheries ecosystems, however this data is too broad in scope, old and lacking in detail to be applicable (*DA: 55*).

## 5.8 Missing Data

#### **Fish species distribution**

No studies have been undertaken to establish which fish species are present or their distribution (on a seasonal basis) specifically within Lebanese waters. Broader generic data does exist for the Mediterranean (*DA: 134*), but this data is heavily extrapolated and does not accurately represent the situation in Lebanese waters.

### Fish species spawning grounds

No studies have been undertaken to establish any data regarding fish spawning grounds specifically within Lebanese waters.

### **Fishing effort**

There is no specific statistical role mandated to the Department of Fisheries & Wildlife relating to fishing effort. This function is stated to be the responsibility of the Department of Statistics and Economical Analysis of the Directorate of Studies & Coordination/Ministry of Agriculture. This department however, does not carry such data at this stage.

Fishing licenses are issued by the Ministry of Agriculture, either by the Department of Fisheries & Wildlife or by the regional Rural Development Departments. Seaworthiness/sailing license by the Ministry of Public Works & Transportation is a prerequisite to issuing such licenses. The whole process of Fishing Licensing is manual and seldom updated. It is likely that the information has not been consolidated and/or computerised.

At present, there is a lack of published fish landing statistics by landing area, by fishing zone or by typology of the fishing industry (vessels). Specifically, data is needed to be able to produce:

- Monthly catch and effort estimates by typology of the fishing industry;
- Monthly catch and effort estimates by type of boat/gear class
- Monthly catch and effort estimates by fishing zones (statistical)
- Monthly catch and effort estimates by landed species.
- Monthly catch and effort estimates by any combination of the above.

## Historic fish catch data

The Lebanese Central Administration of Statistics is mandated to lying down of statistics related to natural wealth including Agriculture. However, they only collect and issue data regarding fruits and vegetables exportation. The Central Administration of Administration does not collect any information about fisheries sector.

The Ministry of Agriculture currently lacks a fisheries monitoring program. The assessment of commercial fisheries project implemented at the Institute of the Environment, University of Balamand covers only the region of North Lebanon, but has

gained extensive experience in monitoring the sector, although the data does not cover the whole of Lebanon's waters, only goes back as far as 2005 and is not yet published.

## 5.9 Discussion

Whilst there is good data relating to imports and exports of fish stock, there is very little data relating to any aspect of fishing effort. This is particularly true of South Lebanon where no monitoring is yet in place to capture this sort of data.

The legal framework of the fisheries sector suffers from the overlapping mandates of different national authorities, which also lack a clear and efficient communication mechanism. The mandates of national authorities are highly sectorial and overlap to an extent that will impact on any planned effective management of the fisheries sector.

The passing of the draft law being formulated to update fisheries management and reporting systems may well result in the removal of the 6 mile fishery limit in Lebanese waters. This 6 mile limit has inadvertently protected the Lebanese marine environment from the dangers of increased use, traffic and exploitation. It should be recognised that there may serious be environmental consequences to removing the 6 mile fisher limit without further legislation or marine protection.



Most of the international conventions pertaining to management of the fisheries sector are not yet implemented. The fisheries sector is poorly managed with very little in the way of monitoring. The implementation of the law is cursory. This situation means there is no effective barrier to illegal fishing activities in Lebanese waters.

The nature of the fishing fleet is reasonably well understood in terms of vessel numbers and equipment used; the fisheries of Lebanon are classified as small scale "artisanal" and traditional based mainly on bottom stationary gear (trammels and longlines), purse seine nets (lampara) and beach seines. A study was conducted on the port of Tyre in 2004, but it was of too small a scale and over too short a period of time to offer a meaningful insight to the fisheries of Southern Lebanon let alone the whole country (*DA: 53*).

This lack of data will be of particular concern to the oil and gas industry as not only does it prevent the establishment of a baseline relating to fish stocks, it also inhibits the Environmental and Social Impact Assessment (ESIA) process as there is insufficient data to perform a meaningful assessment. Knowledge of spawning locations in particular is of great significance when choosing a location for an offshore installation.

There is significant data still to be collected and processed if a baseline for fisheries activity and resources is to be established. The monitoring and data gathering will also

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have to be conducted on a sufficient basis for over a year before any seasonal variation can be analysed. Human and material resources will need to be found if the task of developing and implementing an effective monitoring system is to be accomplished. The inclusion of stakeholders at an early stage would be advised, both in the development of management plans and the application of laws.

It is likely that the oil and gas community will be keen to assist in these matters on grounds of their mutually beneficial nature. For example, resourcing could come forward to conduct spawning habitat surveys, or to conduct monitoring of fish catches / fishing effort on a national scale.

In its current state, the fisheries sector is highly ineffective in managing those activities occurring under its scope of influence. It is highly desirable that a long term strategy for the fisheries sector, supported by all stakeholders is developed.







# 6 Water

# 6.1 Topic

This section considers the data available on water management and usage in Lebanon. Data relating to water usage (use from domestic, industrial and agricultural sources) and water resources (groundwater and surface water) will be assessed. Water quality and wastewater will also be considered.

## 6.2 Regulatory Framework

It is widely understood that Lebanon requires a robust regulatory framework for its water resources. In this context, the establishment of coherent legislation and the regulation of ownership and use of water resources are a prerequisite to averting the high cost of ad hoc approaches to water allocation and control.

Laws and regulations for water quality and water resources protection date back to 1925, though complementary application decrees have not always been written. There are also few laws covering wastewater disposal, solid waste discharge, industrial wastewater discharge, and other water pollutants. The main laws covering water are:

- Order No. 144, 1925: Protection of Surface Water and Groundwater Resources
- Order No. 320/26, 1926: Protection of Catchment Areas

Law No. 144 of 1925 deals with public water rights with respect to rivers and springs, distribution canals and the protection of ground water There have been previous waste management plans (*DA: 200*). Article 2 of the law mandates that surface and groundwater resources belong to the public domain; however, private ownership can be achieved by property acquisition through sale or settlement, in addition to rights acquired prior to the passage of Law No. 320 (*DA: 200*).

Law No. 320 of 1926 which relates to the conservation and use of public water prohibits the undertaking of activities that would impact river flow or the river channel, as well as groundwater exploration near springs and along riverbanks. The law addresses well permits, the quantity of water withdrawn that is exempt from fees, rules for the establishment of commissions for the administration of irrigation and drinking water, collection of government fees, jurisdictions and penalties and disposal of domestic wastewater (*DA: 200*).

Further legislative decrees have been passed since the passing of these laws:

- Decree No. 639, 1942: Protection of Nabaa Al Assal Spring, Faraya
- Decree No. 10276, 1962: Protection Zones for Water Sources and Recharge Areas
- Decree No. 14438, 1970: Restrictions on the Depth of Unlicensed Boreholes
- Decree No. 8735, 1974: Pollution from Solid and Liquid Waste
- Law No. 64, 1988: Pollution from Hazardous Waste
- Decision No. 2528/C, 1996: Protection of Groundwater at El Kneisse
- Decree No. 680, 1998: The Preservation and Protection of Boreholes

Ministerial Decision No. 1/52, July 1996, issued standards for water quality and wastewater discharge. As they were difficult to implement, they were revised under decision No. 8/1, January 2001.

Organization Law No. 221 of May 2000 created five water agencies for Beirut, northern Lebanon, southern Lebanon, southern Beqaa, and northern Beqaa.

There is a need to review, consolidate and update the fragmented and outdated water codes in Lebanon to allow better and more efficient distribution of water resources and create a legal framework that is suited to the current and anticipated water usage of Lebanon.

For further laws and conventions see the Volume 6: Registers.

#### Stakeholders with water management involvement

*Ministry of Environment*: protects the environment, conducts studies on wastewater treatment, permits the establishment of classified organizations, and enforces legislation.

*Ministry of Public Health*: established a Department of Sanitary Engineering to monitor water quality. The ministry also sets standards for drinking water; proposes specifications for wastewater and drinking water networks; recommends action for pollution prevention; and operates water quality equipment such as chlorinators.

*Ministry of Municipalities and Rural Affairs*: supervises municipal works including sewage and drainage infrastructure.

*Council for Development and Reconstruction*: responsible for water, wastewater and solid waste facilities.

National Council and Scientific Research: conducts and coordinates scientific research and contains an environmental division responsible for pollution, marine biology, waste, wildlife, and nature reserves.

## Constraints

The following are a compilation of constraints upon Lebanese water resources management under the existing institutional framework (*DA: 200*):

- There is little integration between the responsibility for water supply and wastewater disposal and treatment.
- There is a lack of cooperation between Cazas (Districts), which has resulted in irregularities in water distribution. Some areas have more water than they need while others face a deficit. Water authorities generally do not account for overall needs and restrict their projects to their area of jurisdiction.
- There is general laxity of government enforcement concurrent with public disregard of existing decrees or laws regulating the water sector. This is mainly due to lack of enforcement personnel, deficient institutional capacities, and weak prosecution of those breaking the law.
- Records pertaining to water resources are scattered among several institutions and require updating to provide an accurate view of the current water situation.
- The number of local committees established during the years of civil unrest increased as water authorities were not able to serve isolated or remote communities. This has led to an overlap in functions between traditional authorities and newly created entities.
- The financing of projects as well as the design are delegated to several institutions leading to overlap and duplication of authority.

- The spatial distribution of the water supply authorities reflects administrative boundaries (County and District) rather than catchments or river basins. This division results in regions that are too small to efficiently manage water resources.
- Water boards and committees are restricted to the operation, maintenance and rehabilitation of water supply networks that are theoretically financed by charges levied on consumers. However, the income generated is not adequate to invest in rehabilitation works or new networks that are desperately needed.
- Theoretically, the responsibility for studying water requirements, developing water resources, designing and expanding networks falls under the jurisdiction of the Ministry of Hydraulic and Electric Resources (MHER). However, the Water Authority of the two largest cities (Beirut and Tripoli) and the National Litani River Authority were also given the responsibility to study and develop their respective systems leading to an overlap in prerogatives.

# 6.3 Strategy and Future Plans

There is a National Water Sector Strategy (NWSS) soon to be released by the Ministry of Energy and Water. This strategy is currently awaiting approval by the Council of Ministers, but is intended to update and improve water management in Lebanon. This will supersede the 2000-2009 water strategy which was created to manage: dams and aquifer



recharge; potable water projects; irrigation projects; wastewater treatment plant construction; and prevention of river flooding. Other strategies for improvement include:

- Develop a water quality management strategy to accompany the water strategy and an integrated action plan for water quality management that includes the private sector.
- Review the existing legal and regulatory framework and develop additional legal texts.
- Review existing standards for enforceability. Pass the pending environmental law and environmental impact assessment laws.
- Improve water quality monitoring including reconnaissance surveys of the status of water quality and the sources of pollution, identify the country's laboratory requirements, and develop a sustainable cost-effective monitoring program.
- Establish a self-monitoring and compliance program for industries. Plans should be overseen and enforced by the Ministry of Environment.
- Develop and implement a program for strengthening national capacities in water quality management including water resources management, wastewater management, operation and maintenance of treatment plants, wastewater

reuse, database creation and updating, information dissemination, community participation, monitoring and enforcement, and new economic measures such as "polluter pays".

Thirty-three wastewater treatment plants (coastal and inland) are currently planned or under construction (See table 6.1). With the location of the eleven wastewater treatment plants located along the coast, (Abdeh, Tripoli, Chekka, Batroun, Jbeil, Kesrouan, Dora (Beirut North) Ghadir (South Beirut), Chouf (coastal zone), Saida and Tyre) the population in and around major urban should centres be connected to the sewer network and 65% of the wastewater problem in Lebanon should be resolved by 2020 (DA: 95). Apart from the coastal stations, twenty-two plants are proposed to be built inland. These plants will be located near major cities such as Zahle, Baalbek and Nabatiyah. The achievement of the



construction of the major large-scale treatment plants should allow the treatment of around 80 % of wastewaters by 2020, *i.e.*, around 1 million  $m^3/day$  of treated wastewater. The remaining 20% should require the construction of about 100 small wastewater treatment plants (*DA: 95*).

Zone	Caza	Location	Implementation Status		
			Under Execution	Under Preparation	No Funding secured
Costal	Akkar	Abdeh		х	
Inland		Michmich		х	
Inland	Minieh - Dinnieh	Backhoun		х	
Costal	Tripoli	Tripoli	Х		
Inland	Becharre	Becharre		Х	
Inland		Hasroun			Х
Inland	Koura	Amioun		Х	
Costal		Chikka	Х		
Costal	Batroun	Batroun	Х		
Costal	Jbeil	Jbeil	Х		
Inland		Kartaba		Х	
Inland	Kesrouane	Harajel		х	
Costal		Kasrouane/ Tabarja			Х
Costal	Metn	Dora			Х
Inland		Khanchara		Х	
Costal	Beabda	Ghadir*			Х
Costal	Chouf	Chouf (Abi younes)	Х		
Costal	South	Saida	Х		
Costal		Sour		Х	
Inland	Hermel	Hermel		Х	
Inland	Baalbeck	Laboue		Х	
Inland		Yammouneh	Х		
Inland		Baalbeck	Х		
Inland	Zahle	Zahle	Х		
Inland		Aanjar		Х	
Inland	Bekaa (Ouest)	Jib Jinnine/ Deir Tahnich	Х		
Inland		Karoun	X (not realised by CDR)		
Inland		Sohmor/ Yohmor		х	
Inland	Hasbaya	Hasbaya		х	
Inland	Nabatiyeh	Jbaa			
Inland		Nabatiyeh	х		
Inland	Bint Jbeil	Shakra		x	
Inland		Bint Jbeil		х	

Table 6.1 Current Situation of Planned Secondary Wastewater Treatment Plant in Lebanon

\*limited to preliminary treatment and its expansion to secondary is yet unknown

# 6.4 Impact from Development of Petroleum Activities

The development of oil and gas production activities in Lebanon (including seismic acquisition, exploration drilling, production and pipeline installation - discussed further in Section 1) could potentially have a significant effect on water resources and management in Lebanon. These potential impacts arise from several different aspects of the development (some aspects are potentially more demanding of water resources than others). These aspects are outlined below.

#### **Seismic Data Acquisition**

*Physical presence* – The survey crews will be predominantly offshore, but will require not more than 150L of potable water per person per day for the duration of the survey. It is estimated that the complement of a seismic vessel would be less than 50 people.

*Waste* – Water waste coming from exploratory and production drilling will include sewerage and grey water. Sewerage and grey water must be treated prior to discharge under the MARPOL Convention, if it is not to be shipped to shore for treatment and disposal.

#### **Petroleum Exploration and Production**

Physical Presence - The crew of a drilling rig or ship in Lebanese waters would require not more than 150L of potable water per person per day for the duration of the campaign. As an approximation, a one well campaign could be in the order of 30 days and a drilling rig or vessel compliment can vary from 70 to 240 people. It is more difficult to assess the scale or duration of a production operation as this will depend largely on the nature of the reservoir, which of course is unknown at this point. The estimated maximum of 150L per person per day is still applicable.



*Waste* – Water waste coming from exploratory and production drilling will include sewerage and grey water. Sewerage and grey water must be treated prior to discharge under the MARPOL Convention, if it is not to be shipped to shore for treatment and disposal.

#### **Offshore Pipeline Construction**

*Physical Presence* – An offshore pipe laying crew in Lebanese waters would require not more than 150L of potable water per person per day for the duration of the campaign. The compliment of a pipe laying vessel can vary greatly; from 10 to 400 personnel. The duration of the pipe laying campaign will be largely dependent on the pipe laying vessel selected and the length of pipeline that is required.

*Waste* – Water waste coming from exploratory and production drilling will include sewerage and grey water. Sewerage and grey water must be treated prior to discharge under the MARPOL Convention, if it is not to be shipped to shore for treatment and disposal.

#### **Onshore Support Facilities**

*Physical Presence* – Although the activities related to an offshore oil and gas industry are predominantly found offshore, there will always be a component that is based onshore (offices, storage depots, accommodation, etc.). It would be misleading to try an approximate the scale of such facilities at this stage as so much will be defined by future actions and events. It has been estimated that the average person in Lebanon requires 200L of potable water per day.

## 6.5 **Possible Development Options**

Lebanon's extensive offshore territory and the deficiency of environmental data - especially for the deep offshore areas - is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration there. A lesson learnt from that situation is that it takes time to acquire and collate data, and this data gathering phase happens piecemeal rather than in a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline Surveys being carried out as part the Environmental and Social Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of contract and a legal requirement in Lebanon. In these circumstances Baseline Surveys are an insurance necessity to guard against future liabilities.

To maximise the value of the surveys Lebanon would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that might accrue due to operator proposed mitigation measures, Lebanon needs to be fully cognisant of best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

It is also worth noting that further research could be backed in Lebanon by international organisations, for example through UN initiatives. Good relationships with any the organisations behind such initiatives and strong communication will hopefully lead to compatible data being gathered by all parties, creating a more complete picture of the subject matter in question.

# 6.6 ESIA Data Requirements

A comprehensive ESIA related to oil and gas activities would require good data relating to the following areas when considering its impact on existing water resources and management:

#### Water resources

Surface water – Accurate and current data will be required to establish:

- What is Lebanon's surface water availability;
- How much is captured so as to be used as a resource;
- Existing demand on water resources.

Groundwater - Accurate and current data will be required to establish:

- The quantity of groundwater available;
- The location and refresh rate of the supplying aquifer/s;
- The sustainable rate at which groundwater may be extracted.

#### Infrastructure

Once the water has been 'captured' within the existing water management infrastructure, it may be classified as a resource. It is important to establish:

- How much water is lost through failing or inadequate infrastructure;
- The locations of key infrastructure (dams, treatment plants, etc.) sites;
- The number of wells (established infrastructure and private).

#### Water use

Establish the total annual exploitation of water resources by Lebanon (differentiating between national systems and private extraction). It is then necessary to ascertain the levels of water usage (including ratio of groundwater to rainwater / runoff use) between the following sectors:

- Agriculture
- Industry
- Domestic

#### Water quality

There is a need to understand the extent to which anthropogenic factors (including agriculture, domestic and industrial wastewater discharges) affect water resource quality.

#### Wastewater management

It is necessary to gain an understanding of how Lebanon manages its wastewater, particularly with regard to industrial wastewater.

## 6.7 Description of Existing Data

Lebanon is considered to be in a relatively fortunate hydrologic position; it receives an average of 661mm per year as compared to 252mm in Syria and 111 mm in Jordan.

Lebanon is typically characterized by a Mediterranean climate. Precipitation mainly occurs between the months of October and March. Coastal areas experience precipitation ranging from 600 to 1,100mm, reaching more than 1,400mm on the peaks of Faraya and Becharreh, whereas a modest 300 to 400mm is recorded inland. Since Lebanon is at a higher elevation than its neighbours, it has practically no incoming surface water flow.

The majority of the rainfall occurs within a short period of time (about 80 days) during the winter season, with practically no precipitation during other periods. Conversely, the peak demand for irrigation of agricultural lands occurs during the summer (dry season) when water is least available.

#### Water resources

In Lebanon, up to date data collection and monitoring techniques are lacking and very much needed to give a clear picture of the state of water resources (*DA: 95*). Rainfall records appear to be more complete than stream flow data. A network of hydrological stations was re-established to be partially operational along major rivers and streams in the early 1990s as part of a governmental rehabilitation drive, but little meaningful data has been derived from this initiative.

Lebanon comprises 17 perennial streams and about 23 seasonal ones, as well as more than 2,000 springs with a flow of around 1,000Mm<sup>3</sup>. The total surface water outflow is estimated at 735 Mm<sup>3</sup>/year, of which 160Mm<sup>3</sup> discharge into the sea. Surface water outflow to the Syrian Arab Republic is estimated at around 425 Mm<sup>3</sup> through the Asi-Orontes River and about 160 Mm<sup>3</sup> to the north of the occupied territories through the Hasbani/Wazani complex. Out of the 17 perennial streams in Lebanon, 8 are protected by Decisions of the Minister of Environment on basis of the law of 1939 for the protection of Natural sites. Other rivers or streams are also protected within the biosphere reserves. The protection of rivers through the mentioned ministerial decisions extends from the crenons to the outlets and covers at least 500 m on both sides of the rivers, including of course the riparian (ripisylvic) habitats.

