SEMIDE
EMWIS

Euro-Mediterranean Information System on Know How in the Water Sector

Technical and financial feasibility studies of the National Water Information Systems in 12 Mediterranean Countries

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Prepared By

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Advanced Computer Services

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ACRONYMS & ABBREVIATIONS

Acronym/abbreviation	Meaning
ABH	*Agences de Bassins Hydrauliques*(Hydraulic Basins Agency)
ADE	*Algérienne des eaux, partenaire de la Lyonnaise des Eaux*/ Algiers Water Undertaking
ANBT	*Agence Nationale des Barrages et Transfert* / National Dam & Water Transfer Agency
ANRH	*Agence Nationale des Ressources Hydrauliques* /National Water Resources Agency
CD	Compact Disc
CDR	Council for Development and Reconstruction
CNRS	National Council for Scientific Research
DHW	*Directions de l'Hydraulique des Wilayas* / Water Resources Governorate
DMS	Document Management System
DoA	Department of Agriculture
DoE	Directorate of Exploitation
DoEH	Department of Environmental Health
DoHER	Directorate of Hydraulic & Electric Resources
DoS	Department of Statistics
DRH	*Directions régionales de l'Hydraulique (*Hydraulic Regional Directorates)
EC WFD	European commission Water Framework Directive
EEBML	Beirut and Mount Lebanon Water Establishment
EELN	North Lebanon Water Establishment
EMARCU	Environmental Monitoring and Research Central Unit
EMWIS	Euro-Mediterranean Information System on Know-how in the Water Sector
ENVIS	Environmental Information System
ES	Environmental Service
EU	European Union
FAS	Financial Accounting System(USAID funded project in Lebanon)
GIS	Geographic Information System
GSD	Geological Survey Department
GSI	Geological Survey of Israel
GTZ	Gesellschaft für Technische Zusammenarbeit
GW	Groundwater
HCEFLCD	*Haut Commissariat aux Eaux et Forêts et à la Lutte Contre la Désertification*(High commission of water, forests and desertification)
HD	Health Department
HR	Human Resources
HTML	HyperText Markup Language
ICT	Information and Communication Technology
IPP	Investment Planning Program (EC funded project in Lebanon)
ISP	Internet Service Provider
MADRPM	*Ministère de l'Agriculture, du Développement Rural et des Pêches Maritimes*(Ministry of agriculture, rural development and fishery)
MEPA	Malta Environment and Planning Authority

MEW	Ministry of Energy & Water
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MoP	Ministry of Planning
MRA	Malta Resources Authority
MRE	*Ministère des Ressources en Eau*/Ministry of Water Resources
MWI	Ministry of Water and Irrigation
NFP	National Focal Point
NITC	National Information Technology Center
NSO	National Statistics Office
NWIS	National Water Information System
ONA	*Office Nationale de l'Assainissement*/ Sanitation National Agency
ONE	*Office National de l'Electricité (Electricity Undertaking)*
ONID	*Office National de l'irrigation et drainage*/ National Agency for Irrigation and Drainage
ONL	Litani River Authority (Establishment)
ONM	*National Meteorological Agency (Ministry of transportation)*/ Office National de la Météo (Ministère des Transports)
ONPE	*Office National de l'Eau Potable*(National office for potable water)
PCBS	Palestinian Central Bureau of Statistics
PHG	Palestinian Hydrology Group
PWA	Palestinian Water Authority
SCADA	System Control and Data Acquisition
SEE	*Secrétariat d'Etat chargé de l'Eau, point Focal National du SEMIDE* (Water commission)
SEMIDE	*Système euro-méditerranéen d'information sur les savoir-faire dans le domaine de l'eau*
SGL	State General Lab
SH	Stake Holder
SIG	*Système d'Information Géographique* / Geographical Information System (GIS)
SINEAU	Système d'Information National des Ressources en EAU
SLWE	South Lebanon Water Establishment
SOP	Standard Operating Procedures
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TOR	Terms Of Reference
USAID	United States Agency of International Development
WAJ	Water Authority of Jordan
WBN	Water Board of Nicosia
WC	Water Commission
WDD	Water Development Department
WIS	Water Information System
WSC	Water Services Corporation
WSWD	West Bank Water District
XML	eXtensible Markup Language

1. EXECUTIVE SUMMARY

In April of 2005, EMWIS awarded **EasyInfo**; "a Jordanian Consulting Company"; a contract to conduct a study to assess the current National Water Information System (NWIS) situation in 12 Mediterranean countries and recommend actions for enhancement. These countries are: Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Syria, Tunisia, Turkey and Palestine. The study commenced on 1/4/2005 and ended on 30/1/2006.

The main objectives of the study can be summarized as follows:-
- Conduct analyses of the water information systems (used or planned) in each country included in the study and assess national needs and requirements, including:
  - Identification of information providers and necessary collaborations.
  - Knowledge of end-users.
  - Organization of the EMWIS National Focal Point (NFP) and its information system as part of the NWIS.
- Defining a set of technical, financial and organizational recommendations and setting a roadmap towards the improvement or the implementation and operation of a NWIS.
- Compile all findings and recommend to EMWIS steps to enhance, smooth and harmonize data sharing between the NWIS and EMWIS.

A NWIS can be defined as a system that stores and processes information shared between the main national water stakeholders in a country. A NWIS is usually a computerized system and is considered as one of the main instruments of the national water policy. It includes institutional and legal information (agreements between stakeholders, ownership, copyright, legal data exchange, etc.), standardization and organizational information (formats, exchange and management procedures, etc.) and information technologies (hardware, software, network, security). Depending on the main purpose of establishing NWIS (defined by stakeholders in the country), the type of information managed could include quantitative information, maps, best practices, directories, water legislation information, and grey literature.

It is anticipated that improvement of NWIS systems in the countries:
- would improve and harmonize information exchange and sharing within the participating countries, thus allowing better water management at the national level and with their neighborhood countries
- will have a direct impact on the quality, availability and flow of information from the participating countries' NWIS to the EMWIS international system via their NFP.

The study was conducted for the following 10 Mediterranean countries who gave their approval to the EMWIS Technical Unit: Algeria, Cyprus, Israel, Jordan, Lebanon, Malta, Morocco, Tunisia, Turkey and Palestine. The EMWIS TU approached Egypt and Syria to include them under this study but both countries did not reply.

For each country visited the consultant prepared a country report which analyzed the current situation of NWIS in that country. Chapter four of this report summarizes the findings per country. Although this report was written as a stand alone document, the need to read every report is still important to understand all the details and get hold of the over all picture.

Synthesis of information gathered revealed that amongst all types of information assessed, the most frequently found literature in all countries under investigation is the quantitative, maps and grey literature.

Different countries use different systems to warehouse water data and information; some are manual while others are computerized. Most of the countries are also using Geographical Information Systems (GIS). Usage of computerized systems in some countries is simple and does not utilize all system features especially with GIS systems that are mainly used for producing maps.

In some countries, the main stakeholder of water information is managing a Water Information System (WIS). A WIS is an information system used by a group of actors that stores and processes water information using information technologies. In the context of this study, WIS identified were only accessed and used by one stakeholder to warehouse quantitative water data and information. Water Information Systems vary in the level of development in the countries visited. Some are simple spread sheets (e.g. MS-Excel) facilitating data entry and retrieval while others are fully developed web based database systems with GIS interface. All countries are using relational databases (either MS-Access or Oracle) and ESRI Arcview and ArcInfo products for their GIS systems. Countries were classified under five different levels with regards to WIS development:

- Advanced level (Algeria and Tunisia)
- High level (Cyprus and Morocco)
- Medium level (Jordan and Israel)
- Development level (Turkey and Malta)
- Pre-development level (Palestine and Lebanon)

While many of the countries visited had a WIS, Algeria is the only country that is developing a National Water Information System but has not yet institutionalized the system. Tunisia has started a project for the development of a NWIS; a feasibility study has been conducted and a detailed design phase for the targeted system should have started in August and finished by December 2005. Apart from Algeria and Tunisia, none of the other countries visited are developing a NWIS but, at the technical level, they are all convinced of the need of such system. Some countries, however, have started initiatives or developed systems that can serve as core components for developing a NWIS like Morocco and Cyprus. Others have systems that can be utilized as back end servers for a NWIS like Jordan and Israel. In Turkey, a new project for developing an internal WIS for the main provider of water information has been initiated. In Malta, the mandated agency for providing water information lacks a WIS for its internal use although the other stakeholders have developed internal systems. Palestine and Lebanon, on the other hand, have fragmented systems available at stakeholder agencies with little facilities for information exchange. In Lebanon, the existing systems hardly satisfy internal needs of stakeholders and major upgrades are required.

The main reasons for the unavailability of NWIS in countries were related to:-
> - Lack of staff within the stakeholders met to develop and manage NWIS. Available staff are not enough and are overwhelmed with other responsibilities
> - Lack of financial resources.
> - Lack of awareness of NWIS benefits.
> - Political situation.
> - Absence of a political decision to establish such a system.

- Lack of the institutional structure and technical infrastructure to collect, store and share data; and unavailability of data.

All countries are facing problems in exchanging water information. Some of the problems are common among a number of countries while others are specific for certain countries. Common or shared problems need to be addressed for all countries because some of these problems can be obstacles that will hinder the development of NWIS in each and every country of those, while others are considered as threats to the institutionalization and sustainability of NWIS after its establishment.

The common problems found are related to:
- Data availability: some data are not measured or collected from field, not computerized, unreliable, contains errors, have a non-compatible formats, confidential or has commercial value (some stakeholders sell data)
- Resources availability: insufficient IT infrastructure, loss or Lack of NWIS-dedicated human resources, lack of financial resources to establish and operate the system
- Organisational framework: lack of NWIS Awareness, no high-level political decision, poor or non-existent relationships between stakeholders, unclear roles and responsibilities for data exchange, lack of data access policies and privileges, no SOPs for data exchange, data monopoly or hesitation to release information

Problems were prioritized based on a collective criterion utilizing the frequency of occurrence, severity, and solvability level.

Country visits have also identified opportunities to develop NWIS in countries. Opportunities include: availability of in-country IT know-how (although the IT know-how is available in the country but it is not available at the stakeholders or the number of staff available are not adequate and are overloaded with other responsibilities), acceptance of NWIS concept during consultation visits, willingness of stakeholders to share information under a NWIS, on-going donors projects in some countries, availability of utilizable IT infrastructure, legal obligation to share data in some countries, existing web-based applications, new organization restructuring allowing for developing new systems for data exchange, available funds in some countries (like Cyprus, Tunisia and Turkey) , in addition to the fact that countries joining the EU have new obligations to provide water information. These opportunities should be utilized when developing a NWIS.

Moreover, EMWIS NFPs capabilities for developing, supervising and hosting NWIS in countries were assessed, the results show that while some EMWIS NFPs have capabilities to develop, supervise and host a NWIS, other EMWIS/NFPs still need lots of support to enhance, consolidate and upgrade their capabilities in almost all categories assessed. Countries were categorized based on the level of their capabilities to coordinate and supervise the NWIS in their countries into three levels:

Level 1: Advanced; the NFP can act immediately as NWIS coordinator and host. Turkey, Morocco and Israel are in this level.

Level 2: Medium capabilities; the NFP needs further support to enhance their capabilities to be able to act as NWIS coordinator and host. Jordan, Malta, and Cyprus belong to this level.

Level 3: Needs major support to strengthen their capabilities to be able to act as a NWIS NFP Palestine and Lebanon are in this level. Algeria's EMWIS/NFP also was categorized in this level as the

NWIS NFP has already been chosen in Algeria and is the Ministry of Water Resources and not the EMWIS NFP.

Stakeholder's relationships within the countries under investigation were also assessed. .Results show that these relationships range from "very strong" -where data exchange takes place on regular basis- to nearly non-existent where data is not exchanged at all between stakeholders . Venn diagrams were produced to show different levels of relationships between stakeholders in countries under investigation in this study.

NWIS readiness among countries was also assessed and was categorized in four groups:
- Most NWIS-Ready Group (Algeria, Tunisia, Morocco)
- Medium to high NWIS-Ready Group (Cyprus, Israel, Jordan)
- Medium to Low NWIS-Ready Group (Turkey and Malta)
- Still-to-be developed NWIS Group (Palestine, Lebanon)

An ideal system for NWIS was then proposed in the form of a web based distributed database system with a GIS interface. NWIS would not store data but serves as a dynamic link between all stakeholders. All stakeholders will manage and update their own database. Each stakeholder will decide on the type of information to share and on access privileges. Stakeholders would still be responsible for all their data collection, entry, verification and maintenance but will have dynamic links to the NWIS. Stakeholders will have three database areas: the first is a public-designated area where public domain data is dynamically linked to EMWIS website and can be shared by any web navigator. The second area will be allocated as a secure area and can only be accessed by privileged users. The third area will also be a secure internal area that will be dedicated for the internal use of a stakeholder. In order to provide extra assurance for countries, the public area and secure area can be physically separated in two servers.

Implementing proposed NWIS in countries must come in two phases:

- **The pre-NWIS development phase**. This can be identified as the preliminary phase for countries to become eligible for NWIS development. The tasks to be implemented in this phase can be summarized in the following: survey of all water data sources, monitoring of water resources, development of standard operating procedures (SOP) for monitoring and data collection, usage of computers and availability of network infrastructure, provision of qualified IT staff, institutionalization of monitoring of water resources, Internet connection availability; and web sites available- at least -for the majority of stakeholders.
- **The NWIS development phase.** This phase includes implementing the following tasks: awareness campaign, obtain political decision to implement NWIS, establish a coordination committee, select host/coordinator; IT staff capacity building, data classification/sharing policy, data collection roles & responsibilities, secure funds, feasibility study; detailed technical design study; write the terms of reference; develop NWIS, validation and test, institutionalization and implementation.

The synthesis revealed that nearly half of the countries visited have already completed the pre-NWIS development stage. Only two countries -Lebanon and Palestine -are still in the pre-development phase and need considerable assistance. Most of the countries have varying levels of progress in the NWIS development phase. Algeria is at the top of the list with its NWIS ready for implantation if not already implemented by now.

Potential actions were identified for EMWIS and donor agencies to help the different countries in implementing a NWIS.

Potential actions where EMWIS can add value are:

1. Development of SOPs for monitoring, data collection and exchange.
2. Conduct awareness raising campaigns.
3. Exchange of experiences between countries
4. Setting up data classification and roles and responsibilities for data exchange.
5. Assist countries in the NWIS administrative preparations such as obtaining a political decision to implement NWIS and formation of coordination committees.
6. Help qualified countries secure funds to implement NWIS.

Donor agencies can provide support to:
1. Conduct detailed studies for NWIS implementation in countries.
2. Develop and design technical specifications for NWIS in countries.
3. Develop, build and institutionalise NWIS
4. Strengthen the capacity of countries to monitor their water resources.

The study has also found out that the main reasons behind the sometimes unreliability and intermittent provision of information to EMWIS by the countries visited can be attributed to one or more of the following;
1. Most of the types of information required by EMWIS e.g. best practices, water legislation information, grey literature, etc. are either not readily available or need time to transfer them into digital format. The only type of information usually available in digital format is the quantitative information but considered as confidential in most of the cases.
2. Unsatisfactory relationships between stakeholders within the country.
3. Overloaded staffs that is busy with other responsibilities.
4. Lack of WIS within some countries.
5. Confidentiality of data and the political situation.

Compiling all the above, a road map was recommended to enhance NWIS in countries. The road map was based on minimizing and solving problems that hinder the development of NWIS, making use of in-country on going opportunities and overcoming weakness points in the NWIS development in all countries covered by this study. The road map steps are:

1. Conduct an NWIS awareness campaign.
2. Obtain a country high-level political decision to establish NWIS.
3. Develop standard operating procedures for data collection and exchange through NWIS.
4. Hire more IT staff in stakeholder organizations and strengthen their capacity.
5. Help establish a NWIS coordination committee in countries under investigation.
6. Coordinate with other donors on-going similar projects.
7. Setting data classification/sharing policy and data collection roles & responsibilities.
8. Secure or help secure funds.
9. Conduct a full feasibility and design study.
10. Conduct a detailed technical design study.
11. Develop and institutionalize NWIS.

The overall rough cost for developing NWIS in 7 countries (Israel, Jordan, Lebanon, Malta, Morocco, Turkey and Palestine) was estimated to be approximately two million Euro. A separate complementary detailed study is required in each country in order to define the detailed technical specifications of each system and hence the exact cost for implementing or enhancing NWIS. Budgets have already been secured for Algeria, Tunisia and Cyprus, but additional funding might be necessary to extend the systems and put in coherence the SOPs and data format with common standards to be defined at the regional level by EMWIS.

