018530 - SWITCH

Sustainable Water Management in the City of the Future

Integrated Project
Global Change and Ecosystems

Deliverable D 1.1.3

Development of effective and interactive computer models for the analysis, integration, and validation of technological options and scenarios, and to develop a decision support system for Jericho water management.

Due date of deliverable: M60
Actual submission date: M60

Start date of project: 1 February 2006 Duration: 60 months

HWE-Palestinian non-profit NGO
UNESCO-IHE Institute for Water Education

SWITCH Deliverable Briefing Note Template

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission	
CO	Confidential, only for members of the consortium (including the Commission Services)	

SWITCH Document
Deliverable D1.1.3

Development of effective and interactive computer models for the analysis, integration, and validation of technological options and scenarios, and to develop a decision support system for Jericho water management.

Good understanding for the limitations and vulnerability of conventional UWM schemes and integrated UWM strategy (developed, tested and applied) based on sustainability and (public health and environmental) risk assessment indicators.

Audience
The document was prepared for an audience both inside and outside the SWITCH consortium. The primary audience consists of planners of water services in small to medium sized towns and decision makers. Also farmers, environmentalists or other stakeholders may also use this product to evaluate the sustainability of various water management and reuse options.

Purpose
The purpose of the document is to review the strategic approach for integrated urban water management for Jericho City in Palestine through the development of a decision support system.

Background
This document serves as a background document and user manual for the Decision Support System for Water Management in Jericho City, downloadable from www.switchurbanwater.eu

HWE work fits under D1.1.3 under WP 1.1 and WP 1.2.

Within the task of HWE in the work packages 1.1 and 1.2, HWE took the responsibility to implement the concepts of WP 1.1 and 1.2 on a pilot area in Palestine. The team of HWE selected Jericho city in the West Bank of Palestine to be the target study area. The importance of this case study is gained from its location within the West Bank, availability of water and lands, tourism locations and industries.

The agricultural, industrial and domestic water demands are very high in Jericho. This puts on local water resources stresses that will negatively impact their availability in terms of quantity (degradation of water levels, decreasing the spring discharges and groundwater abstractions) and quality (high salinity, pollution etc). For this reason, contradictions between environment and socio-economic development are very clear. This called for better understanding of water recourses

management in Jericho. Therefore, there is a need to develop a decision support system for Jericho city.

With regard to WP 1.1 and WP 1.2, HWE completed the following activities:

- Literature review of Palestinian experiences in urban water resources management and decision support systems: this activity includes survey of all decision support systems, management tools and models used for managing urban water systems.
- Literature review of Jericho City and their urban water systems, natural recourses, potential development options for the city: general description of Jericho city in terms of water resources, land recourses, water and waste water services, Socio-economic status (family income, employment, family size, etc) and institutional framework of the city.
- Definition of the stakeholders of the Jericho city: definition the main stakeholders of the city, defining the role of each stakeholder and finally contact them for future cooperation in the project.
- Data collection. Data is the heart of the intended DSS. The collected data was analyzed and stored in the designed database (using Microsoft Access System). The water resources (wells and springs) and their abstractions, water qualities and usage in addition to all socio-economic data were entered to the database.
- Defining the D.P.S.I.R chain of the Jericho Case study: the driving forces, pressures, state, impacts, responses and indicators were defined for the Jericho city. The methodology for this task was carried through the following steps:
    - Literature review of D.P.S.I.R chains of the existing decision support systems in the West Bank.
    - Analysis of the Jericho Case taking into consideration the problems, the potential developments, the weaknesses and strength points in Jericho urban systems.
    - Review of the proposed indicators of SWITCH project.
    - Suggest Multi-criteria analysis methodology to evaluate the suggested management options.
    - Discussions with main stakeholders and water/social/economic expertise.
- Develop the structural framework of the DSS of Jericho city: this DSS is based on the DPSIR methodology. The database was used to evaluate the indicators for each management scenario and then the DSS ranked/selected the best plan which maximizes the Environment/Social/Economic benefits.

- Holding several workshops with Jericho Stakeholders to finalize the database and Jericho DSS as well as the environmental and socio-economic indicators. - Test and validation of the DSS. - Train the Stakeholders on the DSS.
Potential Impact Better management of water resources in Jericho and in towns in similar conditions.
Issues Not applicable
Recommendations

Table of Contents

SWITCH

Sustainable Water Management Improves Tomorrow's Cities' Health

SWITCH is an EU-funded research programme aimed at achieving more sustainable integrated urban water management in the 'City of the Future', 30-50 years from now. Beginning in February 2006, it consists of a Consortium of 33 partner organizations working in 15 European and developing cities worldwide, with UNESCO-IHE as lead partner. The consortium partners are working together to share knowledge and research on a range of tested scientific, technological and socio-economic solutions to urban water management. It is envisaged that such proven sustainable solutions will be adopted globally to replace the many different ad hoc approaches which currently exist and to create a paradigm shift to sustainable urban water management.

Please note that for further information on IUWM and indicators; the reader can go to SWITCH Training Kit Module 1: "Preparing for the future" http://www.switchtraining.eu/index.php?id=7199

HWE

House of Water and Environment

The House of Water and Environment (HWE) is a Palestinian not-for-profit NGO that was established in 2004. HWE aims to promote practical research into the current and future state of water resources and the environment in Palestine and across the region. Although environmental issues are frequently in the news, little understanding surrounds the need to combine different notions of social, technical, and economic sustainability in order to achieve development outcomes that both provide for national development and help to achieve poverty reduction. HWE aims to address this need through mobilizing local and international networks and partnerships to promote a broader analysis of sustainable water resource development and better ‘governance' of the resource. HWE is implementing a wide range of activities including research, development, dissemination of knowledge and training.

HWE's involvement in SWITCH: within work packages 1.1, 1.2 and 4.1

This report is about HWE's involvement in WP 1.1 and 1.2. HWE's involvement in WP 4.1 is presented in a different report.

With regard to WP 1.1 and 1.2, SWITCH aims to develop a coherent strategic approach for integrated urban water management based on sustainability and risk assessment indicators, which will guide actions under the Paradigm Shift and responds effectively to important global change pressure. Also SWITCH aims to develop effective and interactive computer models for the analysis, integration, and validation of technological options and scenarios, and to develop a decision support system.

HWE work fits under D1.1.3 under WP 1.1 and 1.2.

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- Test and validation of the DSS.
- Train the Stakeholders on the DSS.

Although HWE developed this DSS water system for Jericho City it can be adjusted easily to be applied elsewhere.

With regard to WP 1.1 and 1.2, HWE made available the following outputs which are summarized in this document:

- Output#1: Background document about the Jericho Case Study.
- Output #2: Indicators of Jericho DSS
- Output #3: Jericho DSS as a zip file
- Output #4: Manual of using Jericho DSS
- Output #5: Jericho DSS Workshop and Training materials.
- Output #6: Training Workshop report
- Output #7: Paper/poster (conference)
- Output #8: Evaluation of the workshop.

Report Structure and Attachments

The first chapter of this report is a background about Jericho city which is the area of case study. The second chapter contains an evaluation of the environmental and socio-economic indicators for Jericho DSS. Chapter three contains two manuals for using Jericho DSS, the first one is installation manual, and the second is a user manual. Chapter four is the training workshop and the evaluation is presented in chapter five.

This report contains all the above outputs. The report has the following attachments:

- The software programme of the Jericho DSS.
- The training materials which are PowerPoint files.

CHAPTER (1):

Background for the Case Study of Jericho City

1.1 Introduction

Jericho is a town in the West Bank, located near the Jordan River. Situated 250 meters below sea level, Jericho is not only the oldest city in the world (dating back to 7000 B.C.) and the oldest continuously occupied settlement in the world, but is also the lowest living town on earth. While it has a desert climate, Jericho is considered an oasis since it is watered by many springs. This characteristic makes it an important agricultural area, especially for fruits and vegetables.

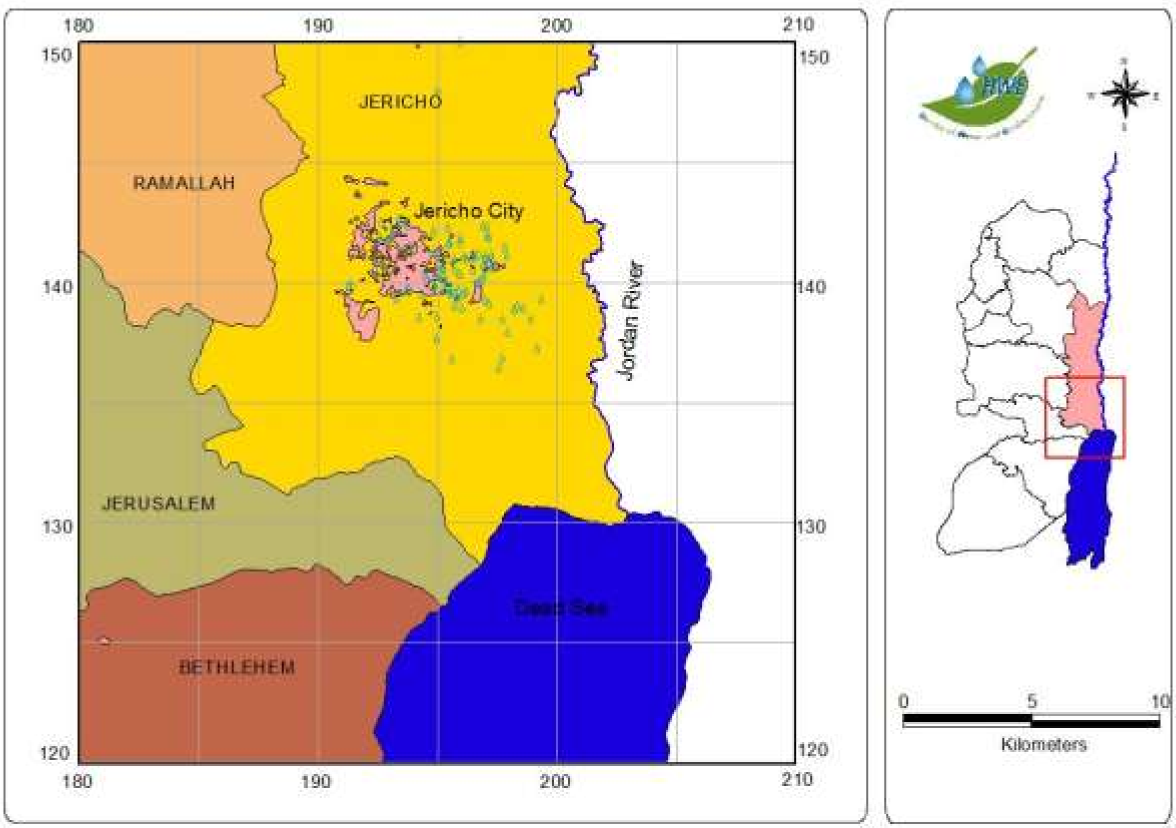


Figure 1.1 Location map of Jericho City

1.2 Water Resources

1.2.1 Groundwater Aquifer Systems

There are several aquifer systems in the Jericho region, mainly:

1- Lower Albian Aquifer System
2- Upper Cenomanian-Turonian Aquifer System
3- Tertiary Aquifer System
4- Quaternary Aquifer System

The *Lower Albian Aquifer System* is composed of the Lower Beit Kahil, Upper Beit Kahil and the Yatta geological formations. The Lower Beit Kahil Formation and Upper Beit Kahil Formation and sometimes the lower part of the Yatta Formation comprise the Lower Aquifer, which is deeply confined across most of the West Bank. It is an excellent regional source of drinking water, the high water bearing capacity and productivity reflects the thickness of dolomitic limestone and limestone. Water quality is generally good, though slightly salinity has been encountered towards the Jordan Valley.

The Upper Aquifer consists of the Turonian (Jerusalem Formation), Cenomanian (Bethlehem and Hebron formations).