Although surface and groundwater are dealt with separately, it should be noted that almost all surface water resources in Lebanon are attributed to ground karstic aquifers. Major surface storage structures such as reservoirs are not abundant in Lebanon; the geologic formations of the mountains with fissured karstic bedrock and narrow steep valleys have high erosion potential and make it difficult to



efficiently store surface waters behind dams or within impoundments. As such, the majority of surface waters are lost to the sea unutilized. The only major reservoir on a river is the Qaraoun Lake which is formed by the rockfill dam on the Litani River with a total capacity of 220Mm<sup>3</sup>. In 2007, the Shabrouh artificial reservoir and dam located in the town of Faraya was inaugurated with a storage capacity of 8Mm<sup>3</sup> and provides water for domestic and irrigation purposes in Mount Lebanon.

The groundwater data available is all based upon measurements made in the 1970's, meaning the data is potentially obsolete and in need of reassessment. The best available data suggests that groundwater recharge is estimated around 3,200Mm<sup>3</sup>, of which 2,500Mm<sup>3</sup> constitute the base flow of rivers. Snow cover is the main source of groundwater recharge, in addition to rainwater percolation which is enhanced by fractures and fissures of a heavily dissected Limestone karstification along the coast of Lebanon.

Relevant studies about snow cover and contribution to water resources are scarce. Snow cover constitutes about 25% of the area above 1,200m and contributes one third of the average yearly precipitation. Melting snow may contribute around 40% to 50% of the discharge of coastal rivers.

In the absence of consistent information, it is generally accepted that approximately 50% of the average yearly precipitation (8,600Mm<sup>3</sup>) is lost through evapotranspiration, while additional losses include surface water flows to neighbouring countries (8%) and groundwater seepage (12 %). This leaves around 2,600Mm<sup>3</sup> of surface and groundwater that is potentially available, of which around 2,000Mm<sup>3</sup> is deemed exploitable.

The map below shows the known water resources available in Lebanon.



#### Infrastructure

The capabilities of the existing wastewater treatment plants is understood, but also deemed to be inadequate - both in capacity and quality - to the countries needs (*DA: 95*).

There is some data relating to the integrity of the water delivery system, however this dates back to the 1980's.

It has also been observed that the Lebanese water resource infrastructure also suffers from an insufficiently skilled staff with few qualified technicians with lack of up-to-date training and limited equipment (*DA: 200*). This has resulted in an inability to conduct proper routine maintenance, measurements or monitor water supply and quality.

It is also believed that the old, improperly designed, inadequately maintained and often undersized distribution networks lead to water losses in excess of 50% of the water initially captured by the system. This situation is exacerbated by severely damaged and outdated irrigation networks that lead to excessive water loss and inefficient distribution as well as Illegal connections to the water supply network.

To date there has also been a lack of implementation of modern irrigation and water saving technologies in government projects.

#### Water use

Several reports have been conducted in an attempt to assess overall water consumption for Lebanon going forward. The variation in these findings shows that no definitive methodology exists for gathering or interpreting the data.

#### Water quality

An increase in human population and urbanization in recent years has resulted in a gradual deterioration of water quality in the Lebanese rivers. Water diversion for power generation, abstraction for expanding irrigation projects and increased residential consumption is significantly reducing available water quantities. Water quality is being drastically affected by untreated sewage and industrial waste dumping, in addition to agricultural runoff (*DA: 200*).

A thermal mapping study in 2004 identified 49 major sources of pollution of the marine environment of Lebanon based on discrimination between the thermal temperatures of sea water and polluted water. Most are related to uncontrolled human activities such as sewage outfalls, refineries and factories. At this time, 53 outfalls were identified along the Lebanese coast, of which 16 are located between Dbayeh (North of Beirut) and Ghadir (South of Beirut). However, these outfalls were not characterized in terms of length, size, flow, etc. (DA: 200).

Credible data indicates that the excessive use of fertilizers especially in areas of intensive agriculture practices has lead to nitrate leaching in high levels and impinged the groundwater quality mainly in the coastal plain. The excessive use of fertilizers especially in areas of intensive agriculture practices has lead to nitrate leaching in high levels and impinged the groundwater quality mainly in the coastal plain. A report demonstrates a clear connection between groundwater pollution and drinking water quality (*DA: 95*). In addition, elevated levels of nitrate are identified in all the major rivers of Lebanon and could be attributed to increasing agricultural fertilizing activities especially between July and August. Moreover, a study on the river Berdawni identified the presence in significant amounts of hydrocarbon compounds and chlorinated organic substances
including alkyl naphthalene showing the presence of pesticide residues(*DA: 200*). Many toxic substances also have detrimental effects on biodiversity such as the use of pesticides on fruits and vegetables or the infiltration of toxic products into the soil. Solid waste affects freshwater quality, sea grasses and marine turtles and changes the habits of fish, birds, mammals, etc and impact their distribution and growth.

Limited information on the chemical quality of Lebanese waters have been collected and published. Some studies identify the impact of industries on Lebanese river quality. One 2004 study assessed the impact of industrial effluent during the summer period on the Nahr Antelias river and identified that increases in major ions, especially sulphate (17.8 mg/L), were mainly due to anthropogenic activities. According to a 2003 report, the increase in water



concentration of Fe, Mn, Zn and Pb in the Nahr Ibrahim River was expected to be from the excessive industrial discharge from the industrial zone (galvanization, steel works, electroplating, battery factory, paint, and furniture and PVC factories). Moreover, it has been noted that the concentration of dissolved Pb reaches a high value of 165 ng/L from samples picked at Antelias River due to the presence of several discharges of sewage and industrial effluents in the catchment of the river (*DA: 95*). It has been reported that the coastal waters, from Tyre to Akkar are contaminated by industrial wastewater discharges as they found high concentrations of Ni (max 41  $\mu$ g/L), Cu (max 33  $\mu$ g/L), Cr (max 160  $\mu$ g/L), especially near the industrial complex of Dora (six tanneries), and As (max 48  $\mu$ g/L) at several locations (*DA: 95*).

Domestic wastewater in Lebanon is being discharged into the Mediterranean Sea as well as into the river system without treatment. As a result the coastal waters, inner rivers and drinking water sources are contaminated with bacteria indicating a great harm to the environment leading to potential public health related hazards. There is good data to suggest that Lebanese coastal rivers are polluted with faecal coliform, indicating significant raw wastewater input (DA: 95). Similar studies assessing the water quality in the major rivers in Lebanon have shown that water samples presented very high concentrations of BOD5. The faecal and total coliform concentrations indicated that domestic wastewaters are discharged into water bodies without treatment. The subject of water quality being impacted from domestic sources has been well researched within Lebanon. Moreover, it was reported in 2007 that total coliform and Escherichia coli were observed in 44% of well samples in Ras Beyrouth, a coastal vital sector of Beirut City with 80,000 citizens. This is the consequence of either wastewater intrusion and/or leaks from sewer pipes. In fact, the sewer pipes in old buildings are above the drinking water pipes. Consequently, 60 to 70% of natural sources are contaminated by chemicals and germs. This contamination increases by 10% during the dry season (DA: 95).

Moreover, raw wastewater is being reused for irrigation in several regions of Lebanon such as in Akkar and Bekaa (Ras El Ain, Zahleh) (MEDAWARE *et al.*, 2004). In fact, there have been reports that in the Bekaa region some of the sewers are purposely blocked to allow sewage to be diverted for irrigation (*DA: 95*).

There is sufficient data to conclude that land contamination is impacting on water quality, but no real monitoring facilities or programmes in place to continually assess this on a national scale or to consider seasonal variation.

Some forms of electricity generation involve the discharge of water. These water discharges can contain pollutants. In addition, drilling and mining operations can affect water quality.

Power plants release wastewater, which can contain pollutants, into streams and other bodies of water. This waste water contains pollutants and is generally hotter than the water in nearby lakes and streams, often harming fish and plants.

The map below shows the locations of the oil burning power stations in Lebanon as well as the industrial and sewage water outlets.



Drilling can also cause underground water supplies to become contaminated with oil, and runoff from the extraction process can affect surface waters. During the transportation of oil, spills can occur, damaging water quality and harming marine life and birds in oceans and coastal waterways.

The Marine National Research Center undertakes monthly surveys to assess the quality of marine water with regards to land based sources of pollution. The information is published yearly in the Lebanese Science Journal and the Marine Center/ CNRS has published a 25 years report of the collected information on the hot spots for pollution. In addition, among the recent studies undertaken by CNRS is a scientific methodology and suggestion of a law project for chemical pollution protection of the Lebanese coast (*DA: 252*).

#### Wastewater management

Beirut has the highest rate of connections to the sewage network (98.3%), followed by the suburbs of Beirut (89.3%) and by the North (53.5%), South (42.1%) and Bekaa (41.1%) regions, while Mount Lebanon has the lowest (33.9%). The remaining areas use septic tanks or drain wastewater in wells. Municipal wastewater management in Lebanon has been absent during many years. Because of civil war, the existing treatment plants were destroyed and/or made inoperative. Untreated wastewaters were directly dumped into rivers, irrigation channels, valleys and ravines as well as into septic systems. Nowadays, the government through its ministries (Energy and Water, Interior and CDR) is working on the construction of wastewater treatment plants. These plants must be designed for the treatment of forthcoming wastewater flows and the quality, these latter being directly proportional to water consumption. Moreover, the design of wastewater collection, treatment and disposal must take into account the flow and the quality of wastewater from domestic and commercial activities as the number of industries existing in Lebanon is limited. Existing industrial wastewater management is ineffective in most areas and the phenomenon is exacerbated by the absence of effective auditing. However, it is estimated that 96% of the industrial stream (excluding tanneries) is nonhazardous and 66 % could be treated as domestic waste; whereas the remaining would require some pre-treatment before discharge into domestic sewer networks (DA: 95).

So far, Lebanon has 31 wastewater treatment plants that are producing around 16,000m<sup>3</sup>/day and are achieving secondary wastewater treatment with a specific objective; the reuse of treated wastewater stream for irrigation and are comprised of small community-based plants. Effluent quality from these plants does not satisfy the national standards for discharge into surface or sea water (*DA: 95*). Therefore their reuse for irrigation practices is highly undesirable. In addition, they generate relatively small quantities of effluent which fluctuate depending on seasons. Furthermore, the cost of transport of the effluent to the areas to be irrigated is unaffordable. Only two plants, in a very limited extend, have their effluent used for irrigation. The first one located in



Jabboule (a village in the Bekaa Mohafaza region) was designed in 1998 to provide a wastewater treatment capacity of  $90m^3/d$  for a population of 600 people, and was planned to run till 2020. It receives only domestic wastewaters since there is no industry on the watershed (*DA: 95*). The second one, Hasbaya plant, has been operational since 2002, with a wastewater treatment capacity of 240 m<sup>3</sup>/d. Unknown portions of the treated wastewater are used

for irrigating trees grown around the perimeter of the plant in order to improve landscape conditions.

Two large-scale wastewater treatment plants, the Ghadir pre-treatment plant and the Tripoli secondary treatment plant, are currently operational. The first one primarily serves the Southern suburbs of Beirut and its surroundings; it also receives influents from sewage trucks from areas not connected to the station. The quantity of wastewater at the entrance of the station is equivalent to 100 tanks of with total



capacity of approximately 2000 m<sup>3</sup>/d. This plant currently operates at half its capacity (46,000 m<sup>3</sup>/d). The planned connected population to this plant should be about 800,000 inhabitants. After preliminary treatment, the concentrations of pollutants in the effluent discharged into the sea do not match with Lebanese standards for discharge to sea with levels for COD, BOD5, TSS, ammonia and organic phosphorus far exceeding the permitted level. The high concentrations of nitrogen and phosphorus underline the fact that the input received by the El Ghadir plant does not derive only from domestic origins. The Ghadir outfall is a 1,200-mm diameter submersed pipeline which extends 2.6 km into the Mediterranean Sea. The outlet point is approximately 60 meters deep thereby achieving some dilution of the disposed wastewater. The secondary Tripoli plant became functional in 2009. Its outfall should release treated water to sea meeting the highest cleaning requirements (BOD5 <25 mg / L, TSS <35 mg / L and H2S <0.1 ppm) with a daily average flow of 135,000m<sup>3</sup>/d.

The capabilities of the existing wastewater treatment plants is understood, but also deemed to be inadequate - both in capacity and quality - to the countries needs.

#### **Climate Change**

The change in climatic conditions being experienced across the globe as a result of the increased concentration of greenhouse gases in the atmosphere since the industrial revolution also affects biodiversity. Lebanon will probably witness a significant reduction in its water resources. With increasing temperatures, precipitation will most likely shift towards rain and away from snow. Further the rain that will fall will probably come during intense storms. These two factors will lead to a reduction in the recharge of groundwater because there will be less snow to infiltrate into the groundwater and also because high intensity rainfall creates more runoff than infiltration (*DA: 152*).

## 6.8 Missing Data

#### Water resources

The fact that all reservoir data is based on surveys done in the 1970's is of concern. The measurements taken during this study need to be repeated using modern methods and to reflect the current status of the aquifer/s.

A definitive study on forecasted water consumption would also be highly beneficial. It will be necessary to establish a baseline for water resource availability, consumption and replenishment rate prior to the introduction of an oil and gas industry to Lebanon.

#### Infrastructure

There needs to be an up to date audit or study done to assess the status of the existing infrastructure, with specific focus on the waste processing plants (quality of service, ability to handle the waste being produced). The study should also accurately assess the current rate of loss from the water delivery system. Capacity for water storage should also be assessed.

### Water use

Although there is a need to assess the water usage across all sectors in Lebanon, of most concern to the oil and gas industry is the industrial sector. This would likely be a breakdown of data relating to the study suggested under water resources above.

#### Water quality

Lebanon has not developed a countrywide database of water quality, though UNICEF reported that 60 to 70 percent of water resources are contaminated. No national initiative aiming at establishing a water quality control system specifically targeting biodiversity conservation is implemented in Lebanon

Sufficient good quality data exists to show that water quality in Lebanon is influenced by various anthropogenic factors including agriculture, domestic and industrial wastewater discharges (*DA: 95*). Work has been done to identify the worst outlets of polluted water to the marine environment. Now a study needs to be conducted based on these locations to establish which pollutants are present and to what extent they are being released into the coastal marine environment. This will help to establish a baseline of coastal water condition prior to the addition of an oil and gas industry.

#### Wastewater management

There needs to be an up to date audit or study done to assess the status of the existing waste water infrastructure, with specific focus on the waste processing plants (quality of service, ability to handle the waste being produced). A monitoring system for the quality of waste being discharged should also be put in place. Monitored parameters would include general water quality parameters, metals and emerging pollutants.

Note: guidance is provided regarding the methodology of data collection in the Reference Field Instruction Manual.

## 6.9 Discussion

Lebanon faces significant challenges in meeting the country's water demand in terms of quantity and quality. Unsustainable water management practices, environmental risks and water governance shortcomings are among the main obstacles facing the sector.

The Lebanese water sector infrastructure is in a poor state and inadequate in its scope to meet the demands put upon it. The majority of wastewater from urban zones is being discharged, without adequate (or in some cases any) treatment or monitoring into the river system or directly into the Mediterranean Sea, creating a potential public health issue and raising a serious geo-environmental problem that might affect coastal marine ecosystems. Potable water networks are frequently contaminated by wastewater infiltration. The Ministry of Environment developed water quality standards in 2001, however little is done to enforce these standards, largely through inadequate resources to enforce them.

The operating water treatment plants that exist are not adequate to meet the demands put upon them, both in terms of volume and the quality of output. It has been reported that even with the presence of water treatment plants, excessive use of river water and the lack of natural flow are hindering the natural biological recovery of river waters with eutrophication being apparent in many of Lebanon's rivers.



Currently, water resources face major pressures from: rapidly growing population, expanding economy, increased urbanization, unregulated in many cases, agricultural activities, and concentrated tourism activities in summer. All are leading to over-exploitation and pollution of water resources, exacerbated by climate change.

There is little information on the wastewater quality in Lebanon and what exists is based on small scale surveys, rather than representing a national overview. As such, steps need to be taken to evaluate the quality of wastewater and monitor its release into the marine environment. Such a project would provide baseline data against which any impacts from the introduction of an oil and gas industry can be assessed.

At present the available data relating to water resources lacks cohesion as there are numerous sources of origin. It would be useful to be able to unify and extend the existing data to provide a better overview of the water resource situation in Lebanon.

There is a considerable amount of work to be done regarding water resources and its infrastructure prior to the possibility of a producing oil and gas industry. However, it is likely that there will be a positive attitude within the oil and gas parties towards assisting with this workload during early stages of any exploration campaigns.

For example, there could be assistance in developing suitable planning and policy implementation, or funding training programs for employees and technicians of water authorities that are essential for the proper operation and maintenance of equipment and facilities including monitoring of water quantity and quality. Further input could come in helping raise public awareness relating of water scarcity issues. Another avenue could be aiding in the launch of educational campaigns targeting the populous, highlighting the scarcity of water and the necessity for conservation.

With increasing global warming, rain levels are being reduced in marginal countries to which Lebanon belongs. Increasing population is resulting in significant water shortages all around the country and Lebanon needs to turn to maximum efficiency in the use of its available resources of fresh water. This need is more pronounced during the dry months of the summer.





# 7 Air

# 7.1 Topic

Air pollution as defined by the World Health Organisation is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. It occurs when various gases, droplets, and particles are found in the atmosphere beyond their normal concentrations and/or introduced to the atmosphere by anthropogenic sources or natural phenomena.

The degradation of air quality in Lebanon is a growing environmental concern and has become a major source of concern to public health. Air pollution in Lebanon is affecting millions of people living in mostly urban and semi-urban areas where smog, small particles, and toxic pollutants pose serious health concerns. In addition to respiratory problems, long-term exposure to air pollution and to certain pollutants can cause cancer and damage to the immune, neurological and reproductive systems.

Many forces, acting together or in isolation, are impacting air quality in Lebanon. These forces may affect ambient and/or indoor air, and may stem from natural phenomena or anthropogenic activities. The driving forces influencing air quality in Lebanon are shown in the diagram below (*DA: 4*).



This section considers the data available on air quality and its management within Lebanon. The available data is assessed in relation to the impacts from and the requirements of a potential oil and gas industry in Lebanon.

# 7.2 Regularity Framework

The laws related to air quality in Lebanon exhibit essential gaps and are often inadequate and incomplete.

There are also many gaps related to environmental standards and conditions, which lacking in comprehensiveness. In addition, the standards do not give a clear indication of minimum and maximum acceptable emission levels making them ineffective.

The conditions of licensing for polluters also neglects environmental aspects especially related to air pollution. Although the Environmental Protection Law No. 444 stipulates that EIAs should be conducted on new potentially polluting projects, there is a lack of texts that determine the quality of information that is required from these studies.

The major weaknesses at the executive level include the lack of environmental planning for pollution control, the necessary executive legal texts, and the necessary human resources and expertise compounded by a lack of equipment to carry out monitoring and inspection of emissions, as well as specialised judges in environment.

The Ministry of Environment (MoE) in Lebanon has developed air emission standards (Decision 8/1 - 2001) related to industrial sectors such as power plants <300MW and the glass and aluminium industries. These newer standards replace the previous corresponding standards under Decision 52/1 - 1996 that relates to maximum levels and exposure times. There are no emission standards for larger power plants >300MW. Moreover, the Ministry has issued a Circular on monitoring emissions from electric generators and sets the technical requirements for mitigation measures for emitting air pollutants and storage of oil or fuels.

In 2005 the MoE drafted a decree for the Protection of Air Quality, which is yet to be endorsed by the Council of Ministers.

Lebanon is signatory to a number of emissions related international conventions, such as the Montreal Protocol and the Vienna Convention. For the full list of laws and conventions see Volume 6: Registers.

# 7.3 Strategy and Future Plans

The Air Quality Department in the Service of Environmental Technology at the MoE is responsible for developing Air Quality Standards, Air Monitoring Programs as well as surveillance and pollution prevention plans for ambient air and national greenhouse gas inventories in Lebanon (*DA: 4*). A National Air Quality Strategy is to be developed by the MoE. A draft law on Protection of Air Quality is also in development which currently contains 34 articles related to ambient air quality and establishing monitoring through:

- establishing a National Program for Ambient Air Quality Monitoring;
- a National Network for Ambient Air Quality Monitoring;
- a National Emission Inventory, and;
- a National Report on the Ambient Air Quality.