2. INTRODUCTION

2.1. Background

The SEMIDE/EMWIS project has started since 1999 with a main objective to "Facilitate access to the existing know-how in the water sector and develop the sharing of information along with preparation of common outputs and cooperation programs between the participating countries".

During the course of its execution, the project defined some problems which affected the advancement and development of the EMWIS project and accordingly reflected on the EMWIS international system. Some of those identified problems are:
- The difference in the level of advancement (and sometimes the absence) of National Water Information Systems in the participating countries: some countries have advanced systems while others have barely started. This difference leads to problems in coordination and communication.
- Lack of coordination between organizations and institutions within the same country which results in data gaps, duplication and discrepancy.
- Difficulties in accessing data, whether because of technical reasons or lack of policies for data access.
- Availability of data in different formats.
- Lack of water data access policies.
- Differences in ICT infrastructures, human resources capacity and in adopted processes for data collection, transfer, storage and dissemination in the participating countries.
- Some countries address the issue of water information in their varying organizations using a micro approach rather than a macro approach. This approach has lead to fragmented systems lacking consistency and integration. These countries might need guidance to a more holistic approach in building water information systems which lead to a more coherent multi-stakeholder water information system on a national level.

To solve these problems, EMWIS is looking at the enhancement of the National Water Information Systems (NWIS) in the participating countries. It is anticipated that improvement of these NWIS systems would improve and harmonise data/information exchange and sharing between these participating countries. It is also anticipated that this improvement will have a direct impact on the quality, availability and flow of information from the participating countries' NWIS to the EMWIS international system via the national focal point in each participating country.

In April 2005, EMWIS awarded **EasyInfo** Consulting Company to conduct a feasibility study to assess the current situation and recommend actions to improve the National Water Information Systems (NWIS) in 12 Mediterranean countries: Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Syria, Tunisia, Turkey and Palestine.

The main objective in pursuing enhancement and improvement of the NWIS in the participating countries is to remove all obstacles at the national level that impede the advancement of the NWIS and, as a consequence, improve and harmonise data/information exchange and sharing between the participating countries and the EMWIS international system via the National Focal point in each participating country. Improvement of the National Water Information Systems will improve the overall EMWIS system.

This study represents the first step for NWIS enhancement by identifying recommended actions for improvement of the Water Information Systems in each country.

2.2. Objectives of study

The Technical and Financial Feasibility Studies of National Water Information Systems-12 countries study- started on 1/4/2005 and ended on 30/1/2006, the main objectives of the study are:

➢ Conduct analyses of the water information systems (used or planned) in each country included in the study and assess national needs and requirements, including:
  - Identification of information providers and necessary collaborations.
  - Knowledge of end-users.
  - Organization of the EMWIS National Focal Point (NFP) and its information system as part of the NWIS.
➢ Defining a set of technical, financial and organizational recommendations and setting a roadmap towards the improvement or the implementation and operation of a NWIS.
➢ Compile all findings and recommend to EMWIS steps to enhance, smooth and harmonize data sharing between the NWIS and EMWIS.

The study aims to accomplish the following targets:

Result 1: Assess current situation of Water Information Systems in the participating countries.

Result 2: Recommend road map for NWIS enhancement or development.

Result 3: Compile all findings and recommend to EMWIS steps to enhance, smooth and harmonize data sharing between NWIS_EMWIS.

2.3. Countries included in study

The study was conducted for the following 10 Mediterranean countries who gave their agreement to the EMWIS Technical Unit: Algeria, Cyprus, Israel, Jordan, Lebanon, Malta, Morocco, Tunisia, Turkey and Palestine. The EMWIS TU approached Egypt and Syria to include them under this study but both countries did not replied.

2.4. Study implementation methodology

Study methodology followed a three phase water fall approach. The phases were distinct but mutually dependent implementation phases.

Phase 1 (April 1st to May 30th): *Inception Phase*. During the first 2 months, the inception phase was dedicated for preliminary analysis and included the following tasks:
  - Identify stakeholders to be met and interviewed in each country.
  - Schedules and detailed plans of the national visits.
  - Prepare letters to stakeholders to prepare for the country visit.
  - Collect preliminary information about the stakeholders.

- Prepare topics to be discussed in interviews (in question form).
- Prepare detailed methodology of analysis.
- Review project plan.
- Draft Inception report.
- Presentation to the EMWIS Technical Unit (TU).

Phase 2 (June 1ˢᵗ to November 20ᵗʰ): *Country consultations-Country analysis*. During this phase, the consultant visited the 10 countries included in the study. The consultant performed the following tasks in each country visited:

➢ Conduct country consultations:
The consultant met with the EMWIS/ NFP and held meetings with all stakeholders of water information defined by the NFP. The consultation visit in each country was concluded with a focus group meeting with all the stakeholders.

➢ Perform Analysis. After each country consultation, gathered information was analyzed for the following:
- Available and planned systems, providers, users, available information and information flow.
- Analyze stakeholders' roles, interests, concerns and difficulties in exchanging information. (Stakeholder analysis matrix).
- Perform SWOT analysis for NWIS.
- Relationships between stakeholders (demonstrated in Venn diagrams in country reports).
- Define difficulties (problems) and build a problem tree.
- Identify the added value and benefits of a NWIS for the stakeholders.
- Envisioned NWIS system.
- Assessment of NFP capacity to manage a NWIS (Spider diagram).
- Cost estimation of envisioned system.

➢ Prepare a country report and send to TU, report included:
- All the analysis.
- Road map for implementation.
- Conclusions and recommendations.

In this phase, the consultant started study in Jordan, tested the methodology set in the inception phase, and refined it.

Findings per country including all the analysis were compiled in 10 country reports, one per country and handed to the Technical Unit.

Phase 3 (November 20ᵗʰ to Feb 1ˢᵗ): *Finalization phase*. This phase included the following tasks:

➢ Synthesizing gathered information and country reports.
➢ Formulating a road map that includes:

1. Definition and prioritization of problems to be addressed and ability for solving problems
2. Options to benefit from the opportunities and strengths defined in SWOT analysis.
2. Define actions for EMWIS needed to enhance NWIS-EMWIS information sharing.
3. Recommendations for EMWIS (what's next).

➢ Preparation of the final report

3. DEFINITION OF AN IDEAL NWIS

A NWIS is a system that stores and processes information shared between the main national water stakeholders in a country. A NWIS is usually a computerized system and is considered as one of the main instruments of the national water policy. It includes institutional and legal information (agreements between stakeholders, ownership, copyright, legal data exchange, etc.), standardization and organizational information (formats, exchange and management procedures, etc.) and information technologies (hardware, software, network, security). Depending on the main purpose of establishing NWIS (defined by stakeholders in the country), the type of information managed could include quantitative information, maps, best practices, directories, water legislation information, and grey literature. A NWIS has usually restricted accesses for the national stakeholders (user or information providers) and a "public window" where any user can find water information. EMWIS is expected to have online links with the "public window" on the NWIS in the countries.

An ideal system for NWIS for the countries visited can be visualized as a web base distributed data base system with a GIS interface. NWIS would not store data (unless otherwise required by the country) but rather it should serve as a communication link between all water information providers in the country and therefore NWIS would have dynamic links with all stakeholder database systems. In an ideal case, all stakeholders will have their own systems which will be managed locally by their IT departments. Stakeholders systems must be web-based applications with databases updated regularly by stakeholders. Stakeholders would still be responsible for all their data collection, entry, verification and maintenance but will have dynamic links to the NWIS. Each stakeholder should decide on the types of information that can be shared publicly, internally by stakeholder staff, or under a secure section which can only be accessed by privileged users like other stakeholders, universities, researchers, decision makers, etc. The stakeholders will offer a public area on their web-based systems where they will publish all the data that can be shared by any web navigator. Some stakeholders will offer a secure area which can only be accessed by privileged users (like the other stakeholders) using passwords. The internal area would be for the internal use of the stakeholder.

Access to the country's NWIS would be via an internet browser. Part of NWIS pages would be open to the public (public will only be able to access information that is classified for public use by stakeholders), the second part would be a secure part which is accessible only by authorized users at stakeholder agencies. Accessibility to the secure part and authorization granting would be the responsibility of a committee that should be formed in the country to coordinate NWIS issues. Among the committee's various responsibilities would be NWIS data security and access rights policies. At the stakeholder's end, the content of the public site and the secure site can be physically separated on two different database servers to ensure security of the secure site. Figure (1) below shows a conceptual visualization for an ideal NWIS.

The public area in each country can then be dynamically linked to EMWIS web site, updating NWIS public site in each country would mean automatic updating of the information conveyed to EMWIS. The decision to connect the country's public NWIS site to EMWIS would be left to each country as this is considered an internal matter for that country.

NWIS systems should be differentiated from Water Information Systems (WIS) systems which are usually used by a group of actors that stores and processes water information using information technologies. In the context of this study, WIS identified were only accessed and used by one stakeholder to warehouse quantitative water data and information. WIS systems are usually stand alone systems with no facilities of online access for other stakeholders in the country or any public user.
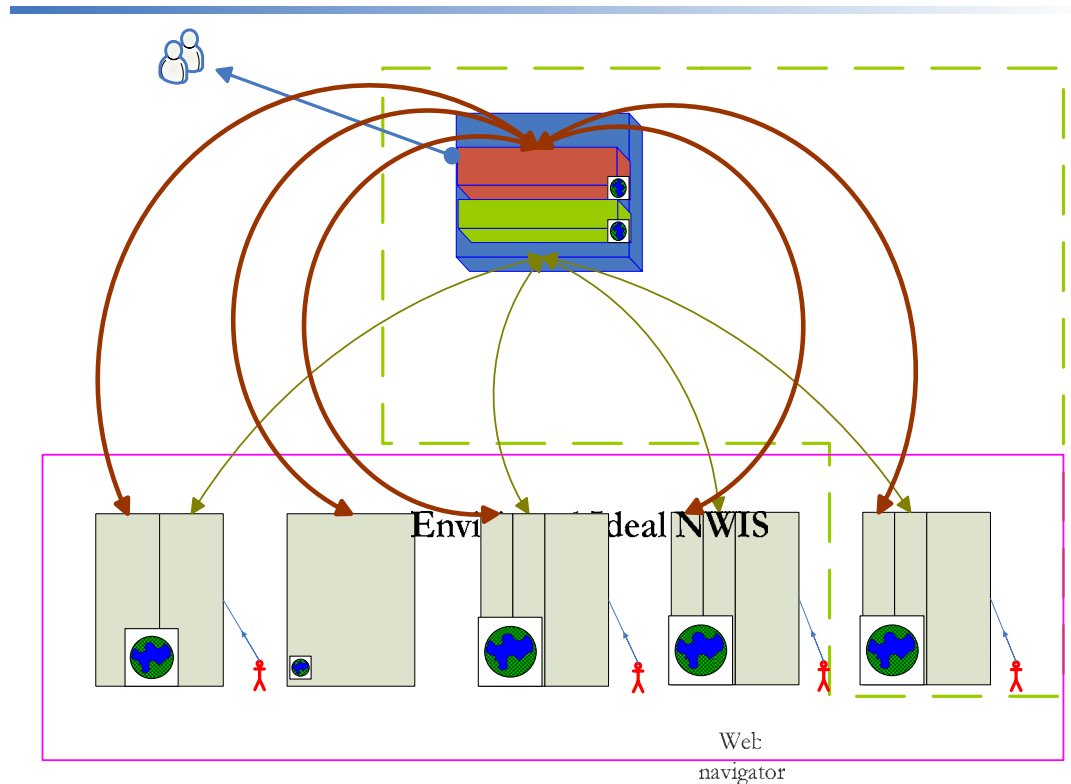
Figure 1- Envisioned NWIS Ideal System Layout

Figure (2) below shows a conceptual visualization of how will the establishment of web based NWIS in each country help alleviate the problematic process of updating EMWIS web site without having to dedicate in-country special resources (human or financial) to ensure on-time updates.

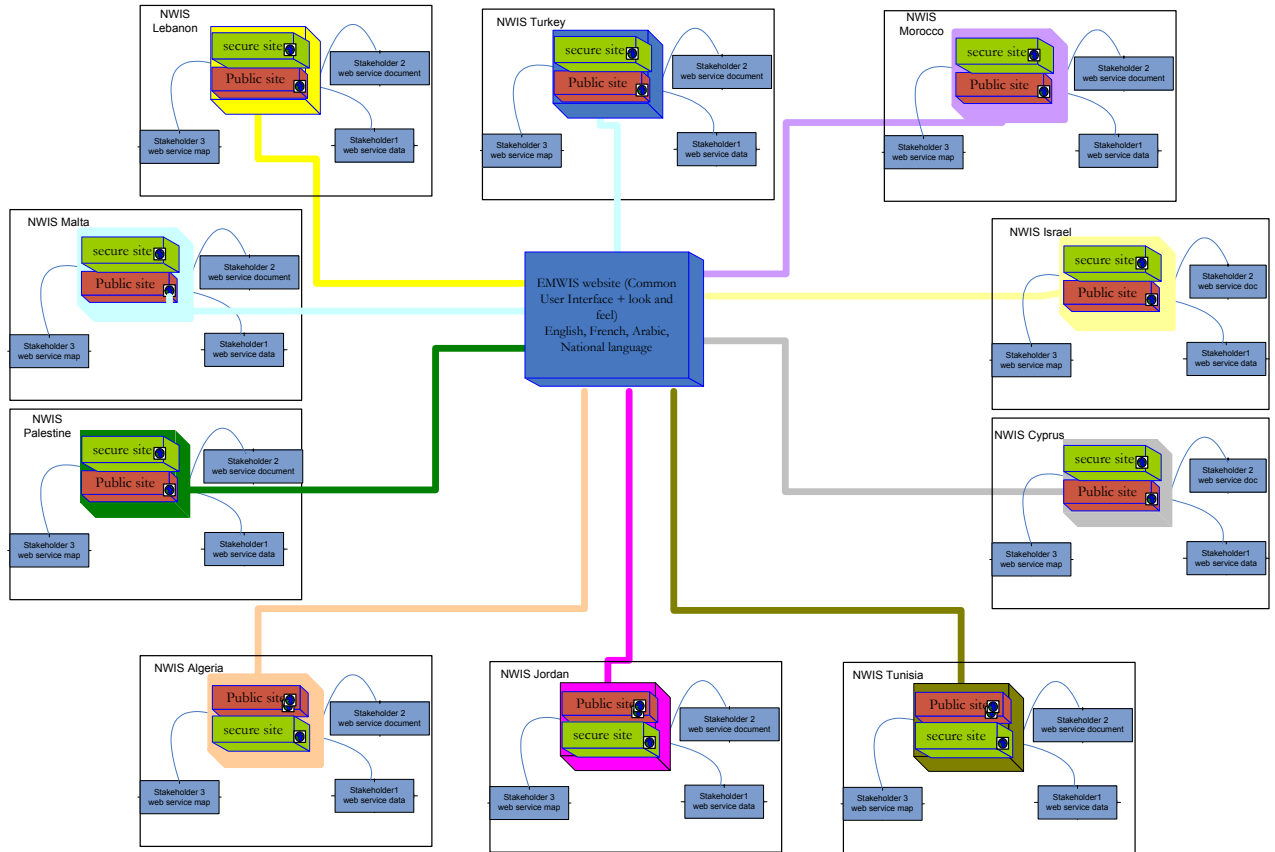Conceptual visualization for future EMWIS – NWIS Network

Figure 2- Conceptual Visualization for Future EMWIS-NWIS Network

4. COUNTRY FINDINGS

4.1. Schedule of country visits

The consultant visited 10 countries: Algeria, Cyprus, Israel, Jordan, Lebanon, Malta, Morocco, Tunisia, Turkey and Palestine according to the following schedule:

Table 1- Country Visits Schedule

Country	Visit starting date	Visit ending date
Jordan	29/05/05	02/06/05
Tunisia	20/06/05	21/06/05
Malta	04/07/05	08/07/05
Cyprus	25/07/05	29/07/05
Israel	02/08/05	05/08/05
Palestine	06/08/05	10/08/05
Morocco	12/09/05	15/09/05
Algeria	18/09/05	20/09/05
Lebanon	03/10/05	05/10/05
Turkey	10/10/05	13/10/05

During these in-countries consultation visits **EasyInfo** consultants interviewed stakeholders of water information in each country individually and collected data by filling specially designed questionnaires. The stakeholders met were previously selected by the EMWIS/National Focal Point in each country (Annex A includes the names of stakeholders met in each country). The consultation visits ended up with a joint focus group meeting to discuss issues related to difficulties in water information exchange and the reasons behind the inefficiencies and obstacles foreseen in establishing NWIS.