Turonian (Jerusalem) aquifer formation consists of massive limestone (sometimes thinly bedded limestone), and dolomitic limestone with well developed karst features. It is part of the Upper Aquifer, but it is isolated from the main part of the Upper Aquifer in the south and parts of the eastern West Bank wherever the underlying Bethlehem Formation becomes a weakly permeable aquitard. It forms a good aquifer especially where the saturation thickness is in tens of meters. Water quality is generally good but in some areas there is evidence of deterioration because of pollution by sewage and agro-chemicals.

The Cenomanian aquifer consists of the Bethlehem and Hebron Formations which are mainly interbedded dolomite and chalky limestone. In the southern and eastern part of the West Bank, the Bethlehem Formation is considered an aquitard, while to the north and west it has aquiferous characteristics. The Lower Part of Yatta formation represents a fair aquifer. The Lower Yatta Formation hydraulically separates the two regional aquifers (Upper and Lower Aquifers) across most of the West Bank, although to the north, the presence of Yatta limestone gives rise to minor springs and seepage. Water levels (heads) in the Upper Aquifer are generally higher than in the Lower Aquifer.

The *Tertiary Aquifer System* is composed of the Beida Formation (Neogene Aquifer). It is composed of conglomerate lenses, limestone, marl and clay with Lower Tertiary age. The Beida Formation is easily recognized by its soft rounded features, light colors and encrusted surface. The lenses of conglomerates and the margins of the formation have good aquiferous characteristics.

The *Quaternary Aquifer System* is composed of three formations: Lisan, Alluvial and Gravel fans. The Lisan Formation (Pleistocene Aquifer), a marl, gypsum and silt unit, is an aquiclude. The Alluvial and gravel fans (Holocene) are distributed in the Jordan Valley. These Alluvial fans are still accumulating after large floods and consist of debris from neighboring lithologies. The alluvium is mainly formed of laminated marls with occasional sands. Gravel fans are widely distributed in the Jordan Valley and have the capability of transferring groundwater from the limestone aquifers.

The Palestinian wells in the Jericho region tap the Upper Cenomanian-Turonian aquifer system and the Neogene and Pleistocene shallow aquifer systems.

1.2.2 Groundwater Basins

The groundwater flow in the Jericho region aquifer system is generally to the east and southeast, in the direction of the Jordan Valley and the Dead Sea. The Jericho district overlies two sub-basins of the Eastern Aquifer System. These two sub-basis are:

1. Auja-Fasayel Sub-basin which drains the Neogene/Pleistocene and Upper Cenomanian aquifers and flows towards the southeast direction.
2. Ramallah-Jerusalem Sub-basin which drains the Neogene and Pleistocene, Lower Cenomanian and Upper Cenomanian aquifers and flows towards the east and southeast direction.

1.2.3 Groundwater Wells

There are 170 wells in the Jericho region, all of which are in the Eastern Basin. 119 of these wells are under Palestinian control and are used for agricultural purposes. 20 wells are owned by Mekoroth while the remaining 31 wells are abandoned. In the Jericho City, there are 29 agricultural wells tapping the Pleistocene aquifer system, with an average monthly abstraction of 0.476 Mcm.

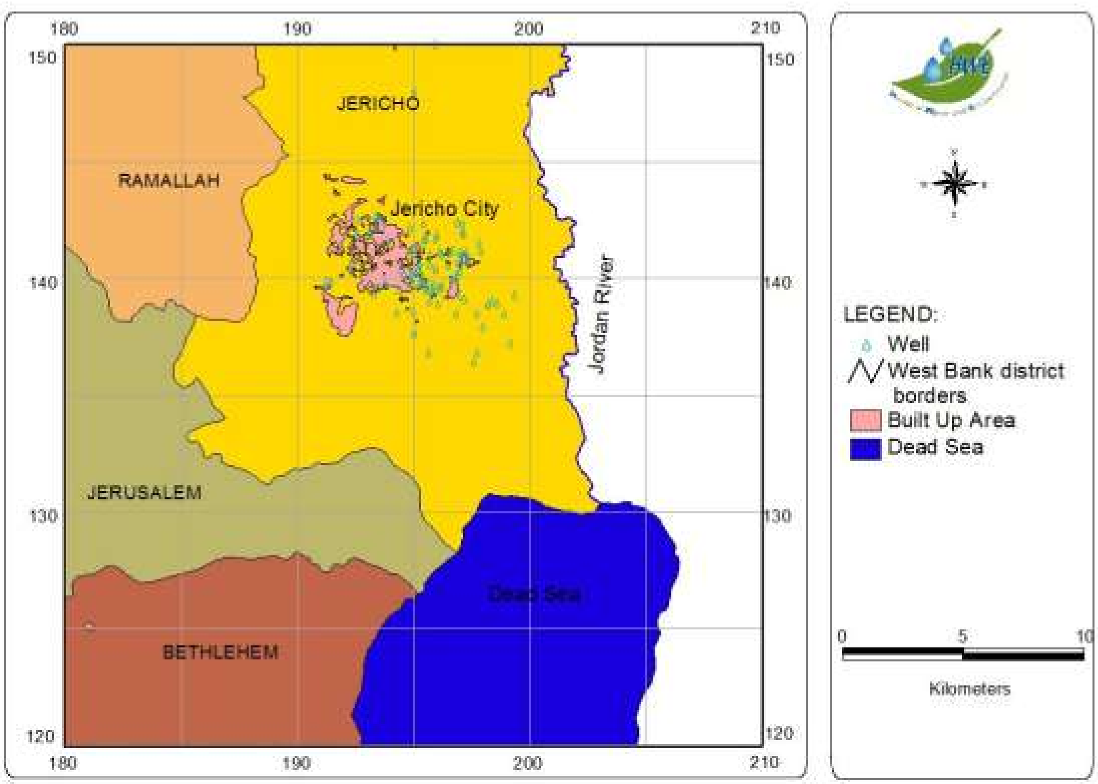


Figure 1.2 Palestinian wells located in the Jericho City

1.2.4 Springs

There are four main spring systems in the Jericho district, as shown in figure 1.3, emerging from the eastern groundwater basin underlying the Jericho area. They are:

1. Wadi Al-Qilt Spring System- Wadi Al-Qilt is fed from three main springs, Ein Fara, Ein Fawwar and Ein Al-Qilt. The average monthly discharge from this spring system is 146775 m^3.

2. Ein Al-Sultan Spring System- which is located to the east of Wadi Al-Qilt in Jericho city and related to the Upper Cenomanian-Turonian Aquifer. The total monthly discharge of this system is 877765 m^3.

3. Al Dyuk Spring System- which is composed of three springs; Dyuk, Nwai'mah, and Susah. The average monthly discharge of the springs in this system is 191402 m^3. They drain the Pleistocene Lisan Formation and are fed from the Cenomanian Ajlun aquifers.

4. Al-Auja Spring System- which drains the Upper Cenomanian-Turonian aquifer. This spring system originates outside the Jericho district borders.

Some 1.27 Mcm/yr of the water from the Jericho region spring systems is utilized for domestic purposes.

1.2.5 Drainage Basins

Six main wadis cross the Jericho region, mainly Wadi Al-Mallaha, Wadi Al-Auja, Wadi Abu Ubeida, Wadi An-Nuw'ema, Wadi Al-Qilt and Wadi Al-Ghazal. Wadi Al-Mallaha runs northsouth, while the remaining five wadis run eastwest. Wadi Al-Auja and Al-Qilt have permanent water flow while the rest are intermittent (ARIJ, 1995). Figure 1.4 shows the drainage wadis in the Jericho area.

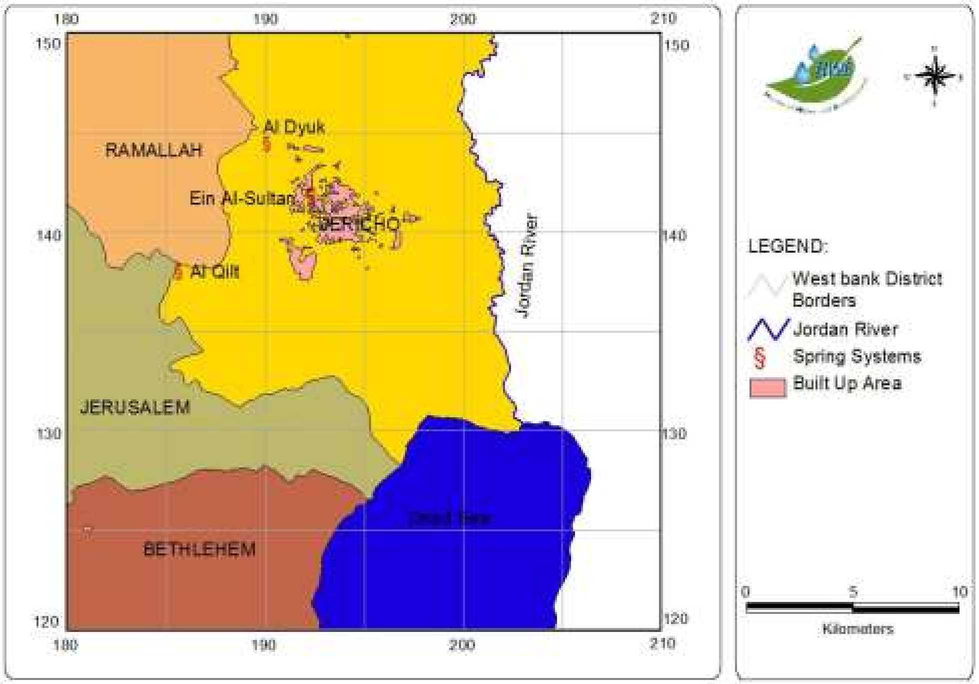


Figure 1.3 Spring Systems in the Jericho Area

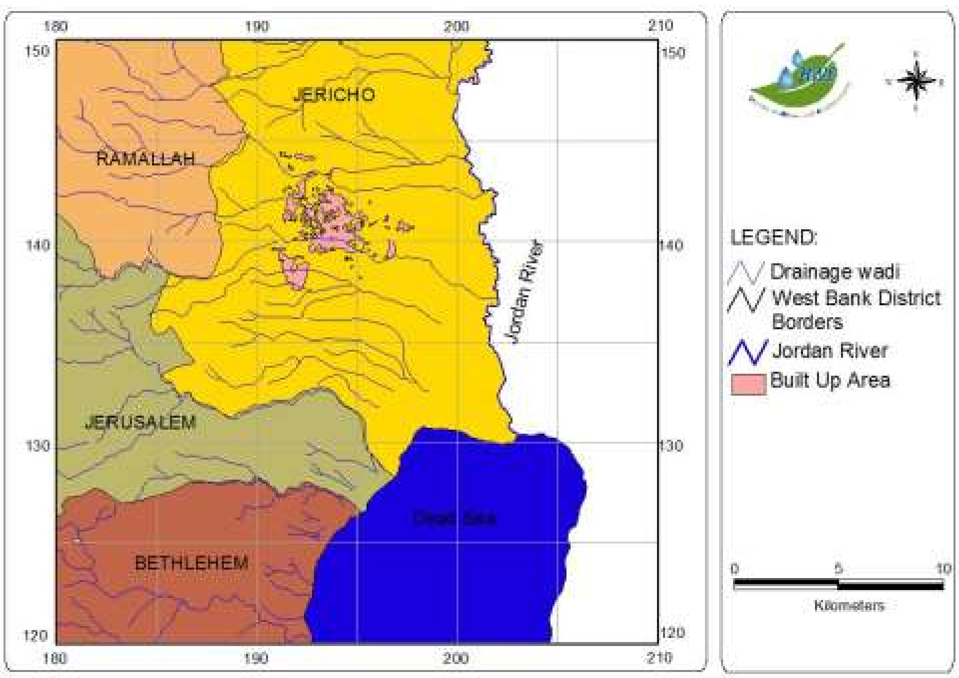


Figure 1.4 Drainage wadis in the Jericho Area

1.3 Water Quality

Water samplings were taken from ninety-six groundwater wells and twenty one springs in the region to define the groundwater quality. Chemical analysis of the water samples was conducted to determine the major cations and anions in the water samples. Table 1 shows the descriptive statistical analysis of the hydrochemical data obtained from the chemical analysis of the major springs in the Jericho region. Appendix A provides a table of the water quality data of these springs.