The law will also set limitations on air pollutants such as Carbon Monoxide (CO), Nitrogen Oxides (NO<sub>x</sub>), Ozone (O<sub>3</sub>), Sulphur Oxides (SO<sub>x</sub>), Non-Methane Volatile Organic Compounds (NMVOC), and Lead (Pb) from various sources.

Several projects are currently underway for the phase-out of CFCs and POPs in accordance with international conventions which Lebanon has ratified. Several universities and institutions have also undertaken some of their own initiatives for

monitoring, which may assist with building air pollution management strategies in Lebanon.

The Lebanese government has set a target of sourcing 12% of its energy needs from renewables by 2020.

## 7.4 Impact from Development of Petroleum Activities

The extraction, stabilisation and export of hydrocarbons involve several processes that give rise to atmospheric emissions which could potentially have an effect on air quality in Lebanon. These include combustion to provide electrical power and to drive compressors and pumps; flaring of excess gas for safety and during well testing; venting during tank loading and incidental releases from fire fighting and refrigeration apparatus.

Combustion and flaring result in emissions of carbon dioxide (CO2), carbon monoxide (CO), methane (CH4) and oxides of nitrogen (NOx) and sulphur (SOx). Small amounts of nitrous oxide (N2O) are also released. Venting releases Volatile Organic Compounds (VOCs) and methane, whilst fire fighting and refrigeration release Halon and chlorofluorocarbons (CFCs).

Atmospheric emissions from offshore operations are implicated in several potential impacts:

- Anthropogenic global warming which is attributable to greenhouse gas emissions, notably CO2 and CH4;
- Stratospheric ozone depletion caused by halon and CFCs which are known collectively as Ozone Depleting Substances (ODS);
- Ground level ozone formation caused by reactions between VOCs and NOx;
- Acidification caused by emissions of acid gases such as NOx and SOx

Emissions from combustion and flaring are most significant because of their global impact. Although ODS have the potential for global impact they are used in relatively small amounts offshore. The potential for ozone formation and acidification is minimised by the geographic location of most offshore installations.

#### Seismic Data Acquisition

The main sources of atmospheric emissions during seismic data acquisition will come from fuel (diesel) combustion on the associated survey vessel/s. Diesel engines produce emissions of carbon dioxide ( $CO_2$ ), oxides of nitrogen ( $NO_x$ ), nitrogen dioxide ( $NO_2$ ), sulphur oxides ( $SO_x$ ) and unburned hydrocarbons. These emissions are anticipated to disperse rapidly under most conditions to levels approaching background within a few tens of metres from their source.

## **Petroleum Exploration and Production**

The main sources of atmospheric emissions during drilling operations will result from diesel combustion from power generation for the drill rig and associated standby vessels. Diesel fuelled power generation will produce minor emissions of carbon dioxide ( $CO_2$ ), oxides of nitrogen ( $NO_x$ ), nitrogen dioxide ( $NO_2$ ), sulphur oxides ( $SO_x$ ) and unburned hydrocarbons. These emissions are anticipated to disperse rapidly under most conditions to levels approaching background, within a few tens of metres from their source.

Atmospheric emissions take place at all stages of oil and gas industry activities. The main sources of these emissions include:

- constant or periodical burning of associated gas and excessive amounts of hydrocarbons during well testing and development as well as continuous flaring to eliminate gas from storage tanks and pressure-controlling systems;
- combustion of gaseous and liquid fuel in the energetic units (diesel-powered generators and pumps, gas turbines, internal combustion engines) on the platforms, ships, and onshore facilities; and
- evaporation or venting of hydrocarbons during different operations of their production, treatment, transportation, and storage.

Flaring of oil-associated gases is sometimes necessary as gases are dissolved in the crude produced oil. As the pressure goes down, the gas bubbles out in amounts up to 300 m<sup>3</sup> for each ton of extracted oil. The associated gases give about 30% of the gross world production of gaseous hydrocarbons. However, because of the undeveloped technology and lack of required capacities and equipment on many field developments, up to 25% of all associated gases are flared.



Components of atmospheric pollution caused by oil and gas development include gaseous products of hydrocarbon evaporation and burning as well as aerosol particles of the unburned fuel. From the ecological perspective, the most hazardous components are nitrogen and sulphurous oxides, carbon monoxide, and the products of the incomplete burning of hydrocarbons. These interact with atmospheric moisture, transform under the influence of solar radiation, and precipitate onto the land and sea surfaces to form fields of local and regional pollution. According to some estimates, up to 30% of the hydrocarbons emitted into the atmosphere during well testing precipitate onto the sea surface and create distinctive and relatively unstable slicks around the offshore installations.

Technical means to rectify and prevent atmospheric pollution during offshore oil and gas production are practically identical to the analogous methods that are widely and often effectively used on land and in other industries. However, offshore atmospheric emissions thus far have not gotten the deserved attention, probably due to the remoteness of these developments from densely populated places.

The option to release gas to the atmosphere by flaring and venting is an essential practice in oil and gas production, primarily for safety reasons. Flaring is the controlled burning of natural gas produced in association with oil in the course of routine oil and gas production operations whereas venting is the controlled release of unburned gases directly into the atmosphere. The availability of a flare or a vent ensures that associated natural gas can be safely disposed of in emergency and shutdown situations. Where gas cannot be stored or used commercially, the risk of fi re and explosion must be reduced by either flaring or venting.

It is in an oil company's interest to minimise the amount of gas flared in order to realise as much value as possible from the hydrocarbons being produced. A variety of mechanisms may potentially be used to minimise flaring.

However, it may not be technically or economically feasible to sell some or all of the gas, for reasons that are often a combination of geography, availability of customers, and government energy policies. Similarly, it may not be technically or economically feasible to re-inject the gas into underground reservoirs. Therefore, gas may have to be flared as

a waste product. In some cases, venting may be preferable to flaring, depending on considerations such as local noise impacts, toxicity of gases being produced, and hydrocarbon content of the gas.

For environmental and resource conservation reasons, flaring and venting should always be minimised as much as practicable, consistent with safety considerations.

Flaring and venting can have local environmental impacts, as well as producing emissions which have the potential to contribute to global warming. Available data indicate that, on a worldwide basis, gas flaring contributes only 1% of anthropogenic carbon dioxide emissions, and flaring and venting contribute only 4% of anthropogenic methane emissions.

## **Pipeline Construction**

The main sources of atmospheric emissions during pipe-laying will result from diesel combustion as fuel and for power generation on the associated vessel/s. Diesel engines produce emissions of carbon dioxide ( $CO_2$ ), oxides of nitrogen ( $NO_x$ ), nitrogen dioxide ( $NO_2$ ), sulphur oxides ( $SO_x$ ) and unburned hydrocarbons. These emissions are anticipated to disperse rapidly under most conditions to levels approaching background within a few tens of metres from their source.

## **Onshore Support Facilities**

Atmospheric emissions during construction of associated onshore facilities will mainly arise from increased road traffic by heavy duty vehicles. Emissions from onshore support installations are comparable to those of light industry. There is also the potential for emissions to be generated from any onshore processing of reservoir hydrocarbons.

## 7.5 Possible Future Development

Lebanon's extensive offshore territory and the deficiency of environmental data - especially for the deep offshore areas - is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration there. A lesson learnt from that situation is that it takes time to acquire and collate data, and this data gathering phase happens piecemeal rather than in a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline Surveys being carried out as part the Environmental and Social Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of contract and a legal requirement in Lebanon. In these circumstances Baseline Surveys are an insurance necessity to guard against future liabilities.

To maximise the value of the surveys Lebanon would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that might accrue due to operator proposed mitigation measures, Lebanon needs to be fully cognisant of best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

## 7.6 ESIA Data Requirements

A comprehensive ESIA related to oil and gas activities would require good baseline data of the relevant atmospheric pollutants to evaluate the impact such developments will have on the current atmospheric status in Lebanon.

Reliable and comparable data needs to be collected on a national scale for the atmospheric pollutants widely known to be generated by the oil and gas industry. At least one year of consecutive data will be required to allow for seasonal variations in background levels. As an indication, atmospheric data as described could be required for the following relevant pollutants:

- Sulphur Dioxide (SO<sub>2</sub>)
- (Sulphur Oxides) (SO<sub>x</sub>)
- Sulphur Dioxide (H<sub>2</sub>S)
- Carbon Monoxide (CO)
- Carbon Dioxide (CO<sub>2</sub>)
- Nitrogen Oxides (NO<sub>x</sub>)
- Nitrogen Oxide (NO)
- Nitrogen Dioxide (NO<sub>2</sub>)
- Methane (CH<sub>4</sub>)
- Hydrofluorocarbon (HFC)
- Perfluorocarbons (PFCs)
- Suspended Particulate Matter (particulates) (SPM or PM<sub>10</sub>)

The types and levels of atmospheric emissions being generated by the various stages of hydrocarbon exploration / production are widely known and understood within the oil and gas industry. Industry recognized computer modelling tools are available to predict atmospheric impacts; however the outputs are of little value without meaningful baseline data.

# 7.7 Description of Existing Data

Air pollution in Lebanon is increasing precipitously because of an ineffective pollution control system. Air pollution in cities is due to exhaust gases from motor vehicles as well as areas near power plants and cement factories (*DA:152*). Beirut is often observed to be enveloped in smog that covers the city, particularly in summer. It is caused by the high concentration of chemical and toxic particles that circulate in the air.



Air pollution control strategies are divided into two main categories. The first is set up to control the emission of gases; this type of control system is implemented in Lebanon but needs more control and supervision to be effective. The second category is the control of particulate emission, and this type is rarely used in Lebanon because of its costs and its complexity. Emission of gases control systems are most frequently aimed at controlling the release of toxic gases from vehicles and factories such as carbon dioxide, carbon monoxide, and sulphur dioxide. These gases are considered the main cause behind global warming and ozone depletion. Under the emission of gases control system, the most efficient methods used are filtration and absorption. The Ministry of Environment under the Lebanese law enforces factories to use filters that purify these gases and prohibit



their emission to the environment. In fact, according to the report of ministry in 2004, these filters have helped in decreasing the emission of carbon dioxide (Ministry of environment website). Absorption technique is another technique that is used by big factories (plastic manufacturing companies) that produce gases which are hard to be filtered by normal filters. These companies rely on a tool called "baghouse" which stores the toxic gases in something like bags and then they get rid of these bags by using complicated chemical reactions. This technique is more complicated than filtration and is more expensive. In Lebanon, not all companies comply with such strict environmental regulations, but instead they simply deposit those bags directly into the environment making this control system useless (*DA: 406*).

Atmospheric pollution has been the subject of very little research in Lebanon. The air quality of the cities and areas of large human population is considered to be poor, and the quality of the air decreases with the increase of factories. In 1973, the National Council for Scientific Research (NCSR) launched a scheme for the continuous observation of contents in the air of harmful matters (gas and dust). The war put an end to the project and since then atmospheric pollution has been largely unmonitored.

Air pollution has not been the subject of any regulation with the exception of the prohibition of the importation and use of diesel vehicles (law of the 10th June, 1961 and decree 579 of the 1st August, 1956) and the required conditions for vehicle engines, which currently are not being applied. There exists no authority in Lebanon which is directly responsible for the quality of the air and the protection of the atmosphere against pollution.

The major pollutants of the atmosphere are the cement works, refineries, thermoelectric power houses, a multiplicity of small combustion sources, and generators installed at numerous industrial premises and residences to compensate for power cuts. Production of electrical energy pollutes the atmosphere by the discharge of thermoelectric power plants. There are currently four functioning oil burning power stations in Lebanon detailed in the table below.

Name	Description	Image	Location (Dec. Deg.)
Zouk Thermal Power Plant	Zouk Thermal Power Plant Lebanon is located at 13.5 km NE of Beirut, Mount Lebanon, Lebanon. This infrastructure is of TYPE Oil Power Plant with a design capacity of 607 MWe. It has 4 unit(s). The first unit was commissioned in 1984 and the last in 1987. It is operated by Electricite du Lebanon (EDL).		Latitude= 33.969 Longitude= 35.604
Zahrani CCGT Power Plant	Zahrani CCGT Power Plant Lebanon is located at 7 km SWS of Jall Aairam, Mediterranean Coast, South Lebanon. This infrastructure is of TYPE Gas Power Plant with a design capacity of 470 MWe. It has 3 unit(s). The first unit was commissioned in 1998 and the last in 2001. It is operated by Electricite du Lebanon (EDL) and Enel Produzione.		Latitude= 33.496089832825, Longitude= 35.337975025177

#### Oil burning power stations of Lebanon

Jieh Thermal Power Plant	Jieh Thermal Power Plant Lebanon is located at Mediterranean Coast 10 km N of Sidon, South Lebanon. This infrastructure is of TYPE Oil Power Plant with a design capacity of 346 MWe. It has 5 unit(s). The first unit was commissioned in 1970 and the last in 1981. It is operated by Electricite du Lebanon (EDL).	Latitude= 33.647475074694 Longitude= 35.399601459503
Deir- Ammar CCGT Power Plant	Deir-Ammar CCGT Power Plant Lebanon is located at Dir-Ammar, 6.5 km NEN of Tripoli, North Lebanon. This infrastructure is of TYPE Gas Power Plant with a design capacity of 470 MWe. It has 3 unit(s). The first unit was commissioned in 1998 and the last in 2002. It is operated by Electricite du Lebanon (EDL) and Enel Produzione.	Latitude= 34.465036762176 Longitude= 35.894179344177

Source: <u>www.globalenergyobservatory.org</u> , <u>www.edl.gov.lb</u> and Google Earth

The sulphur content of fuel used in Lebanon is high and so are  $SO_2$  emissions. However, fuel of low sulphur content costs 20 to 30% more than the type at present used. The treatment of pollutants is also costly and would represent substantial charges to the cost of energy.

In Lebanon, the transportation and energy sectors - mainly via power stations - cause air pollution which contributes to the increase in greenhouse gases, contributing to global warming.

A study was conducted in 2002 on Lead levels in the atmosphere following a ban on leaded fuels in 2001. The study only covers the Beirut area and the study was run for a short duration (*DA: 339*).

A study of ambient  $NO_2$  concentrations in Beirut was conducted from December 2004 to June 2006. The study is limited to the Beirut area, but was conducted over a sufficient period to assess seasonal variation in the results (*DA: 340*).

A study of ambient SO<sub>2</sub> concentrations in Beirut was conducted from December 2004 to July 2006. The study is again limited to the Beirut area, but was conducted over a sufficient period to assess seasonal variation in the results. The report also indicated that long-range transport can account for around 50 % of Beirut's SO<sub>2</sub> levels (*DA: 341*).

A study of the inorganic chemical composition of atmospheric particulate matter in the region of Chekka was conducted in 2008. The study was conducted over a period of 2

months, so although the methodology is sound, the duration of the data gathering means that no seasonal variation can be assessed. The results showed that Calcium concentrations were in the same order of magnitude as other regions in the Mediterranean Basin (*DA: 96*).

An air pollution study was conducted by the Lebanese American University in 2004 to measure levels of a selection of industrial



pollutants (*DA: 226*). The study was of sufficient length to provide an analysis of seasonal variation, but only covered the geographical area of the Chekka and Koura region.

# 7.8 Missing Data

Much of the air quality data obtained from research initiatives cover Beirut and northern cities around industrial sites due to their high emission levels, however similar studies need to be conducted in southern regions and other industrial sites. Ideally a national air monitoring program of known industrial pollutants should be implemented to provide background and baseline data.

Although recent studies follow good methodology, inconsistencies arise between studies and the different methodologies prevent meaningful comparison of the studies.

## 7.9 Discussion

Existing data collection and monitoring studies in Lebanon have been limited in scope, largely incomparable and spatially limited, despite increased investment efforts from municipalities and universities.

Current air quality monitoring programmes take place in Beirut, Chekka, Salaata, and Tripoli. These locations cover target pollutants from different sources ranging from urban area, industrial sites (cement and fertiliser factories), to thermal power plants and refineries, and are generally focussed in the north of the country where heavy industry is located. Therefore, in order to obtain a more holistic vision of the extent of atmospheric emissions in Lebanon such monitoring programmes need to be extended to cover other regions such as the in south and around other industrialised areas.

The current status of Lebanese air quality data is a significant obstacle to any meaningful analysis to establish a baseline for the atmospheric environment.

A robust regulatory framework for enactment and enforcement of emissions standards is necessary for any improvements to be made to control the rate of atmospheric emissions. For instance, the absence of regulations governing vehicle emissions and vehicle retirement age hinders the promotion of a reduction plan. Moreover, inappropriate emissions standards for industries and a lack of their enforcement are major constraints.

The Government of Lebanon published in 2010 a policy paper in which it clearly demonstrates its commitment to the promotion and support of public, private, and individual renewable energy initiatives. The government is also looking to promote a culture of demand side management and energy efficiency. However, the lack of climate change expertise, personnel shortages and budget constraints has rendered the MoE incapable of carrying out routine inspections of industrial and other sources of air pollution and has in part prevented it from establishing meaningful ambient air quality standards.

Considerable strengthening of existing institutions and encouragement of private sector participation in providing environmental services and non-governmental organisations for monitoring and enforcement in strongly needed. This effort should be focused on the Ministry of Environment with encouragement to private sector participation in providing environmental services and Non-Governmental Organizations for monitoring and enforcement. Comprehensive and valid baseline data on the composition of Lebanon's atmosphere would be highly desirable by the oil and gas community. To this end it is likely that support and resourcing could be found to help gather the data and implement the monitoring programme required.



**OC** 

# 8 Waste

## 8.1 Topic

This section considers the data available on municipal solid waste management (MSWM) in Lebanon. Data relating to waste generation, waste streams, segregation, classification and disposal will be assessed. Data pertaining to waste infrastructure will also be considered.

## 8.2 Regulatory Framework

Due to a fragmented legal framework and vague institutional setting, Lebanon lacks a solid national policy, national strategy, and MSWM plans to define overall goals and provide direction for MSW initiatives. This, in turn, discourages private sector investment at both the national and local level. Lebanese legislation associated with solid waste management (SWM) is often outdated and incomplete. There is a weakness in the definition and vocabulary of technical terms and also the distinction between the types of waste according to their sources and their nature.

Existing legislation consists of fragmented clauses not specifically dealing with MSW, with exceptions being Decree 8735 of 1974, which stipulates MSWM as a municipal responsibility and Decree 9093 of 2002, which grants municipalities incentives to host waste management facilities. Other legal texts address different waste types or sources, such as Law 387/94 and Law 64/88 on Hazardous Wastes.

Moreover, current legislation does not address waste classification, attribute responsibilities to the various stakeholders, set provisions for technical standards and specifications, involve the private sector, allow for public participation, or cover financing and cost recovery. It is also outdated and does not incorporate modern environmental principles.

The Ministry of Interior and Municipalities (MoIM) has jurisdiction for municipalities, which in turn are responsible for implementing MSWM operations, specifically collection and disposal. The Ministry of Environment (MoE) establishes and monitors environmental standards and develops strategies, while the Council for Development and Reconstruction (CDR) is responsible for implementing Emergency MSWM Plans.

However, a closer look at the institutional framework reveals many gaps and overlaps.

Although the legal framework clearly assigns collection and disposal responsibilities to municipalities, represented by MoIM at the national level, MoE is also responsible for regulating the sector. As a result, both MoIM and MoE have jurisdiction over MSWM policy, legislation, strategy, and planning; and both have developed MSWM strategies for the country. To further complicate matters, CDR was appointed by the Council of Ministers (CoM) to propose a MSWM plan for Lebanon and to launch international tenders for this purpose.

For further laws and conventions see the Volume 2: Registers.

# 8.3 Strategy and Future Plans

Several areas have been identified by the Ministry of Environment in which improvement in solid waste management is needed. These areas are listed here;

• The enactment of existing waste legislation;

- The introduction of law relating to Integrated Solid Waste Management (ISWM). This law has been drafted but not implemented;
- Introduction of waste-to-energy (WTE) legislation to assist in implementing Decision 55/2010;
- Identification of suitable WTE technologies;
- Launch national guidelines for compost quality;
- Raise public awareness of the issues relating to SWM in Lebanon;
- Launch waste minimisation strategies;
- Improve waste treatment strategies and facilities and;
- Improve waste disposal strategies and facilities.