4.2. Countries specific findings

4.2.1 Algeria

Algeria is considered a pioneer country in the region for establishing a National Water Information System called **La base Eau**. This system is expected to be launched and operational by the end of September 2005. The system was designed to incorporate all water information that covers the needs of the different stakeholders at the Ministry of Water Resources (Ministère des Ressources en Eau- MRE) and all the directorates and basin agencies that are connected to it.
The idea of establishing the system started in 2002. The system was implemented in 3 phases:

Phase 1: Detailed study to assess the water information needs for all the country. The duration of the study was 18 months and covered the following stakeholders:

- Agence de bassin hydrographique (ABH) which includes 5 basin agencies
- Ministère des Ressources en Eau (MRE)
- Agence Nationale des Ressources Hydrauliques (ANRH)

- Agence Nationale des Barrages et Transfert (ANBT)
- Office National de l'irrigation et drainage (ONID)
- Algérienne des eaux (ADE)
- Office Nationale de l'Assainissement (ONA)
- Directions de l'Hydraulique des Wilayas (DHW)

Phase 2: System development, MRE outsourced the development to an Algerian company which started the work early 2004 and will complete the system in September 2005. Duration of development phase was 18 months.

Phase 3: Institutionalization and usage. This phase will start as soon as the development of the system is completed It will include installing the system at the five basin agencies and training users on how to utilize and effectively operate it. This phase will also include data entry to the system.

La base Eau was developed using Microsoft VB.Net along with the MS SQL. For the GIS, ArcGIS 8 and 9 were used. The system is a web based application that can be used by all the users connected to the ministry's network (intranet), there will be around 200 users accessing all the information that are stored in the database. La base Eau uses the browser to access the application, a very simple and easy to use interface was created for the users with facilities to query, report, manage, enter and visually see point sources using GIS output. The system was designed to warehouse 800 data items for different types of information. System management, coordination and hosting of **La Base Eau** is the responsibility of the MRE central office in Algiers, they are the National Focal Point (NFP) of the NWIS but not the NFP of EMWIS.

Yet a foreseen problem in this system lies in the undeveloped information systems at data providing agencies. The anticipated users of the system (listed above) are also the main providers of water information to the system. Some of these providers have not yet developed their own internal systems to warehouse their collected data. Therefore, a foreseen obstacle for populating **La base Eau** in Algeria is the lack of internal systems at the stakeholder institutions which provide data to the basin agencies that in turn enter data to the system. This is expected to impact the readiness of data for updating **La base Eau.** Therefore, it is strongly recommended to start establishing these internal systems at the stakeholder institutions. Annex B includes a proposed future setup for **La base Eau** which proposes developing internal systems at each stakeholder agency in order to automatically provide its water information to the basin agencies and thus to the central **La base Eau**.

All stakeholders of water information including ONA, ADE, ANRH, ANBT, ONM, ONID, DHW, Ministry of Industry, Ministry of Environment and the five basin agencies in Algeria exchange data and info with the NWIS NFP (MRE central offices in Algiers) on a national level, many of these stakeholders have regional offices, data collected by regional offices is delivered to the basin agency covering that region and then forwarded by the basin agency to the centre at MRE. Therefore coordination of water information exchange on a national level is the responsibility of MRE central offices.
On the other hand EMWIS NFP; "The Constantine Basin Agency" has links with the regional offices of stakeholders in Constantine area. They collect data from stakeholders and enter it to the database system in Constantine and then forward it to MRE to be saved with all other basins data. This collected data will be warehoused under **La Base Eau** NWIS in the near future.

Since Algeria is the first country to establish a National Water Information System and since the system developed in Algeria complies with the requirements of a NWIS, it is strongly recommended

to benefit from the knowledge and experience acquired during the development of **La base Eau** in Algeria and exchange the experience and knowledge gained with other participating countries of EMWIS. The Algerian NWIS can be shown as a model for other countries; it will reduce the time and effort needed for each country to establish a NWIS. The experts in Algeria can also share the difficulties and challenges they encountered. The model in Algeria is a successful one. It took 3 years from starting the initiative till reaching the goal.

4.2.2   Cyprus

The main providers of water information in Cyprus are WDD, SGL, GSD and the Meteorological department. Currently there is no NWIS in Cyprus but there is a shared water data system called **ENVIS** between three of the main stakeholders in Cyprus. The system contains a major part of the quantitative water information but lacks all other types of information. The system was developed by the USGS under a USAID project to warehouse and share information between three of the main stakeholders (WDD, GSD and the meteorological department) but is not accessible by other stakeholders. The ENVIS system can serve as a core for a future NWIS in Cyprus. The user interface needs to be redeveloped using XML to enable transforming the application into a web based application. Stakeholders in Cyprus attributed the unavailability of NWIS in Cyprus to the following:

- o   NWIS was never though off.
- o   Fear of the time, effort and cost needed to implement an NWIS system.
- o   Lack of financial resources.
- o   Lack of Human resources.

After Joining the EU in 2004, Cyprus has new obligations towards the EU. Cyprus has to provide water information to the EU under the Water Framework Directive. In a step to alleviate the burden of this process, the EU has already secured the funds for Cyprus to build a Water Information System through a project called "*Development of Integrated Water Monitoring Programmes and Tools for Cost – effective Monitoring and Assessment to Support Sustainability of Water Resources and the Implementation of Water Framework Directive 2000/60/EC in Cyprus*/ The Transition Facility Project". The project coincides with the objective of this study (i.e. the need to establish a NWIS in Cyprus). A detailed needs assessment study have not yet been conducted and a conceptual design has not yet been drafted.

The availability of funding through the EU project solves the main obstacle (i.e. lack of financial resources) on the road to establish a NWIS. It is very important to establish a special unit or department under the WDD that is responsible for the NWIS system. This is considered a prerequisite for the success of the targeted system. It is also important to establish an NWIS committee, where all stakeholders would be represented. Each stakeholder will nominate a representative to act as a member of NWIS committee. This member should have among other responsibilities the role of acting as a liaison officer with the unit or department in WDD that will be responsible for NWIS. The WDD capabilities to coordinate and supervise the NWIS were assessed and a spider diagram that reflects the findings was developed and included in Annex D.

Apart from the *Water Information System* planned to be developed under the EU project, none of the stakeholders have near future plans for improving their information systems. This is mainly due to the lack of IT human resources in their departments. The long term plans of stakeholders do not take into consideration the idea of acting as a node under a NWIS.

As a conclusion based on the analysis, a conceptual design for the envisioned NWIS is proposed (see Annex B). The proposed NWIS will be web-based with links to all stakeholders. The main providers of water information to the system would be: the WDD, GSD, Meteorological department and the SGL. While the first three institutions currently share the existing ENVIS system which facilitates ease of exchange of water information, the SGL is not hocked up to that system and cannot exchange information with others via the ENVIS system. It is proposed that the four main stakeholders of water information share one system making use of ENVIS (but with major enhancement). The providers should dedicate a portion of their system for posting the data that can be shared with the other stakeholders. This part of the stakeholder's system will be linked dynamically to the NWIS system which will provide information under its secure part to other stakeholders and to the public in general utilizing its public part.

To achieve the proposed NWIS in Cyprus, a roadmap was formulated and is attached in Annex C.

4.2.3   Israel

Main stakeholders of water information in Israel were identified by the National Focal Point (NFP) of EMWIS project to be: Water Commission, Ministry of Health, Geological Survey of Israel, and Mekorot Water Company. All stakeholders met in Israel are users, providers and generators of water information.

At the beginning of the consultation visit, almost all stakeholders did not see the importance or even the possibility of establishing a NWIS in Israel that can be used for raw data exchange as it is not only a technical or/and financial matter, but also, a political matter.   During individual meetings, stakeholders were convinced about the conceptual idea of NWIS but some felt it may be "unrealistic" or "utopian" to implement such system for raw data. Other stakeholders believed that it can be done but in phases, starting with non-restricted public domain water information.

Among the stakeholders in Israel, the Water Commission and Mekorot are the main providers of water information. Most of the stakeholders exchange water information with the Water Commission mainly by exchanging documents automatically (via email, intranet, diskettes or CDs) or by referencing the annual reports. All stakeholders have web sites. Most stakeholders publish some information and reports on the web site. The web sites are mostly in Hebrew, some are bilingual (Hebrew/English). Stakeholders' have information systems that are adequate for their current internal use, but will need enhancements to be able to connect to a future web based NWIS. Therefore, none of the stakeholders are currently technically ready to act as a back end server in a distributed database setup under the NWIS envisioned.

A NWIS is not available in Israel. The main causes for the unavailability of NWIS in Israel are attributed to the following:

- Stakeholders are not aware of the benefits of NWIS.
- Lack of financial resources.
- The current political situation.
- No standard operating procedures for data exchange in some stakeholders.

Establishing a NWIS system in Israel might face the following obstacles:

- Current political situation, Israel has a different situation than other countries regarding what water information can be shared with the public and even between the stakeholders. Therefore, implementing NWIS for exchange of raw data in Israel may be more difficult in comparison with the other countries.
- Getting the political decision to establish a NWIS.
- Non-confidential data monopoly and control are still very present in the stakeholders' mentality.
- The Israeli bureaucracy, an internal problem, which is beyond the stakeholders' representative met.
- Sensitivities regarding data to be shared between stakeholders through NWIS.
- Absence of policies for data access and sharing and anticipated difficulties in drafting such policies (i.e. who can access what , who has the mandate to grant access…etc)
- Unavailability of standard operating procedures for data exchange in some stakeholders.

During the consultation visit, stakeholders did not point out a definite coordinator for a NWIS. The Water Commission seems to be the most appropriate institution for NWIS coordination. Annex D includes a spider diagram that reflects the capabilities of the Water Commission to supervise mange and host a NWIS in Israel.

As a conclusion drawn from the analysis, two options were proposed for the conceptual design of the envisioned NWIS (see Annex B). Both options suggest an integrated web-based application with a GIS interface. While the first option proposes a centralized database system at the backend, the second option proposes a distributed database system getting information through dynamic links with data providers. The consultant recommends the distributed system but the decision is left to the stakeholders as it is related to security considerations.

To achieve the proposed NWIS in Israel, a roadmap was formulated and is attached in Annex C.

4.2.4   Jordan

Main stakeholders of water information in Jordan were identified by the National Focal Point (NFP) of EMWIS project to be: Ministry of Water and Irrigation (MWI), National Information Technology Center (NITC),Ministry of Agriculture (MoA), Department of Statistics (DoS), Ministry of Environment (MoE) and the Environemtnal Monitoring and Research Central Unit (EMARCU). Among the stakeholders in Jordan, MWI is the main provider and user of water information.

MWI generates its own data and deals with most stakeholders in the water sector. MWI has implemented information systems over the past several years with the help of a number of projects and donors. Examples include the Water information system (WIS), the GIS system, the national water master plan (NWMP), the document management system which is still under development. Access to these systems is restricted to authorized users inside the ministry. One of the main reasons for the limited access to the systems is the unclear policies of access rights even

inside the ministry. All stakeholders suffer from the slow response of the ministry in providing information and therefore require a neutral body to be in charge of the proposed NWIS. Stakeholders consider that MWI should be the coordinator for water information exchange and updating of the NWIS.

Most of the stakeholders exchange information with MWI mainly by exchanging documents either automatically (via email, diskettes or CDs) or using hard copies (paper). The information exchange process between stakeholders is considered unsatisfactory by consensus of all stakeholders.

All stakeholders have web sites, all sites except for EMARCU web site are static, they are brochure like web sites rather than dynamic web based applications. Apart from EMARCU, none of the stakeholders are technically ready to act as a backend server in a distributed database setup under the NWIS envisioned. DoS is the only stakeholder that is offering around 80% of its information on its web site, nevertheless DoS site needs to be upgraded from an HTML based site to a web based application integrated to a database system.

Although most stakeholders have their own internal information systems, a NWIS is not available in Jordan.   Furthermore, the stakeholders currently have difficulty amongst themselves to share water information. The main causes for the unavailability of NWIS in Jordan are attributed to the following:

- Absence of a political decision to establish such a system.
- Lack of financial resources.
- Lack of sensitivity classification for data to define what type can be shared through NWIS.

In Jordan, the NITC has the mandate to develop national information systems. Among the systems developed is the environment information system which contains national water information. The currently available system cannot be considered as a NWIS: it needs to be re-engineered to become a suitable system to host the envisioned NWIS. NITC possesses the technical know how but lacks financial and human resources.

Despite the fact that the MWI is the most influential stakeholder, the other stakeholders did not accept it as a host to the NWIS. Stakeholders favour that the host of NMWIS should be a neutral body and that is not the case with MWI. As a conclusion of the analysis, the NITC was recommended as the host organization to operate and maintain the database. The MWI will remain as the focal point responsible for the coordination efforts that will ensure the timely input of stakeholders' reliable data into NWIS. The MWI and NITC capabilities to coordinate, supervise or host the NWIS were assessed and shown in a spider diagram in Annex D.

A conceptual design for the envisioned NWIS was proposed (see Annex B). The proposed NWIS will be web-based with links to all six stakeholders. The NITC will act as the host and technical arm for servicing the NWIS. All stakeholders will manage their own systems with dynamic links to NWIS. Each stakeholder will decide which type of information to share. MWI will be the main coordinator among all stakeholders to ensure timely exchange of reliable water information between the stakeholders. A conceptual diagram is shown in the report with details on the proposed NWIS system in Jordan.

To achieve the proposed NWIS in Jordan, a roadmap was formulated and is attached in Annex C.

4.2.5 Lebanon

Main stakeholders of water information in Lebanon were identified by the National Focal Point (NFP) of EMWIS project (MEW) to be: MEW/Directorate of Exploitation (DoE), MEW/Directorate of Hydraulic & Electric Resources (DoHER), Beirut and Mount Lebanon Water, Establishment (EEBML), South Lebanon Water Establishment (SLWE), North Lebanon Water Establishment (EELN), Establishment of the Bekaa' , Litani River Authority (ONL) .

On 3/10/2005, the water sector in Lebanon had a major organizational restructuring. Twenty water authorities were merged into four public institutions (i.e. EEBML, SLWE, EELN, and Bekaa'). The MEW became the public organization responsible for supervising these four establishments. This restructuring was based on the law 221 that was issued in May of 2000, amended by the law 241 in August of 2000, and further amended by the law 337 of 2001.

In Lebanon, a NWIS does not exist. Stakeholders in Lebanon are interested in establishing NWIS on the national level and are willing to go forward provided that they get financial aid. Many stakeholders did not know about the specific benefits NWIS can bring them prior to this study. It was necessary to demonstrate to stakeholders that NWIS is needed. It is also important to consider- prior to the implementation of NWIS -that there are major steps to be taken in the stakeholders institutions to upgrade their data collection procedures, enhance or develop database systems and establish web sites.

In Lebanon, the main reasons for the absence of NWIS are attributed to the following:
- Lack of the institutional structure and technical infrastructure to collect, store and share data (this is expected to change due to the recent institutional restructuring).
- Lack of financial resources.
- Stakeholders are not fully aware of the benefits of data exchange.
- Absence of standard operating procedures for data exchange in some stakeholders.
- The political situation.
- Unavailability of data.

It is also anticipated that establishing NWIS system in Lebanon may face the following obstacles:

- Failure to get political decision to establish NWIS.
- Lack of financial resources to improve and upgrade stakeholders' information systems.
- Unavailability of staff and vacant important positions due to the hiring freeze.
- Delays and problems in the implementation of the new institutional setup.
- Unavailable and unreliable data.

It should be noted, however, that despite the obstacles mentioned, there are opportunities in Lebanon that will greatly support the stakeholders prior to and during the establishment of NWIS and is highly recommended to be utilized, these opportunities are:

1. The concurrent donor projects like the IPP and the FAS. These projects are working to upgrade the data collection, storage and exchange. With better coordination, the work can better serve the overall goal of establishing a NWIS.

2. The stakeholders are starting to recognize the importance of NWIS especially after the development of the new water establishments. MEW recognizes the importance of sharing data on the national level and even some pieces of data on the regional level that might come handy in the negotiation, planning, and research phases.

Currently, none of the stakeholders can be considered to be technically ready to act as a backend server in a distributed database setup under the envisioned NWIS. Some stakeholders' IT systems are not even adequate for their own current data collection and sharing purposes. Internet connections are not available in most of the stakeholders' institutions and when present, they are usually slow and need upgrading.