Table 1 Statistical analysis of the hydrochemical data at the major springs in the Jericho region

Parameter	Minimum	Maximum	Mean	Standard Deviation	Acceptable maximum limit mg/L*
pH	7.0	8.5	7.8	0.3	6.5-8.5
Electrical Conductivity (µS/cm)	379	1031	650	140	-
Ca^{+2} (mg/L)	39.7	130.2	77	20	100
Mg^{+2} (mg/L)	1.3	31.4	15	7	50
Na^{+1} (mg/L)	16.5	89.5	30	17	200
K^{+1} (mg/L)	0.3	13.4	4	3	10
HCO_3^{-1} (mg/L)	114.3	330.5	252	53	-
NO_3^{-1} (mg/L)	8.9	120.6	30	22	70
Cl (mg/L)	30.5	115.9	50	19	250
TDS(mg/L)	210	557	353	82	1000
Fecal Coliform (colony/100ml)	10	1000	205	291	0
Total Coliform (colony/100ml)	32	1000	324	324	0-3
SAR	0.4	2.3	0.9	0.4	-
SSP	12.5	41.6	22.1	8.2	-

Source: SUSMAQ, 2003

All the springs in the Jericho region are used for irrigation except Ein Al-Sultan and Ein Al Dyuk, which are used for both domestic and irrigation purposes. To identify the water quality for irrigation, the sodium concentration percentage (SSP), electrical conductivity (EC) and the sodium absorption ratio (SAR) were used.

Sodium concentration is an important index in the evaluation of irrigation water, as it has an influence on soil permeability. The sodium content is expressed in terms of the SSP, which is defined as:

$$SSP = ((Na^{+} + K^{+}) / (Ca^{+2} + Mg^{+2} + Na^{+} + K^{+}))*100$$

Where the concentrations are in meq/L.

According to SSP and EC values of the spring water samples which were taken, the water ranges from “good” to “permissible” for irrigation purposes.

In the evaluation of irrigation water, the Sodium Adsorption Ration (SAR) is another important index because it is considered to be directly related with the water adsorption by the soil. It is calculated according to the equation:

$$SAR = Na^{+}/((Ca^{+2} + Mg^{+2})/2)^{0.5}$$

Where the cations are expressed in milli-equivalent per liter.

The SAR value for the water samples ranges from 0.4 and 2.3, with an average of 0.9. This indicates that the water from most springs has low sodium and can be used for irrigation on almost all soils with little danger.

The total dissolved solids (TDS) and electrical conductivity (EC) cause osmotic pressure, which, if it changes, may change the uptake rate of water into the plant. The values of TDS and EC indicate that the water is of medium salinity. Therefore, it may be used to irrigate plants with moderate salt tolerance if moderate amount of leaching occurs.

Chemically, the concentrations of the major cations and anions in the samples taken fall within the acceptable standards of the PWA. Among the springs studied in the Jericho region, none of them were free of coliform bacteria. Therefore, the water of all the springs is not suitable for drinking unless disinfected.

1.4 Wastewater

1.4.1 Wastewater Disposal

Similar to other districts in the West Bank, the responsibility of wastewater management in the Jericho district is either through the municipalities, villages, village councils or UNRWA in the refugee camps.

Wastewater collection networks are totally lacking in the Jericho district. Cesspits are the commonly used method of wastewater disposal. Cesspits serve either a single house or sometimes a cluster of houses. The soil in the Jericho district is sandy, high in salinity, and low in clay and organic matter. Therefore, cesspits in Jericho are usually built with all their sides (except bottom) lined with concrete to prevent them from collapsing.

As the Jericho municipality lacks vacuum tankers, wastewater from filled cesspits is evacuated by private vacuum tankers. The wastewater is then disposed of into vacant lots without consideration of its impact on soil or groundwater. Some of the common sewage disposal areas are located to the east of Jericho city and to the south of El-Auja village.

Due to the lack of collection networks in the Jericho district, little work has been done to analyze the raw wastewater. In general, the wastewater in the West Bank is high in biochemical oxygen demand (BOD), ranging 600-900 mg/l owing to the low domestic water consumption. The total estimated annual water consumption for domestic use in the Jericho district is around *2 Mcm* based on a yearly capita consumption of *94 cm.* The high per capita consumption in the Jericho district is due to the usage of water for irrigation purposes.

1.4.2 Environmental-Related Problems

There are many different types of pollutants contaminating the water resources of the Jericho district. One of the main problems is the wastewater flowing from the settlements in the eastern hills which is contaminating the stream of water emerging from Wadi Al-Qilt. Flooding of cesspits, especially in the winter time, is a major environmental problem throughout the West Bank and in the Jericho district. This flooding of raw wastewater is the major cause of infectious disease transmission, bad odors, and mosquito presence.

1.5 Demography and Population

Compared to other regions in the West Bank, the Jericho region has a relatively low population density. This is due to the large Israeli designated closed military areas, military bases, nature reserves and the Israeli settlements located there. The present population of the Jericho district is estimated at 43,620 Palestinians, living in the city of Jericho, the four villages (Al-Auja, An-Nuwe'ma, Dyouk Al-Tahta and Dyouk Al-Fouqa) and the two refugee camps (Ein Al-Sultan and Aqbat Jaber) (PCBS, 2006). The growth rate for the West Bank, in general was 3.0% in 2006.

Employment and income are indicators of the economy and standard of living in any country. For Palestine, all the available figures are general and not specific for one region or district. Approximately 18.5% of the male population in the West Bank is unemployed, while 21.6% females are unemployed. The average net daily wage of employees working in the Palestinian territories is $17.10 for males and $16.30 for females (PCBS, 2007).

1.6 Industrial sector

Jericho is one of the lowest cities in the world. Its climate is hot and dry in summer and mild in winter, supporting the growth of such crops as dates, bananas, and citrus fruits. Most of Jericho's agricultural land is irrigated by small private wells that provide water throughout the year. In addition to agricultural activities, Jericho has a long-standing tourist industry. Road traffic from Jerusalem and other cities in northern Israel converges in Jericho, and roads continue south to the Dead Sea and the Negev.

The Jericho area is characterized by its small business community that is one of the direct results of the 1967 war, when most of the refugee camps near the city fled to Jordan. Currently the economy of Jericho area is dominated by agriculture and agriculture related businesses.

1.7 Tourism

Jericho is a favorite winter resort due to its moderate climate. It is certainly the best tourist destination in Palestine during the winter months. The Jericho oasis is so fertile and lush in its growth of tropical plants and bananas that it seems a miracle in this dry terrain, but it is the underground streams that feed the soil. Before the second Intifada, Jericho was packed with hotels and restaurants. In the 1990's, the Palestinian authority opened Palestine's first casino (Oasis), which thrived until the outbreak of the Intifada in September 2000.

Among the most popular tourist attractions is the Monastery of St.George, carved out of a canyon wall overlooking Wadi Al-Qilt. This Greek Orthodox monastery was originally built in the fifth century as a spiritual center for monks. Other attractions include Hisham's Palace, a beautiful desert ruin of the Umayyad Caliph Hisham Ibn Abdul Malik from the 8th century, and Nabi Musa, a 12th century pilgrimage shrine believed to be the spot where Moses is buried. Jericho also recently added a telepherique cable car to its list

of attractions, which is located at Elisha's spring and allows a ride to the Greek Orthodox Monastery on the Hill of Temptation.

Figure 1.5 Monastery of St.George in Wadi Al-Qilt

Jericho city is the only passenger terminal for Palestinians to exit the country to Jordan through the King Hussain (Allenby) Bridge. The Allenby Bridge is a bridge that crosses the Jordan River, and connects Jericho in the West Bank to the country of Jordan. It is currently the only exit point for West Bank Palestinians into Jordan. The annual average daily traffic on the bridge was estimated at 2,900 pedestrians in 2005.

1.8 Agricultural Sector

1.8.1 Soil Description

As shown in Figure 1.6, the Jericho city falls over mainly the Loessial Serozem soil type. A description of this soil types and the others found all over the Jericho district follows.

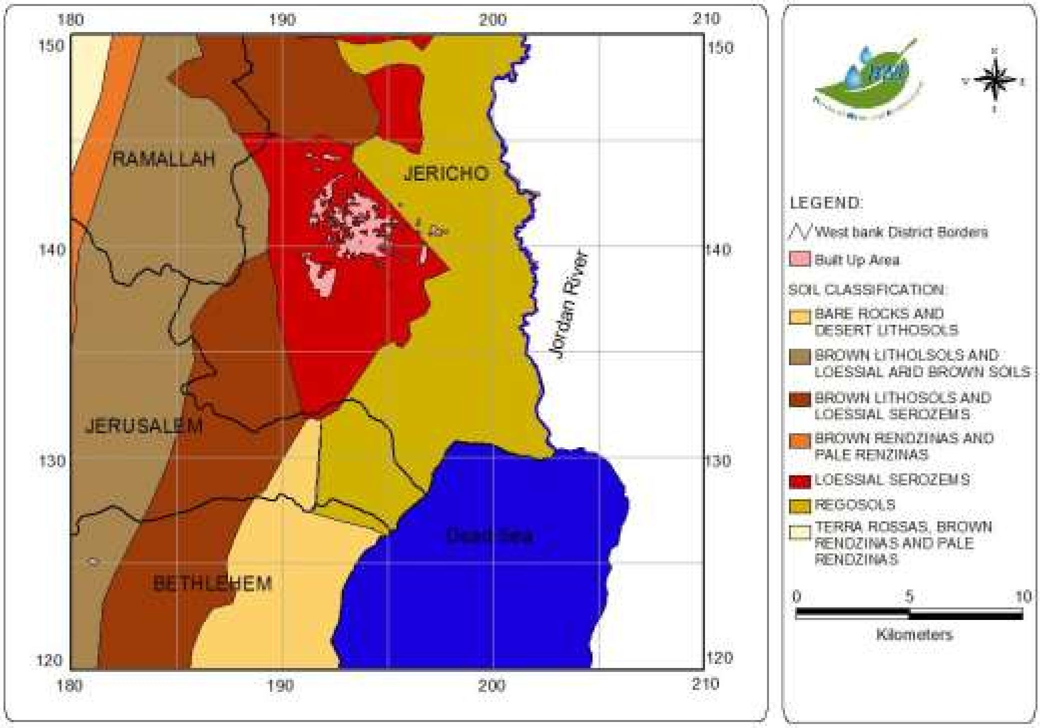


Figure 1.6 Soil Types in the Jericho District

Brown Lithosols and Loessial Arid Brown Soils

Rocky outcrops in such soils range between 50-60%. They are pale brown to yellowish brown or brown, loamy and calcareous. Brown lithosols are found in the pockets among the rocks. Loessial arid brown soils are found on flat hilltops, plateaus and foot-slopes. The parent rocks of this soil association are chalk, marl, limestone and conglomerates. The deeper layers consist of either brown clay or yellowish brown loam. Field crops are planted in areas where the top soil is deep enough and sloping is moderate. However, in shallow and steep areas, grazing is the common activity. Major vegetation types are *Ballotetlia undulatae and Aretemisietea herbae-albae.*

Brown Lithosols and Loessial Serozems

Lithosols are typical of the steep hill slopes. Brown lithosols are found also on small plateaus. Inclusions of loessial Serozems are found in broad valleys, terraces, and on large plateaus. The soils are originally formed from limestone, chalk, dolomite and flint. The structure of this horizon is subangular blocky or prismatic, with many lime nodules. The transition to the rocks is mostly sharp. Many rock outcrops are found, usually at the surface; the soil is restricted to the pockets among these rocks. Major vegetation types found in these regions are *Anavasetea articulatae and Zygophyllum.* Such soils suffer from extensive erosions due to runoff, especially in steep slopes. The soil association is also suffering from salt accumulation due to limited salt leaching capabilities. The current land use is restricted to winter crops that are grown by Bedouins in some wadis.

Regosols

This soil is found as bad-lands along the terrace escarpments in the Jordan Valley. The soils are quite variable in texture and color. The soil parent materials are sand, clay and loess. The dominant vegetation types found in this region are *Anabasis articulate, Salsola vermiculata and Salsola tetrandra.* The area is used for grazing.