A draft National Environmental Action Plan (NEAP) was developed by the European Community MEDA MSC-IPP Environment project (2002-2005) with the Ministry of Environment, which addresses a complete list of environmental problems facing Lebanon, identifies in as practical detail as possible all methods, including general policies, of mitigation, assigns precise institutional responsibilities for these steps and provides cost estimates for measures where appropriate and possible. The planning horizon is five to ten years. The actions included in the draft NEAP, relevant to waste resources and management are:

- Develop a National Strategy for Solid Waste Management
- Develop the legal and regulatory frameworks for SWM
- Implement the strategy:
  - Develop Local MSWM plans
  - Execute Local MSWM plans
  - Construct MSW facilities
  - Develop PP at local and central levels
  - Establish knowledge and information infrastructure
  - Develop capacity building
  - Promote waste reduction and recovery
  - Promote energy recovery from waste
  - Rehabilitate existing dumps
  - Coordinate with funding agencies
- Set up a Waste Exchange Programme

The waste management strategy of the present Government plan was initiated in 1998 and is due to conclude in 2014. A new plan is proposed to start in 2014, with the aim of progressively replacing all landfill sites with Incineration for Energy plants.

## 8.4 Impact from Development of Petroleum Activities

The development of oil and gas production activities in Lebanon (including seismic acquisition, exploration drilling, production and pipeline installation; discussed further in Section 1) could potentially have a significant effect on the SWM resources of Lebanon.

These potential impacts arise from several different aspects of development. These aspects are outlined below.

Like any industry, the offshore oil and gas industry inevitably generates several waste streams during exploration and production activities. These waste streams are of two main types:

- operational wastes that are discharged to sea under permit or authorisation, for example produced water.
- other wastes, which are unwanted materials that are stored on the installation and returned to shore for disposal or recycling.

These materials range from inert platform wastes (e.g. general waste, paper, glass, cardboards etc) and garbage to scrap metals, empty metal and plastic drums, oils, sludge and chemicals.

The volume of waste varies with the level of maintenance, drilling and production activities. Scrap metals are generated during shutdown, construction and/or refurbishment. Plastic and metal drums are employed for the supply and use of chemicals offshore. Special wastes arise from drilling, workover and platform maintenance activities and mostly include residual hazardous fluids e.g. biocides, surfactants, emulsifiers, corrosion inhibitors, oxygen scavenger, greases, fuels, hydraulic oils, paints, thinners, lubricants, anti-freeze, cleaning solvents and batteries.

## **Seismic Data Acquisition**

*Waste* – The survey crews will be predominantly offshore, and it is estimated that 1.5kg of domestic waste per person per day will be generated for the duration of the survey. It is estimated that the complement of a seismic vessel would be less than 50 people.

#### **Petroleum Exploration and Production**

## **Operational Waste**

Practically all stages and operations of offshore hydrocarbon exploration and production are accompanied by undesirable discharges of liquid, solid, and gaseous wastes.

The proportions and amounts of discharged wastes can change considerably during these operations. For example, the amount of solid drilling cuttings usually decreases as the well gets deeper and the hole diameter becomes correspondingly smaller. The volumes of produced waters increase as the hydrocarbon resources are being depleted and production moves from the first stages toward its completion. Drilling in the upper layers of bottom sediments (up to approximately 100 m) can be done without using complex drilling fluids. In such cases, seawater with additives of special clay suspensions can be used instead.



## **Produced waters**

The discharges of produced waters are a waste stream of great significance. Produced waters usually include dissolved salts and organic compounds, oil hydrocarbons, trace

metals, suspensions, and many other substances that are components of formation water from the reservoir or are used during drilling and other production operations. Besides, produced waters can mix with the extracted oil, gas, and injection waters from the wells. All of the above make the composition of the discharged produced waters very complex and changeable. It is practically impossible to speak about some average parameters of this composition. Hundreds of thousands of tonnes of injection water are pumped into the injection wells for maintaining the pressure in the system and pushing the hydrocarbons toward the producing wells. These waters need to be cleaned before they are discharged into the sea.

Another characteristic of the chemical composition of most produced waters is their very high mineralization. It is usually higher than the seawater's salinity reaching up to 300 g/l. Such mineralisation is caused by the presence of dissolved ions of sodium, potassium, magnesium, chloride, and sulphate in produced waters. Besides, produced waters often have elevated levels of some heavy metals as well as corrosion inhibitors, descalers, biocides, dispersants, emulsion breakers, and other chemicals.

Recent studies have revealed that produced waters frequently contain naturally occurring radioactive elements and their daughter products, such as radium-226 and radium-228. They are leached from the reservoir by formation waters and are carried to the surface with produced waters, oil, and gas. During contact with seawater, these radionuclides interact with sulphates, precipitate, and form a radioactive scale. In spite of a relatively low level of radioactivity, concern exists that this process can create centres of increased radioactive risk. This phenomenon has become a focus of attention in a number of countries. Applying the regulations defined by some international agreements, such as the London Dumping Convention (1972), that do not allow discharges of radioactive material into the marine environment are considered to be good practice.

Depending on its quality following treatment, the produced water is either discharged into the sea or injected into the disposal well. Sometimes the oil-water mixtures are transported along pipelines to onshore separation units.

Produced waters, including injection waters and solutions of chemicals used to intensify hydrocarbon extraction and the separation of the oil-water mixtures, are one of the main sources of oil pollution in the areas of offshore oil and gas production. It is significant that, as a hydrocarbon reservoir is being depleted, the ratio between the water and oil fraction in the extracted product increases and water becomes the prevailing phase. At the same time, both the volumes of discharged waters and the difficulties of their treatment increase.

## **Drilling fluids and cuttings**

All types of drilling are generate drilling wastes, including drilling muds and cuttings. The volume of drilling wastes usually ranges from 1,000 to 5,000 m<sup>3</sup> for each well. Such wells can number into dozens for one production platform and many hundreds for a large field. Drilling cuttings separated from drilling muds have a complex and extremely changeable composition. This composition depends on the type of rock, drilling regime, formulation of the drilling fluid, technology to separate and clean cuttings, and other factors. However, in all cases, drilling fluids (muds) play the leading role in forming the composition of drilling cuttings.

No standard formulation exists for drilling fluids as their composition depends on the needs of the particular situations. These differ considerably in different regions and may even radically change during each drilling process while drilling rocks of very different structure (from solid granite formations to salt and slate strata). At present, two main

types of drilling fluids are used in offshore drilling. They are based either oil based (diesel, paraffin oils, and so on) or on water based (freshwater or seawater with

bentonite, barite, and other components added). In recent history, the preference has been to use the less toxic water-based drilling fluids. However, in some cases, for example during drilling of deviated wells through hard rock, using oil-based fluids is still inevitable. The oil-based fluids, in contrast with the water-based ones, are usually not discharged overboard after a single application. Instead, they are regenerated and included in the technological circle again. Alternative drilling fluids are composed mainly from low-molecular-weight, less toxic and more water-soluble, aromatic compounds and substances of paraffin structure. Research in this direction continues at present. Products of animal, vegetable, or synthetic origin are tested in order to find the optimal base for drilling fluids.

The environmental hazard of drilling muds is connected, in particular, with the presence of



lubricating materials in their composition that usually have a hydrocarbon base. They are needed for effective drilling, especially in case of slant holes or drilling through solid rock. The lubricants are added into the drilling fluids either from the very beginning as a part of the original formulations or in the process of drilling when the operational need emerges. In both cases, the discharges of spent drilling muds and cuttings coated by these muds contain considerable amounts of relatively stable and toxic hydrocarbon compounds.

Drilling muds and cuttings are saturated with hundreds of very different substances and compounds. It is their discharge into the sea that poses one of the main ecological threats during offshore oil production. Biocides are of particular concern, which are used to suppress microflora in the drilling and other circulating fluids. The composition of some compounds is not always known and some biocides are highly toxic. Many countries either discourage or prohibit the use of these methods by the offshore oil and gas industry. Drilling discharges also contain many heavy metals (mercury, lead, cadmium, zinc, chromium, copper, and others) that come from components of both drilling fluids and drilling cuttings.



Drilling cuttings are removed from drilling muds and cleaned special separators. in The amount of oil left on cuttings after cleaning is much higher when using oil-based fluids. Separated drilling muds and cleaning fluids used to treat cuttings are partially returned to the circulating system. Drilling cuttings and the rest of the drilling muds are either dumped overboard or transported to the shore for

further treatment and disposal, depending on the situation and ecological requirements. The first approach is the most usual and is practiced almost everywhere, whilst further onshore treatment is only applied where it is identified as an essential ecological requirement.

Produced sand can also be extracted with oil from a well. The amount of produced sand coated by oil can vary a lot in different areas and even during production in the same area. In some cases, it constitutes a considerable part of the extracted product. Most often, this sand is cleaned and dumped overboard at the well site. Sometimes, it is baked or calcified and transported to the shore for disposal.

The other discharges into the marine environment (deck drainage, sanitary and domestic wastes, and so on), do not play essential roles in the environmental situation in the areas of oil and gas developments. They are treated and disposed in accordance with the norms regulating discharges from the ships.

## Other Waste

Large quantities of produced waters, drilling muds and drilling cuttings as well as discharges of storage displacement and ballast waters are the source of regular and long-term impacts of the offshore industry on the marine environment. Besides these discharges, sometimes the need arises to conduct a one-time discharge of short duration. In particular such situations include chemical discharges during construction, hydrostatic testing, commissioning, pigging, and maintenance of the pipeline systems. The pipeline discharges usually contain corrosion and scale inhibitors, biocides, oxygen scavengers, and other agents. The volumes of these wastes can be rather considerable. The discharge regime usually ensures that the dilution decreases the concentration and toxicity of the wastes to safe levels beyond a 500meter radius from the place of discharge.



Similar situations emerge during other technological and maintenance activities. Examples include cleaning and anticorrosion procedures, discharging the ballast waters from the hydrocarbon storage tanks, well repairing, well workover operations, replacing the equipment, and others. These discharges often contain surface-active substances, such as lignosulfonates, lignites, sulfo-methylated tannins, and many other chemicals with about a hundred names.

Domestic waste generated by the crew of a drilling rig or ship in Lebanese waters would be in the order of 1.5kg of domestic waste per person per day for the duration of the campaign. As an approximation, a one well campaign will be in the order of 30 days and a drilling rig of vessel compliment can vary from 70 to 240 people. It is more difficult to assess the scale or duration of a production operation as this will depend largely on the nature of the reservoir, which of course is unknown at this point. The estimated 1.5kg per person per day is still applicable.

#### **Offshore Pipeline Construction**

*Waste* – Waste generated by an offshore pipe laying crew in Lebanese waters would be in the order of 1.5kg of domestic waste per person per day for the duration of the

campaign. The compliment of a pipe laying vessel can vary greatly; from 10 to 400 personnel. The duration of the pipe laying campaign will be largely dependent on the pipe laying vessel selected and the length of pipeline that is required.

Hazardous Waste – Hazardous waste generated during pipeline laying operations will include;

- Contaminated packaging;
- Used absorbents;
- Used filters;
- Cloths contaminated by dangerous substances;
- Oil filters, and
- Lead batteries.

It would be misleading to try and estimate quantities of hazardous waste to be generated as this would be determined by variables that are unknown at this time.

## **Onshore Support Facilities**

*Physical Presence* – Although the activities related to an offshore oil and gas industry are predominantly found offshore, there will always be a component that is based onshore (offices, storage depots, accommodation, etc.). It would be misleading to try and approximate the scale of such facilities at this stage as so much will be defined by future actions and events, but it is a reasonable assumption that any such facilities will increase demand on the SWM resources of Lebanon. It has been estimated that the average person in Lebanon generates 0.7 to 1.1 Kg per day per person per day (*DA: 4*).

#### Potential environmental impacts

Although some wastes are inherently hazardous, they will only present a risk to the environment if they are improperly managed. Modern disposal and recycling techniques

such as engineered landfill, incineration and recovery of waste oils minimise the environmental impact.

Disposal to landfill is costly and considered unsustainable in the long term. As such operators seek to segregate wastes to reduce the quantity of material going to landfill and to maximize reuse or recycling. There are some waste streams that are currently difficult to dispose of other than by landfill.



# 8.5 **Possible Development Options**

Lebanon's extensive offshore territory and the deficiency of environmental data - especially for the deep offshore areas - is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration there. A lesson learnt from that situation is that it takes time to acquire and collate data, and this data gathering phase happens piecemeal rather than in a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline Surveys being carried out as part the Environmental and Social

Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of contract and a legal requirement in Lebanon. In these circumstances Baseline Surveys are an insurance necessity to guard against future liabilities.

To maximise the value of the surveys Lebanon would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that might accrue due to operator proposed mitigation measures, Lebanon needs to be fully cognisant of best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

It is also worth noting that further research could be backed in Lebanon by international organisations, for example through UN initiatives. Good relationships with any the organisations behind such initiatives and strong communication will hopefully lead to compatible data being gathered by all parties, creating a more complete picture of the subject matter in question.

## 8.6 ESIA Data Requirements

A comprehensive ESIA related to oil and gas activities would require good data relating to the following areas when considering its impact on existing solid waste generation and management:

#### **Municipal waste**

Accurate and current data will be required to establish:

- The capability for handling and transporting the solid waste it is anticipated will be produced from the addition of an oil and gas industry;
- The amount of land fill space available and the rate at which it is being filled.

#### Hazardous waste

Accurate and current data will be required to establish:

- The facilities for handling and processing hazardous waste in country;
- The logistics in place to transport hazardous waste if in country treatment is not viable.

#### Industrial waste

Accurate and current data will be required to establish:

• The facilities for handling and processing industrial waste in-country.

#### Infrastructure

Accurate and current data will be required to establish:

- The structural integrity of the landfill sites available;
- The locations of key infrastructure sites (landfill sites, treatment plants, etc.).

## Waste management

It is necessary to gain an understanding of how Lebanon manages its waste, particularly with regard to industrial, hazardous and municipal waste. This will include an understanding of upcoming changes in waste management practices within Lebanon.

## 8.7 Description of Existing Data

#### Municipal waste

Lebanon generated an estimated 1.44 million tons of Municipal Solid Waste (MSW) during the period 2000 to 2001; the equivalent of 3,940 tons/day, or about 0.92 kg/capita/day.1 MSW generation rates vary between 0.75-1.1 kg/day in urban areas to 0.5-0.7 kg/day in rural regions, with an expected annual growth rate of 6.5% Without taking into account waste reduction and prevention practices, projections indicate an increase to 4.45 million tons MSW by 2024 (see DA 390).

Illegal dumping and open burning of MSW are common throughout Lebanon, with almost every town or city having an open dump within its jurisdiction. However, MSWM practices vary significantly in the different regions.

Based on the Emergency Plan for SWM implemented in 1997, three private sector contracts were authorized by the Government of Lebanon (GoL). The Greater Beirut Area (GBA) is well served in terms of street cleaning and MSW collection, treatment, and disposal, although there are issues surrounding the costs and efficiency of the system. The main



shortcoming is the sorting and treatment capacity. Approximately 15% of the collected MSW is composted and only 5% recycled. This means 80% of the MSW is dumped, resulting in a drastic shortening of the projected lifespan of the sanitary landfills specified in the Emergency Plan of 1997 (*DA: 390*).

Outside the GBA, MSWM systems are generally characterized by a rudimentary 'collect and dump' approach. Under the direct responsibility of individual municipalities, MSW is usually collected by small-scale private haulers, transported to an open dump within the municipality, or burnt in the open air. This releases hazardous gases and unpleasant odours into the atmosphere. As well as being unsightly, illegal dumping and uncontrolled burning also destroys flora and fauna and serves as a dwelling for disease-carrying pests. Recycling efforts are limited to independent scavenger activities.

Smaller villages with no municipal authority typically have no collection or disposal services and as such inhabitants burn their waste in their backyards or throw it in nearby valleys / uncontrolled dumps in neighbouring municipalities.

However, some municipalities have on their own initiative and with the support of international funding agencies developed and implemented plans for the management of MSW. MSW from Greater Tripoli is collected and disposed of in the Tripoli dump, rehabilitated as part of the National Emergency Reconstruction Project (NERP). Costs there are significantly lower than GBA (*See document 2197-REG-ALL-0004, (DA: 390*).

#### Hazardous waste

It is known that Lebanon has no facilities for the processing of hazardous waste. All hazardous waste that is collected is transported out of the country (in line with the Basel Convention) for processing.

Medical waste has recently been recognised as a separate waste stream to domestic waste and being treated accordingly. Now it is autoclaved (irradiated) and added to domestic waste.

#### Industrial waste

What constitutes special waste is defined within Decree 5243/2001.

#### Infrastructure

There is a clear layout of how municipal waste is handled once collected under the 1997 emergency plan. Lebanon has two main Landfills, funded by World Bank and built to internationally accepted standards and classified as Sanitary Landfills under Lebanese Law. They are for Beirut, at Naameh and for Mount Lebanon at Zahle. There is also a facility at Bsalim, which is for inert materials only. These sites service approximately half of Lebanon's population. Elsewhere solid waste is largely either dumped or burned.

There is no source separation carried out, any segregation is at landfill site

#### Waste management

Lebanon has generated waste management plans in the past (*DA: 309, 390 and 391*), however these have proved ineffective in managing the waste streams being generated.

Three solid waste management plans (WMP's) are in force today:

- The Emergency Plan for Solid Waste Management (1997)
- The Master Plan for Solid Waste Management (2006)
- The Waste-to-Energy Plan (2010), fully implemented by 2014

### 8.8 Missing Data

#### **Municipal waste**

The waste streams and their management are largely understood.

#### Hazardous waste

Existing data is good for hazardous waste as it is all recorded in line with the Basel Convention. There is no data for processing hazardous waste as there is no infrastructure to support this.

#### Industrial waste

There is little data regarding the composition of industrial waste. A clear industrial waste management plan is also absent.

## Infrastructure

The extent and status of the solid waste handling infrastructure in Lebanon is largely understood.

## Waste management

<image>

There is sufficient data regarding the waste management plans in effect.

## 8.9 Discussion

The issue surrounding solid waste management in Lebanon is not so much one of a lack of data as it is a lack of legislation and enforcement to implement the existing solid waste management plans. In the absence of robust legislation with its subsequent enforcement, illegal waste disposal is commonplace, particularly with regard to construction and demolition waste. A law was drafted in 2005 on Integrated Solid Waste Management (ISWM) but is still awaiting approval. It is hoped that - if enforced - this legislation will enhance waste prevention and reduction along with waste management in general.

It is also apparent that the existing solid waste handling infrastructure is dramatically overworked (both sanitary landfill sites are operating in excess of their anticipated intake figures). In addition to this, these sites only service half of Lebanon's population. The remaining populous has little choice but to burn or dump the waste they produce.

Uncontrolled dumping and haphazard burning of MSW are symptoms, not causes of a mismanaged MSW sector. A multitude of factors have restricted progress in this sector, beginning with the Civil War in the mid-70s and extending to the present day, political interference coupled with limited resources have had the greatest impact.

During the Civil War (1975-1990), uncontrolled dumping and burning throughout the country was commonplace due to the absence of state and local authorities. The end of the war saw a massive population migration from rural regions towards GBA, dramatically shifting MSW loads and unbalancing the management systems in place at the time.

A wide range of management and technical skills are required at both national and municipal level for effective MSWM. Further capacity building is needed to upgrade the technical knowledge of existing staff and expand resources.

The situation is aggravated by there being no coherent legal and institutional frameworks. Hence, individual initiatives are restricted by a lack of a national policy, strategy, or plan for guidance and direction. Furthermore, limited public understanding and awareness also hamper progress.

The industrial waste stream is of particular concern to the oil and gas industry as this accounts for a significant percentage of the waste it produces (including hazardous waste). The lack of data regarding the composition of industrial waste is of concern as this effects any assessment of the impact an oil and gas industry will have on the existing infrastructure.

There are significant steps to be taken for Lebanon to establish a solid waste infrastructure sufficient to its needs. However, it will be in the interests of prospective oil and gas partners to establish a fully capable and efficiently operating solid waste infrastructure and management system. To this end it is likely that there will be a positive attitude within the oil and gas parties towards assisting with this workload during early stages of any exploration campaigns. For example, there could be assistance in supporting suitable planning and policy implementation, or funding in public awareness strategies relating to waste management issues. Another avenue could be aiding in the launch of educational campaigns targeting the population, highlighting difficulties and hazards surrounding poor waste management and the necessity for the correct treatment of waste.