It is highly recommended to implement NWIS in Lebanon in two stages. Stage one is the pre-NWIS preparation stage while stage two is the NWIS development stage. The most important step in the preparation stage is the collection of data and monitoring of major water sources (i.e. water levels and production flows) and implementing SOPs for data collection and exchange.

It is also recommended to establish the institutional mechanism to ensure the proper coordination between stakeholders, since the current situation reveals a duplication of efforts which is creating inefficiencies in the development of automated systems for water information.

Stakeholders in Lebanon can reduce the time, effort and cost needed for development and upgrading of the stakeholders' IT capabilities in Lebanon by learning success and failure stories from other countries in the region.

As a conclusion stemming from the analysis, it is still early to fully envision a system for NWIS in Lebanon. Priority should be given to setting up data collection and exchange procedures, institutionalization of these procedures, collecting the data. Only after that an automated solution can be envisioned or thought of. A general conceptual design for the envisioned NWIS is proposed (see Annex B). The main participants of NWIS are proposed to be all the water authorities in Lebanon. It is also recommended that MEW acts as the coordinator and host of the NWIS system after qualified staff are appointed to follow-up and manage the system. MEW capabilities to coordinate and supervise the NWIS were assessed and a spider diagram that reflects the findings was developed and included in Annex D. It is also proposed that all stakeholders met should coordinate and unify their efforts to adopt one Water Information System (WIS) at their establishments since they all have the same responsibilities but in different geographical locations in Lebanon and would thus have the same needs. The WIS proposed system should be a web-based application with distributed databases maintained regularly by stakeholders.

To achieve the proposed NWIS in Lebanon, a roadmap was formulated and is attached in Annex C.

4.2.6   Malta

Main stakeholders of water information in Malta were identified by the National Focal Point (NFP) of EMWIS project to be: Malta Resources Authority (MRA); the NFP for EMWIS project, Water Services Cooperation (WSC), National Statistics Office (NSO), Health Department (HD) and Malta Environment and Planning Authority (MEPA). Among the stakeholders in Malta, WSC is the main provider of water information. Most of the stakeholders exchange information with WSC mainly by exchanging documents automatically or by referencing the annual reports published by WSC on their web site.

Currently there is no NWIS in Malta nor is there any system that could be considered a core system for developing NWIS. MRA- EMWIS NFP- does not have a water information system but rather works with excel sheets and access tables. Unavailability of NWIS in Malta can be mainly attributed to the following:

- Lack of human resources.
- Lack of financial resources.
- The idea of a NWIS is new and has not been thought of before in Malta.

All stakeholders in Malta have web sites. Most stakeholders publish their annual report on the web site. All sites except for MEPA web site are HTML based with no database. In Malta, the MRA, HD, NSO and WSC are heavily dependent on the usage of MS-EXCEL sheets, which is a time and resources consuming practice. Apart from MEPA, none of the stakeholders systems are technically ready to act as a backend server in a distributed database setup under the NWIS envisioned. Currently WSC is developing a new Water Information System to serve its needs. The system will be developed using Oracle database and will have a GIS interface when required. Once the system is ready, it can act as a backend server in the NWIS envisioned system, but needs a lot of development until then.

Stakeholders in Malta have different plans for the future regarding their information systems. These plans are focused on their internal systems and internal needs. The idea of acting as a node under a NWIS was not in their plans as this has been the first time they gather to discuss a National Water Information System in Malta. But now they are willing – at the technical level - to meet and confer more often and create a NWIS.

All stakeholders are unanimously accepting the Malta Resources Authority MRA to be the NWIS National Focal Point. MRE capabilities to coordinate and supervise a NWIS were assessed and are shown in Annex D. However, MRA insufficient financial capability, lack of human resources and unavailability of an IT core system do not enable MRA to develop or host NWIS.

As a conclusion from the analysis, a conceptual design for the envisioned NWIS was proposed (see Annex B). The proposed NWIS will be web-based with links to all five stakeholders. MRA will act as the coordinator of the NWIS -by consensus of all stakeholders present to the joint meeting - . MRA has the mandate but not the resources to implement a NWIS. To overcome this difficulty, the consultant recommends outsourcing of the design, development and hosting of the NWIS system in Malta. All stakeholders will manage their own systems with dynamic links to NWIS. Each stakeholder will decide which type of information to share. MRA will be

responsible for coordinating between all stakeholders to ensure timely exchange of reliable water information among them.

To achieve the proposed NWIS in Malta, a roadmap was formulated and is attached in Annex C.

4.2.7   Morocco

Main stakeholders of water information in Morocco were identified by the National Focal Point (NFP) of EMWIS project to be: Secretary of state in charge of water, EMWIS NFP, Hydraulic Basins Agency and Hydraulic Regional Directorates, National office for potable water, Ministry of Interior, Ministry of Agriculture, Rural development and fishery and the High commission of water, forests and desertification. Main providers of water information are SEE, ABH & DRH, ONEP and MADRPM. Majority of the quantitative water data is collected by the Basin agencies (ABH & DRH) and the SEE.

Currently there is a Water Information System in Morocco called BADRE21. The system contains a major part of the quantitative water data but lacks qualitative information like gray literature, best practices, water legislation information…etc. The system was developed by the SEE to be a centralized system where all data is entered in the centre at SEE office in Rabat. The system operation was then decentralized and the system software was replicated in the 7 basin agencies (ABH) and 2 directorates (DRH) available in Morocco. Although the software was installed in these agencies and in spite of the fact that facilities are available to transfer information from these agencies to the centre at SEE office, the data is not regularly updated. The staffs in the agencies are still not fully utilizing the BADRE21 system because they are not familiar with it. They are overwhelmed with responsibilities, and don't have enough time for data entry and processing. Therefore, although a very comprehensive system is available for water data warehousing in Morocco, it is not fully utilized. To solve these problems, SEE will subcontract the data entry and maintenance of BADRE21 to a private contractor who will update all the data and train the basin agencies' staff to use it.

In Morocco, four of the basin agencies (Oum Rbia, Sebou, Tensift and Loukkos) have recently developed a web interface for the BADRE21 system. Every agency subcontracted the development of the web interface independently. All four agencies subcontracted the development to one private company in Morocco. In general the 4 interfaces have the same architecture, schemes and data base structure; the systems differ in the look and feel. These agencies are using a web interface for their internal use under their intranets (not connected to the central data base at SEE). Similar systems are intended to be adopted by the other basin agencies and the centre at SEE.

Apart from the *BADRE21,* only ONEP is currently developing an information system and intends to launch it by the end of 2005. None of the other stakeholders have near future plans for implementing an information system. MoI, MADRPM and HCEFLCD are currently using EXCEL sheets and some Access tables to warehouse their data.

SEE has recently adopted the Humming Bird Document Management System and has a plan to scan all the documents available into this system.

BADRE21 can be used as a core to build a NWIS which is currently not available in Morocco for the following reasons:

- NWIS was never thought off.
- SEE has recently decentralized its Water Information System which is still not fully functional.
- Lack of Human resources.

To build a NWIS in Morocco making use of the currently available BADRE21 system , a two phase approach is recommended:

Phase 1: Putting the BADRE21 system available at SEE and ABH & DRH into action: populate it with the information available at the 7 ABHs and 2 directorates, and then upgrade the BADRE21 into a web based application. When this phase is finished a large part of the NWIS is constructed since most of the data needed for NWIS will come from the BADRE21 system.

Phase 2: Develop a web based application for NWIS which will integrate BADRE21, the ONEP system and the MADRPM system. In the case of MADRPM the system needs to be developed, while in the case of ONEP they need to enhance their system to be able to share relevant data under the NWIS system.

All stakeholders are accepting unanimously the SEE to be the NWIS National Focal Point. SEE capabilities to coordinate and supervise a NWIS were assessed and are shown in Annex D. SEE has already allocated most of the finances necessary for implementing the first phase of establishing a NWIS in Morocco.

As a conclusion from the analysis, a conceptual design for the envisioned NWIS is proposed (see Annex B). The proposed NWIS will be built using the BADRE21 as a core after its upgrade to a Web-based application; NWIS will have links to the four main providers of water information. The Basin agencies will load their information immediately to BADRE21 which in turn will be connected to the NWIS. SEE will act as the coordinator and host of the NWIS by consensus of all stakeholders met. SEE, ONEP and MADRPM will decide which type of information to share under the NWIS and make the information available on their secure or public site. SEE will be responsible for coordinating between all stakeholders to ensure timely exchange of reliable water information between them.

To achieve the proposed NWIS in Morocco, a roadmap was formulated and is attached in Annex C.

4.2.8   Palestine

Main stakeholders of water information in Palestine were identified by the National Focal Point (NFP) of EMWIS project (PWA) to be: Palestinian Water Authority (PWA), Ministry of Agriculture (MoA), Ministry of Planning (MoP), Palestinian Central Bureau of Statistics (PCBS), Palestinian Hydrology Group (PHG).

The PWA has the responsibility to collect, analyze and publish information related to water. The PWA has the largest hydrological and rainfall databases amongst all stakeholders. MoA is responsible for collecting agriculture related water information such as irrigation quantities, cropping patterns, crop water requirement…etc. MoP is considered the most advanced stakeholder with respect to the GIS infrastructure and staff qualifications. MoP is embarking on the establishment of a national web-based GIS for the country as a whole. PCBS has, by far, the largest statistical database system in Palestine, the system deals with 41 sectors including the water and environment. PHG has a GIS system that is connected to an ACCESS database. It is considered a generator of its own data although it is a NGO.

Currently, none of the stakeholders' systems is considered to be technically ready to act as a backend servers in a distributed database setup under the envisioned NWIS. Stakeholders' Water Information Systems are not even adequate for their own current data sharing. Internet connections available at the stakeholders' institutions are relatively slow and stakeholders need to be connected to the internet through faster connections.

A NWIS is not available in Palestine; only fragmented systems are available at stakeholders. Stakeholders agreed on the concept of establishing a NWIS and showed the stakeholders' willingness to cooperate towards a NWIS but differed on the management approach. It was clear that stakeholders have conflicts regarding the mandate of collection and dissemination of water–related data in Palestine. According to Palestinian Statistics Law, it is within PCBS's mandate to collect, analyze, and disseminate data including water statistics. On the other hand, PWA insists that the Palestinian Water Authority Law grants PWA the mandate to collect and disseminate not only water data, but also water-related information. Due to these conflicts, no unanimous decision as to which stakeholder can host, supervise and mange the proposed NWIS could be reached. Assessment of the capabilities of three stakeholders to supervise and manage NWIS was made and shown in a spider diagram in Annex D

The main reasons behind the unavailability of NWIS in Palestine can be attributed to the following:

- Conflicts, unclear roles and responsibilities, in addition to poor relationships between some stakeholders.
- Lack of financial resources.
- Stakeholders are not fully aware of the benefits of NWIS over the manual systems.
- No standard operating procedures for data exchange in some stakeholders.
- The current political situation.

Establishing a NWIS system in Palestine may face the following obstacles:

- The disagreement regarding the hosting and coordination of NWIS between stakeholders can really hinder the progress of establishing NWIS.
- The unclear roles and responsibilities regarding data collection and dissemination.
- Political instability and the Intifada.
- Lack of financial resources to improve and upgrade stakeholder's information systems.
- Failure to get a political decision to establish NWIS.
- The unsatisfactory relationship between stakeholders may lead to some stakeholders withdrawing from the project.

Despite the obstacles and threats foreseen for establishing a NWIS in Palestine, two opportunities were defined which stakeholders in Palestine should capitalize on to help establishing a NWIS;

- The first opportunity is the concurrent National GIS Project that will be implemented at the MoP in the near future. The project has similar conceptual design and web-based technology as NWIS and will be applied on a GIS platform. Although the MoP had no plans to include NWIS in their design prior to the consultation visit, they are now willing to consider it once all stakeholders agree on the concept. Applying NWIS as a part of the National GIS is considered highly cost-effective and technically feasible.
- The second opportunity exists within the PCBS as this stakeholder is establishing a Dynamic Statistical Database System. This system is a database that allows data providers to update data independently. It will provide a user friendly interface that will allow users to query for any information required. The system will be utilizing a web-based technology which is similar to NWIS recommendations. Implementing NWIS as part of the statistical system may prove to be an option worth further investigation. If NWIS was not implemented as part of this statistical system then NWIS should have a dynamic link to this system for all water statistical data in Palestine. The PCBS system will act as a main backend server for the NWIS system.

Based on the analysis, a conceptual design for the envisioned NWIS was proposed (See Annex B). The main proposed participants of NWIS are: Palestinian Water Authority, Ministry of Agriculture, Palestinian Central Bureau of Statistics, Ministry of Planning, and the Palestinian Hydrology Group. It is also recommended that the participants list should include the Negotiation Support Unit and the National Water Council since they are main users of the system. NWIS is proposed to be part of the National GIS system that will be developed at the MoP. It is recommended that MoP act as the technical arm for servicing the NWIS. It is also proposed that all stakeholders met have their own systems managed locally in their IT departments and have dynamic links to the NWIS. Information systems of stakeholders must be web-based applications with databases updated regularly by stakeholders.

To implement the proposed NWIS in Palestinian, a roadmap is recommended and is attached in Annex C.

4.2.9 Tunisia

Tunisia is considered a pioneer country in the region for initiating the establishment of a National Water Information System. The initiative was an outcome of a two-year study that was conducted between 1996 and 1998 and focused on the assessment of the water sector in the country. Several pillars were identified by the study, most of which focused on supporting research institutions and data related organizations.

The establishment of the National Water Information System NWIS (Système d'Information National des Ressources en EAU - SINEAU) was a recommendation of one of the pillars under the above mentioned study. As a follow-up stage, a feasibility study financed by the World Bank was conducted in the year 2002 and is still on going. The study comprised of four stages:

- Phase 1: Preliminary Assessment Phase (Bilan de L'existant).
- Phase 2: General Conception (Concept Général).
- Phase 3: Detailed Conception (Concept détaillé).
- Phase 4: Preparation of tender documents and request for proposals (Elaboration du cahier des charges et du dossier d'appel d'offres)

Currently the study is in its third phase and is expected to be concluded by the end of July 2005. Phases 1 and 2 are already completed. The last phase is intended to commence in August and finish by December 2005. The implementation of this project is expected to take two more years and one year as a testing period.

Different stakeholders of the NWIS (SINEAU) were identified under the study. A list of the stake holders can be found under the EMWIS/SEMIDE website **WWW.SEMIDE.tn**. The NWIS (SINEAU) stakeholders are:

- Ministry of Agriculture and Hydraulic Resources (Ministère de l'Agriculture et des Ressources Hydrauliques).
- Ministry of Environment and Sustainable development (Ministère de l'Environnement et du Développement Durable) .
- Ministry of Higher Education (Ministère de l'Enseignement Supérieur).
  Ministry of Scientific Research of the Technology and Capacity development (Ministère de la Recherche Scientifique, de la Technologie et du Développement des Compétences).
- Ministry of Public Sanitation (Ministère de la Santé Publique).
- Ministry of Transport (Ministère du Transport).
- Ministry of Tourism (Ministère du Tourisme).

The feasibility study was conducted under the framework of the Ministry of Agriculture and Hydraulic Resources/ General Administration of Water Resources (Direction Générale des Ressources en Eaux). Several negotiations are still undergoing in order to decide who will be hosting the NWIS (SINEAU), a reason for the delay of the project implementation. According to the feasibility study three scenarios were proposed for hosting the NWIS (SINEAU):

Scenario 1: Establish an independent unit mandated to coordinate between the different stakeholders and follow-up implementation of the NWIS (SINEAU). The disadvantage of this scenario is that it is **costly, time-consuming and requires a political decision.**

Scenario 2: Voluntary Scenario where each stakeholder is given the option to participate in the NWIS (SINEAU). This scenario has a very significant disadvantage, because important information would be missed and not shared if any stakeholder decides not to participate in NWIS, thus the NWIS would lose its credibility of being a comprehensive national system.

Scenario 3: Compulsory Scenario where a distributed database system will be developed under the umbrella of the Ministry of Agriculture and Hydraulic Resources. The System will have links with all stakeholders' systems. Each stakeholder would be responsible for the development, updating and maintenance of his own systems.

The "Institution de la Recherche et de l' Enseignement Supérieur Agricole" -IRESA. (Research and Higher Agriculture Education Institute) working under the administration of the Ministry of Agriculture and Hydraulic Resources was nominated as a competent and resourceful candidate for hosting the NWIS (SINEAU) system. The institution has all the technical facilities and know-how to implement the system. It was also recommended that each stakeholder nominates a liaison officer to coordinate with the Host of the NWIS (SINEAU).