Loessial Arid Brown Soil

This soil is formed originally from conglomerate and/or chalk and mainly found on gently sloping plateaus as well as dissected plateaus with locally hilly topography. Major vegetation type found in this region is *Achilleetum santolinae.* The main current land use consists of various field crops and some horticultural crops planted as irrigated crops. Wheat, barely and sorghums are also grown as dry-farming crops.

Regi-soils and Coarse Desert Alluvium

It is found in plains and dissected low plateaus and characterized by large valleys and alluvial fans. Its parent materials are of mainly unconsolidated mixed stone and deposits. At greater depths there are stones and weathered rocks. Gypsum crystals or petrogypsic horizons are found in the deeper soil layer. The vegetation is restricted in few areas to rivulets. In most areas, dwarf shrubs such as *anabasis articulate and Reaumuria* are dominant. The area is of almost no agricultural value with the native vegetation able to supply only very poor grazing for camels, goats and sheep.

Calcareous serozems

It is formed mainly as a result of flooding of the Jordan River. It is originally formed from limestone, chalk, and marl. These are deep, highly calcareous grayish brown, medium to fine textured soils. They are often gypseous or even saline at depth. The aridity restricts plant growth resulting in low soil organic matter content in the soil (0.5-1.5%). The soil may be of almost any texture. Leaching is slight, basic cation saturation is about 100 %, and primary minerals make up most of the soils forming parent rock. Some soils have lime cemented hardpans that restrict root penetration. Many of these soils are among the most productive soils when they are irrigated and fertilized. The soil's low humus contents make addition of nitrogen essential. In contrast, a lack of leaching allows potassium accumulation. Potassium deficiency is rare, being found only in sandy soils and few shallow soils or in soils developed from low potassium parent material. The lack of leaching does result in soil pH values of about 7-8.5. Deficiencies of zinc and iron, and to a lesser extent manganese and copper, are common. Irrigation is essential. If the soils are not already salty, irrigation water may add enough to develop salty soils. The vegetation is restricted to *Salsoletum villase.* The current land use is restricted to winter grazing.

1.8.2 Planted Crops

Despite the high temperature, evaporation, and low rainfall, Jericho is distinguished for its agricultural activities. Agriculture is successful due to the combination of Jericho's location below sea level, year-round warm weather and the availability of water for springs and wells.

The main cultivated crops in the Jericho area are vegetables, including melons, fruit trees and field crops and forages. The area of field crops is approximately 22,200 donums. The area of orchards land is about 3412 donums. Tomatoes, squash, cucumbers, eggplants and sweet corn are the main vegetables grown in Jericho.

The cropping season in Jericho usually extends from September through June. The planting dates fall in two long periods, from September until January for winter cropping, and from February to April for summer cropping. So that they can cultivate a second summer crop, farmers often plant some of the plots with short life cycle crops. This results in an increase of the effective cultivated area.

The main cultivated field crops are namely wheat and barley. Alfalfa and Egyptian clover fields are also common. Six main types of fruit trees are cultivated in the Jericho area:

- bananas- which have the largest cultivated area of all fruit trees
- citrus trees- there are 6 cultivated types of citrus trees, including five different varieties of oranges
- date palms
- grapes
- olives
- loquats

CHAPTER (2):

Evaluation of Environmental and Socio-Economic Indicators for Jericho City- Case Study

2.1 Introduction

The Integrated Water Resources Management (IWRM) Tool is a management tool used to evaluate the overall socio-economic and environmental situation of a specific region for a specific period of time, the management period. This region could be at a national (*West Bank and Gaza*), regional (*e.g. northern part of the West Bank*), governorate (*e.g. Jericho district*) or local (*e.g. Jericho city*) scale. In general this tool is an interactive computer-based system intended to help decision makers utilize data and models to identify and solve problems and make decisions.

In our case, the IWRM tool was developed for the Jericho city, located in the eastern part of the West Bank. Background information regarding the city of Jericho is available in Chapter 1.

The development of an IWRM tool starts from a baseline situation (2005-2006) of the target region. Therefore, a baseline survey and understanding of the social, economic and environmental aspects is necessary.

The baseline survey of the target region should include a:

- Water resources survey in terms of quantity and usage (wells, springs, harvested water, purchased water from Mekerot (The Israeli National Water Company) external water, desalinization water, treated wastewater)
- Socio-economic survey (population, population growth rate, employment, income, water and wastewater services)
- Wastewater treatment and reuse survey (treatment plants and their inflows and outflows, water reused)
- Agricultural survey (crop types and requirements, crop net benefits, available agriculture areas)
- Industrial survey (industries and their requirements, connections to the wastewater treatment plants) and

  - Leakage in both connected and unconnected domestic and agricultural systems

2.2 Objectives of the tool

In general, the main objectives of the IWRM tool are:

- Building a rational environment and socio-economic database for a specific area.
- Evaluate the baseline situation in terms of social, economical and environmental aspects as well as the future situations.
- Facilitate the opportunity to build social, industrial and agricultural future plans

The specific objectives, in our case, of the IWRM tool are to:

- Estimate the domestic, agricultural and industrial future water:
  - demands
  - supplies
  - leakages
  - consumptions
  - gaps
- Estimate the future employment in different sectors as well as unemployment in the target area.
- Estimate the future income from different sectors in the target area.
- Estimate the future wastewater production from different sectors, collection (conventional and unconventional types), treatment and reuse in the target area.

To achieve the above mentioned, the following section (Section 2.3) presents the methodology on how to use the IWRM tool.

2.3 Methodology

In order to develop and use the IWRM tool the user must go through a number of stages. These stages are illustrated in Figure 2.1 and presented in the following main stages:

- Stage I:
  - Collect the socio-economic and environmental baseline data.
  - Prepare the entry data for the IWRM Tool.
- Stage II
  - Build the future social, water resources, industrial and agricultural plans for the target area.
- Stage III
  - Build the rational database and calculation
- Stage IV
  - Evaluation
- Stage V
  - Results

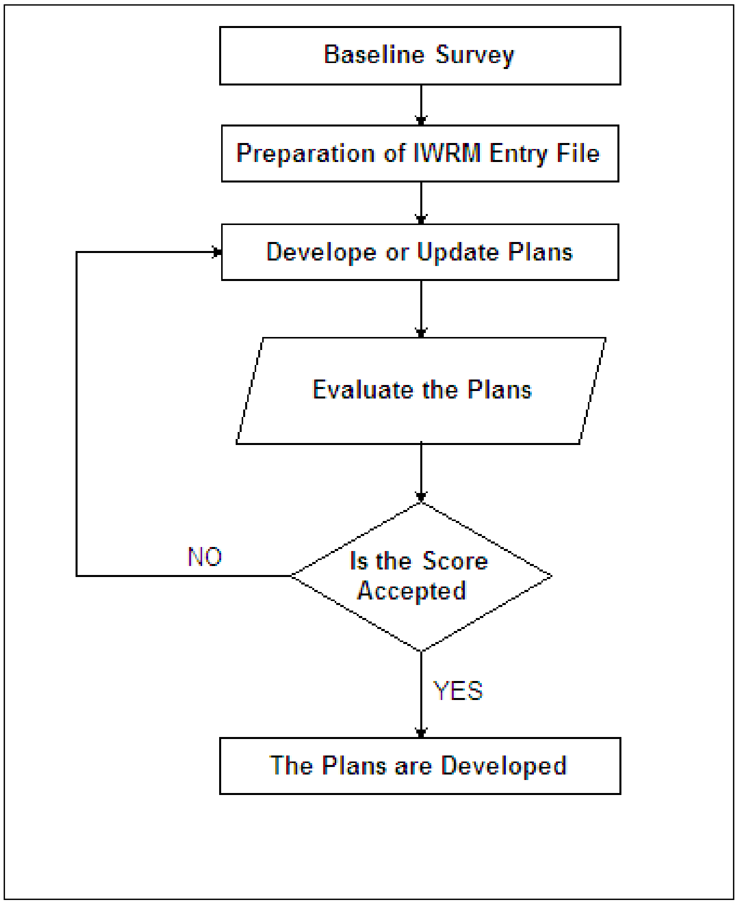


Figure 2.1: The stages of using the IWRM tool

2.4 Data Entry

Several databases are to be established for the compilation of the data necessary in the calculation processes. Easy to use Microsoft Access tables have been prepared that are ready for filling in the data for the baseline year 2005/2006 for the targeted study area. There are seven separate database tables concerning agriculture, community, external water resources, industry, springs, wells and wastewater treatment plants. Each column in

the database table corresponds to a parameter also known as field (see Figures 2.2-2.8). The data type determines the kind of values that users can store in the field (text, number, etc.) and the field description explains the field and is displayed in the status bar below the table. This step is a very important one since the results largely depend on the data used for the analysis. Thus it is significant to invest efforts in collecting these data before running the Integrated Water Resources (IWRM) Management Tool.

Field Name	Data Type	Description
Crop	Text	Name of crop
Area	Number	Area cultivated with that particular crop (Dunums)

Figure 2.2: Agricultural database description

Field Name	Data Type	Description
Name	Text	Name of community
Pop	Number	Population
Labor force	Text	Percentage of the population older than 15 years of age (Labor force according to PCBS)
FWNCoverage	Number	Percentage of freshwater network coverage
WWNCoverage	Number	Percentage of wastewater network coverage
EmpGO	Number	Percentage of employment in governmental organizations from the total labor force
EmpNGO	Number	Percentage of employment in non-governmental organizations from the total labor force
EmpPrvt	Number	Percentage of employment in the private sector from the total labor force
IrrLand	Number	Area of irrigated lands (Dunums)
RfLand	Number	Area of rainfed lands (Dunums)
MekerotDom	Number	Domestic water supply from Mekerot (Cm/yr)
MekerotAgri	Number	Agricultural water supply from Mekerot (Cm/yr)
HarvDom	Number	Harvested rain water for domestic puroses (Cm/yr)
HarvAgr	Number	Harvested rain water for agricultural purposes (Cm/yr)
WWTP	Text	Wastewater treatment plant availability

Figure 2.3: Community database description

Field Name	Data Type	Description
ID	Text	Identification code of the external water resource (What is meant by external water resources are those that are situated outside the study
Agriculture	Number	Agricultural use (Cm/yr)
Connected supply	Number	Connected domestic supply (Cm/yr)
Unconnected supply	Number	Unconnected domestic supply (Cm/yr)

Figure 2.4: External water resources description

Field Name	Data Type	Description
Name	Text	Name of industrial establishment
Personnel	Number	Number of employed personnel
Consumption	Number	Water consumption (Cm/yr)
FWNcoverage	Number	Percentage of freshwater network coverage
WWNcoverage	Number	Percentage of wastewater network coverage
WWProd	Number	Percentage of produced wastewater from consumed water
WWReused	Number	Percentage of wastewater reused
WWTP	Text	Wastewater treatment plant availability

Figure 2.5: Industrial database description

Field Name	Data Type	Description
ID	Text	Spring code
Agricultural use	Number	Percentage of use for agricultural purposes from the total discharge
Connected domestic use	Number	Percentage of use for network-connected domestic purposes from the total discharge
Unconnected domestic use	Number	Percentage of use for unconnected domestic purposes from the total discharge
Israeli usage	Number	Percentage of Israeli control and use
Discharge	Number	Discharge of the spring in 2004 (Cm/yr)

Figure 2.6: Spring database description

Field Name	Data Type	Description
ID	Text	Well code
Agricultural use	Number	Percentage of use for agricultural purposes from the total abstraction
Connected domestic use	Number	Percentage of use for network-connected domestic purposes from the total abstraction
Unconnected domestic use	Number	Percentage of use for unconnected domestic purposes from the total abstraction
Israeli usage	Number	Percentage of Israeli control and use
Abstraction	Number	Total well abstraction in 2004 (Cm/yr)
Licensed quota	Number	Licensed abstraction quota for each well (Cm/yr)

Figure 2.7: Well database description

Field Name	Data Type	Description
Name	Text	Name of the wastewater treatment plant
External inflow	Number	The inflow entering the treatment plant from external sources that exist beyond the case study boundaries (Cm/yr)
Outflow	Number	The outflow leaving the treatment plant (Cm/yr) as a percentage from inflow
Reuse	Number	Percentage of the total treated wastewater reused

Figure 2.8: WWTP database description

The data base has been developed to be used as part of the Decision Support System, to be developed as explained in the next section.