# 9 Social

## 9.1 Topic

In order to conduct a Social Impact Assessment it is necessary to have collated detailed information on: Demographic trends, wealth distribution, employment/workforce, poverty, ethnicity make-up, cultural set-up, political set-up, gender, life expectancy, literacy, land ownership, land usage (agriculture and natural resources), sensitive locations, crime, infrastructure, energy use, locations of necessities (schools, hospitals, water wells, shops etc.), health (own section devoted to this area), tourism (own section devoted to this area), identification of any focus groups (fisheries co-operatives and fishermen will be allocated such status in this SEA).

With social factors straight numbers and statistics are not enough. Analysis and discussion is also required in order to fully understand human needs, behaviours and potential reactions

# 9.2 Regulatory Framework

Lebanon has a complex and diverse cultural set-up and this is reflected in the legal system and regularity framework: Lebanon's legal system includes both a national civil jurisdiction for certain matters of personal status for the non-Muslim population, and special tribunals for each of Lebanon's religious communities. Different codes under each of the fifteen religious jurisdictions regulate most matters of personal status. Traditional relationships, notably a division between public and private areas of life, are essential to the Lebanese social and political structure. Religious and confessional authorities reflect prevailing social values and preserve the special inviolability of the family. It is therefore more difficult to adapt legislation to this area of the law.

Lebanese laws or regulations that may affect or be affected by oil and gas activities in relation to Social factors are:

## Gender

There are no uniform laws surrounding gender, as stated above it is dependent on religious jurisdiction. Lebanese society is patriarchal in general, but women's situation and level of protection within the family vary depending on religious affiliation. Lebanon's third periodic report to the Committee on the Elimination of Discrimination against Women (CEDAW) states that "whichever denomination she belongs to, a Lebanese woman is a victim of gender discrimination in her contact with the personal status laws".



## Family Code:

Lebanese women have only a moderate level of legal protection within the family context. The legal age of marriage varies amongst the different personal status codes, but two common features are evident: first, that women can generally be wed at a younger age than men; and second, that marriages can be authorised at even earlier ages. The recognised marriageable age for women ranges between 12.5
(or puberty) and 18 years, and between 16 (or puberty) and 18 years for men. Thus early marriage is not uncommon, although no official statistics are currently available.

Polygamy is permissible only among the Muslim population, following provisions in Islamic Sharia law. Muslim men are allowed to take as many as four wives, provided they can support all wives financially and treat them all fairly and equally.

Although some personal status codes assign rights and duties equally to both spouses during married life, parental authority belongs primarily to fathers. Most personal status codes also name men as the rightful guardians, whereas women are merely custodians with no legal rights. Upon birth, children are assigned to the religious sect of their father. Women cannot confer citizenship to children born to a non-Lebanese father.

In the event of divorce, all personal status codes initially grant child custody to the mother. In some cases, custody is transferred back to the father when children reach a certain age. Most Christian denominations and Islamic Shia consider that divorced mothers who wish to remarry forfeit their custody rights. If the mother dies, or is absent for other reasons, the Sunni sect normally transfers custody to the closest female relative.

Inheritance laws differ between Muslims and non-Muslims. Islamic law provides for detailed and complex calculations of inheritance shares. Muslim women may inherit from their fathers, mothers, husbands or children and, under, certain conditions, from other family members. But their share is generally smaller than a man's entitlement: daughters, for example, typically inherit half as much as sons. This is commonly justified by the argument that women have no financial responsibility towards their husbands and children.

The Inheritance Act (1959) for non-Muslims establishes that men and women shall be treated equally and receive the same shares of inheritance. In reality, cultural practices and customs sometimes favour male heirs.

# Physical Integrity:

Lebanon provides a moderate level of protection for the physical integrity of women. Awareness of violence against women, including domestic violence, has increased in recent years, thanks largely to efforts by local and regional NGOs. The design and implementation of government policies in this area, however, has been rather poor. Existing law does not recognise the concept of spousal rape. In general, the actual reporting by victims of domestic abuse remains low.

Female genital mutilation is not practiced in Lebanon and there is no evidence to suggest it is a country of concern in relation to missing women.

#### Ownership Rights:

There are no legal restrictions on women's ownership rights, including access to land and access to property other than land, provided that they are 18 years or older. Patriarchal traditions may work against women in some aspects of ownership, but limitations more often arise from the fact that many women remain unaware of their economic and legal rights. This is particularly true in rural areas.

Women are legally entitled to access to bank loans and can enter into financial contracts, but some limitations are evident in practice. For example, the CEDAW reports that among an estimated 30 institutions lending to small-scale rural projects, only nine provide men and women with equal conditions. Moreover, women's share of the loans from these nine credit institutions ranges between only 10 and 20 per cent. There are

two organisations that lend exclusively to rural women, however data on the number and size of the loans are not available.

#### Civil Liberties:

Legally, Lebanese women have a moderate degree of civil liberty; it is sometimes difficult for them to exercise their rights. There are no legal restrictions on freedom of movement for Lebanese women. The law allows women to apply for passports without the permission of their husbands. In practice, the extent to which Muslim women can move freely outside the household or travel abroad often depends on their husbands and other family members.

Women have freedom of dress, but the number of women who wear a veil in public has increased since the 1980s. Still, Lebanon is more liberal than other Middle Eastern countries, in part because of its large Christian and secular communities.

Although gender inequalities may not be relevant at the SEA phase, it will undoubtedly become relevant during later phases. Major corporations regard equality amongst any group as high priority, also during construction phase it will be important to ensure harmony between workers and the locals (the workers will be predominantly male) by adhering to local customs. Technically women are only allowed to vote in Country elections if they are 21 years of age and with an elementary level of schooling, whilst their male counterparts are obliged to vote when they are 21 plus. This regulation appears lax (in middleclass Beirut at least), however this mentality may hinder or interfere with the way a corporation would wish to conduct stakeholder engagement following international protocol.

#### **Child Labour**

During the SEA phase regulations with regards to children may not be of high relevance, however big corporations have a reputation to protect and will want to be viewed as morally ethical. They will therefore not want any affiliation with companies that either promote or turn a blind eye to child labour or work trafficking. Child labour is prevalent within the tobacco fields, dangerous workshops and organised begging. Lebanon ratified



the Convention on the Rights of the Child in May of 1991 with no reservations. The Convention does not carry the force of law in Lebanon.

There is little information available regarding Lebanon's implementation of Article 12 of the CRC with respect to the child's right to be heard in child protective proceedings, or regarding child protective proceedings generally. Children are not regarded as citizens with rights that enable them to enjoy

legal and social competence. The age of majority is eighteen, and a minor is considered capable of discretion at fifteen years. The general custom of corporal punishment as a form of disciplining children is accepted under the Penal Code.

#### **General Labour**

An anti-trafficking in persons act was implemented in 2003 and again big corporations will want to be seen to have a moral compass and will not want any affiliation with other companies or individuals who promote or ignore such practices.

#### **Refugee Status**

Lebanon is not party to the 1951 Convention relating to the Status of Refugees or its 1967 Protocol, and does not have a functioning refugee law in accordance with international standards. The 1962 Entry and Exit Law prohibit refinement of "political refugees" and allow any foreigner, whose life or liberty is in danger for political reasons, to seek asylum. Furthermore most non-Palestinian refugees cannot move freely within the country for fear of arrest. The Government restricts movement mostly at



checkpoints, where many police and military officials do not respect UNHCR documents, especially after the conflict in Nahr al Bared. With refugee camps (specifically Palestinian) based along the coast and in the south of the country they are bound to have an impact and be impacted by oil and gas activities. This may be cause for concern as refugees have limited mobility (legally binding) and are not awarded the same rights as Lebanese Nationals (in terms of employment, health and educational rights). This will cause complications in regards to Project related RAPs (Resettlement Action Plans), stakeholder engagement and corporate ethical responsibility.

Additionally Palestinian groups in the refugee camps operate their own system of justice outside Lebanon's control, resolving disputes in traditional, tribal fashion. It is highly likely that the planned route will impact Palestine Camps based in and around the south of the country, therefore it is recommended to exercise considerable caution when venturing into these parts, during stakeholder engagement for example.

#### **Freedom of Speech**

The Constitution provides for freedom of speech and of the press. However in the past the Government has limited these rights in practice, particularly by detaining and charging activists critical of government policies and by intimidating journalists and broadcasters into practicing self-censorship. The Government has previously censored television and radio broadcasts on a case-by-case basis. Presently there are no restrictions regarding the internet. Freedom of speech is hugely relevant to stakeholder engagement, data gathering (including household questionnaires) and corporate responsibility in general.

#### Infrastructure

Due to the extremely fragmented civil infrastructure situation there seems very little in the way of a regulatory framework. However the ministry of post and telecommunications overlook and regulates the implementation of local laws and legislations governing the introduction of telecommunication technology such as Satellites, T.V., Radio and satellite broadcast, and reception and retransmission. The ministry of information technically is responsible for media broadcasts however private companies such as LBC (Lebanese Broadcast Corporation) has much more leverage and influence. This will be relevant to oil and gas activities in regards to stakeholder engagement, and ensuring proper protocol is followed.

# 9.3 Strategy and Future Plans

CEDAW (Committee on the Elimination of Discrimination Against Women)

• Currently have a range of issues and concerns that they are pursuing with Lebanese Government, this NGO have strong International backing.

EastMed (FAO) in collaboration with Balamand University

• Alongside comprehensive marine, environmental and ecological surveys EastMed aim to conduct a first-ever national Socio-Economic survey commencing early 2012.

# ECHO, ESME & UNDP

• Continuation of work and community incentives in regards to 'Restoration & Preservation of Lives and Livelihoods' (DA 68).

# GNESD (Global Network on Energy for Sustainable Development)

- Reduce both network technical losses and network non-technical losses, and collect all its issued bills.
- Speed up the shift to natural gas in the thermal power plants and the upgrade of operation and maintenance of the whole network.
- Implement both solar hot water heating systems and fluo-compact lamps.
- Address the standardisation and labelling of electrical equipment and speed up the creation of a Lebanese centre for energy conservation.

ILDES (Lebanese Institute for Economic & Social Integrated Development)

- To fight against rural exodus and emigration of the Lebanese population.
- To participate in the creation of regional poles of development.
- To promote, in this frame, a development process respecting the environment.
- To reinforce inter-community life.

# <u>Lebanese Republic Council for Development & Reconstruction in collaboration with the</u> <u>General Directorate of Urban Planning</u>

- Introduce a new Law of Urban Planning and Law of Construction concerning natural flood and landslide hazards.
- Develop and reform current Urban Planning framework (including overhaul of infrastructure) (DA: 4).
- Maintain better control over water resources and close down all illegal water supplies.
- Act vigorously for 'disconnecting' the social policy of the Government from the EDL. Suggesting that the Government should be made responsible for the energy bills of vulnerable people and not the distributor.
- Maintenance and rehabilitation of existing national road network.
- Release, reconstruction and preservation of the old railway lines for future use as inter-urban rail lines. This is completely incompatible with MoEW's oil and gas plans.

# Ministry of Social Affairs

• Various agendas to improve state health, education and civil infrastructure.

#### Telecommunications Regulatory Authority of Lebanon

- Bearing in mind the need to safeguard competition and investment incentives, the TRA intends to promote infrastructure sharing.
- This is inclusive of the civil engineering and non-active elements of a network (e.g., towers, masts, ducts and conduits)

# UNHCR (UN Refugee Agency)

• Urges the Lebanese Government to amend its 1962 Law on Entry and Stay of Foreigners with a view to de-penalise the illegal entry or presence of refugees recognised by UNHCR.

 Develop a specific legal framework defining and protecting rights and freedoms of refugees and provide for the issuance of temporary residency permits for persons under UNHCR's mandate, pending the identification of a durable solution for them.

UNRWA (United Nations Relief and Works Agency for Palestine Refugees in the Near East)

- Raise awareness and promote Governmental activity regarding Palestinian Refugee inequalities (employment, poverty, education, legal status and lack of national status).
- Seek to expand its partnerships with other NGOs as well as the Lebanese Government.

# 9.4 Impact from Development of Petroleum Activities

As regards to how the development of oil and gas activities will impact social issues is a complex and multifactorial debate. Whilst environmental impacts may be straight forward i.e. a type of fauna may be in jeopardy due to Industry activities thus certain mitigations can be put in place (or not). In terms of identifying social impacts it is necessary to be aware of all Development impacts (from water, waste, air omissions, coastal impacts, environmental impacts, visual impacts, economic impacts, political impacts etc.) Essentially all Industry impacts affect the human population directly or indirectly. However some are more direct and prominent than others:

The 2006 attack by Israel has left Lebanon's infrastructure utterly fragmented and in disrepair. Oil and gas activities will undoubtedly put a strain on an already struggling urban and civil infrastructure (electricity, road networks, ports, water usage, waste water and sewerage, to name but a few.)

- Agriculture and general employment may also be impacted by oil and gas activities (the exploration and drilling will be offshore, however the Industry Zone of Influence includes more access routes which are onshore).
- Health has its own Gap Analysis, however it is also important to mention it in the



Social Gap Analysis. If existing infrastructure is feeling the added strain of a new industry this will in turn impact on health services and access to these services. Not forgetting adding to the existing problem of toxic water and air quality and emissions.

• Resettlement and creation of unemployment could potentially be an impact felt by oil and gas activities. If the Pipeline is to be located onshore (along the coast) this will be at the detriment of settlers and hoteliers (tourism in general). RAPs are regarded as a last resort for oil & gas companies due to complexities around legal status, international and media pressures and the added expense this may cause the developers. As mentioned previously a significant number of refugee camps are

located along the southern coast. As these settlers are classified as illegal this would add extra complication in relation to RAPs.

- Land disputes invariably become an issue with the arrival of oil and gas activities, and determining who owns the land (especially in terms of procurement and/or reimbursement) can prove costly.
- Fisheries and fishermen (commercial and recreational) are regarded as an important and influential stakeholder in terms of this Development. They may face temporary disruption both offshore and onshore due to oil and gas activities.
- Migration towards Industry activities are often felt by the arrival of major developments, this in itself can cause unwanted impacts: conflict between newly arrived inhabitants and locals, an increase in crime due to actual or perceived job or resources loss/gain, not forgetting increasing the strain on the local infrastructure.
- The arrival of a major Development will put an international spotlight on all activities with NGOs, media and PR companies making an often heavy physical and vocal presence. This is further reason for corporations to be seen to be following ethically and morally correct protocol. Therefore adhering to international regulations on basic human rights, equalities (gender, age, caste and ethnicity) and freedom of speech is extremely relevant.
- Lastly, as oil and gas activities develop so will community and stakeholder engagement. Managed correctly the impacts of household surveys, for example, can be kept neutral if not transpire to be wholly positive by instilling national pride, a sense of ownership and a feeling of involvement.

# 9.5 Possible Development Options

Lebanon's extensive offshore territory and the deficiency of environmental data, especially for the deep offshore areas, is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration. A lesson learnt from this situation is that it takes time to acquire and collate data, and this data gathering phase happens piecemeal rather than in a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline surveys being carried out as part the Environmental and Social Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of contract and a legal requirement in Lebanon. In these circumstances Baseline Surveys are an insurance necessity to guard against future liabilities.

To maximise the value of the surveys Lebanon would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that might accrue due to operator proposed mitigation measures, Lebanon needs to be fully cognisant of best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

Depending on the phase in the lifecycle of the Development, one can predict general social concerns. At the SEA phase of exploration for oil and gas in Lebanese waters it is safe to assume that the social impacts will not be excessive. During this phase fishery co-operatives, fishermen and the tourism industry (including coastal hotels) are the only stakeholder groups that will be temporarily impacted. Assuring quality and focused

stakeholder engagement is imperative in order to ease into the next Development phase with optimum 'buy in'.

# 9.6 ESIA Data Requirements

In order to conduct a comprehensive Social Impact Assessment for the ESIA of quality, the social data acquired must be both extensive and in-depth. The social data is typically gathered from socio-economic surveys, which include mayor's questionnaire, household questionnaire and identified focus groups. Data is also acquired through desktop study and consultations. These techniques provide enough information to assess the baseline of the socio-economic situation within the Zone of Influence. A sound baseline facilitates reliable and credible assessment and predictions regarding both Industry impacts and social concerns. Due to the devastation that the 2006 war had on infrastructure, displacement, health and access routes it is imperative that all data acquired and used is post 2006.

#### Post-2006 Data Required Basic Social Areas of Interest

Detailed demography

• Including trends, population characteristics (ethnic, religious, caste and hierarchy make-up) age spread, life expectancy/birth rates, literacy rates, gender divides.

Poverty and wealth distribution

• This includes employment statistics, housing and lifestyle quality.

<u>Workforce</u>

• Type, location and land usage, for example port usage.

Cultural and political information/custom

• Detail is needed on all ethnic groups and sects that make-up Lebanon (legal and illegal residents).

Land use, land ownership and sensitive location awareness

• This affects both SIAs & HIAs.

#### **Infrastructure**

- Extensive coverage of existing infrastructure and its limitations.
- Energy and water usage and functionality.
- Locations of essential amenities hospitals, schools, shops, fire stations, police stations etc.

#### **On the Ground Observations**

- Local expectations, perceptions, concerns and knowledge of the Development and potential impacts.
- Security assessment (local and national level) including a grasp of crime type and frequency.
- Identification of any focus groups (fisheries co-operatives and fishermen will be allocated such status in this SEA).

# 9.7 Description of Existing Data

A considerable amount of pre-existing socio-economic data is rejected as it was gathered pre-2006, rendering it obsolete.

Currently data on existing infrastructure, energy and water usage is adequate and provides useful insight into the disrepair and stresses it puts on daily life in Lebanon. (*DA: 02, 03, 07, 26, 40, 199*). However, the surveys are usually generated from a national census or from surveys that have omitted any sign of a standard methodology, which effects data credibility.

Socio-economic surveys have been conducted at regional levels; however they all fail to delve into detail regarding demography and population make-up. All of the social studies reviewed (including the National Household Surveys) paint a picture that is not in keeping with the actual cultural make-up that is present in today's Lebanon. Various NGO's studies are able to give numbers on the variety of ethnic cultures within Lebanon, yet they are stand-alone studies that really need to be incorporated into one wide and comprehensive survey at a national level. Nonetheless sound data has been found regarding straight statistics on: life expectancy/birth rates, literacy rates, gender divides in the workforce and education, employment statistics and type of workforce. (DA: 02, 03, 05, 06, 08, 10, 11, 15, 16, 26). Again the main criticism is that there is no differentiation made between class, ethnicity or religious affiliations. It is essential to be able to spot trends and assess vulnerable groups by noting the sub-group that an individual may belong to.

Currently all of the social surveys reviewed have failed to cover or explore the diverse make-up of Lebanon (and potential conflicts or injustices this may entail) apart from brief percentages of the country's ethnic make-up (not including non-nationals). Generally the data provided lacks in a sound methodology and discussion or analysis of the findings.

Due (directly) to the 2006 Israeli attack Lebanese essential amenities are often extremely impoverished (*DA: 302*) and in disrepair. It was noted that the general infrastructure is at a lower functioning level than Lebanon in the 1970s, with an estimation of \$2.5 billion worth of damages inflicted upon essential amenities and urban infrastructure (USA Today). Again this information is extremely useful; however it is based on UN estimations and newspaper reports not credible surveys with repeatable methodologies. There are mixed accounts regarding the standard of essential amenities, but it is widely noted that access to many of these have been affected by the 2006 war. Further impacts felt by the 2006 war were the level of internal-displacement (*DA: 302*). There is not enough data on this issue but it will raise serious concerns over any proposed Resettlement Action Plans.

In terms of social concerns and the identification of land use, land ownership and sensitive location very little has been recorded. It is noted that the 2006 war has also affected good data and record collection of these issues.

# 9.8 Missing Data

The social component of an ESIA will be focused on the gathering of baseline data related to potential impacts ruminating from oil and gas related activities. All baseline surveys are by their very nature the starting point for long term monitoring and impact mitigation.

Having established what social data is required for an ESIA, and what actual data is available, it is then necessary to identify the missing data (the core of any Gap Analysis).