During the feasibility study the following difficulties were encountered:

- There is no general understanding of NWIS (SINEAU) among the stakeholders; they consider it as a custom designed system for the General Administration of Water Resources (Direction Générale des Resources en Eau DGRE) since it is the main data provider (DGRE almost provide 80% of the information). This misconception can be changed by making the stakeholders aware of the benefit of NWIS (SINEAU). The Ministry is aware of the importance of an awareness program that has to be conducted in phases to reach all stakeholders and convince them of the importance and benefits of the system to all of them.
- There are no set standard procedures for data exchange. Researchers and private sector institutions need to send official letters to get data. Standard Operation Procedures for data exchange between stakeholders need to be defined.

 It is anticipated that difficulties in implementing the system might arise. These difficulties are related to the difference in data format and precision among the different stakeholders.

Since Tunisia is one of the first countries under this study who initiated the establishment of a National Water Information System, it is clear from their experience that the establishment of such a system takes a long time; in the case of Tunisia, it is taking 3 years for the feasibility study and is expected to take 3 more years for launching and officially operating the system.

Findings and results of the Tunisian feasibility study can be beneficial for all the other countries in the region that can benefit from the lessons learned and the experience gained. Exchanging the knowledge gained under this study with the other participating countries of EMWIS can be of great benefit. It will be an opportunity for all participating countries to see how these studies are conducted, what are the difficulties and challenges and what kind of options are available.

4.2.10 Turkey

Stakeholders of water information in Turkey were identified by the National Focal Point (NFP) of EMWIS project (DSI) to be: General Directorate of State Hydraulic Works (DSI), Elektrik Isteri Etud Idaresi   (EIE), Ministry of Environment (MoENV), Turkish State Meteorological Service (DMI), State Institute of Statistics (DIE). The three main stake holders are: DSI, EIE and MoEnv.

Among the stakeholders in Turkey, DSI is the main provider of water information; it has 85-90% of water information. Most of the stakeholders exchange information with DSI mainly by exchanging documents automatically in hard copies or by referencing the annual reports published by DSI.

DSI does not have a unified database system to store and process data. Different departments of DSI have adopted different systems to store and analyse their data with no integration between these systems. These systems do not even satisfy the needs of the users in the departments or the needs of other stakeholders. DSI has recently realised the handicap of the current situation and have started a project to develop a unified Water Information System (WIS) to be used by all departments in DSI. The planned WIS will include all water data collected and will be a web-based application with a GIS interface developed using Oracle and NET solutions. It is anticipated that the design and implementation phase of the WIS will take approximately two years; and the system would be operational by the end of 2007. DSI has already secured the funds for system implementation.

In addition to the WIS development project, DSI has started a pilot project to develop a GIS system. During the pilot project, the technical know-how has been developed in DSI. The system still does not cover all of Turkey and needs to be applied for all basins. DSI has also an intranet system which includes: legislation, laws, DSI library, literature, regulations, projects, training, phone book, events and announcements. This system can serve as a source for information under the NWIS system.

In addition to DSI, MoEnv and EIE also collect water information. MoEnv is mainly interested in water quality and quantity data of point-source pollutions. MoEnv has developed a new web-based application called ENVIFO with the help of an EU-funded project. The system is designed to warehouse data of air, water and soil pollution. Although the system has been developed and ready for use, it is still not populated with data. EIE collects surface water levels (elevations), discharges and qualities for potential sites for hydropower. This data is stored under a software system called Hydro. EIE sells information to other stakeholders.

A NWIS is therefore not available in Turkey; the main cause for the unavailability of NWIS in Turkey is that a system like NWIS needs human resources, proper infrastructure and digitised data. All these requirements were not available at the DSI few years ago. Recently, the DSI has taken the following measures to improve the situation:

1. Upgraded the computer and communication infrastructure at the DSI central and regional offices. (The currently available infrastructure can easily host a system like NWIS.)
2. Digitized all the data that were available on paper format. Although the data are available under different fragmented systems, the entry of the majority of the data has been done.
3. Built the IT staff capacity to be able to manage systems like WIS and NWIS.

Now, the implementation of NWIS is more realistic and feasible than before.

The other reason for not implementing NWIS is that the idea of a NWIS is new and has not been thought of before.

Stakeholders have different plans for the future regarding their information systems. These plans are focused on their internal systems and internal needs. The idea of acting as a node under a NWIS was not in their plans as this has been the first time they gather to discuss a National Water Information System in Turkey. But now, they are willing – at the technical level - to meet more often and create a NWIS.

As a conclusion stemming from the analysis, a conceptual design for the envisioned NWIS is proposed (see Annex B).It is proposed to implement the system in 2 phases:

- o Phase 1: develop the planned WIS which will serve the internal needs of the DSI and will provide a unified system to store the majority of water information. The design of the system should take into account the future NWIS design so that expansion of WIS to NWIS would require minimal changes to the system.
- o Phase 2: Establishment of the NWIS system with the participation of MoEnv, DIE, DMI, and EIE -if they agree.

The proposed NWIS will be web-based with links to all stakeholders. DSI will act as the coordinator and host of the NWIS -according to the consensus reached by all stakeholders present at the joint meeting. Annex D includes a spider diagram that reflects the capabilities of DSI to coordinate and supervise the NWIS in Turkey. DSI has the mandate to collect and disseminate water data. All stakeholders will manage their own systems with dynamic links to NWIS. Each stakeholder will decide which type of information to share. DSI will be responsible for coordinating between all stakeholders to ensure timely exchange of reliable water information between the stakeholders. Stakeholders who sell their data like DMI and EIE can still have dynamic links to their web sites where they can offer their services.

To implement the proposed NWIS in Turkey, a roadmap is recommended and attached in Annex C.

4.3. Cost estimate for developing NWIS in each country

The exact costing of all the required systems was beyond the scope of this study. Therefore, a rough cost was performed. A separate complementary detailed study is required in order to define the technical specifications of each system and hence the exact cost for implementing or enhancing NWIS in each country. The proper cost includes many variables that depend on what is currently available and what are the detailed features of the system envisioned in each country. A rough cost for implementing NWIS in each country is listed in the table below. In addition to the cost listed in the table, estimates for in-kind contributions by the stake holders have been established for each country (available in individual country reports).

Table 2- Cost Estimate for NWIS Implementation in Countries

Country	Cost range in Euro		remarks
	From	To	
Jordan	245,000	330, 000	
Malta	239,000	324,000	
Israel	297,000	382,000	
Palestine	287,000	372,000	
Morocco	189,000	189,000	
Lebanon	272,000	375,000	
Turkey	134,000	184,000	The cost is for upgrading the planned WIS which has a secured budget already to NWIS
Tunisia*	-	-	Has already allocated budget for NWIS through a World bank project
Cyprus*	-	-	EU has already secured a fund of 586,000 Euro for implementing NWIS in Cyprus.
Algeria*	-	-	Has already developed NWIS.
Total for all countries	**1,663,000**	**2,156,000**	

* Additional budget might be necessary to extend the system and to put in coherence the SOP and data format with common standards to be defined at the regional level by EMWIS.

5. SYNTHESIZED COUNTRY FINDINGS

5.1. Common types of Water Information available in countries:

Water information available in the countries visited was classified under the following different categories:

- Quantitative Data.
- Maps.
- Grey Literature.
- Call for Papers/Tenders.
- Legislation.
- Training information. / Conferences.
- Standards/Best Practices.
- Information about Innovative technologies used in the water sector

Details of the information available in each country are included in the country reports. Synthesis of available information in all countries visited revealed the following:

Quantitative Data: This is the numerical data monitored and collected by countries. This type of data was found in all countries visited at varying levels. Some countries are using high technologies like SCDA and telemetry to collect this data and automatically store it in database systems while other countries have not yet adopted monitoring programs for manual regular collection of such data. Quantitative data can be subdivided into the following subcategories:

- Groundwater.
- Hydro-meteorological.
- Operational Data.
- Water Uses and demand.
- Water Quality.
- Rainfall.
- Water project information.

Maps: Maps are considered a valuable type of data, mostly existed in digital format in Geographic Information Systems (GIS). This form of data is an asset to a NWIS especially if it included a GIS interface. Different countries have digitized different maps, some of the maps mentioned by different stakeholders in the countries were:

- Land Use.
- Topography.
- Streams.
- Basin and catchments Areas.
- Land Fills.
- Water supply network.

- Wells\sewage networks.

Not all of these maps are available in all countries.

Other types of information: Other types of water information that were reported in countries include: Grey Literature, call for papers/tenders, legislation, training information /conferences, standards/Best Practices, and innovative technologies.

The types of information that were commonly found in most of the countries are: quantitative data, maps, and grey literature. The availability of these types of information in all the countries does not mean it fulfils the actual needs of the stake holders. The least type that was reported in the countries under investigation is the innovative technology and call for papers/tenders type of information. The following spider diagram shows the percentage availability of the different types of data for all the countries
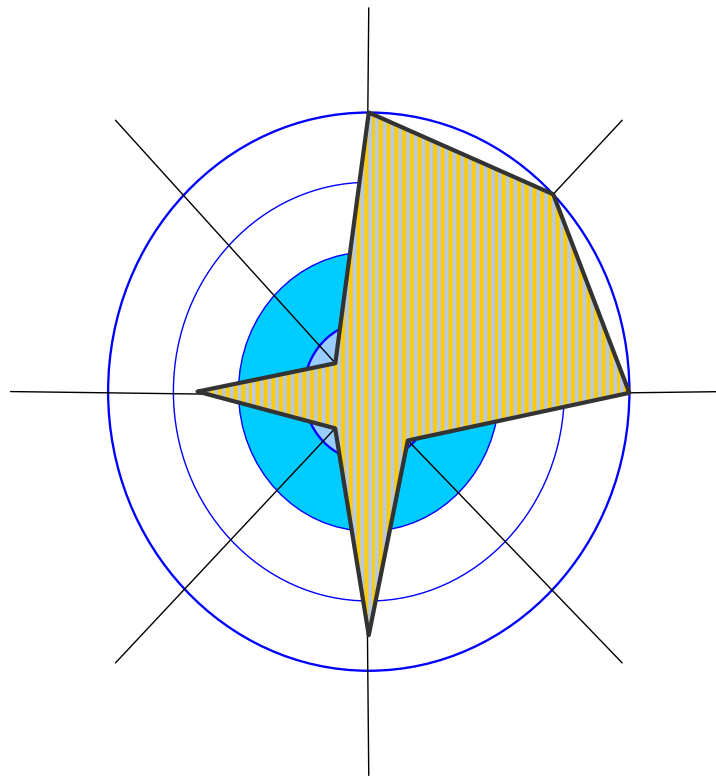
Figure 3- Availability of Types of Information in Countries

5.2. Types of systems used to warehouse/exchange water Information in countries

Different types of systems were reported to be in use in the countries for warehousing and exchanging water information. Many of these systems can be utilized in developing a NWIS in each country. The following table demonstrates the systems used and their percentage availability in countries. It should be noted though that although the countries are using these systems, they might not be fully utilizing their features. For example GIS systems were available in all countries but were found to be used in many cases for producing maps, and were not fully developed GIS connected to a database system. Another example is the usage of the MS-Access database in some countries in a very basic manner just to build data entry tables and simple Add-hoc queries. The idea behind showing the table below is to demonstrate that these systems are available in the different countries but the know-how for using them efficiently must be developed.

Table 3- Percent Availability of Different Information Exchange Systems

Systems used to warehouse and exchange water information	% Availability
Geographic Information Systems (GIS)	100
Web Page	100
Data Base (Access, Oracle)	100
Manual Paper/Phone/fax etc…	100
Excel/Word Sheets	100
Intranet	75
SCADA/telemetry	75
Web-based Application	37.5

Note: Tunisia and Algeria are not included

The Doughnut chart below depicts the % availability of the different systems used in all the countries visited.
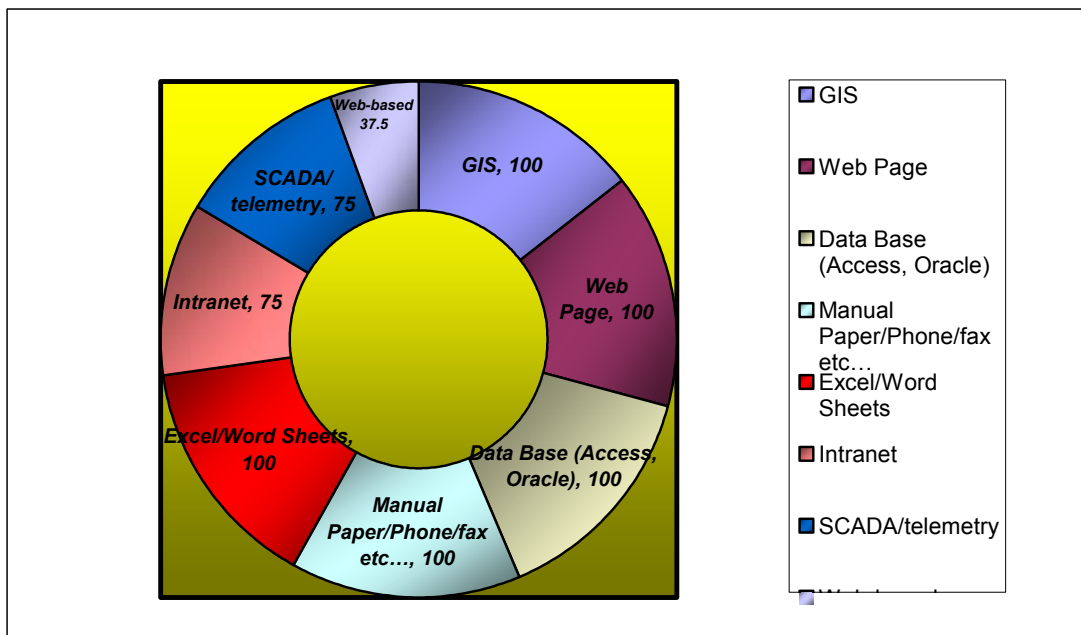

Figure 4- Types of Systems Percent Availability in Countries

5.2.1 Comparison of Water Information Systems' development status in countries

Water Information Systems (WIS) systems are usually used by a group of actors to stores and processes water information using information technologies. In the context of this study, WIS identified were only accessed and used by one stakeholder to warehouse quantitative water data and information. These systems facilitate easy access and exchange of water information. Availability of WIS systems can be considered a major step towards implementing NWIS in countries (see chapter "Ideal NWIS"). Most of the countries visited have already implemented Water information systems. Yet these systems vary in the level of development; some systems are simple excel sheets facilitating data entry and retrieval while others are fully developed web based database systems with GIS interface. All countries are using either MS-Access or Oracle databases. All countries are using the ESRI Arcview and ArcInfo products for their GIS systems, but in most countries the usage of these products was limited to producing thematic maps. Countries were categorized based on the level of development of water information systems into five development levels:

Level 1 Advanced Level: The countries belonging to this level have Water information systems that are advanced to a level very close to or even implemented NWIS web-enabled system to share data amongst their stakeholders. **Algeria, Tunisia** can be considered at this level. While Algeria has implemented a NWIS, Tunisia is still in the design phase.

Level 2 High Level: The countries in this level have developed a WIS system that is shared by more than one stakeholder and the system can be used as a core system to develop NWIS. Cyprus and Morocco can be categorized in this level. Cyprus has developed the ENVIS system and Morocco has developed the BADRE21 system. Both systems can serve as a core for a NWIS. Cyprus has already secured funds to upgrade its system into a NWIS.

Level 3 Medium Level: Countries in this level have developed Water Information Systems but these systems are currently used only by agencies who developed them and sharing information with other stakeholders is done offline. Israel and Jordan are classified under this level. EMWIS/ NFP in these countries is considered the main provider of water information and has already developed an information system to store water data . These systems have facilitated the data exchange process with other stakeholders. The systems can serve after proper upgrading as backend servers to the distributed NWIS envisioned in these countries.

Level 4 Development Level: Turkey and Malta are classified in the development level. In both countries the EMWIS/ NFP is mandated to provide water information to the other stakeholders as well as to the public but in both countries a WIS does not exist at the EMWIS/NFP agency. Turkey on one hand has already initiated a project to implement a WIS but is still in the feasibility phase. Malta on the other hand does not have plans for developing a WIS at the EMWIS /NFP agency but one of the main stakeholder agencies in Malta is developing a water Information system to host most of the water data collected in Malta.

Level 5 Pre-development Level: Lebanon and Palestine are classified in the pre WIS-development level. Water Information Systems in these countries are still not developed and there are main requirements that should be met before developing a WIS or a NWIS in these two countries. Some of these requirements are: availability of data and monitoring networks,

availability of Internet conections in addition to arriving at a consenses over the mandate of water information collection and dissemination- as is the case in Palestine .