2.5 The Decision Support System (DSS) for Jericho City

The DSS for Jericho City is composed of two parts:

1- Integrated Water Resources Management (IWRM) Tool–
This tool will integrate urban water management issues in terms of Environment, Social, Economy, Health aspects, etc. The tool will help

decision makers develop management plans and test them to get the over all situation on a city scale.

2- Decision Support Tool (DST) –
This tool will be used to evaluate and rank a set of suggested management plans based on a set of Environmental and Socio-Economic indicators.

As presented in the previous sections, the IWRM tool will be based on IWRM concepts to quantify the following parameters:

- Supply to different water sectors
- Demand for different water sectors
- Supply/Demand gaps for all sectors
- Water consumption in all sectors
- Un-accounted for water
- Generated wastewater
- No. of created jobs
- Family income

Theory behind the DSS – DPSIR Concept

The Decision Support Tool (DST) will be based on the Drive-Pressure-State-Impact-Response Framework (DPSIR). The DPSIR framework is presented as a system for organizing information that emphasizes cause-effect relationships designed for environmental problem solving. It is a methodological framework (or guideline) for decision makers, which summarizes key information (indicators) from different sectors.

After different meetings with stakeholders and the review of available documents, the DPSIR framework for the city of Jericho was determined as shown in Figure 2.9 below.

The Driving Forces

The following driving forces on the system were identified:

- Population Growth
- Industrial Growth
- Agriculture Growth
- Climate
- Tourism
- Hydro-Policy/Institutional Conflict: Conflict between Israelis/Palestinians or between different local institutions

The Pressures

The pressures on the system for Jericho city were identified as:

- Demand for domestic use
- Demand for industrial use
- Demand for agricultural use
- Demand for tourism use
- Climate change:
    - Change in rainfall quantities/qualities
    - Change in temperature
- Point/Non-point pollution sources (Agriculture, Industry, Tourism, Human)
- Needs for Water/Wastewater services development

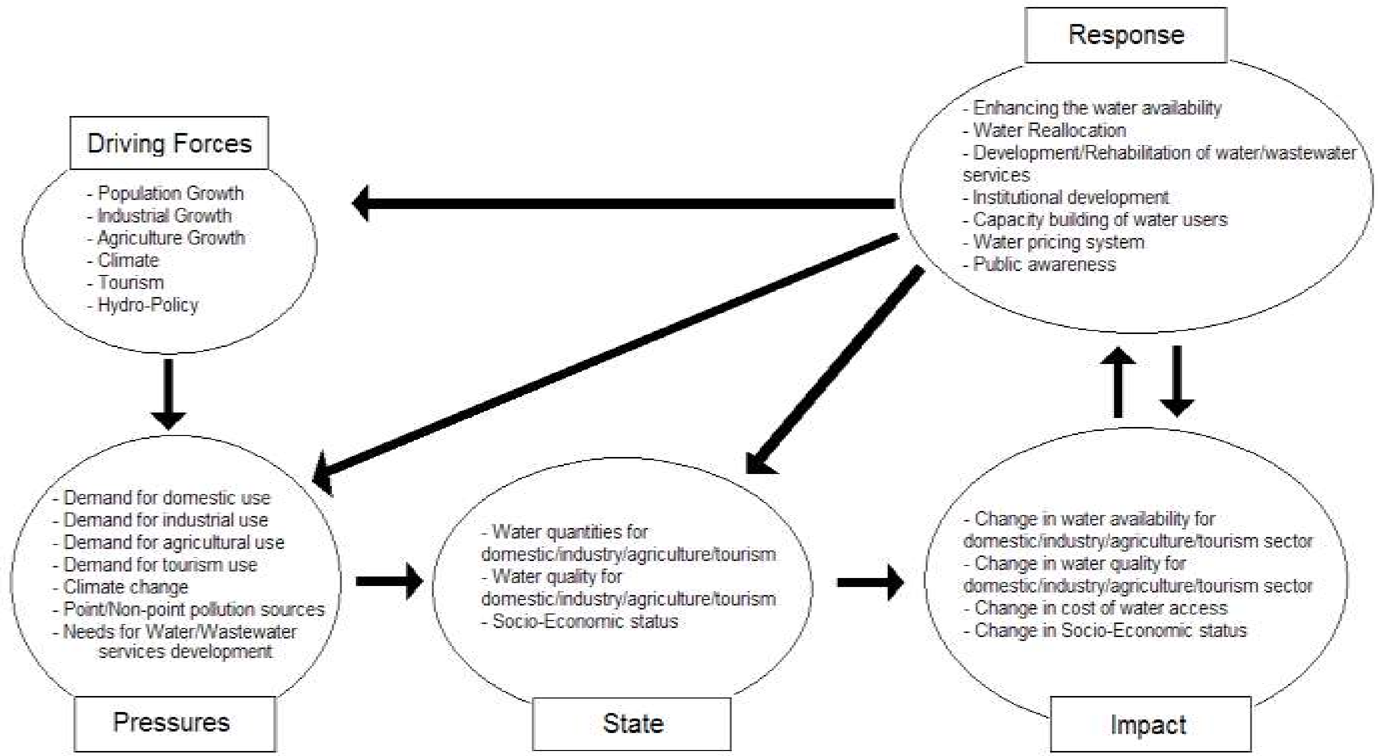


Figure 2.9: D.P.S.I.R Representation

The State

The State of the System is evaluated based on:

- Water quantities for domestic/industry/agriculture/tourism
- Water quality for domestic/industry/agriculture/tourism
- Socio-Economic status (e.g. household income, job creation, social acceptance, water/wastewater services)

The Impacts

Impacts on the System are measured or estimated based on:

- Change in water availability for domestic/industry/agriculture/tourism sectors
- Change in water quality for domestic/industry/agriculture/tourism sectors
- Change in cost of water access
- Change in Socio-Economic status

The Responses

Based on the driving forces, pressures, state of the system, and the impacts on the system, the following responses are to be made (Management Options)

- Enhancing the water availability
    - Water Reclamation
    - Artificial Recharge
    - Water transfer
    - Etc.
- Water Reallocation
- Development/Rehabilitation of water/wastewater services
- Institutional development
- Capacity building of water users
- Water pricing system
- Public awareness

2.6 Evaluation

ASCE (1997) carried out an extensive study in which an MCDA technique (Composite Programming) was applied to the integrated environmental evaluation of water resources development projects. They produced a manual (1988) for the application of the technique, and applied it in several case studies. It is proposed to employ this technique for the evaluation of Management Options.

The starting point with this method is a set of basic indicators which must be defined so as to describe comprehensively the economic, social and environmental performance of a set of management options or plans. The values of these basic indicators are standardized to values between 0 and 1; zero and one corresponding to the best and worst values of the basic indicators respectively.

The next step is to group the basic indicators to a second level. The values of these indicators are calculated based on the values of standardized basic indicators with the weight applied by the decision makers to each indicated group. Then the second group is grouped in the same way to a third level of indicators which represents the environmental and socio-economic indicators. The values of these third level indicators are used to calculate the final overall indicator which represents the distance of the tested management option from the ideal point as shown in Figure 2.10.

The output of this method is the ranking of the alternative management options based on their distances from the ideal point. The result can be shown on a graphical plot, (Figure 2.11), within the three defined zones (Good, Acceptable and Poor management options).

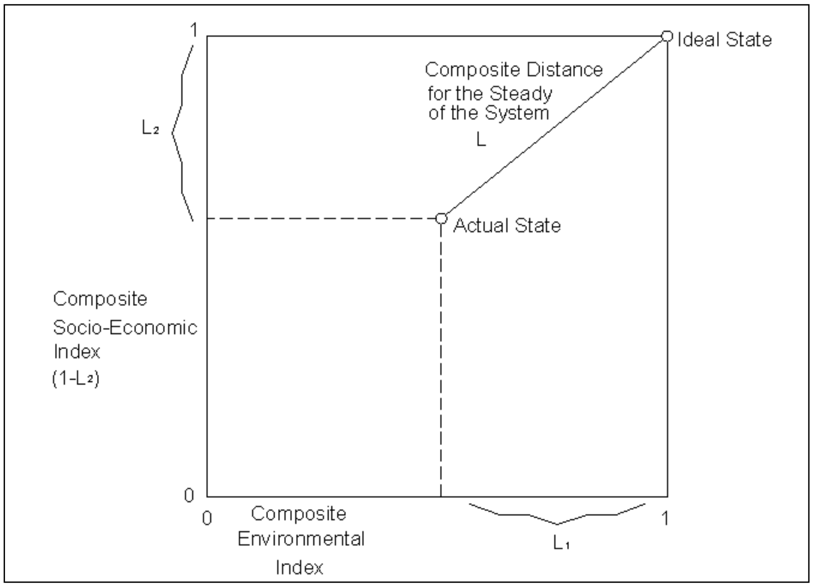


Figure 2.10: Distances from ideal point

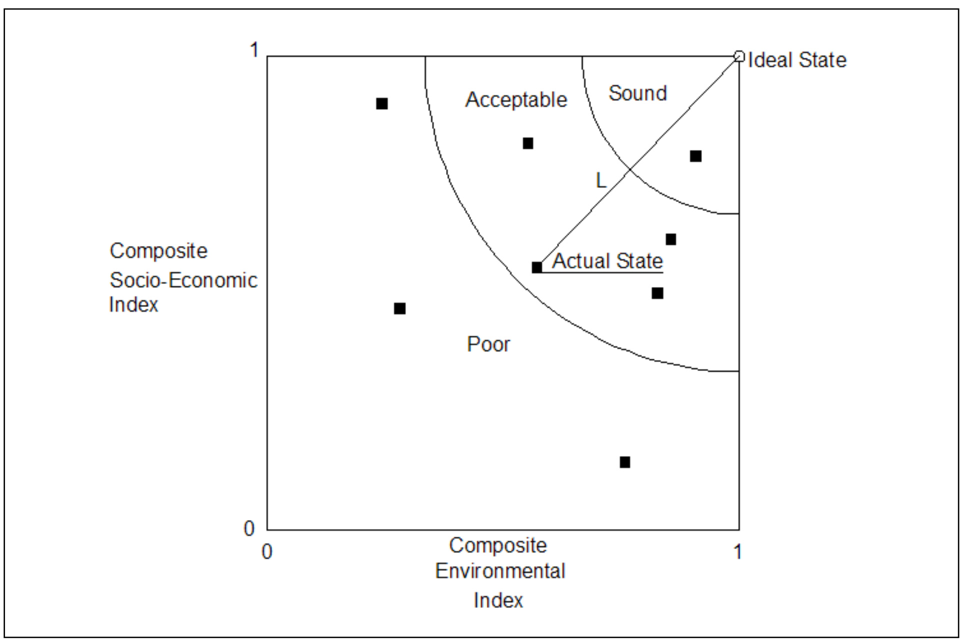


Figure 2.11: Graphical representation of a set of ranked management options

First level indicators

A total of fifteen indicators have been identified for the first level; nine environmental and six socio-economic indicators (see Figure 2.12). These indicators give a general view of the situation if a certain option is to be implemented.

Indicator	Description	Dimension
En01	Supply/Demand Gap in Agriculture Sector	cm/yr
En02	Supply/Demand Gap in Domestic Sector	cm/yr
En03	Leakage in Agriculture Sector	cm/yr
En04	Leakage in Domestic and Industrial Sectors	cm/yr
En05	Treatment of Wastewater	Dimensionless
En06	Supply/Demand Gap in Industrial Sectors	cm/yr
En07	Un-used Water	cm/yr
En08	Solid Waste	% collected
En09	Soil Quality (salinity)	ppm
SC01	Average Water Consumption for Population Connected to Network	L/C/D
SC02	Average Water Consumption for Population Not Connected to Network	L/C/D
SC03	Percentage of Population Connected to Freshwater Network	Dimensionless
SC04	Percentage of Population Not Connected to Wastewater Network	Dimensionless
SC05	Average Income	$/C/D
SC06	Job Creation	Job/Yr

Figure 2.12: First level indicators

The results of the calculation processes fall in a range between the best and worst possible values for that specific indicator.