# **VOL 4 - GAP ANALYSIS**

Missing Data	Partially or Totally Missing	Relevance to an ESIA	Further Comments	
National level Socio-economic studies.	Totally	High	EastMed aim to conduct the first-ever Nation-wide socio- economic survey in early 2012.	
Existing surveys omitting sound methodologies.	Partially	High	Without a methodology section a scientific study is not credible.	
Demographic detail.	Partially	High	Currently details on household ethnic make-up, religion, caste, class etc. is missing.	
Land ownership, Land usage, sensitive locations & Land disputes.	Partially	High	There is existing data (though slight) revealing land usage and sensitive locations. However land ownership and discussion on past land disputes are missing in entirely.	
Specific details on Palestinian Refugee camps (location, population & customs).	Partially	High	Data on this area may be extremely relevant to Industry impacts if details on the locations coincide with oil and gas activities. Currently too little is known in this area.	
Locations and quality of essential amenities (hospitals, schools, shops, fire stations, police stations etc.)	Totally	High	It is necessary to obtain this data in order to assess potential oil and gas related impacts.	
Local expectations, perceptions, concerns and knowledge of the Industry and potential impacts.	Totally	High	This data is essential in order to ensure smooth community and stakeholder buy-in and engagement. Information dissemination of oil and gas activities and general Industry awareness incentives are crucial at an early stage.	
Security assessment (local and national level) including a grasp of crime type and frequency.	Totally	High	Arrival of oil and gas activities can influence migration, internal-conflicts and potential thefts. It is necessary to know the Baseline on crime, community cohesion and attitudes towards non-Lebanese companies/individuals.	

# 9.9 Discussion

From an extensive review of available socio-economic related data there are areas that raise concern. Some of these concerns are more serious than others.

#### Infrastructure Concerns

- The current state of Lebanese infrastructure, including energy, water quality and availability, waste management, hazardous waste, urban transport links and road networks, will find it hard to cope with the added pressure that oil and gas activities may bring.
- Lack of communication between high level stakeholders and policy makers. The Lebanese Council for Development and Reconstruction, in collaboration with the General Directorate of Urban Planning, are intending to reinstate the old railway lines for use as inter-urban rail lines. This is completely incompatible with MoEW's plan to use it as a pipeline route.

#### **Ensuring Corporate 'Buy-in'**

 Issues or discrepancies over freedom of speech, human rights (including child labour & human trafficking) and ethnic inequalities that is not compliant with IFC or any major corporation's standards and regulations.

# **ESIA Related Concerns**

- The lack of an existing complete socio-economic survey, at national level. The individuals at CAS (Central Administration for Statistics) proved extremely useful however straight statistics with no analysis or discussion are limiting.
- Major corporations have publically stated policies and standards and work to a Company Code of Conduct. Internationally Recognised Industry Best Practice, often based on Equator Principles and IFC Performance Standards, are the norm in well regulated oil and gas projects. Community Investment Programmes are now the norm and this should be taken into consideration at an early stage.



# I I I I I



# 10 Health

# 10.1 Topic

'Health Impact Assessment' (HIA) is a compound term reflecting two different concepts—health and impact assessment. 'Health' is broadly defined by the World Health Organization (WHO) as a state of complete physical, mental and social well-being and not simply the absence of disease or infirmity. Within this context, health is considered as a resource for everyday life, not simply as the object of living. Health is characterized as a positive concept emphasizing social and personal resources as well as physical capabilities. 'Impact Assessment' describes the systematic analysis of the lasting or significant changes, positive or negative, intended or not, in people's lives and the natural environment brought about by a given action or series of actions. The WHO/ECHP report *Health Impact Assessment: main concepts and suggested approach* (Gothenburg consensus paper, 1999) describes HIA as 'a combination of procedures, methods and tools by which a policy, programme or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population'.



As currently practiced, two key characteristics define HIA: predicting the consequences of different options; and influencing and assisting decision makers. A comprehensive HIA is a participative and interactive process with a broad range of stakeholders at every level within the host society. In addition, health assessment, along with its environmental and social components, is increasingly considered by international stakeholders (for example non-governmental organizations (NGOs) and financial institutions) as an essential component of the overall impact assessment process. HIA can be used at any stage of the industry life cycle, whether this is new country entry, exploration and development, modification of an existing activity or closure of previous projects.

HIA makes recommendations to mitigate impacts and enhance health opportunities as part of the planning process for health outreach programmes that extend beyond the fence line and into surrounding communities. This may include proposals for health outreach programmes or for other social programmes, for example, vocational training, local water projects, and market gardens. All such programmes can provide health benefits. HIA seeks to identify and estimate the lasting or significant changes of different actions on the health of a defined population. These changes can be positive or negative, intended or not, single or cumulative. Furthermore, the range of changes may or may not be evenly distributed across the population. The potential for uneven differences is a major concern for many HIA practitioners and is generally referred to as the 'assessment of equity'. The overall mitigation strategy is further developed into an implementation plan that includes a long-term monitoring (surveillance) programme. The overall programme should be periodically evaluated and reviewed.

Health in relation to impact assessment is determined by a multiplicity of factors, including socio-economical, environmental and ecological concerns.

Table 1. Comparison of HIA and other common Impact Assessments								
	НІА	EIA		SIA		ESIA		Strategic Environmental Assessment
<ul> <li>F</li> <li>E</li> <li>I</li> <li>I</li></ul>	Recommended by the WHO, EU, WB, UNEP, LO, FAO. mpact on health status, with the definition of health encompassing the state of complete ohysical, mental and social well- being. Health is determined by a multiplicity of factors ncluding socio- economic and environmental factors. Community participation critical integral part of the process.	<ul> <li>Often required by legislation.</li> <li>Impact on the environment (soil, air, water, wastes, fauna, flora and human activities.</li> <li>Consultation phase often legislated.</li> </ul>	•	Usually carried out voluntary by the Company (not legally binding, but a Bank requirement). Impact on communities. Consultation required all through the process and as a tool to collect baseline information.	•	Often required by legislation. Impact on both environment and communities. Health impacts are rarely detailed and restricted to negative impacts. Consultation phase often legislated.	•	Usually carried out voluntary by the Company. National and regional policy and impacts considered. Integrates health, social and environmental policy issues. Starts well in advance of plan or Development execution.

#### Understanding the Importance of HIAs

Usually Development and location specific, starts during Development conception, its results feed decisions in the design phase, implementation & throughout the Development life cycle.

# **10.2 Regularity Framework**

Lebanon has a complex and diverse cultural make-up and this is reflected in their legal system and regularity framework. As is typical of many Lebanese sectors health infrastructure and service has been left in disarray as a result of the 2006 attack by Israel. Typically there is a lack of clarity over proposed policies and applied policies.

Lebanese health policies and regulations described below are unlikely to be impacted by oil and gas activities especially during the exploration phase, but health care is an area that is often included in a company's community investment schemes.

In November 1999, the then newly-established Secretariat of the Inter-Ministerial Committee for health reforms proposed a set of key principles for health reforms in Lebanon. Among these principles are the following:

- Every Lebanese citizen has the right for comprehensive health care, irrespective of his/her ability to pay, and within the capabilities of the State.
- It is the duty of the State to lay the foundations for a healthcare system that is sustainable and comprehensive. The health care delivery system shall include promotion, prevention, curative, and rehabilitative care, offered within all health care institutions; hospitals, clinics, diagnostic and treatment centres. The system shall ensure quality services, in an equitable and accessible manner. It shall also minimize waste and overhead costs.
- The healthcare system will be based on a partnership between the public and private sectors, facilitating coordination and complementarity between all of health groups and institutions, on a stable and long-term partnership.
- The healthcare system priorities will be to ensure access and coverage to all groups especially senior citizens, disabled and the medically indigent population groups.
- The Public sector will collaborate with all public institutions, regional and international non-governmental organizations, universities, institutes, syndicates, and international organizations and associations.
- Refer to the Legal Register for specifics on the Lebanese Framework Law on the Protection of the Environment (Law 444/2002), this law covers the health impacts waste water, polluted water and soil, waste disposal and transport pollution (*DA:316*).

It is unclear if any of these policies have actually been applied.

## 10.3 Strategy and Future Plans

# <u>Lebanese Republic Council for Development and Reconstruction (General Directorate of</u> <u>Urban Planning)</u>

Within the context of the land use plan, the expected initiatives of the Government in the health care sector are the following:

#### **General Health**

- The health sector requires major efforts in balancing supply and demand of health services. The establishment of a health plan map is a necessity for the regulation of the supply in the regions (hospitals, health care centres, dispensaries), but also technical plateaus (number of beds for short, medium and long stay, medical and para-medical staff, etc).
- Health care services should not be conceived only in the framework of hospital structures and health care centres: home hospitalisation and ambulatory health care formulas constitute lower cost alternative solutions that should be encouraged and established.
- It will be appropriate, according to an accurate evaluation of needs, to establish an
  expected balance between public and private offers. In the current situation of
  public finances and the fact that health care cost is being paid by the user and by the
  relevant social funds equally to the private and public sectors, the public sector
  should refrain from creating an offer wherever the private offer is already
  satisfactory.

#### Solid Waste and Contaminated Water

- Ensure the MoE have the power to contest the locations of landfills decided by the municipalities based on EIAs if sites were judged unacceptable for public health considerations (impact on water resources, agriculture, fishing etc.)
- High on the agenda is the current state of waste water, hospital waste and solid waste disposal. It is recommended that MoE work in collaboration with Ministry of Public Health for hospital waste and the Ministry of Industry for industrial wastes.
- Researchers from AUB are intending on conducting trails in water disinfection using natural UV rays to kill off certain water borne bacteria. This is dependent on University financing and the 2012 budget.

# **10.4** Impact from Development of Petroleum Activities

Impact on health issues from the developing oil and gas industry is a complex and multifactorial debate and has to be seen in the full context of impacts on all bio-physical and socio-economic aspects. Essentially all Project impacts directly or indirectly affect the human population of a Project area.

 The 2006 attack by Israel has left Lebanon's infrastructure fragmented and in disrepair. The development of an oil and gas industry will undoubtedly put a strain on an already struggling urban and civil infrastructure, such as electricity, road networks, ports, water usage, waste water and sewerage (DA:302).



• There are numerous studies that highlight

the negative impacts that the 2006 war has had on the population's mental state, further reason to ensure quality and proactive stakeholder engagement.

- Agriculture and general employment may also be impacted by oil and gas activities (the initial industry activities will be offshore; however its Zone of Influence includes access routes and construction onshore.) A fear or perception of loss of income or loss of control can also trigger mental stress disorders.
- If the existing infrastructure is feeling the added strain of oil and gas development this will in turn impact on health services and access to these services. There is also a cumulative impact on air emissions and potential pollution events. According to the American University of Beirut (AUB) the shortage of medical equipment (including syringes) with a lax approach to blood screening has led to a rise in HIV. Detailed reports are not readily available.
- Researchers at AUB propose that water borne diseases are extremely frequent and much higher than any recorded data may suggest. They attribute this to the deterioration of the domestic water supply and private well sources due to sea and waste water infiltration.
- Resettlement and creation of unemployment could potentially be a consequence of industry development, but equally job creation. Onshore pipeline construction along the coast would require resettlement and disruption to local businesses. Resettlement Action Plans (RAPs) are considered a last resort by responsible companies due to complexities around legal status, international and media pressures and the added expense this may cause the developers. A significant number of refugee camps are located along the southern coast which would add political complexities to the situation. Since the 2006 war high levels of mental disorders have been recorded amongst those that were internally-displaced due directly to war outcomes so additional disruption may have a cumulative impact.
- Major developments tend to promote migration towards the activities. This in its self can cause unwanted impacts: violent altercations between newly arrived inhabitants and locals, an increase in crime due to actual or perceived job or resources loss/gain, increasing the strain on the local infrastructure.

# **10.5** Possible Development Options

Lebanon's extensive offshore territory and the deficiency of environmental data, especially for the deep offshore areas, is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration. A lesson learnt from this situation is that it takes time to acquire and collate data, and this data gathering phase happens piecemeal rather than in a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline surveys being carried out as part the Environmental and Social (including Health) Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of contract and a legal requirement in Lebanon. In these circumstances Baseline Surveys are an insurance necessity to guard against future liabilities.

To maximise the value of the surveys Lebanon would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that

might accrue due to operator proposed mitigation measures, Lebanon needs to be fully cognisant of best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

During the offshore exploratory phase it is not anticipated that oil and gas development will have any impact on the health of the Lebanese population. Onshore construction and future development of an industry that typically involves large numbers of multinationals travelling in and out of the country will undoubtedly impact on the health status and health infrastructure of Lebanon.

# **10.6 ESIA Data Requirements**

In order to conduct a quality and comprehensive Health Impact Assessment for the ESIA, the community health data acquired needs to be both extensive and in-depth. The health data is typically gathered alongside the socio-economic surveys (which include mayor's questionnaire, household questionnaire and identified focus groups), data is also acquired through desk-top study and consultations. The techniques described above, should provide enough information in order to assess the baseline of the socio-economic (including health) set-up of an area affected by oil and gas activities. Having a sound grasp of the baseline situation ensures future assessment and predictions regarding both the Development and social/community health concerns are credible and reliable. Due to the devastation that the 2006 war had on infrastructure, displacement, health and access routes it is imperative that all data acquired and used is post 2006.

#### Types of post-2006 health data needed

Whilst evaluating industry related impacts on health it is important to apply a broad framework that considers both social and biomedical determinants of health. The table below provides a comprehensive check list in order to achieve a quality HIA for the ESIA.

#### **Basic Health Areas of Concern**

#### **Respiratory Infections**

 Including, but not exclusive to: acute respiratory infections (ARIs – bacterial and viral), pneumonias, tuberculosis.

#### **Vector-related Disease**

Including but not exclusive to: malaria, typhus, dengue.

#### **Sexually Transmitted Infections**

• Including, but exclusive to: HIV/AIDs, genital ulcer disease, syphilis, gonorrhoea, chlamydia, hep B.

#### Soil & Water Borne Disease

 Including, but exclusive to: soil transmitted helminths (STH), leptospirosis, schistosomiasis, meliodosis, cholera.

#### Food & Nutrition-related Issues

• Including, but not exclusive to: stunting, wasting, micro-nutrient deficiencies, changes in agricultural practices, gastroenteritis (bacterial and viral) and food safety.

#### Accidents & Injuries

• Including, but not exclusive to: traffic and road related incidents, construction (home and Project) and drowning.

#### **Exposure to Potentially Hazardous Materials**

 Including, but not exclusive to: pesticides, inorganic and organic fertilizers, road dusts, air pollution (indoor and outdoor related to heating practices, cooking, vehicles), landfill refuse or incarceration ash, disposal of solvents, paints, oils or cleaning agents.

#### Psychosocial

 Including, but not exclusive to: relocation, violence, security concerns, substance abuse, depression and social cohesion.

#### **Cultural Health Practices**

 Including, but not exclusive to: the role of traditional medical providers, local or indigenous medicines and unique cultural or ethnic health practices.

#### Health Systems Infrastructure & Capacity

- Including, but not exclusive to: physical infrastructure, staffing levels and technical capabilities of health care facilities at local, district and national levels.
- Including, but not exclusive to: co-ordination and alignment of a Project with existing national and provincial level health programmes (malaria, TB, HIV/AIDs.

# 10.7 Description of Existing Data

Currently data on existing domestic infrastructure, energy and water usage is adequate and provides useful insight into the disrepair and stresses it puts on daily life in Lebanon. (DA: 02, 03, 07, 26, 40,199).

There is also sufficient data regarding staffing levels and technical capabilities of health care facilities at local, district and national level. However the surveys



are usually derived from a national census or from surveys that have omitted any sign of a standard methodology, which may alter the data credibility. Due directly to the 2006 Israeli attack Lebanese essential amenities are often extremely impoverished (*DA: 302*) and in disrepair. It was noted that the general infrastructure is at a lower functioning level of 1970s Lebanon with an estimation of \$2.5 Billion worth of damages inflicted upon essential amenities and urban infrastructure (USA Today).

Although this information is important it is based on UN estimations and newspaper reports, not credible surveys with repeatable methodologies. There are mixed accounts regarding standard of essential amenities, but it is widely noted that access to many of these have been impaired by the 2006 war. A further impact from the 2006 war is the increased prevalence of internal-displacement (*DA: 302*). There is not enough data on this issue but it will exacerbate any Resettlement Action Plan s (RAPs).

In terms of psycho-social concerns over identification of land use, land ownership and sensitive location very little has been recorded. It is noted that the 2006 war has also adversely affected data and record collection of these issues.

There is very little information on water borne diseases, toxic soils used in agriculture, and general health of the population – mentally or physically. Information concerning hazardous waste location and disposal is also lacking. Health surveys have been conducted at local, district and national levels; however they all fail to delve into detail regarding type of disease, cause and host (what social group does the individual belong to? For example might a certain group be more susceptible than another?) The current data lacks detail which prohibits trend spotting.

# 10.8 Missing Data

The HIA component of an ESIA will be focused on the gathering of baseline data related to potential impacts from oil and gas related activities. All baseline surveys are by their very nature the starting point for long term monitoring and mitigation.

Having established what health data is required for an ESIA, and what actual data is available, it is then necessary to identify the missing data (the core of any Gap Analysis).

Missing Data	Data Partially or Relevance to Totally Missing the ESIA		Further Comments		
Respiratory infections	Totally	High	This type of data is useful when assessing levels of poverty.		
Existing surveys omitting sound methodologies.	Partially	High	Without a methodology section a scientific study is not credible.		
Demographic detail and type of illness/disease.	Partially	High	Currently details on in-patient ethnic make-up, religion, caste, class etc. is missing. How can trends be spotted without the finer detail? Currently there are only rough details on the top 10 'killers' in Lebanon with no reference to causes or survival rates. Data does exist on traffic and road related incidents – however it hele detail and enshuis		
Land ownership, Land usage, sensitive locations & Land disputes.	Partially	High	There is existing data (though slight) revealing land usage and sensitive locations. However land ownership and discussion on past land disputes are missing in entirely. This can be cause for huge mental anguish – lacking a sense of belonging.		
Frequency of water & soil borne diseases.	Missing	High	This also takes into account waste and toxic impacts on natural resources.		
Specific details on Palestinian Refugee camps (location, population & customs).	Partially	High	Data on this area may be extremely relevant, if details on the locations coincide with oil and gas activities. Currently too little is known in this area.		
Locations and quality of essential amenities (hospitals, schools, shops, fire stations, police stations etc.)	Totally	High	It is necessary to attain this data in order to assess potential oil and gas related impacts.		
Local expectations,	Totally	High	This data is essential in order to ensure smooth community and		

#### Missing Community Health Data

and knowledge of the Development and potential impacts.			stakeholder buy-in and engagement.
Security assessment (local and national level) including a grasp of crime type and frequency.	Totally	High	Arrival of oil and gas activities can influence migration, internal-conflicts and potential thefts. It is necessary to know the Baseline on crime, community cohesion and attitudes towards non-Lebanese companies/individuals.

# 10.9 Discussion

From an extensive review of available health related data there are areas that raise concern.

#### Infrastructure Concerns

• The current state of Lebanese infrastructure, including energy and water quality and availability, waste management, hazardous waste, urban transport links and road networks are unable to cope with the added pressure that oil and gas activities may bring. This will produce adverse indirect effects on health aspects.

#### **ESIA Related Concerns**

• The lack of an existing complete health survey, with detailed accounts of disease, host, frequency, survival rates and analysis means that a full HIA would be required for the ESIA baseline studies. It would be advisable that the HIA be partly carried out alongside the Social Impact Assessment. The Central Administration for Statistics (CAS) provided a range of social and health related data and proved extremely useful however straight statistics with no analysis or discussion are limiting.

Major corporations have publically stated policies and standards and work to a Company Code of Conduct. Internationally Recognised Industry Best Practice, often based on Equator Principles and IFC Performance Standards, are the norm in well regulated oil and gas projects. Community Investment Programmes are now the norm and this should be taken into consideration at an early stage.



# **NSNS**

# 11 Tourism

# 11.1 Topic

Beirut, with its Western attitudes and diversity, has long attracted tourists from the Gulf region and served as a second home to Arabs living in morerestrictive countries. Tourism generates 20% of the country's gross domestic product. The tourism industry in Lebanon has been historically important to the local economy and remains to this day to be a major source of revenue for Lebanon.