The figure below classifies countries into the five levels of WIS development listed above
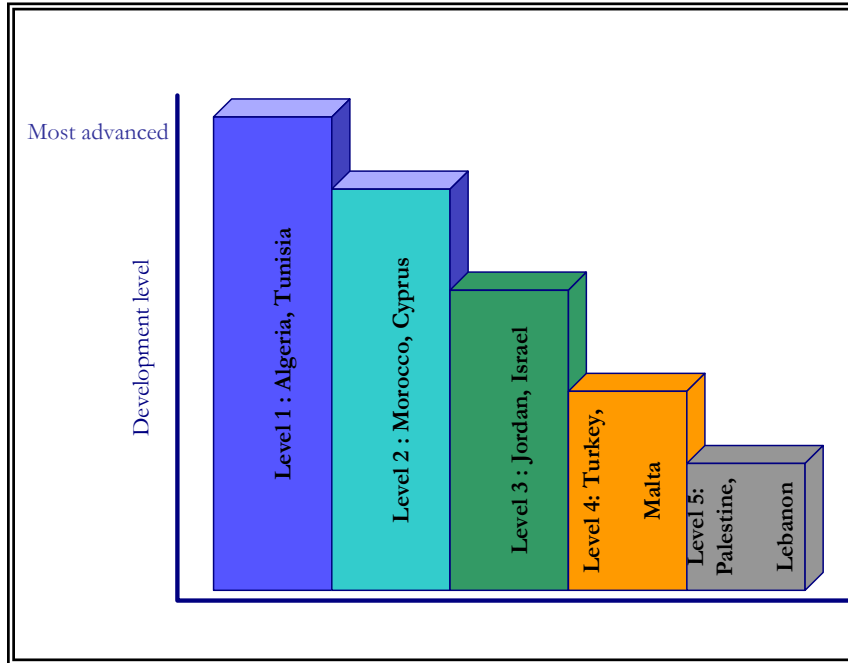

Figure 5- Development Status of the Water Information System in Countries

5.3. Common problems and threats for establishing NWIS

During the consultation visits in each country, several problems in exchanging water information were identified. Some of these can be considered obstacles to the development of NWIS in that particular country. Others can be considered as threats to NWIS even after establishment. Problem tree diagrams that show the root-cause analyses for each country were presented in the country report. Threats were identified for each country in SWOT analysis tables in the country reports.   In this section, a synthesis approach was adopted to arrive at common problems and their associated frequency of occurrence in all countries under investigation. Furthermore, the problems were also sorted according to priority which was considered a function of the severity and relative ease of solvability of each problem. Common problems were identified, some of them were also identified as threats to the establishment or sustainability of NWIS, the table below lists these problems and highlights problems anticipated to be a threat:

Table 4- Common Problems Present in Countries Visited

Problems	Threat	Frequency [1]	Severity[2]	Solvability[3]	Solving priority
Insufficient IT infrastructure (Software, Hardware)		high	severe	easy	high
Lack of NWIS Awareness		high	severe	easy	high
No SOPs for data exchange		high	serious	easy	high
Lack of financial resources to establish and operate	√	high	severe	moderate	high
Unclear roles and responsibilities for data exchange		high	serious	easy	high
All or some data not measured or collected from field		high	minor	difficult	high
Loss or Lack of NWIS-dedicated human resources	√	high	severe	moderate	high
Non-compatible data formats for data exchange		high	serious	easy	high
No or change in high-level political decision for NWIS	√	high	severe	difficult	low
Some stakeholders sell data which is a burden on data exchange		medium	minor	moderate	medium
Some data cannot be shared because they are confidential	√	medium	serious	difficult	medium
Data is not reliable and contains errors		medium	minor	moderate	medium
Lack of data access policies and privileges		medium	severe	easy	medium
Poor or non-existent relationships between stakeholders	√	medium	severe	difficult	medium
Data monopoly or hesitation to release information	√	medium	serious	moderate	medium
Some or the majority of data are not computerized		medium	severe	easy	medium
Political situation	√	low	severe	difficult	low
No organizational structure for SH institutions	√	low	severe	difficult	low
Fears of data security breaches and hackers	√	low	severe	easy	low
No internet connections		low	severe	easy	low

1- Frequency: of occurrence: High=occurs in. > 60% of countries).
                    Medium=occurs in 30%-50% of countries.
                    Low=occurs in< 30% of countries..
2- Severity: effect on NWIS: Severe=can significantly hinder or stop NWIS
                    Serious=can slow NWIS
                    Minor=acknowledged but will not stop NWIS
3- Solvability: difficulty to solve problem:
                    Difficult= not easily solved, requires extensive effort.
                    Moderate=possible to solve but needs time and financial resources.
                    Easy

These problems were further classified according to three distinctive characteristics: the first is the frequency of problems occurrence in countries; the second is the severity of these problems and the third is the solvability of problems. All these criteria were used to come up with a priority to solve these problems that ranged from low to high priority.

The figure below graphically ranks the different types of problems according to their frequency of occurrence.
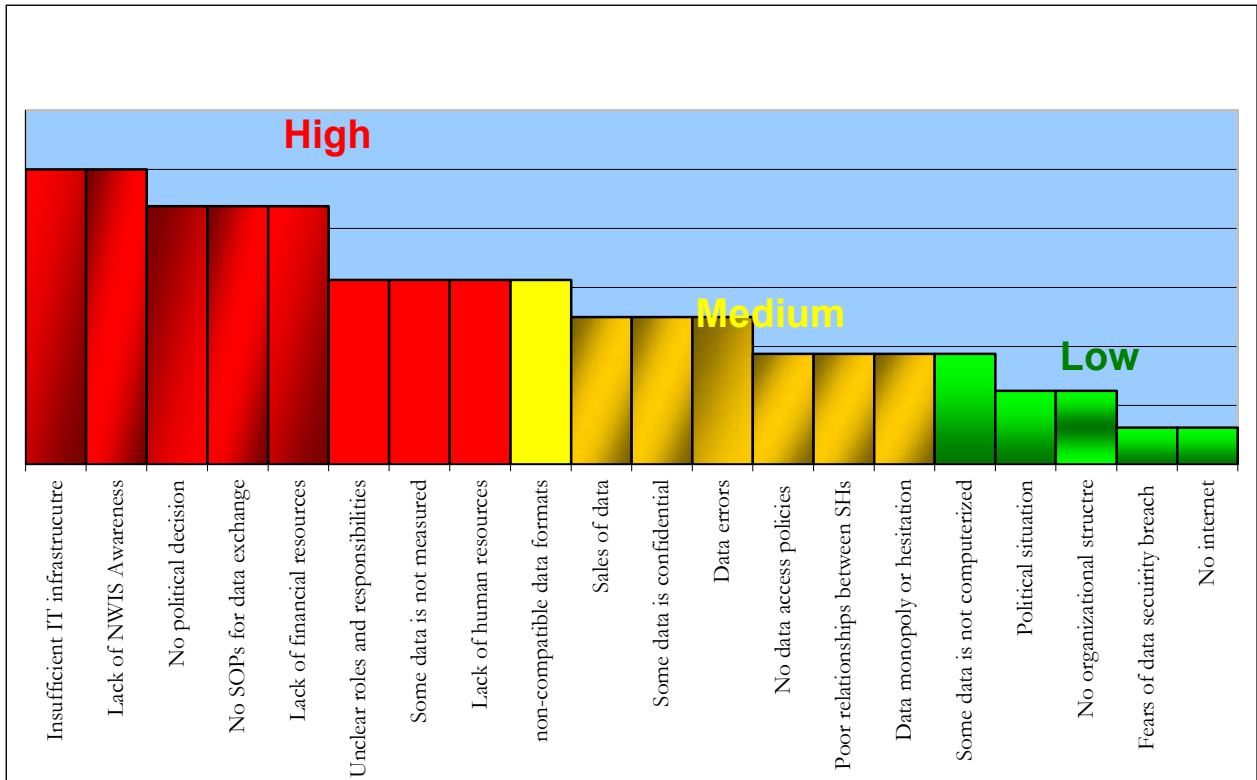

Figure 6- Frequency of Different Types of Problems

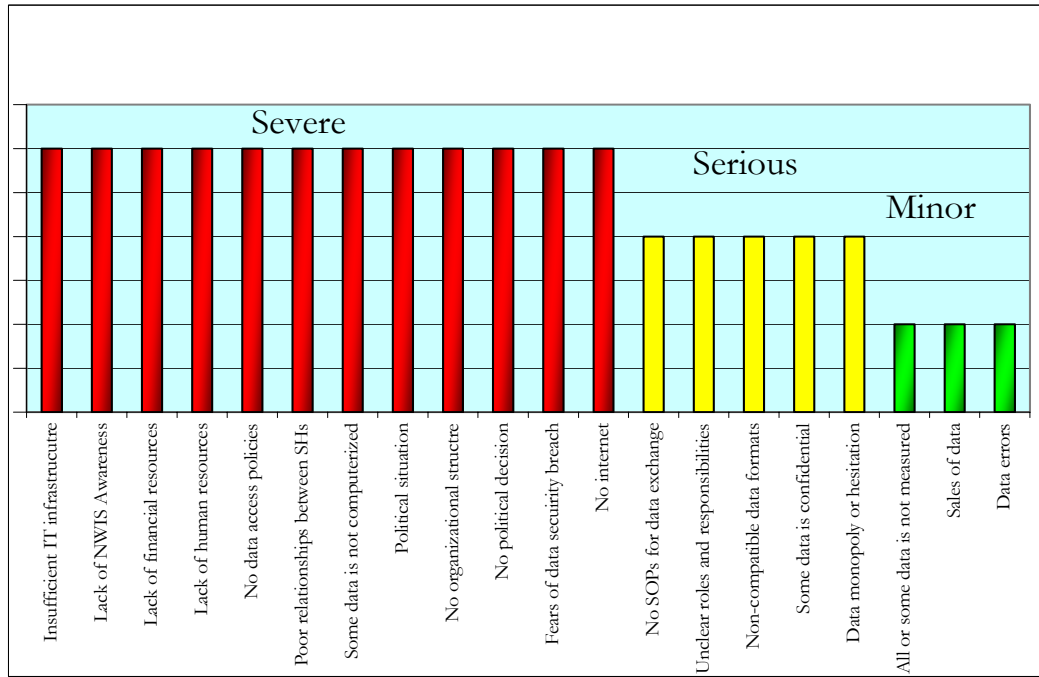The following figure demonstrates the severity of every problem.

Figure 7- Severity Levels of Problems

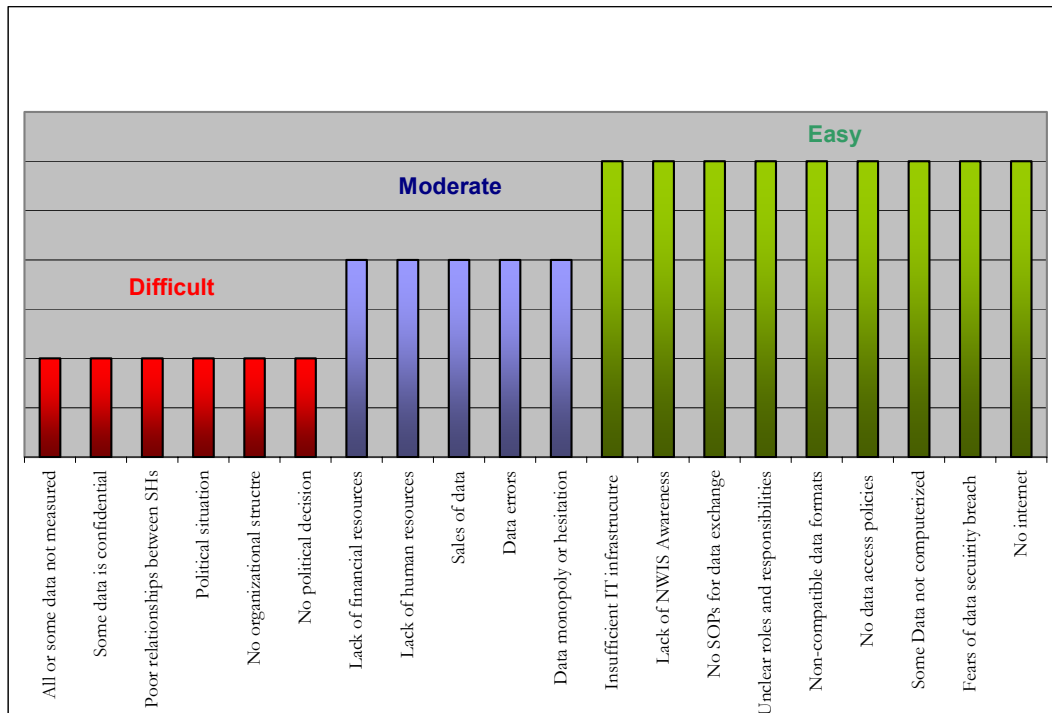The figure below shows all the problems identified and their associated level of solvability.

Figure 8- Solvability Levels of Problems

5.4.   Opportunities to NWIS in countries under investigation

Opportunities were identified during the in-country visits and included under a SWOT analysis section for each country in country reports. Many of these opportunities can be considered as assets to be utilized in the development of NWIS in the countries.

The following opportunities we identified in many countries:

- Stakeholders are facing problems in current data exchange procedures.
- Acceptance of NWIS concept during consultation visits.
- Willingness of stakeholders to share information under a NWIS.
- On-going donors' projects related to water information in some countries
- Availability of utilizable IT infrastructure in some countries.
- Legal obligation to share/provide data.
- Existing web-based applications.
- New organization restructuring allowing for developing new systems for data exchange.
- Availability of in-country IT know-how (although the IT know-how is available in the country but it is not available at the stakeholders or the number of staff available are not adequate and are overloaded with other responsibilities).
- Available Funds/partial or full in some countries like Cyprus and Tunisia.
- Countries joining the EU have new obligations to provide water information; this requires a platform for exchanging information with stakeholders and EU.

5.5. EMWIS NFPs assessment:

EMWIS National Focal Points capabilities to coordinate and supervise the NWIS in their countries were assessed and a spider diagram that reflects the findings for each country was developed and is included in Annex D.

The following criteria were used for assessment:

- Human Resources- Technical skills.
- Financial capability to manage NWIS system.
- Acceptance by other Stakeholders.
- Political mandate.
- Infrastructure.
- Availability of links with other stakeholders.
- Availability of a core system to build on.
- Level of data ownership.