Environmental indicators

En01, En02 and En06 represent the supply-demand gap in the agricultural, domestic and industrial sectors:

- Values: equal demand - supply
    - $En01_{Value} = D_{Agr} - S_{Agr}$
    - $En02_{Value} = D_{Dom} - S_{Dom}$
    - $En06_{Value} = D_{Ind} - S_{Ind}$
- Best values are when the gap is zero:

- $En01_{Best} = 0\ m^3/yr$
- $En02_{Best} = 0\ m^3/yr$
- $En06_{Best} = 0\ m^3/yr$

– Worst values: are when the gap equals the demand:

- $En01_{Worst} = D_{Agr}$
- $En02_{Worst} = D_{Dom}$
- $En06_{Worst} = D_{Ind}$

En03 and En04 represent the leakage in the agricultural, domestic and industrial systems:

- Values: equal to the actual leakage
  - $En03_{Value} = D_{Agr} - S_{Agr}$
  - $En04_{Value} = D_{Dom} - S_{Dom}$

– Best Values: are when the leakage is zero:

- $En03_{Best} = 0\ m^3/yr$
- $En04_{Best} = 0\ m^3/yr$

– Worst Values: are when the gap equals the supply:

- $En03_{Worst} = S_{Agr}$
- $En04_{Worst} = S_{Dom}$

En05 represents treated water.

– Values: are equal to the quantities of treated water

- $En05 = WW_T$

– Best Values: are when all produced wastewater is treated :

- $En05_{Best} = WW_{Col}\ (m^3/yr)$

– Worst Values: are when no wastewater is treated:

- $En05_{Worst} = 0\ m^3/yr$

En07 represents Un-Used Water.

– Values: are equal to the quantity of unused water

- $En07 = S_{Unused}\ (m^3/yr)$

– Best Values: are when all the supplied water is used

- $En07_{Best} = 0\ m^3/yr$

- Worst Values: are when the supplied water for different sectors is not used:
  - $En07_{Worst} = S\ (m^3/yr)$

Socio-economic indicators

SC01, SC02 represent the average water consumption of the connected/unconnected population to water supply:

- Values: are equal to the actual consumption
  - $SC01_{Value} = LCD_{Con}$
  - $SC02_{Value} = LCD_{Uncon}$
- Best Values: are when the consumption equals the WHO standard (150 l/c/d):
  - $SC01_{Best} = D_{WHO}$ (l/c/d)
  - $SC02_{Best} = D_{WHO}$ (l/c/d)
- Worst Values: are when the consumption is equal to zero:
  - $SC01_{Worst} = 0$ l/c/d
  - $SC02_{Worst} = 0$ l/c/d

SC03, SC04 represent the percentage of the population connected to a freshwater/wastewater network:

- Values: are equal to the actual population connected
  - $SC03_{Value} = POP_{ConFWN}$
  - $SC04_{Value} = POP_{ConWWN}$
- Best Values: are when the whole population is connected
  - $SC03_{Best} = 100$ %
  - $SC04_{Best} = 100$ %
- Worst Values: are when the population is not connected
  - $SC03_{Worst} = 0$ %
  - $SC04_{Worst} = 0$ %

SC05 represents the average income

- Values: is equal to the actual income
  - $SC03_{Value} = I$
- Best Values: are equal to specific values
  - $SC05_{Best}$ = (e.g. 10 $/c/d)
- Worst Values: when there is no income
  - $SC03_{Worst}$ = 0 $/c/d

SC06 represents the Job Creation

- Values: are equal to the actual number of employees
  - $SC06_{Value} = E$
- Best Values: are when all required jobs are available
  - $SC06_{Best} = R_{Emp}$ (job)
- Worst Values: are when there are no jobs available
  - $SC06_{Worst} = 0$ (job)

To facilitate the comparison of these values in a simplified form, all indicators are normalized to figures ranging from 0 to 1 using the following equation:

$$IN_{St} = \frac{IN_{Best} - IN_{Value}}{IN_{Best} - IN_{Worst}}$$

where:

IN: Indicator (*En01,…,En07 and SC01,…,SC05)*

St Standardized value

Best: Best value (one)

Worst: Worst value (zero)

Second level indicators

In order to give a single value that assesses the environmental and socio-economic status after adopting a certain management option the second level indicators were developed as in the following two equations.

$$En^{2d} = \sqrt[2]{w_{11} \times En01^2 + w_{12} \times En02^2 + w_{13} \times En03^2 + w_{14} \times En04^2 + w_{15} \times En05^2 + w_{16} \times En06^2 + w_{17} \times En07^2}$$

where:

En01,...,En07: First level environmental indicators

w_{1j}: Weighting (importance), 1: environment, *j*: indicator

En^{2d}: Second level environmental indicator

$$SC^{2d} = \sqrt[2]{w_{21} \times SC01^2 + w_{22} \times SC02^2 + w_{23} \times SC03^2 + w_{24} \times SC04^2 + w_{25} \times SC05^2 + w_{26} \times SC06^2}$$

where:

SC01,...,SC06: First level socio-economic indicators

w_{2j}: Weighting (importance), 2: socio-economic, *j*: indicator

SC^{2d}: Second level socio-economic indicator

Third level indicators

In order to facilitate the comparison of the effects of the implementation of different management options a third level indicator was defined that gives a broader more integrated view:

$$Score = \sqrt[2]{w_{En} \times En^{2d} + w_{Sc} \times SC^{2d}}$$

where:

En^{2d}: Second level environmental indicator

SC^{2d}: Second level socio-economic indicator

w_{En}: Weighting (importance of environmental issues)

w_{Ec}: Weighting (importance of socio-economic issues)

The final result of the third level indicator may be classified into one of the following categories:

100 > Score >= 90 Grade= Excellent

90> Score >= 80 Grade= Very Good

80 > Score >= 70 Grade= Good

70 > Score >= 60 Grade= Fair

60 > Score >= 50 Grade= Bad

50 > Score >= 0 Grade= Fail

2.7 Results

The results of the Jericho DSS tool may be illustrated in many different forms, including:

- Scores
- Plans
- Reports

Scores

As a final result of the third level indicator, a score is obtained, which falls into one of six categories in addition to the second level environmental and socio-economic scores.

Plans (2006-2030)

Different management plans may be proposed for the management time period ranging from 2006 to 2030. These plans include activities that may fall in one of the following fields:

- Water Supply: Shows the volume of water that is allocated from different sources to different sectors of use :
  - Wells
  - Springs
  - External
  - Harvested
  - Mekerot
- Agriculture Plan: This plan includes the future agricultural activities to be implemented in the target area. This of course depends on the water available for this sector and the land suitable for agriculture.

- Industrial Plan: Future industrial activities depend on the availability of water allocated for this sector and on the needs on a national level.
- Treatment Plan: This plan includes activities for the development of wastewater treatment plants and the reuse of this treated water.
- Community Service Plan: This plan includes a strategy for the connection of communities with water and wastewater services.

Reports

- Water supply: the tool generates five reports that show the quantities of water that are supplied for different purposes and from different sources (domestic, industry, agriculture, unused water, the total supply). These reports take the form of either tables or bar diagrams.
    1) Water consumption: these reports illustrate the quantities of water that are consumed by the three sectors (domestic, industry and agriculture).
    2) Water demand: these are the results showing the quantities of water needed to achieve the demand in the three sectors.
    3) Water Supply-Consumption-Demand and Supply-Demand Gap: Four reports show the quantities of water that are supplied, consumed and needed and the supply-demand gap of the three sectors.
    4) Supply-demand gap: These reports show the supply-demand gap of the three sectors.

2.8 Comparison of UNESCO method against other multi-criteria methods

MCDA Methods

To ensure that the development of a sustainable water resources management plan for a country is in fact sustainable, the economic, social and environmental objectives must be considered. Yet a conflict occurs if development in one objective is prioritized at the cost of degradation in another. For example, socio-economic development may be prioritized at the expense of degradation in environmental quality. Essentially, an acceptable balance between these two conflicting objectives must be established which reflects the overall

preference of society. To reach such a balanced position, in support of the decision-making process, Multi-criteria Decision analysis (MCDA) techniques have been developed to allow different preferences to be expressed through the MCDA process. Conflicting preferences can be resolved by establishing trade-offs between the different objectives. This process is depicted graphically in Figure 2.13.

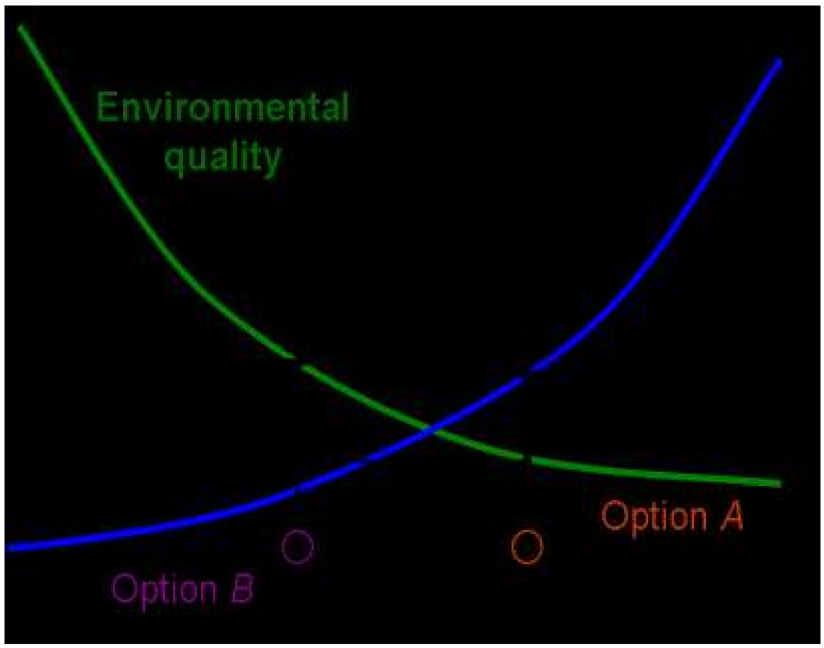


Figure 2.13: Tradeoff between environmental and economic objectives

Suppose a decision maker (DM) has to choose between **Options A** and **B.** If the DM is willing to choose **Option B** rather than **A,** then the DM is willing to forego ΔER to prevent a decrease in environmental quality ΔEQ. Tradeoffs reflect the preferences of the decision-maker. The MCDA procedure can help in expressing the different preferences of the stakeholders, and in arriving at a compromise solution which is acceptable to the different parties.

SUSMAQ Management Options and the Decision Support Tool (DST)

SWITCH project builds on the work and results of SUSMAQ project with regards to DSS.

Within the SUMAQ project, “Sustainable Management of the West Bank and Gaza Aquifers”, a framework was proposed for the evaluation of Management Options. This project, carried out by a partnership between the Palestinian Water Authority and the University of Newcastle and funded by the United Kingdom Government’s Department for International Development (DfID), aimed to increase understanding of the sustainable yield of the West Bank and Gaza aquifers under a range of future economic, demographic and land use scenarios, and to evaluate alternative groundwater management options.

The management options which were suggested for evaluation in SUSMAQ were categorized into the following 3 headings which are used for the Hydro- political and Socio-economic scenarios:

1. Current State-
2. Consolidating State
3. Long-term Development

CHAPTER (3):

Manual of Using Jericho DSS

3 Introduction

The development of the Decision Support System (DSS) for Waste Water Treatment Technologies has been a part of the EU funded Water Databanks IV (WDB IV) project. The project was a follow up to the WDB III project phase during which project an earlier, more limited, version of a spreadsheet based decision model had been developed. The overall objective of the WDB IV project is to enhance the ability of the Core Parties (Israel, Jordan, West Bank and Gaza) to quantify problems related to water availability and waste reuse and identify and analyze measures to be taken to enhance water reuse .