There is a high likelihood that the intended oil and gas activities will be located both onshore and offshore. In turn this may cause temporary or



and offshore. In turn this may cause temporary or sustained impacts felt by coastal and marine tourism in Lebanon. Currently Lebanon's coastal tourism makes up 71% of the entire tourist industry. The oil and gas industry impacts will be felt along the coast, which may affect beach access and use. Another cause for concern is the status of the hotels, marinas and resorts situated along the coast. Further complications arise with the knowledge that many hotels and marinas built pre and during 2006 are without permits,

rendering them illegal. This reiterates the problem envisaged by RPS regarding land use and land ownership in respect to all oil and gas activities within Lebanon.

Established Tourist Niches				
ТҮРЕ	DETAIL	Possibility of Being Affected by Oil and Gas Activities		
Beach & Coastal	Including, but exclusive to: bathing, hotel resorts, scuba- diving, water sports, recreational fishing. This type of tourism is especially attractive due to 200km of coast and 300 days of sunshine per year.	нідн		
Mountain & Eco-tourism	Including, but not exclusive to: Skiing, camping, motor- cross, mountain biking.	LOW		
Archaeological Trips	Including Anjar, Baalbek, Byblos, Qadisha &Cedar Forest etc.	LOW		

# **11.2 Regularity Framework**

After Lebanese independence, the General Tourism Commission (CGT or Commissariat Général du Tourisme, de l'Estivage et de l'Hivernage) was created in 1948 to monitor tourism professions and promote Lebanese tourism abroad.

In 1959, the CGT was annexed by the Ministry of Information which became the Ministry of Information, Orientation, and Tourism. However, it was the National Tourism Council (CNT or Conseil National du Tourisme in French), a private organization, which effectively promoted tourism in Lebanon.

The growth of tourism on a global scale led to the creation of the Ministry of Tourism in 1966 (Law 21/66, issued on March 29, 1966), composed of the General Directorate of Tourism (Direction Générale des Affaires Touristiques).

Decree no. 7142 was issued on April 20, 1967, defining the specific tasks that fell under the separate responsibility of the National Tourism Council, including overseas promotion and execution of tourism projects. However, this decree was repealed by Decree no. 2829, issued on October 10, 1992, which transferred these tasks to the Ministry of Tourism.

It may be more useful to look at the coastal regularity framework, due to its lack of application tourism has grown in an uncontrolled manner: There is one law on coastal development dated June 24, 1966, though there is no legislation comprehensively covering the coast or the environment.

Legislation that may be relevant to the tourism industry is covered under the many environmentally concerned laws that can be found in the SEA Legal Register (2197-REG-ALL-001)

# 11.3 Strategy and Future Plans

Tourism Minister Fadi Abboud intends to improve the necessary infrastructure to develop the tourist industry.

There does not appear to be too much activity in this area, most of the tourists are either from wealthy Arab states who wish to have a cooler summer, or from foreign business' and interested groups/individuals.

The biggest criticism of the MoT is that it does not fulfil its environmental responsibilities when executing touristic projects. The MoT is also accountable for protection of natural sites and sceneries and application of relevant laws and regulations, this area appears to be completely neglected.

# 11.4 Impact from Development of Petroleum Activities





Potential impacts on tourism from offshore exploration would affect a limited area and be of temporary duration. Production phase would prolong the disturbance, but this would only affect offshore activities such as recreational fishing. However, the impacts from the construction of

associated developments onshore, such as pipeline construction or an LNG plant, would be of much greater significance; although, even then of a temporary nature and more a nuisance value. The 2006 attack by Israel has left Lebanon's infrastructure fragmented and in disrepair. Oil and gas activities will undoubtedly put a strain on an already struggling urban and civil infrastructure, electricity, road networks, ports, water usage, waste water and sewerage, although it is not anticipated that this will be noticed by tourists. Tourists are

also heavy users of infrastructure, for example an average tourist uses 450 litres of water per day compared to a man on a drilling rig who uses 200 litres per day.

As oil and gas activities develop so will community and stakeholder engagement. Managed correctly the oil and gas industry and the tourist industry are not incompatible. For instance: The seaside is of infinite economic value to the country, whose



economy depends on abundant tourism as a major source of revenue, and whose fishing communities depend on it for their livelihood. Preserving its cleanliness is therefore not only a public concern, but an economic one, an area in which the oil and gas industry could help promote.

At this stage it is not envisaged that the oil and gas industry will be involved in tourism, apart from liaising with hotel owners on temporary disturbance.

# 11.5 ESIA Data Requirements

In order to conduct a quality and comprehensive Social Impact Assessment for the ESIA, the social data needs to be both extensive and in-depth. The social data is typically gathered from socio-economic surveys which include mayor's questionnaire, household questionnaire and consultation with identified focus groups. The significance of tourism in the general socio-economic context will be assessed, as will the impacts on it from oil and gas activities. Due to the devastation that the 2006 war had on infrastructure, displacement, health and access routes it is imperative that all data acquired and used is post 2006.

# 11.6 Description of Existing Data

A considerable amount of the pre-existing tourist related data is rejected as it was gathered pre-2006, rendering it obsolete.

There are minimal credible surveys on the Lebanese tourism industry. The facts reviewed to date are generated by the Ministry of Tourism, Travel Agent's websites and various newspaper articles.

However, credible data that has focused on the negative impacts of tourism is available (*DA: 338*). The population density in Lebanon's coastal areas is the highest in the region and these areas are not covered by land use planning. This has resulted in urban sprawl and tourism development that encroach upon agricultural land and natural areas. Lack of legislation, weak enforcement capability and a lack of appreciation for the environment have resulted in:

- Uncontrolled urban sprawl and illegal construction in coastal areas.
- Encroachment on the maritime public domain and limited public access to vast areas.
- Pollution of coastal waters by municipal wastewater.
- Only one coastal area protected.

# 11.7 Current Tourism Industry

Lebanon is currently marketing herself as a diverse nation with ancient history which is rebuilding itself after the 2006 attacks by Israel *(DA: 302)*. Lebanon claims to offer a varied tourist package: from ancient Roman ruins, to well preserved castles, limestone caves, historic Churches and Mosques, beaches nestled in the Mediterranean Sea, traditional Lebanese cuisine, nonstop nightlife and discothèques, to mountainous ski resorts.



Significant private investment is currently being made in the modernization and expansion of this sector and international hotel

companies have returned to Lebanon. Casino du Liban, which historically constituted a major tourist destination, reopened in 1996. Lebanon prides herself on being the only country in the Arab world that offers skiing and related winter sports activities. The Government believes that, because of the return of peace and stability to the country and with the on-going development of the necessary infrastructure, tourism will again contribute significantly to Lebanon's economy. Lebanon's tourism industry also relies on the large number of Lebanese living abroad, who return regularly to the country during the summer season.

# 11.8 Missing Data

The impacts on the tourism industry will be incorporated within the social component of an ESIA, which will be focused on the gathering of baseline data related to potential impacts from oil and gas related activities. All baseline surveys are by their very nature the starting point for long term monitoring and mitigation.

Missing Data	Partially or Totally Missing	Relevance to the Project ESIA	Further Comments
Location of Tourist hot spots.	Partially	High	The archaeological, winter and in- land ecotourism niches are unlikely to be impacted by oil and gas activities. However there is not enough detail on coastal resorts, beach access and seasonal usage.
Income distribution of tourism industry intake.	Partially	High	Data is lacking in assessing how much the tourist industry is worth, and how much each area brings in comparison to each other. Eg ecotourism turnaround compared to beach front hotel income?
Assessment of a failing infrastructure.	Partially	High	Is the tourist industry affected by urban infrastructure limitations? Oil and gas activities may increase these impacts.

Data that will be required for an ESIA will include the following:

Existing surveys omitting sound methodologies.	Partially	High	Without a methodology section a scientific study is not credible.
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# 11.9 Discussion

From an extensive review of available data it is envisaged that the initial stages of the development of an oil and gas industry will not significantly impact on the tourist industry. However, onshore oil and gas development does have the potential to cause temporary nuisance and disturbance, causing further areas of contention over land use and land ownership.





# 12 Cultural Heritage

This section of the SEA will address the baseline and potential impacts on the physical remains of the human past both offshore (i.e. wrecks, man-made coastal structures, prehistoric landscapes) and on the coastal zone onshore (buried archaeological remains, standing historic buildings and historic landscapes).

# 12.1 Regularity Framework

## International Treaties and Standards

Many of Lebanon's commitments with regard to protection of the historic environment derive from its membership of UNESCO and its status as a signatory state of the World Heritage Convention (1972). This commits it, among other things, to 'ensure that effective and active measures are taken for the protection, conservation and presentation of the cultural and natural heritage situated on its territory' (Article 5). The Convention also makes the provision for the creation of World Heritage Sites, representing sites of the highest order of international significance. Lebanon has five established World Heritage sites including two in the coastal zone: the Phoenician ports of Byblos and Tyre. These are subject to strict regulation which is regularly monitored by UNESCO's implementing body, ICCROM. Development within the World Heritage site boundaries – or within their wider settings – is strictly controlled under the terms of the convention.

Lebanon has also ratified the UNESCO Convention on the Protection of Underwater Cultural Heritage, adopted in 2001. The main principles of this can be summarised as follows:

- A pledge to preserve underwater archaeology for the benefit of humanity;
- That underwater heritage should not be commercially exploited for trade or speculation;
- A presumption in favour of preserving underwater heritage in situ;

It also enumerates a number of specific measures by which these principles should be put into practice. In the context of the proposed expansion of the development of offshore oil and gas Article 5 is of particular significance:

Each State Party shall use the best practicable means at its disposal to prevent or mitigate any adverse effects that might arise from activities under its jurisdiction incidentally affecting underwater cultural heritage.

While there are no international standards adopted by the oil and gas industry that directly relate to the assessment, management or protection of the historic environment during exploration and production, some essential principles have been set out in World Bank guidance on Environmental Assessment. These include World Bank Operational Policy 4.01 relating to Environmental Assessment (2004) and Guidelines for Environmental Assessment of Energy and Industry Projects (1991). In considering potential environmental effects of gas and oil exploration, the latter document states: '...appropriate resource surveys of the areas that may be affected by the project prior to any disturbance', including 'an inventory of cultural and historic resources' (p.57, Table 10.7). Suggested mitigation strategies 'based on identified resource conflicts', include:

• Avoidance

• Recovering and archiving cultural and historic resources

#### National Law and Standards

The Lebanese Antiquities Law that underpins the protection of cultural heritage in the country is a hybrid of French antiquities law dating back to 1933. Also relevant is Law 444/2002: Protection of the Environment.

The body responsible for the management and protection of cultural heritage in Lebanon is the Directorate General of Antiquities (the DGA) which is part of the Ministry of Culture. The DGA is split into three further directorates as follows:



- Directorate of Archaeological Monuments and Built Heritage responsible for the overall management and listing of sites and buildings of archaeological and historic value, including sites in territorial waters;
- **Directorate of Archaeological Excavations** responsible for the management and regulation of archaeological fieldwork, including salvage archaeology carried out in the context of new development;
- **Directorate of Movable Archaeological Property** responsible for museums and the management and protection of portable heritage.

At present the post of Director General of the DGA is empty and decisions relating to cultural heritage are therefore the direct responsibility of the Minister of Culture advised by a council of specialists.

The DGA have also established a Maritime Archaeology department based at Tyre.

# 12.2 Strategy and Future Plans

A number of measures relating to the protection of cultural heritage within Lebanese waters are currently pending. These include:

- Measures, under the terms of the 2002 Law for Environmental Protection, establishing the principles of EIA according to World Bank guidelines;
- A law relating to the implementation of Integrated Coastal Zone Management presently under consideration under an EU funded programme which includes detailed measures for the management and protection of cultural heritage

#### Impact from Development of Petroleum Activities

The main anticipated impacts of oil and gas operations in the future can be summarised as follows:

- Impact of exploration activities (e.g. test drilling) on sites of historic value (e.g. wrecks, aircraft crash sites, prehistoric landscapes) on the seabed;
- Impact of the development of offshore production infrastructure (e.g. drill platforms, pipelines) on underwater sites of heritage significance;
- Impacts of development of onshore production infrastructure (oil refineries; oil and gas terminals; pipelines) on coastal and terrestrial sites of heritage significance (harbour facilities, buried archaeological remains, standing historic buildings, World Heritage Sites – i.e. Tyre and Byblos)

#### **ESIA Data Requirements**

Key areas of data acquisition recommended in order to enable an appropriate level of assessment of future oil and gas exploration in Lebanese territorial waters is as follows:

- A list of all formally protected heritage sites within the study area;
- A digital inventory of known underwater sites of historic/archaeological importance within Lebanese territorial waters;
- A digital inventory of known sites of cultural heritage significance along the Lebanese coastline;
- A risk map of Lebanese territorial waters and the Lebanese coast showing areas of archaeological/historical sensitivity.

# 12.3 Description of Actual Data

There is currently no publicly available inventory of marine or terrestrial sites of heritage significance in Lebanon. It is understood that the DGA has initiated the compilation of such an inventory of terrestrial sites, but the extent to which this project has progressed is unknown. It is clear, nevertheless, that the DGA does hold extensive archives regarding the location, extent and condition of sites and buildings of heritage importance across Lebanon.

With regard to the World Heritage Sites of Byblos and Tyre there is likely to be extensive documentation regarding the precise extent, nature and condition of the protected areas held by the DGA and its associated institutions.

Official sources of data apart, there are extensive sources of published information relating directly or indirectly to historic and archaeological sites. These include:

- Academic books and journals
- Non-academic guidebooks
- Historic maps
- Remote sensing datasets (e.g. bathymetric/geophysical surveys of areas of the seabed undertaken for a variety of research and commercial purposes and held by a range of private and public institutions; satellite imagery; aerial photography (historic aerial photographs being a particularly important source);
- Individual researchers

# 12.4 Missing Data

The scattered nature of the data sources described above sources means that they require collation, analysis and digitisation (using GIS) in order to be suitable for use in the ESIA report. The available information is also very patchy, being the result of multiple isolated interventions, rather than a systematic programme of national data collection or survey. As a result there will inevitably be many lacuna in the data, in particular in the offshore zone. Underwater sites of heritage significance by their nature are hidden. As there has been only limited work on the underwater resource – much of it focussed around the key Phoenician ports of Byblos and Tyre – there are clearly large numbers of ancient wrecks and other sites of historic value that remain unidentified. Within the coastal zone, to a depth of c.30m (i.e. the limit of standard recreational scuba diving),
most if not all wreck sites on the sea floor have suffered from widespread and comprehensive looting over the past 40 years, which mean that much information will have been irretrievably lost. In deeper waters, the use of maritime geophysics - if carried out to appropriate specifications - has to potential to identify large numbers of undisturbed ancient wrecks.

Information from the coastal zone is also incomplete, being concentrated on historically attested sites from the Phoenician and Graeco-Roman periods. In reality it is unlikely that any significant stretch of the Lebanese coast is without extensive traces of past human activity, given the importance of this area at all periods of human development. Absence of information cannot, therefore, be equated with the absence of heritage assets. In many ways the key factor in the modern context is the degree to which development of the coastline over the past 50 years has destroyed any such remains. In this context it should be remembered that archaeological remains can often survive in relatively high states of preservation beneath modern buildings, particularly where they use piled foundations and ground level concrete slabs.

# 12.5 Discussion



The Lebanese coast and territorial waters has exceptionally high potential for the preservation of remains of historic and archaeological importance. This is the result of Lebanon's position as a crossroads of cultures at the eastern end of the Mediterranean, with exceptionally and internationally renowned remains of Bronze Age, Assyrian, Phoenician, Greek, Roman and medieval Christian and Islamic cultures. Along the coastline this is exemplified by the Phoenician cities of

Byblos and Tyre, both of which are World Heritage Sites, seminal in the development of Mediterranean culture. The offshore resource is less well-known although work in recent decades has discovered important underwater remains relating to the ancient harbours of Byblos, Tyre and Berytus (ancient Beirut).

Legal protection for the cultural heritage in this area is provided firstly through international conventions including the UNESCO World Heritage Convention and, of particular importance for coastal and offshore resources, the Convention on the Protection of Underwater Cultural Heritage. The key institution for the protection of Lebanon's cultural heritage is the DGA which falls within the Ministry of Culture.

Problems with an outdated legal structure, a lack of institutional resources and trained specialists and weak and contradictory planning controls has led to widespread uncontrolled development along the coastline which has caused extensive damage to many sites of historic and archaeological importance. Equally it has resulted in a lack of protection for underwater sites leading to widespread looting, particularly of wreck sites in shallow water.

In the absence of a systematic inventory of terrestrial and maritime sites of historic/archaeological significance, a baseline survey of cultural heritage will require that the extensive known published and unpublished sources of information are brought together into a single GIS database. This should form the basis for a risk map, identifying:

- areas and sites of the highest level of significance where development should be avoided if at all possible;
- areas of medium sensitivity where archaeological surveys should be carried out in advance of any development in order to provide guidance for detailed proposals;
- areas of low sensitivity (e.g. areas previously subject to significant development or areas where historic/archaeological sites have been proven to be absent) where development can proceed without any further measures.

Given the relatively weak state of Lebanese institutions responsible for protecting cultural heritage, the ESIA and the development of offshore oil and gas fields represents an opportunity, in collaboration with the DGA and other relevant incountry organisations, to strengthen and support the administrative infrastructure in this area. As well as providing opportunities for international energy



companies to contribute to the preservation of this resource, there is also potential to attract additional funding from external bodies whose aim is to the preservation and better understanding of the underwater and coastal resources of the region (for example the Honor Frost Charitable Trust). Two key areas where the ESIA could contribute would be:

- An archaeological component to the proposed bathymetric/geophysical mapping of the seabed, with the potential of identifying hundreds of previously unknown underwater sites.
- The development of onshore and offshore GIS cultural heritage inventories, which would have the potential for form the basis for a Lebanese digital national monuments record.







# 13 Anthropogenic Impacts

# 13.1 Topic

This section considers the data available on anthropogenic environmental impacts in Lebanon. The primary focus of this chapter is to consider non routine impacts (such as hydrocarbon spills, chemical spills, fire and unexploded ordnance) but other anthropogenic impacts not covered elsewhere in the Gap Analysis will also be considered here.

# **13.2 Regularity Framework**

Given the nature of unplanned anthropogenic events, they can derive from a number of sources and as such different laws / regulations / decrees will apply depending on the circumstances.

The protection of the environment against pollution from hazardous wastes and hazardous materials (1998) sets the basis for licensing of facilities specialised in the disposal of hazardous waste, and gives the MoE the authority for licensing and monitoring of the facilities. This is particularly applicable as the cleanup of many types of anthropogenic impact will result in the production of hazardous waste.

Environmental Protection Law 444 (2002) addresses aspects of anthropogenic impacts within various sections:

- Article 44: Provides the control of the import, production, extraction, handling, and disposal of chemicals that might threaten health, safety and general environment through primary licensing and continuous monitoring, notably in emergency cases.
- Supports the Polluter Pays principle
- Stipulates the necessity to set standards for the movement of hazardous material
- Forbids all discharges, immersions or burning in the Lebanese territorial waters of every material that may directly or indirectly harm human health or the activities of marine creatures

Legal provisions relating to noise pollution could be strengthened through the Environmental Protection Law No.444 that ensures the environmental protection of all types of pollution. The law does include a set of standards and conditions particularly related to noise as well as several incentives to mitigate noise pollution. However, the effectiveness of this law depends on the ratification and implementation of supplementing decrees.

Emergency and Incident response (such as response to a fire) falls largely under the provision of the General Civil Defence Directorate and is conducted in line with the following legislation:

- Law No. 50 of 5 August 1967;
- Law No. 7563 of 8 September 1961;

• Law No. 4082 of 14 October 2000

The Ministry of Interior and Municipalities is responsible for General Civil Defence Directorate. The Directorate undertakes operations in an automatic and decentralized way but in coordination with other divisions within related divisions.

The General Civil Defence Directorate has four administrations. These administrations are:

- Operations and services administration;
- Administrative relations and preparations administration;
- Training administration;
- Technical matters administration.

Lebanon is also a full or partial signatory to the following international conventions:

- International Convention on Civil Liability for Oil Pollution Damage (Brussels)
- International Convention relating to Intervention on the High Seas in cases of Oil Pollution Casualties (Brussels)
- International Convention for the Prevention of pollution from Ships- London (MARPOL 73/78) (1993)
- Convention for the Protection of the Mediterranean Sea Against pollution (Barcelona)
- Protocol Concerning Co-operation in Combating Pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency (Barcelona)

For further laws and conventions see Volume 6: Registers.