Assessment of NFPs showed that the EMWIS / NFP in some countries is capable of developing, supervising and hosting a NWIS. An example is shown in the spider diagram below:
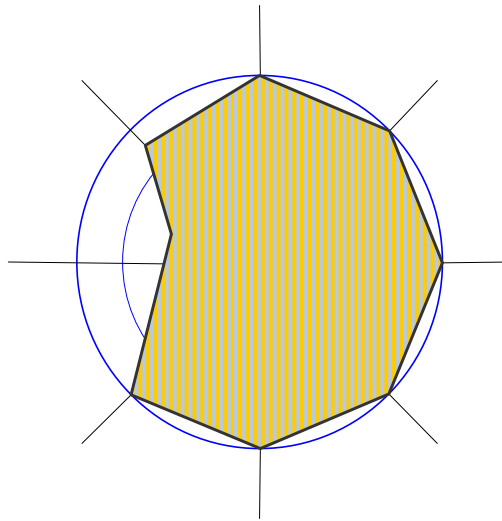

Figure 9- Example 1 of NFP Assessment (Spider Diagram)

While in other countries EMWIS/NFP needs a lot of support to strengthen their capabilities in almost all aspects to be able to implement a NWIS. The spider diagram below shows a typical case in which the EMWIS NFP has the political mandate and is accepted by other stakeholders but needs capacity building and strengthening in all other aspects:
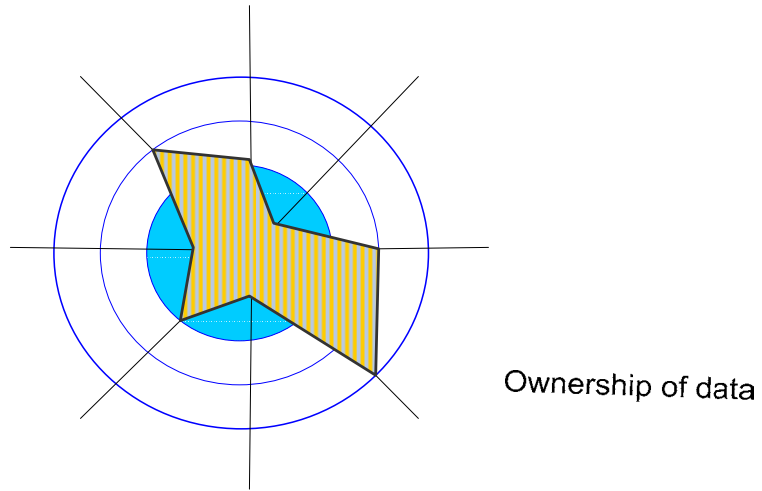
Figure 10- Example 2 of NFP Assessment (Spider Diagram)

In another case, no consensus was reached as to which agency is to develop, support and host NWIS, therefore 3 agencies were assessed as shown below:
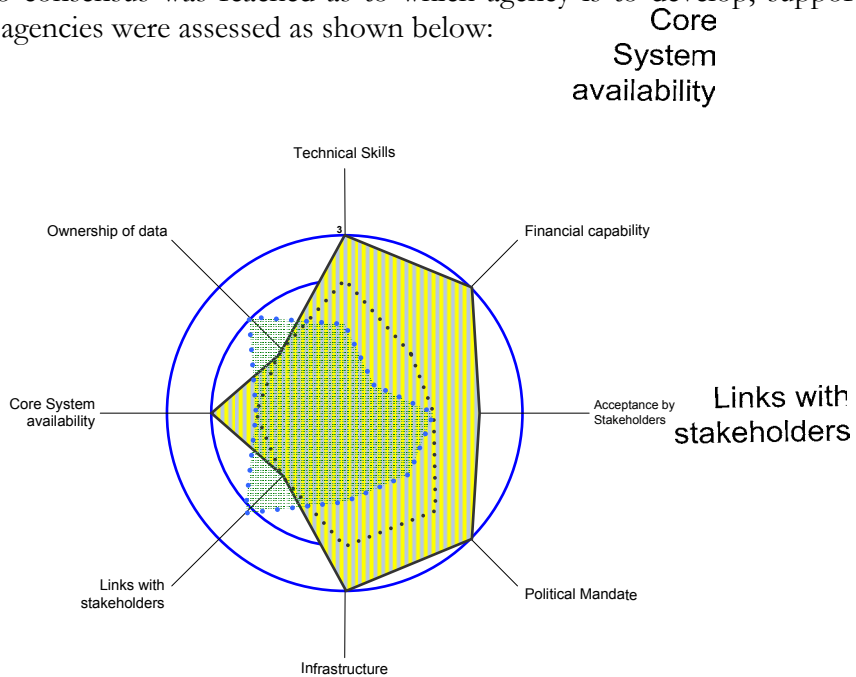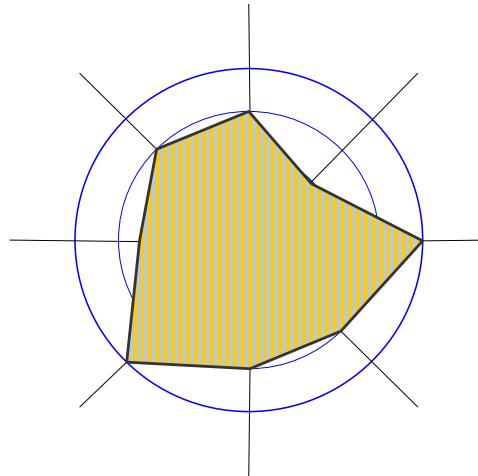

Figure 11- Example 3 of NFP Assessment (Spider Diagram)

Apart from the extreme cases listed above, the spider diagram of EMWIS NFPs in other countries reflected points of strength and weakness of NFPs. These countries should capitalize on their

strengths and try to work towards strengthening their capacities in the weak areas to be able to develop a NWIS. A typical spider diagram for countries in this category is shown below:

Figure 12- Example 4 of typical NFP Assessment (Spider Diagram)

Countries were categorized based on the level of their capabilities to coordinate and supervise the NWIS in their countries into three levels:

Level 1: Advanced; countries belonging to this level have EMWIS NFPs who are ready to act immediately as NWIS coordinator and host. Countries belonging to this level are Turkey, Morocco and Israel.

Level 2: Medium capabilities; countries belonging to this level have EMWIS NFPs who have the basic capabilities but needs further support to enhance their capabilities to be able to act as NWIS coordinator and host. Some of the NFPs under this category can act as coordinators of NWIS immediately but not as a host of NWIS. Countries belonging to this level are Jordan, Malta, and Cyprus.

Level 3: Countries belonging to this level have EMWIS NFPs who are either not suitable to act as NWIS NFPs as it is the case in Algeria where the NFP has already been chosen to be a different stakeholder (i.e the MRE), or the capacity of EMWIS NFP in most of the categories assessed was very low which means that the EMWIS NFP needs a lot of support to strengthen its capabilities in almost all aspects to be able to implement a NWIS as it is the case in Palestine and Lebanon.

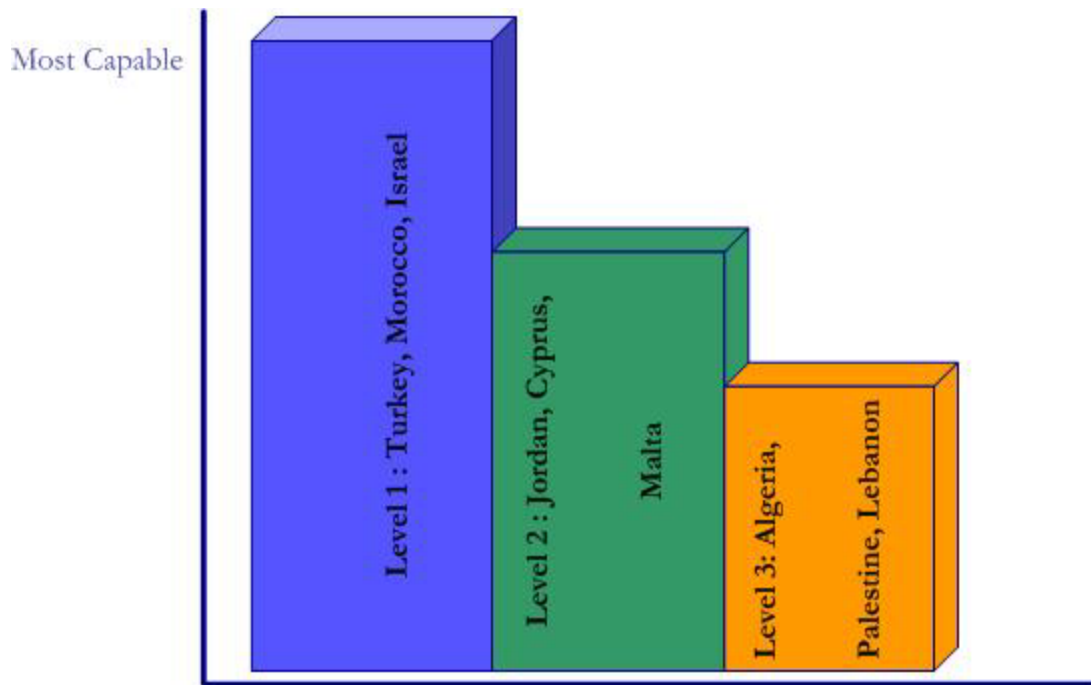The figure below shows the countries under the different categories:

Figure 13- EMWIS NFPs categorized according to their capabilities to coordinate and host NWIS

5.6. Readiness of Countries for NWIS Development:

Two distinct phases in NWIS development were defined to enable assessment of countries readiness to implement NWIS; the Pre-NWIS development phase and the NWIS development phase. These 2 phases are required to develop a NWIS in any country. While the first phase is considered as a preparatory phase, the second is the implementation phase. These two phases require following typical steps to implement them. This section defines these phases and their requirements, and then shows the percentage fulfilment of these steps in countries under investigation. The percentages can help show the steps where support is needed in those countries and therefore can help identify potential projects in the region that can address a common need.

Pre-NWIS development phase

The pre-NWIS development phase prepares the country towards preparing the infrastructure needed before the development of NWIS. The typical pre-NWIS steps are:
- Survey of all water data sources.
- Monitoring of Water resources.
- Development of Standard Operating Procedures for monitoring and data collection.
- Usage of computers and availability of network infrastructure.
- Having qualified IT staff.
- Institutionalization of monitoring by having a specialized data collection and monitoring department.
- Internet connection availability.
- Web sites available for some or all stakeholders.

Once a country has fulfilled most of these basic requirements for NWIS, it naturally proceeds forward to the next development phase.

NWIS development phase :

- While the pre-NWIS development phase prepares the country for developing NWIS and has many steps that are not specific to NWIS but are necessary for its development, the NWIS development phase has specific steps for developing NWIS in countries. The typical NWIS development steps are:

  - Conduct awareness campaign.
  - Obtain political decision to implement NWIS
  - Establish a coordination committee
  - Overall NWIS Concept.
  - Select host/ coordinator.
  - IT staff Capacity Building.
  - Data Classification/sharing policy.
  - Data Collection Roles & Responsibilities.
  - Secure Funds.

- Feasibility Study & Design.
- Detailed Technical Design Study.
- Write the TOR.
- Develop NWIS.
- Validation and testing
- Institutionalization & implementation.

Synthesizing information obtained from countries showed that about half of the countries visited have completed the pre-NWIS development stage. Roughly the other 30% of the countries has a pre-NWIS development level of around 60%. The remaining 20% of the countries has no significant progress in the pre-development stage. For the NWIS development phase, the progress of the countries visited can be categorized into three groups. The first group, entailing 30% of the countries, in which progress ranged from approximately 60% to a near-perfect 100% in the case of Algeria. The second group where the progress hovered around 25% covered around 40% of the countries. The final group has 30% of the least NWIS-developed countries.

The following table shows the percent of the countries that has already started or completed the shown steps of each of the two stages:

Table 5- NWIS Country Development Level

Step/Phase of Development	% of Countries that Implemented Step
Pre-NWIS development phase	
Survey of water data sources	80
Monitoring of Water resources	50
Development of Standard operating procedure for monitoring and data collection	20
Supporting computerization	90
Having qualified IT staff	55
Institutionalization of monitoring by having a specialized data collection and monitoring department	80
Internet connection availability	80
Web sites available for some or all stakeholders	80
NWIS development phase	
Awareness Campaign	10
Political Decision	20
Coordination Committee	20
Select host/ coordinator	70
Staff IT Capacity Building	80
Data Classification/sharing policy	20
Data Collection Roles & Responsibilities	40
Secure Funds	30
Feasibility Study & Design	20
Detailed Technical Design Study	20
Write TOR	10
Develop NWIS	10
Institutionalization & implementation	0

With reference to the table above and taking into consideration other criteria like the level of WIS development, number and level of risk to implement NWIS, assessment of NFP and the cost factor, the NWIS-readiness was aggregated for the countries into four cluster groups as follows:

Group 1: Most advanced NWIS-Ready Group: this group was considered to be the most ready for NWIS. It contains Algeria as the most NWIS ready of all the countries in the study group where Tunisia and Morocco are closely lagging behind.

Group2: Medium High NWIS-Ready Group: This group is considerably advanced in the development of NWIS. Having Cyprus, Israel and Jordan in it, this group can be categorized as completing the Pre-NWIS stage and still have around 75% of the steps to be completed to get to NWIS system.

Group3: Medium Low NWIS-Ready Group: This group which contains Turkey and Malta is around 50% through the pre-NWIS stage and still has steps to be completed to be ready for NWIS implementation.

Group4: Still-to-be Developed NWIS Group: This group is categorized as the most countries in need of support to advance through the pre-NWIS and NWIS development stages. The consultation visits proved very beneficial as it explained further to the stakeholders of these countries the need for NWIS. These countries expressed willingness to proceed in the development of NWIS.

Figure - 14- below graphically depicts the different clusters of NWIS-readiness among the countries under study in a bar chart diagram
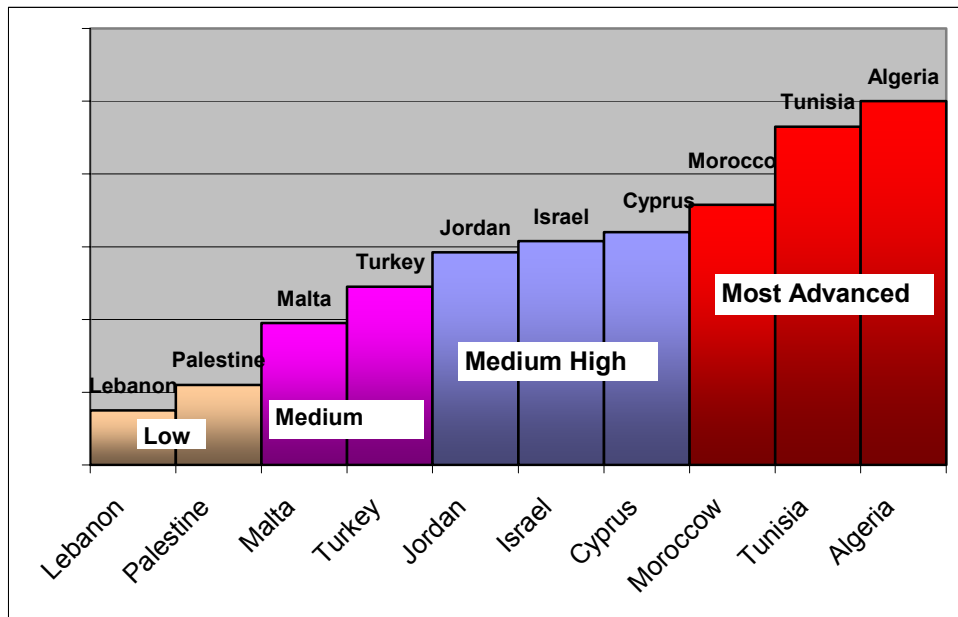

Figure 14- NWIS Readiness among Countries

5.7. Relationships between stakeholders in countries

Relationships between stakeholders with regards to the exchange of water information were assessed in the different countries and Venn diagrams were produced to show these relationships, Venn diagrams produced for all countries are attached in Annex E.

Relationships between stakeholders are considered an asset to the establishment of a NWIS when they are close or a threat when they are weak. Furthermore, weak relationships also reflect on exchanging information with EMWIS as some of the information required by EMWIS is not available at EMWIS NFP organization and needs to be gathered from other stakeholders. The example below shows a Venn diagram for a country that has strong relationships between the stakeholders where exchange of water information is done on a regular basis.

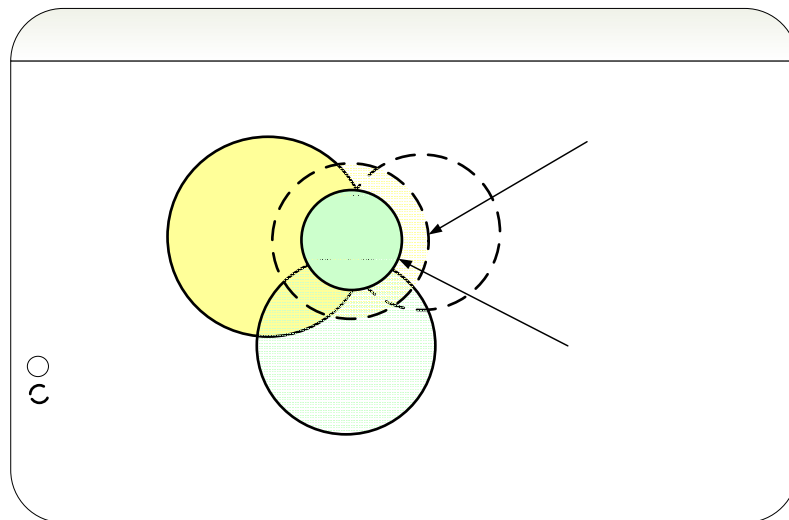**Figure 15- Example of Good relationships between stakeholders (Venn diagram)**

In other cases, not all stakeholders are exchanging information although the exchange is required, leading to weak relationships in information exchange between stakeholders as shown below
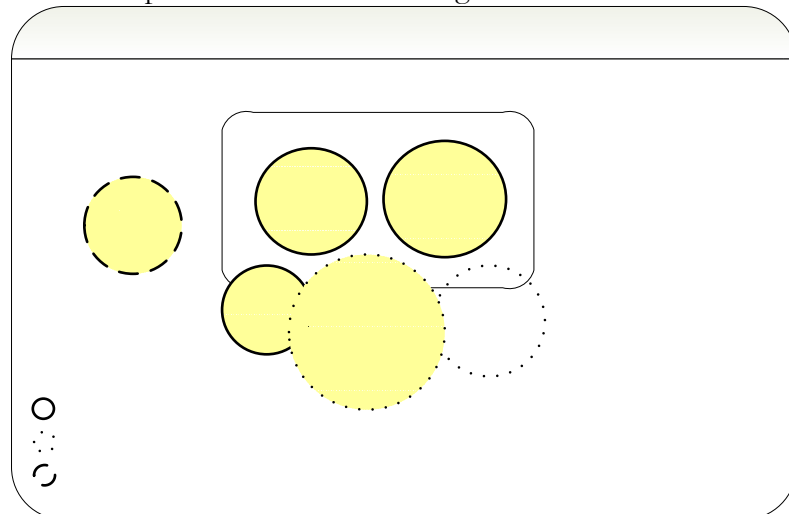
Venn
NWIS Stake

SH1

Figure 16- Example of Weak relationships between stakeholders (Venn diagram)

Generator/providers   **SH2**

In most of the countries visited, the relationship between stakeholders is satisfactory. In Palestine stakeholders have conflicts regarding the mandate of collection and dissemination of water–related data, relationships between stakeholders should be strengthened and the mandate of data collection and dissemination should be clarified, these are two pre-requisites for establishing NWIS in Palestine. In Lebanon and due to the previous organizational structure; relationships between stakeholders with regards to data and information exchange were weak, however it is anticipated that the new organizational structure would strengthen these relations and enhance the data exchange process.