The basis for this process is the available water resources monitoring data and options to adapt and enhance these databases to decision maker's needs, whereas different core parties have different requirements for enhancement. Recommendations from the previous phase 3 and interaction with the Core Parties during the project have been the main inputs for the model design work that the DSS team has done during the project period (2005-2008). The result of the work was a "spreadsheet based model and navigation system (DSS)", that does allow the water resources planners of the core parties to enter and analyze water use and reuse cases based on water availability (quality and quantity) and reuse options (with an emphasis on waste water reuse for irrigated agriculture).

Two manuals were established for using Jericho DSS which are:

- Installation Manual.
- User Manual.

3.1 Installation Manual

3.1.1 Required Hardware

DSS-WDB works on IBM-compatible personal computers equipped with at least:

- A Pentium or compatible processor;
- 512 Mb internal memory (1 GB recommended);

- 20 GB available on the hard disk;
- a CD drive;
- a graphics adapter with 20Mb video memory and screen resolution 800x600. Recommended is 32Mb video memory and a screen resolution of 1024x768

3.1.2 Getting Started

The DSS WRMTPal can be started immediately by running the execution files. To run the Software correctly, Please consider from the beginning the following"

1. The software should be located on Drive C with folder named WRMTPAL, this folder should at least include the following :

Database (Access DB): includes all the data
Case study (Access DB): includes the data for the period selected
DST SUSMAQ (Excel File): include management options and indicators values
WRMTPAL (Executable file): to run the case study

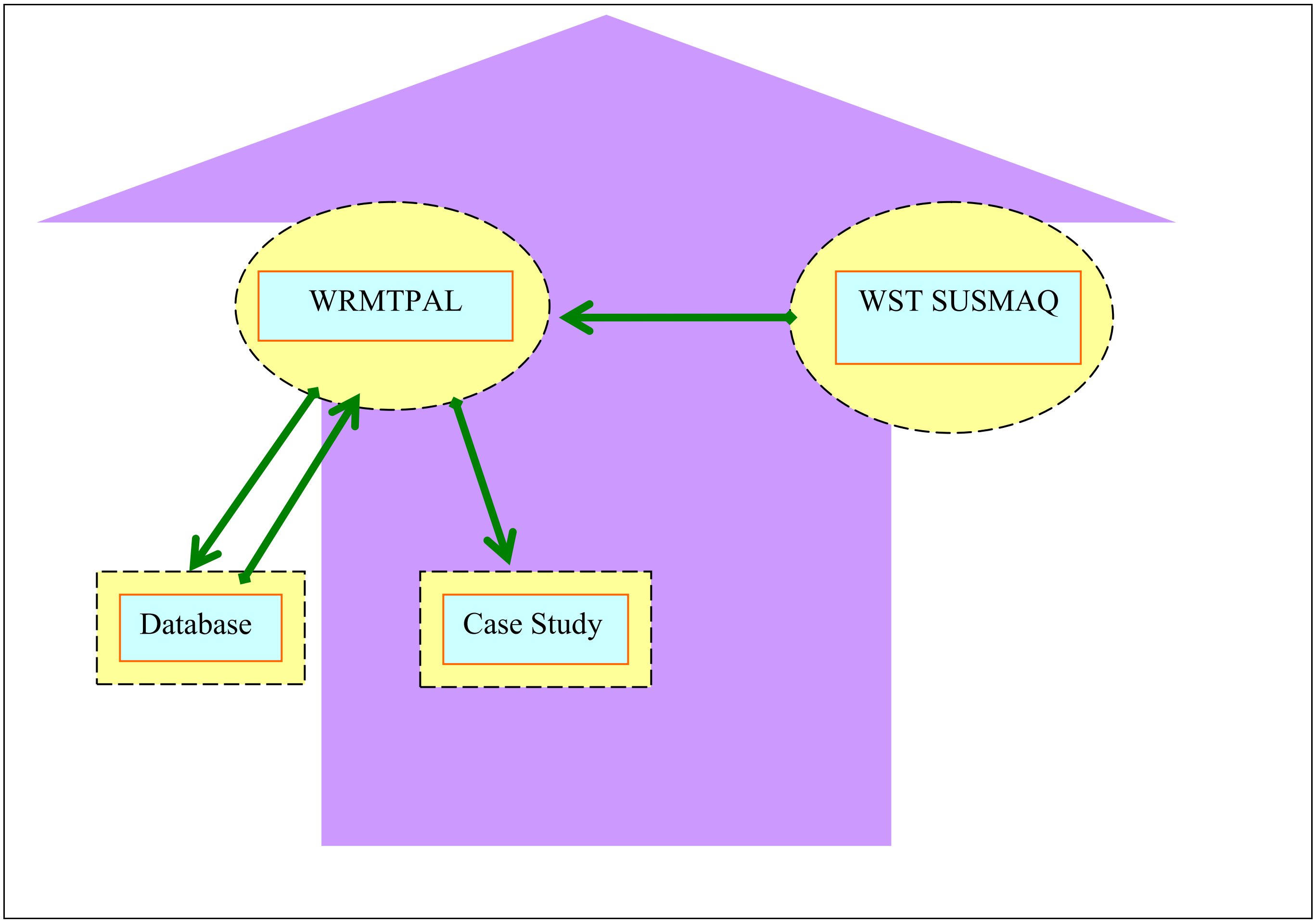
2. Be sure that .net is already installed in your machine.

This is the suitable environment to run the software

In case a complete run will be done then first DSS WRMTPAL should be run and activate. Based on this DSS the second DSS DST SUEAQ will be directly linked to the first one.

3.1.3 Link between Project Components

The different project components are strongly linked. The following diagram is visualizing the inter-relationship between the components and supply of equipment.



3.1.4 Installation of the DSS into the System

There are three steps required to install the software for the first time, which are:

Step 1: Install windows installer

Figure 3.1

Step 2: install dotnetx35.exe

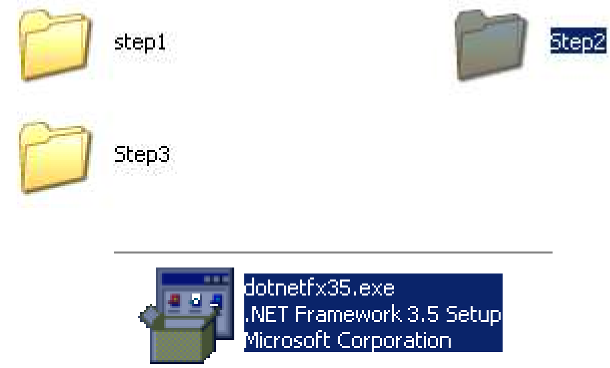


Figure 3.2

Step 3: install the DSS

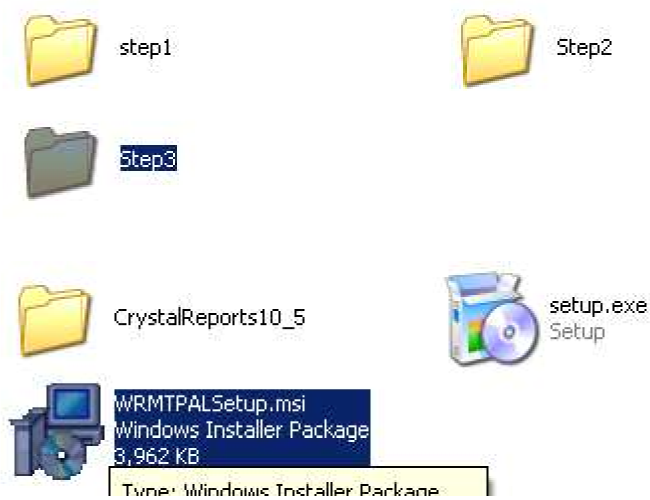


Figure 3.3

The software will create a folder WRMTPAL on drive C. After doing these steps the software is ready to be used

3.2 User Manual

3.2.1 DSS Interface System

What is the DSS interface system?

DSS Interface System is a computer program that has been designed to link data base with the DSS system, facilitate data entry and data manipulation, and management

of WWDSS case studies. This will enhance the ability of the water resources planners to quantify problems related to water availability and wastewater reuse and identify and analyze measures to be taken to enhance water reuse.

Steps in using the DSS interface system:

User typically carries out the following steps when using the DSS Interface System to develop a case:

1. Gather data and information about the selected study area, wastewater generation quantity and quality (domestic and industrial), wastewater treatment plants, hydro logical characteristics, water sources and agricultural demand in the study area.
2. Edit the data and the properties of the components that make up the case.
3. Export the case to the navigation system.
4. Obtain the results of the built case.

DSS Interface System Workspace

The basic DSS Interface System as shown in Figure 3.4 consists of three main user interface elements:

- The ribbon bar at the top.
- The menu bar at the left side.
- The indicators view at the right side.

Figure 3.4

3.2.2 MENU BAR

The Menu Bar located across the top of the DSS Interface contains a collection of menus to control the program which includes:

- New Case.
- Load Previous Case.
- Main Crop.
- Constants.
- Base Year.
- Evaluate.

3.2.2.1 New Case

This command will establish a new case plan.

When pressing the new command button the open file dialog (as in figure 3.5) appears to choose which database to use as a base of the information for the new case. Based on that database the system will create a new database named (Database.mdb) and imports all of the information from that database.

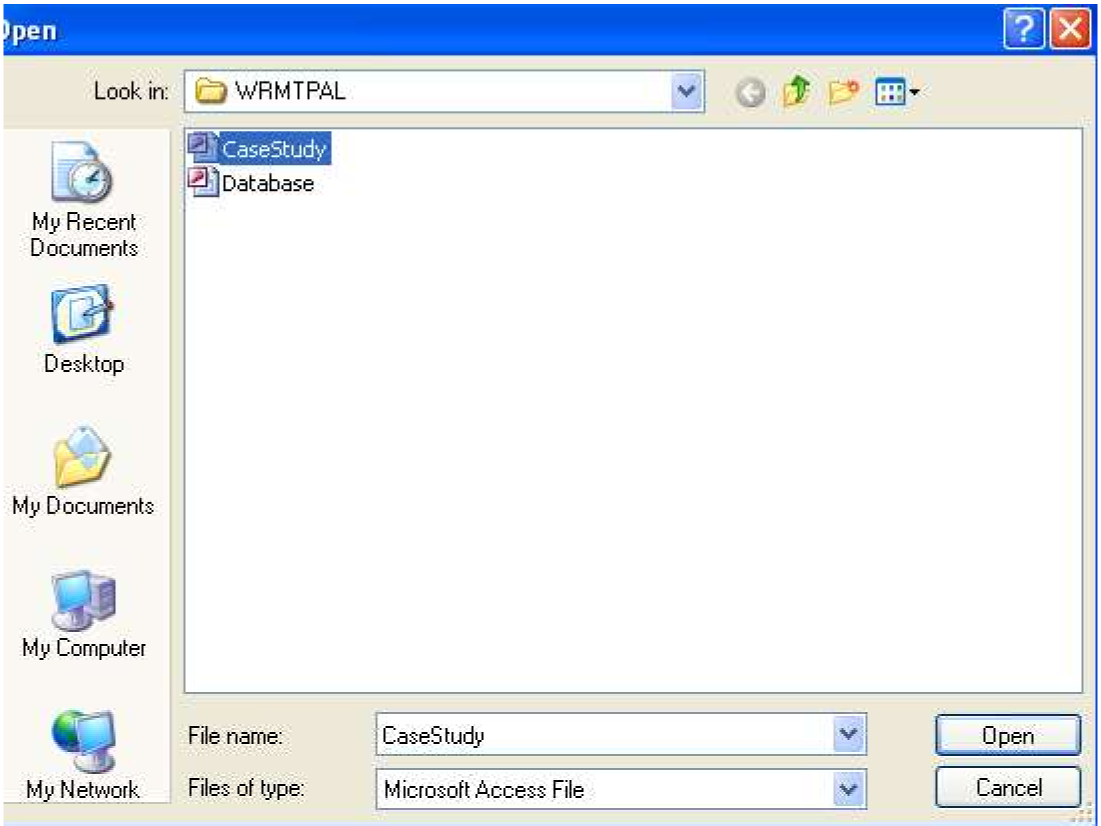


Figure 3.5

After selecting the database, the message box tells you that the baseline data has been successfully loaded as shown in Figure 3.6.