# 13.3 Future Plans

Several areas have been identified (in particular by the United Nations Development Program (UNDP) following the 2006 conflict) where steps should be taken to remedy existing impacts and reduce the likelihood of impacts resulting from future accidental anthropogenic events (*DA: 66*);

- The introduction of law relating to Integrated Solid Waste Management (ISWM). This law has been drafted but not implemented;
- A remedial investigation and feasibility study (in particular covering the Baalbeck area) due to damaged petrol stations and industrial facilities (current status unknown);
- Soil monitoring in vulnerable areas to ensure pollutant levels are within acceptable levels;
- The cleanup operation following the 2006 oil spill to be supported by a comprehensive ongoing monitoring program aimed at conducting a full marine biodiversity assessment which would become the backbone of a long term monitoring strategy for the Lebanese coastal zone ;

- Interventions at forest areas damaged with fire and by other sources to be implemented (including enhanced assessment and monitoring of the ecosystems);
- Remaining unexploded ordnance to be cleared at an accelerated rate to avoid further environmental and socio-economic impacts;



- Key recommendations made to improve environmental legislation related to accidental anthropogenic impacts include;
- Adoption of the National Implementation Plan for Persistent Organic Pollutants (prepared by MoE);
- Development of the necessary regulatory framework related to environmental response in emergency situations.

The following recommendations were made with specific regard to oil spill response in a report to the IUCN (Lebanon Oil Spill Rapid Assessment and Response Mission final report) following the oil spill from the Jiyeh plants fuel storage tanks in 2006 (*DA: 150*);

- Develop and approve a robust National Contingency Plan for Lebanon;
- Develop an in-region oil spill response capability, with a response base, trained personnel and equipment in Lebanon;
- Conduct a Risk Assessment for future spills in eastern Mediterranean;
- Implement a Phase II NRDA programme, with a public symposium to present scientific results of the NRDA programme, and to conduct a scoping process for Restoration;
- Lebanon to sign and ratify the tier-two and tier-three international spill compensation protocols – the International Oil Pollution Compensation (IOPC) Fund, and the Supplementary Fund, bringing spill liability coverage up to about \$1.1 billion (USD);
- Continue a comprehensive marine environmental monitoring programme / strategic environmental assessment (SEA) for the eastern Mediterranean;
- Establishment of a Lebanon National Oil Spill Fund (based on a nominal tax on imported petroleum products) to be used to support all government activities

with regard to spill prevention and response preparedness, etc. In the future. Many other nations have such funds, and it would greatly ease the financial burden of reprogramming funds in emergency response situations in the future.

- Survey other coastal states globally to ascertain which still do not have a National Contingency Plan, which may be vulnerable to oil pollution disasters, and then assist those coastal states in the formulation of a NCP as soon as possible.
- Consider amendments to the international pollution compensation regime that would allow the three-tiered funds to be available to cover wartime related spills or otherwise establish a \$100 million USD fund to be made available on an emergency basis for other wartime related spills. As well, the international compensation regimes must be amended to cover all environmental injury in spills, not simply those limited injuries that may be amenable to direct Restoration initiatives as is currently the case.

# 13.4 Impact from Development of Petroleum Activities

The development of oil and gas production activities in Lebanon (including seismic acquisition, exploration drilling, and production and pipeline installation - discussed in detail in Section 1) could potentially have a significant effect in Lebanon by increasing the potential for accidental anthropogenic impacts. These potential impacts arise from several different aspects of the development (the source and probability of an incident do vary) and are mostly classified as loss of containment events. These aspects are outlined below.

### Seismic Data Acquisition

*Unexploded ordnance* – Seismic survey vessels will be predominantly located offshore with occasional port calls. They do not carry or require explosive ordnance to function and as such will not have an impact in this manner.

*Hydrocarbon spill* – Whilst Seismic survey vessels have no contact with reservoir hydrocarbons, they do carry fuel (diesel) and as such the potential for a hydrocarbon spill exists.

*Chemical spill* – Seismic survey vessels will carry a quantity of chemicals that pose a risk to the environment. These chemicals are required for the day to day running of a marine vessel and are not related to the task of conducting a seismic survey. The presence of these chemicals dictates that the potential for a chemical spill into the environment exists.

*Unplanned Fire* – Seismic survey vessels will carry a volume of combustible materials (the most obvious and significant of which being diesel fuel). The vessel will also have numerous sources of ignition on board, creating the circumstances for an unplanned fire to occur. A worst case outcome from such an incident would be the loss of the vessel and crew.

*Noise* – The impact of noise generated during a seismic survey is dependent on the strength of the sound source as well as the sound transmission conditions of the receiving environment.

Sources of noise related to activities of a seismic survey vessel are predominantly linked to the firing of air guns, the running of its diesel engines and its DPS thrusters (if equipped).

*Light* – Ship lighting will create (or add to background levels) light pollution in the waters of Lebanon. The location of the site will determine the extent of the impact against background light levels. Light can interfere with marine turtles nesting on the coast.

#### **Petroleum Exploration and Production**

*Unexploded ordnance* – Explosive ordnance is used in exploration and production operations. It is predominantly used to penetrate potential hydrocarbon reservoirs. The explosive material will be stored and used offshore, however land based transportation may be and storage may be required. The use of explosives in the oil and gas industry worldwide is commonplace and well understood, with industry best practice being widely followed. However, the presence of the explosive material dictates an increase in the possibility of unexploded ordnance.

Hydrocarbon spill – The purpose of hydrocarbon exploration is to discover new hydrocarbon reserves. The purpose of hydrocarbon production is to bring these reserves to the marketplace in a commercially viable and safe manner. The act of extracting hydrocarbons (in particular oil) from a



reservoir increases the potential for a hydrocarbon spill or blowout event to occur (a spill being a loss of contained fluids as opposed to a blowout which is uncontrolled flow from a well under pressure). There is a global wealth of knowledge relating to hydrocarbon spills and the adoption of best practice to reduce the risk of occurrence to as low as reasonably practicable. It is also worth noting that the production of gas reserves carries significantly lower environmental risk than the production of oil reserves.

*Chemical spill* – Offshore exploration and production facilities will carry a quantity of chemicals that pose a risk to the environment. These chemicals are required for the day to day running of an offshore facility and some are also used as part of exploration and production processes. The presence of these chemicals dictates that the potential for a chemical spill into the environment exists.

*Unplanned Fire* – Offshore exploration and production facilities will carry a volume of combustible materials (examples being fuel and potential reservoir hydrocarbons). These

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facilities will also have numerous sources of ignition on board. As such there is the potential for an unplanned fire to occur.

*Invasive Species* – Invasive alien species are non-native species which have been introduced by human activities and which now propagate and spread independently in a country and its waters. Such species often invade and replace indigenous flora and fauna, thus causing a loss of biodiversity. It is recognised that vessels / installations being brought into new waters on oil and gas business provide a potential pathway for alien invasive species. At present, the Invasive Alien Species issue in Lebanon is not of high priority, probably because their posed threat is temporarily hidden, at least in the sea, by the lack of relevant studies and assessments (*DA: 252*).

*Noise* – The impact of noise generated during a drilling campaign is dependent on the strength of the sound source as well as the sound transmission conditions of the receiving environment.

Sources of noise related to activities of the semi-submersible rig/drill ship include pumps, non-propulsion engines, generators, ventilators and other onboard machinery. Sound and vibration paths on semi-submersible ships are mainly through air or through the risers, in contrast to the direct paths through the hull of a drill ship. In addition to the emissions from machinery onboard vessels, noise could also be produced by thrusters to maintain its position.

Noise will also be produced by supply vessels and helicopters which will visit the rig on rotation.

*Light* – Installation lighting will create (or add to background levels) light pollution in the waters of Lebanon. The location of the site will determine the extent of the impact against background light levels. Light can interfere with marine turtles nesting on the coast.

### **Onshore Support Facilities**

*Unexploded ordnance* – Explosive ordnance is used in exploration and production operations. It is predominantly used to penetrate potential hydrocarbon reservoirs. The explosive material may be stored onshore for a time and on land transportation may also be required. The use of explosives in the oil and gas industry worldwide is commonplace and well understood, with industry best practice being widely followed. However, the presence of the explosive material dictates an increase in the possibility of unexploded ordnance.

*Hydrocarbon spill* – It is probable that hydrocarbons produced offshore will be transported onshore (either by tanker or pipeline) for use, refinement storage and / or onward transportation. These activities by their nature increase the possibility of a hydrocarbon spill occurring. There is a global wealth of knowledge relating to hydrocarbon spills and the adoption of best practice to reduce the risk of occurrence to as low as reasonably practicable. It is also worth noting that the production and storage of gas reserves carries significantly lower environmental risk that the production of oil reserves.

*Chemical spill* – Onshore oil and gas facilities house a variety of potentially harmful chemicals. These chemicals are required for the day to day running of the facility and may also include stored chemicals for offshore use as part of exploration and production processes. The presence of these chemicals dictates that the potential for a chemical spill into the environment exists.

*Unplanned Fire* – Onshore oil and gas facilities may house a volume of combustible materials (examples being fuel and certain process chemicals). These facilities will also have numerous sources of ignition on board. As such there is the potential for an unplanned fire to occur.

# **13.5 Possible Future Development**

Lebanon's extensive offshore territory and the deficiency of environmental data - especially for the deep offshore areas - is reminiscent of the situation in the North Sea in the 1960's at the start of oil and gas exploration there. A lesson learnt from that situation is that it takes time to acquire and collate data, and this data gathering phase happens piecemeal rather than in a single, huge exercise.

In recognition of this experience it is suggested that Lebanon could envisage a series of location specific Baseline Surveys being carried out as part the Environmental and Social Impact Assessments (ESIAs) performed by the operators who acquire the License Block rights. Operators will expect to carry out comprehensive ESIAs as a condition of contract and a legal requirement in Lebanon. In these circumstances Baseline Surveys are an insurance necessity to guard against future liabilities. This baseline data is also likely to include contaminated land assessment and fingerprinting of any hydrocarbons already present in the environment. This will facilitate matters of liability at the time of abandonment or following a spill / blowout incident.

To maximise the value of the surveys Lebanon would need to closely manage the ESIA process carried out by the operators. To maximise the benefits and compensation that might accrue due to operator proposed mitigation measures, Lebanon needs to be fully cognisant of best interests and development requirements in the varying sectors. This may include research funding for further survey and monitoring, equipment or a variety of investment programmes.

# 13.6 ESIA Data Requirements

A comprehensive ESIA related to oil and gas activities would require good data relating to the following areas when considering its impact on existing emergency response procedures and facilities and potential to generate an incident exceeding the scope of these facilities:

### Unexploded ordnance

Accurate and current data will be required to establish:

• The capability for responding to the increased likelihood of an incident derived from the addition of an oil and gas industry;

- Comprehensive and reliable data relating to any known unexploded ordnance within Lebanon that may impact on oil and gas operations;
- Existing facilities and procedures for the responsible handling and disposal of explosive material;
- The logistics in place to transport explosive material if in country disposal is not viable.
- Measures to be taken to ensure the safety of all members of the workforce.

### Oil spills

Accurate and current data will be required to establish:

- The capability for responding to the increased likelihood of an incident derived from the addition of an oil and gas industry;
- Comprehensive and reliable data relating to the current environmental baseline – in particular the marine and coastal environments;



- The facilities in place to handle the hazardous waste potentially generated by an oil spill incident;
- The logistics in place to transport hazardous (oiled) waste if in country treatment is not viable.
- The baseline environment regarding hydrocarbons for liability purposes.

### **Chemical spills**

Accurate and current data will be required to establish:

- The capability for responding to the increased likelihood of an incident derived from the addition of an oil and gas industry;
- Comprehensive and reliable data relating to the current environmental baseline – in particular the marine and coastal environments;
- The facilities in place to handle the hazardous waste potentially generated by a chemical spill incident;
- The logistics in place to transport hazardous (contaminated) waste if in country treatment is not viable.

### Unplanned fire

Accurate and current data will be required to establish:

• The capability for responding to the increased likelihood of an incident derived from the addition of an oil and gas industry, both onshore and offshore;

• The likelihood and pathways by which such a fire could impact the local community / infrastructure.

# 13.7 Description of Existing Data

### Unexploded ordnance

A global land mine survey was conducted by the UNDP in Lebanon in 2003 (*DA: 71*). This survey was comprehensive (estimated to have included data from 96.9% of the affected communities), providing good information on which areas were affected by unexploded ordnance contamination and to what extent. The distribution of the contamination from unexploded ordnance was well understood.

However, the conflict in 2006 resulted in a further influx of explosive materials to Lebanon. In 2006 the UNDP conducted a rapid environmental assessment for greening recovery, reconstruction and reform (*DA: 66*). This report states that over one million cluster bombs are reported to have been dropped over Lebanon during the conflict, leading to a considerable quantity of unexploded ordnance. The locations of these unexploded ordnances are largely unknown.

The data from the 2003 global land mine survey is still valid, but no longer represents a comprehensive summary of unexploded ordnance in Lebanon.

### Oil spills

The history of oil spills goes back as far as the oil industry itself. Lessons have been learned and shared globally each time a spill has occurred. As such there is a wealth of knowledge available on how to respond to and manage an oil spill, especially from an environmental perspective. Global expertise are available on matters such as response planning, oil spill computer modelling, spill monitoring and assessment, environmental cleanup, oiled waste disposal, wildlife rescue and spill containment. Companies have also been put in place by the oil and gas industry for the specific purpose of providing response capabilities in the event of a spill (if contracted to do so). Oil Spill Response Limited (OSRL) is an example of one such company.

Following the spill from the Jiyeh power plants fuel tanks in 2006, much is known about Lebanon's existing oil spill response planning and capabilities through the national response to this incident. The response is documented in the IUCN Lebanon Oil Spill Rapid Assessment and Response Mission (2006) final report (*DA: 150*).

Following the 2006 Jiyeh spill there has been a significant amount of assessment and monitoring of the Lebanese onshore coastal zone. The UNDP Oil Spill Shoreline Survey from Tyre until the Northern Border of Lebanon (2009) Provides good information on the coastal (shore based) environmental baseline after the Jiyeh spill (*DA: 402*). This spill was so comprehensive in its coverage of the Lebanese coastal zone (about 150km of a 220km coastline) that it effectively made nearly all relevant baseline data prior to this event obsolete.

#### **Chemical spills**

All industrial chemicals produced today should have a Material Safety Data Sheet (MSDS) (also known as PSDS, Product Safety Data Sheet) relating to the chemical. This is an important component of product stewardship and workplace safety. It is intended to provide workers and emergency personnel with procedures for handling or working with that substance in a safe manner, and includes information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures. MSDS formats can vary from source to source within a country depending on national requirements.

MSDS information may include instructions for the safe use and potential hazards associated with a particular material or product. There is also a duty to properly label substances on the basis of physico-chemical, health and/or environmental risk. In some jurisdictions the MSDS is required to state the chemical's risks, safety, and effect on the environment.

This information should be freely available for any industrial chemical being used and should provide sufficient information to ensure a suitable response strategy can be put in place at a facility level.

Environmental Law 444 covers chemical spills with regard to the marine and coastal environment.

#### **Unplanned fire**

Fire is deemed to pose a minimal threat to the offshore environment. Likely environmental receptors in the vicinity of any onshore oil and gas facilities are also considered to be of low significance. As such the existing levels of data regarding current fire response facilities are considered to be sufficient.



#### **Incident Response**

Emergency and Incident response (such as response to fires) falls largely under the provision of the General Civil Defence Directorate. These Responsibilities are focused on activities that take place in peaceful times in order to achieve the following goals:

- To undertake necessary security measures on the national level;
- To be well prepared and get better equipment;
- To interfere to ensure the security of population on all Lebanese territories.

The exact capabilities and resources available for emergency response under the General Civil Defence Directorate are unknown, but are widely believed to be insufficient.

## 13.8 Missing Data

#### Unexploded ordnance

As previously stated, the conflict in 2006 resulted in a further influx of explosive materials into Lebanon. In 2006 the UNDP conducted a rapid environmental assessment for greening recovery, reconstruction and reform. This report states that over one million cluster bombs are reported to have been dropped over Lebanon during the conflict, leading to a large quantity of unexploded ordnance. The location of this unexploded ordnance is largely unknown.

### Oil spills

At this time, there is not an approved National Oil Spill Contingency Plan for Lebanon in place. There is also little or no data relating to in-region oil spill response capabilities, response bases, trained personnel or equipment.

To date Lebanon has not signed or ratified the tier-two and tier-three international spill compensation protocols – the International Oil Pollution Compensation (IOPC) Fund, and the Supplementary Fund. Lebanon would also benefit from a National Oil Spill Fund to be used to support all government activities with regard to spill prevention and response preparedness, etc. Such a fund would greatly ease the financial burden of reallocating funds in emergency response situations in the future. See volume 2 for the National Contingency Plan (NCP) for Lebanon.

A comprehensive marine environmental monitoring programme has not yet been put in place. As such there is very little in the way of baseline data for benthic flora and fauna and other marine life.

### **Chemical spills**

It is to be expected that any reputable company operating within the oil and gas industry will have a comprehensive understanding both of the chemicals they will be handling and industry best practices. These will be detailed in the companies Chemical Management Plan (CMP). Chemical usage and impact will also be considered as part of the ESIA process prior to in country operations. As such they would make sufficient provision in terms of planning, equipment and competency for any chemical spill they are likely to generate.

#### **Unplanned fire**

Fire is deemed to pose a minimal threat to the offshore environment. Likely environmental receptors in the vicinity of any onshore oil and gas facilities are also considered to be of low significance. As such the existing levels of data regarding current fire response facilities are considered to be sufficient.

# 13.9 Discussion

In Lebanon, intervention following an accidental loss of containment is limited to relief efforts after an incident has taken place. Very little if any preventative measures are in place to stop the incident from occurring and/or to militate against its consequences in a

controlled methodical manner. This absence results in more significant damages resulting from the incident.

The present lack of baseline environmental data could potentially create complications establishing liability in the event of cumulative impacts. For example, the oil spill of 2006 will mask any future oil spills unless a baseline is established and the oil from the spill fingerprinted.

It is of great importance for Lebanon to develop a disaster risk management and disaster risk reduction strategy sufficient to its needs.

It is recognised that the introduction of an oil and gas industry to Lebanon will increase the potential of an oil spill incident occurring. Lebanon has had firsthand experience of the effects of a large oil spill as recently as 2006. The Government of Lebanon at present has no National Oil Spill Contingency Plan. This situation meant that Lebanon was almost entirely unprepared for the 2006 oil spill and resulting cleanup operation. The government lacked an effective emergency response organisational structure, finances, equipment, and personnel to mount an effective spill response. The cleanup from a large oil spill also generates considerable volumes of hazardous waste (including the cleaning materials once used). Lebanon currently has no facilities for disposing of hazardous waste with all such waste being transported out of the country under the Basel Convention.

The National Contingency Plan will be a crucial document as far as any prospective oil and gas companies are concerned. Such companies will expect to work in line with industry best practice and will be keen to support government initiative and policy in this matter. A draft National Contingency Plan is presented in Volume 2.

As a result of numerous conflicts, the Lebanese landscape has been contaminated with unexploded ordnance at various times in recent history. The situation was well understood following a comprehensive survey in 2003, however the conflict in 2006 resulted in a new influx of unexploded ordnance and the extent and locations of areas affected by this contamination are not known. It has been noted that unexploded ordnance rarely affects roads, housing and other major types of infrastructure. This will effectively reduce the level of exposure on a prospective oil and gas industry (with the exception of onshore pipe-laying).

Lebanon has not yet signed or ratified the Convention on the Prohibition of the Use, Stockpiling, Production, and Transfer of Anti-Personnel Mines and on their Destruction. This being said, Lebanon does publicly support its underlying principles and implements all relevant international standards and protocols.

Fire has been discussed in this section in the interests of completeness, as the presence of an oil and gas industry will increase the statistical likelihood of an accidental fire occurring. However, given the physical locations likely to be occupied by any oil and gas related infrastructure/equipment and the surrounding environmental receptors, it is deemed unlikely that they will represent any significant environmental impact other than a short term spike in atmospheric pollution levels. They do of course, pose a safety hazard for people.