6. CONCLUSIONS

6.1. General conclusions

The following are the conclusions of the final study which covered the syntheses of 10 countries:

- Most of the countries visited have not developed or thought of developing a national water information system. The main reasons for not developing such systems were related to one or more of the following:

    1- Lack of human resources within the stakeholders met
    2- Lack of financial resources.
    3- Lack of awareness of NWIS benefits.
    4- Political situation.
    5- Absence of a political decision to establish such a system.
    6- Lack of the institutional structure and technical infrastructure to collect, store and share data.
    7- Unavailability of data.

- Algeria is the only country among the countries included in this study that is developing a NWIS but has not yet institutionalized the system. Tunisia has started a project for the development of a NWIS; a feasibility study has been conducted and a detailed design phase for the targeted system should have started in August and finished by December 2005. Apart from Algeria and Tunisia, none of the other countries visited are developing a NWIS. But, at the technical level, they are all convinced of the need of such system. Some countries, however, have started initiatives or developed systems that can serve as core components for developing a NWIS like Morocco and Cyprus.Others already have systems that can be utilized as back end servers for a NWIS like Jordan and Israel. In Turkey, a new project for developing an internal WIS for the main provider of water information has been initiated. In Malta, the mandated agency for providing water information lacks a WIS for its internal use although the other stakeholders have developed internal systems. Palestine and Lebanon, on the other hand, have fragmented systems available at stakeholder agencies with little facilities for information exchange. In Lebanon, the existing systems hardly satisfy internal needs of stakeholders and major upgrades are required.

- All stake holders met in countries visited are now convinced of the need of a NWIS. Although some of them were reluctant at the beginning of the study, the technical explanations provided, the potential benefits and the collaboration at the national level were considered as very positive.

- The types of information that were most commonly found in all countries are; quantitative data, maps, and grey literature. The least frequently found types reported in the countries are the innovative technology and call for papers/tenders types of data.

- Assessment of the relationships between stakeholders within the different countries shows that these relationships range from "very close" where data is exchanged on regular basis to "nearly non-existent" where data is not exchanged at all between stakeholders.

- Assessment of EMWIS NFP's capabilities to develop, supervise and host a NWIS in the countries visited revealed that some of the NFPs are capable of assuming the role of a NWIS NFP while others still need lots of support to enhance their capabilities and capacity to be a NWIS NFP. In other countries, capabilities of more than one stakeholder were assessed since there were conflicts between stakeholders over the mandate of water information collection and dissemination. Countries were categorized based on the level of their capabilities to coordinate and supervise the NWIS in their countries into three levels:

  Level 1: Advanced; the NFP can act immediately as NWIS coordinator and host. Turkey, Morocco and Israel are in this level.

  Level 2: Medium capabilities; the NFP needs further support to enhance their capabilities to be able to act as NWIS coordinator and host. Jordan, Malta, and Cyprus belong to this level.

  Level 3: Needs major support to strengthen their capabilities to be able to act as a NWIS NFP Palestine and Lebanon are in this level. Algeria's EMWIS/NFP also was categorized in this level as the NWIS NFP has already been chosen in Algeria and is the Ministry of Water Resources and not the EMWIS NFP.

- All countries are facing problems in exchanging water information; these problems can be considered as obstacles for implementing NWIS. Some of the problems are common between countries while others are specific for some countries. Common problems need to be addressed for all countries as some of these problems can be considered obstacles to the development of NWIS in each country, while others can be considered as threats to the institutionalization and sustainability of NWIS after its establishment. Some of the problems were identified as difficult–to-solve like: the unavailability of data, the confidentiality of data, the poor relationships between stakeholders or the political situation in countries. These problems clearly affect exchanging information with EMWIS as well. These problems need to be addressed individually by each individual country.

- Two distinct phases in NWIS development were defined; the Pre-NWIS development phase and the NWIS development phase. These 2 phases are required to develop a NWIS in any country. While the first phase is considered as a preparatory phase, the second phase is the prerequisite implementation phase.

- Countries readiness for NWIS was assessed and accordingly countries were divided according to their readiness to implement NWIS into four groups:

  Group 1: Most advanced NWIS-Ready Group: this group includes Algeria, Tunisia and Morocco. While Algeria is leading in this group, Tunisia and Morocco are currently closely lagging behind.

Group2: Medium-High NWIS-Ready Group: This group includes Cyprus, Israel and Jordan. These countries have almost completed the Pre-NWIS stage and have completed some of the steps required under the NWIS development stage.

Group3: Medium-Low NWIS-Ready Group: This group includes Turkey and Malta. These countries are half way through fulfilling the pre-NWIS stage and have completed some of the steps required under the NWIS development stage.

Group4: Still-to-be Developed NWIS Group: This group is still in the pre-development phase of NWIS. The group includes Palestine and Lebanon. Both countries are categorized as the most countries in need of support to advance through the pre-NWIS and NWIS development stages.

- Since many countries are not aware of the benefits of NWIS for solving and facilitating their data exchange problems, the launching of awareness raising campaigns in the countries under investigation is of crucial importance in order to convince their high-level decision makers of the benefits of NWIS, and thus arriving at the required political decision. Lack of such a political decision at the high level is not only considered an obstacle to the establishment of a NWIS, but can rather become a threat to the sustainability of the NWIS system.

- Main reasons (obstacles) behind the sometimes unreliability and intermittent provision of information to EMWIS by the countries visited can be attributed to one or more of the following:

  o Most of the types of information required by EMWIS e.g. best practices, water legislation information, grey literature, etc. are either not readily available or need time to transfer them into digital format. The only type of information usually available in digital format is the quantitative information but considered as confidential in most of the cases.
  o Unsatisfactory relationships between stakeholders within the country.
  o Overloaded staffs that is busy with other responsibilities.
  o Lack of WIS within countries.
  o Confidentiality of data and the political situation.

  Creation of a NWIS within each country will remove or alleviate the first four obstacles mentioned above and will greatly facilitate the transfer of information to EMWIS. It is very hard for EMWIS to remove the fifth obstacle as it is beyond its authority

- It can be deduced from the study visits that wherever regulations for data exchange and information provisions existed, the flow of data and response of stakeholders were much smoother and timely. A clear example of this is the EU Water Framework Directive which obligates both Cyprus and Malta to provide data to EU on timely and defined format standards. Therefore, the need for a memorandum of understanding to regulate the flow of information within the countries or to EMWIS is needed to regulate the types of data and oblige the countries to fulfil the agreements.

- Finally, it can be concluded that all the countries need assistance regarding the development of NWIS but with varying degrees. Focus should be made on trying to help all countries to

eventually bring them to a compatible level. But at the same time and for the purpose of obtaining a lead example to use in the awareness campaigns, countries with advanced NWIS development like Algeria and Morocco should be immediately assisted to get their NWIS up and running.

6.2. Action opportunities for EMWIS and donors agencies

SWOT analyses were performed per country and were included in the country reports. The analysis identified country specific opportunities which the country should utilize and capitalize on to implement a NWIS. In this section specific action opportunities for EMWIS and donor agencies are identified. These opportunities are derived from Table 5 in section 5.6 which lists the steps needed to implement NWIS and their current percentage fulfilment in countries. The steps that are lagging in most countries (50% or more of the countries have not yet fulfilled them) are identified as opportunities for EMWIS and/or donor agencies to enhance the current situation in countries towards implementing NWIS. Table 6 below lists these opportunities.

Table 6- List of Opportunities for EMWIS and Donors Agencies

Action Opportunity	% of Countries that need to implement this step	Opportunity for EMWIS	Opportunity for donor agencies
Pre-NWIS development phase			
Strengthen country capacity in monitoring water resources	50		√
Development of standard operating procedure for monitoring and data collection	80	√	
Assigning more IT staff in stakeholder organizations	45		
NWIS development phase			
Conduct Awareness Campaigns o promote for NWIS between stakeholders and higher management	90	√	
Help countries take high level political decision to implement a NWIS	80	√	
Help establish a Coordination Committee in countries to prepare and implement NWIS	80	√	
Setting Data Classification/sharing policy, data collection roles & responsibilities	60	√	
Help country secure funds for implementing NWIS	70	√	
Conduct a detailed study for NWIS implementation	80		√
Develop technical specifications and design for NWIS	80		√
Write the TOR	90		√
Develop NWIS	90		√
NWIS Institutionalization & implementation	100		√

6.3. Road Map for EMWIS to Aid in NWIS Development

In order to come up with a road map that aims to develop/enhance NWIS in as many countries as possible, the following criteria were adopted:

- Minimizing obstacles and solving problems that hinder the development of NWIS in the countries
- Capitalizing and making use of in-country on going opportunities that can fortunately help NWIS development
- Carefully identifying and containing (if possible) the threats to the development of NWIS or to a developed NWIS in any country
- Recognizing and strengthening the weaknesses (gaps) in the NWIS development in all countries

Using the afore-mentioned criteria, the following road map is recommended for EMWIS or any donor agency to go forwards, the road map lists the action required , the problem or obstacles it deals with, the threats it is containing and the opportunity utilized (when applicable):

Table 7- Actions Road Map and their Effectiveness

Action	Problem/obstacle Addressed	Opportunity to utilize	Threats Contained
Conduct an NWIS Awareness Campaign	Lack of NWIS Awareness	After this study all NFPs know about NWIS and enthusiastic about implementing it in their countries	
Obtain a country high level political decision to establish NWIS	No or change in high-level political decision for NWIS	Act immediately after the consultant visit since most stakeholders in countries are willing to go forward with data sharing through NWIS	Contains or even eliminates one of the major threats to NWIS in the countries which is lack or change of political decision
Development of Standard operating procedures for data collection and exchange through NWIS	unavailability of SOPs for data exchange	Step in countries where they are in the process of organizational restructuring	Protect NWIS to a certain degree from possible future organizational restructuring threats
Hire more IT staff in stakeholder organizations	Loss or Lack of NWI-dedicated human resources	Available of in-country IT experience and knowledge	With dedicated staff the threat of loss of qualified staff will be reduced
Help establish a Coordination Committee in countries	Poor relationships between Stakeholders		Will significantly reduce the threat of stakeholders withdrawing from NWIS by actively letting them participate in the committee
Coordinate with on-going similar projects		Availability on-going projects that are working on similar ideas to jointly build NWIS whenever possible. This opportunity will help reduce the funds required to implement NWIS.	
Setting Data Classification/sharing policy, data collection roles & responsibilities	Unclear roles and responsibilities for data exchange		
Secure funds	lack of financial resources to establish and operate NWIS		Eliminates the major threat to NWIS in almost all the countries, the threat of lack of financial resources
Conduct a full feasibility study and design

Detailed Technical Design Study

Develop and institutionalize NWIS | unavailability of NWIS in countries | | Contains the Major threat in countries of losing information and the threat to EMWIS system of not having updated information |

7. RECOMMENDATIONS

7.1. Recommendations for EMWIS:

Although the EMWIS /NFPs in most of the countries visited are influential in the water sector in their respective countries, other stakeholders are holding big stakes with regard to water information and needs to be more involved and aware of what is being implemented under EMWIS, many stakeholders visited in countries did not know about EMWIS. It is recommended to hold more awareness campaigns and to involve stakeholders in sub-projects or tasks under the EMWIS project.

To improve exchange of information between countries and EMWIS, information required for EMWIS should be classified into two categories per county:
1- Readily available and computerized Information per country
2- Information that is not readily available and requires time and effort for preparation.
Readily available information should be updated regularly by countries while time consuming Information can be updated on annual or by-annual basis.

Developing NWIS systems in countries will take two to four years depending on country's readiness level. During this period and to ensure regular updating of EMWIS site information, it is recommended that EMWIS subcontracts a third party for two to four years to help countries prepare information in the proper format and uploads it to the countries EMWIS site. This will help solve most of the problems pertaining to the outdated country sites under EMWIS international site.

This study has introduced NFPs and stakeholders in countries to NWIS concept, yet it is recommended to have a group meeting in Algeria around mid 2006 when Algeria's NWIS is up and running to demonstrate a live system and share the Algerian experience.

Subsidize Internet connections for NFPs who lack or have slow internet connections.

Road map steps listed in section 7.2 below should be followed in each country, yet steps 8 to 11 in the road map can follow one of the following scenarios:

1- Develop NWIS individually per country.
2- Develop one NWIS system that can be used by all countries following the ideal system conceptualized under this study. The system should have features that allow customization for countries specific needs. This scenario will reduce the cost tremendously but might face some objections from countries.
3- If Algeria (who is the source code owner of the unique NWIS found between countries visited) is willing to share the source code with other countries with appropriate customization, this would be a great opportunity to utilize since it is the least time& effort consuming and the most economic.

Finally, the following are recommended immediate next steps with regards to NWIS development assistant to countries:

- The recently-designed NWIS in Algeria needs to be followed up to ensure that launching and use of NWIS went successful. If launching the system in Algeria faces obstacles, then help Algeria to overcome these obstacles in order to ensure successful implementation of NWIS.
- Start awareness raising campaigns through seminars to keep the momentum going after the consultancy visits which also served as a promotional campaign for NWIS.
- Help Morocco finish the last step needed to transfer their WIS to NWIS.
- Help enhance Palestine and Lebanon's readiness to NWIS level from the pre-development level to the development level or even to the medium level.
- EMWIS can help all countries implement any or all of the first eight steps in the road map.

7.2. Recommendations for NWIS development/enhancement:

Since NWIS is virtually not implemented in any country except for Algeria, it is highly recommended that countries get varying levels of assistance from EMWIS and donor agencies in order to enable them to establish NWIS which proved to be a major pre-requisite to water information exchange with EMWIS. Country specific recommendations and roadmaps are included in country reports.

A successful road map for developing/enhancing NWIS in countries should be built on the following criteria:

- Minimizing and eliminating obstacles and problems that hinder the development of NWIS in the countries. Begin with higher priority, most frequent and at the same time most damaging problems.
- Capitalizing and making use of in-country on going opportunities that can fortunately help NWIS development. This will lessen the amount of assistance from EMWIS or donor agencies
- Carefully identifying and containing -to the extent possible- the threats to the development of NWIS or to a developed NWIS in any country. Care should be taken to the lack of financial resources and the political instabilities threats in some countries. The effect of these can be damage even the well developed NWIS.
- Recognizing and rectifying the weak points (gaps) in the NWIS development in all countries.

Using the afore-mentioned criteria, the following road map is recommended for EMWIS or any donor agency to go forward:

1. Conduct an NWIS Awareness Campaign.
2. Obtain a country high-level political decision to establish NWIS.
3. Development of Standard operating procedures for data collection and exchange through NWIS.
4. Hire more IT staff in stakeholder organizations.
5. Help establish a NWIS Coordination Committee in countries.
6. Coordinate with other donors for similar on-going projects.
7. Setting Data Classification/sharing policy, data collection roles & responsibilities.
8. Secure or help secure funds.

9. Conduct a full feasibility study and design.
10. Conduct a detailed technical design study.
11. Develop and institutionalize NWIS.

8. ANNEXES

Annex A: Stakeholders of Water Information met in each country

Annex B: Conceptual design for the envisioned NWIS in countries

Annex C: Proposed road map for establishing NWIS in each country

Annex D: Assessment of EMWIS/NFP capabilities to coordinate, manage and host NWIS in each country.

Annex E: Venn Diagrams for NWIS stakeholders relationships in countries