Figure 3.6

Note: the default base line database is (casestudy.mdb) which can be found in (C:\WRMTPAL) folder.

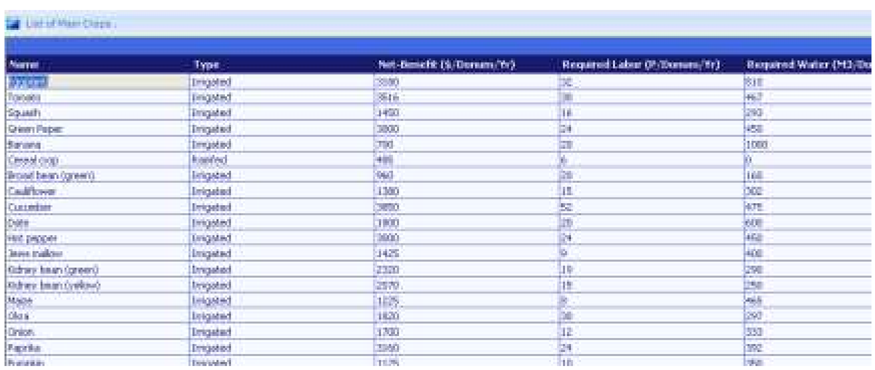
3.2.2.2 Load previous case

This command is to load case study you used previously and saved. All the steps of this procedure are the same like new. The difference is only filling the data, where all the steps required are the same.

3.2.2.3 Main Crop

This form includes all the data required in agriculture. It contains:

Field	Description
Name	Name of the crop
Type of irrigation	irrigated or rain fed
Net benefit	the estimated benefit in dollar per donum in the year
Required labor	the estimated persons per donum in the year
Required water	the estimation of water needed in cubic meter per donum in the year


List of Main Crops

Name	Type	Net-Benefit ($/Donum/Yr)	Required Labor (P/Donum/Yr)	Required Water (M3/Do
[illegible]	Irrigated	3300	30	510
Tomato	Irrigated	3516	30	467
Squash	Irrigated	1450	16	293
Green Paper	Irrigated	3800	24	450
Banana	Irrigated	790	20	1000
Cereal crop	Rainfed	485	6	0
Broad bean (green)	Irrigated	960	20	160
Cauliflower	Irrigated	1380	15	302
Cucumber	Irrigated	3850	52	475
Date	Irrigated	1800	20	600
Hot pepper	Irrigated	3800	24	450
Jews mallow	Irrigated	1425	9	400
Kidney bean (green)	Irrigated	2320	19	298
Kidney bean (yellow)	Irrigated	2570	15	250
Maize	Irrigated	1025	8	465
Okra	Irrigated	1820	30	297
Onion	Irrigated	1700	12	333
Paprika	Irrigated	3360	24	392
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure 3.7

This table is typical table from FAO. You can edit the values, add new crops, delete crop, etc the same like all other plans and constants

3.2.2.4 Constants

This includes the social, economical, and environmental constants used in the calculations

- **Income constants**: the estimated income in dollars per capita per the day for all sectors (Governmental, NGO's and private sector.
- **Leakage in the distribution System**: for both the water networks or nonconventional systems and agriculture.

- **Demand Constant**: This is the demand for water for domestic, agriculture and industrial use.

- **Working days**: estimated the real working days in the year excluding the holidays.

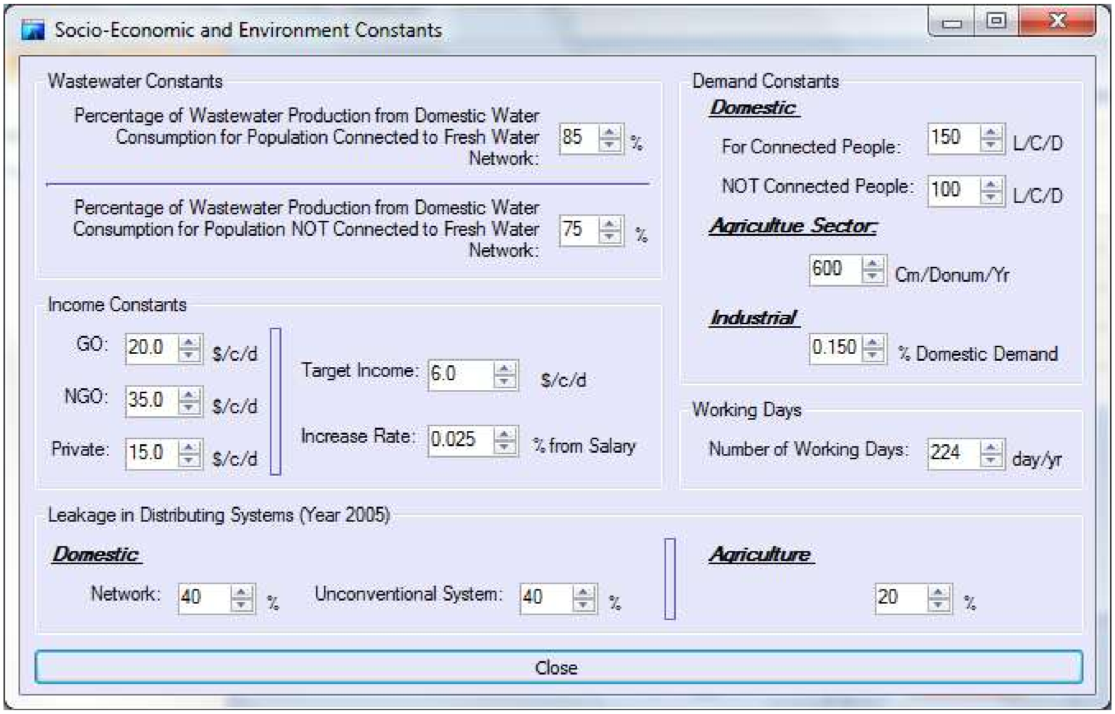


Figure 1.8

3.2.2.5 Base Year

This command defines the base year to start the planning period. It is normally the current year. After clicking this command a form appears to set the base year and the plan period. The plan period values are:

- 3 years plan.
- 5 years plan.
- 10 years plan.
- All years plan: this depends on the data entered in the data base.

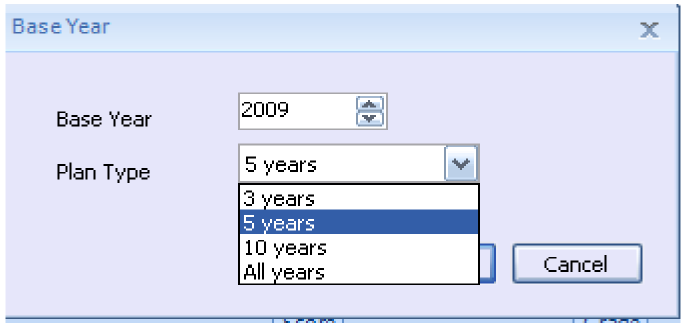


Figure 3.9

3.2.2.6 Evaluate

This is the calculations and results steps.

To make the evaluation for the plans, it is necessary to fill data for all plans, check the constant values, and ensure the units.

After finishing the evaluation process, the calculation values appear in the indicator values.

3.2.3 Working on cases

For the first time in using the system you must start a new case by pressing the new command after that when you back to the system you have to use the load previous case command and you must enter the data for all of the items listed below as shown in Figure 3.10.

Figure 3.10

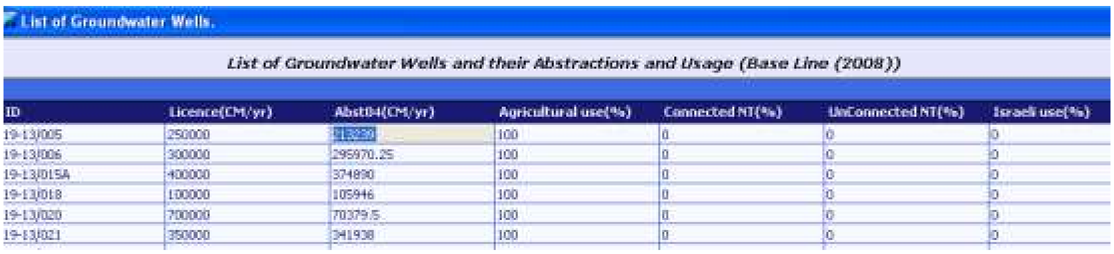
3.2.3.1 Reset for new plan

It gives you an empty data sheet to fill all of the required information if you didn't press this command and started with the rest of the list, it will includes all information stored in the selected database.

3.2.3.2 Groundwater wells Plan

Groundwater is the main source of water in the area. When selecting this command (as shown in Figure 3.11) a list of all wells appears as shown in Figure 3.12

Figure 3.11



List of Groundwater Wells.

List of Groundwater Wells and their Abstractions and Usage (Base Line (2008))

ID	Licence(CM/yr)	Abst04(CM/yr)	Agricultural use(%)	Connected NT(%)	UnConnected NT(%)	Israeli use(%)
19-13/005	250000	[illegible]	100	0	0	0
19-13/006	300000	295970.25	100	0	0	0
19-13/015A	400000	374890	100	0	0	0
19-13/018	100000	105946	100	0	0	0
19-13/020	700000	70379.5	100	0	0	0
19-13/021	350000	341938	100	0	0	0

Figure 3.12

At the lower part of groundwater wells sheets, you find different summaries of data and another options for data editing, saving, etc

Edit baseline wells: To enable and start the editing of data.

Save Edit: To save the edited data.

Use the last updated DB: to use data already entered in the database.

Reset well DB: to clear the wells data.

After that click **next** to go to the next sheet as shown in Figure 3.13 & 3.14.

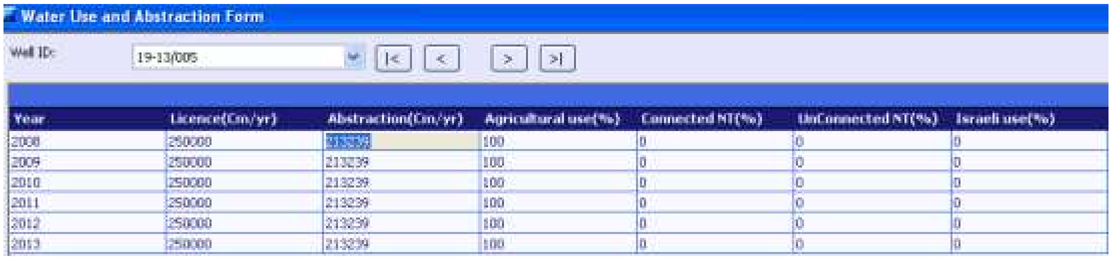
This sheet includes a summary for the last sheet, you can use the arrows to move from a well to another. Also the lower part f the sheet contains different options to deal with data:

Edit well Use: to change the usage of the well from agriculture to domestic and vise versa

Editing tools: enable you to change the quantities and percentages

Create New Well: to add new well to the database

Water Budget: total abstraction of the wells

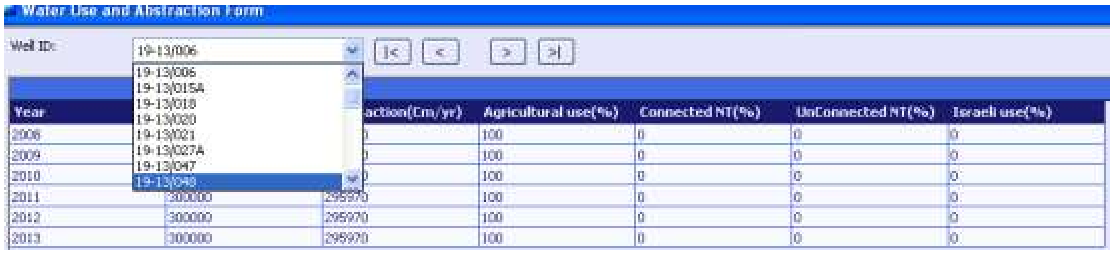


Water Use and Abstraction Form

Well ID: 19-13/005

Year	Licence(Cm/yr)	Abstraction(Cm/yr)	Agricultural use(%)	Connected NT(%)	UnConnected NT(%)	Israeli use(%)
2008	250000	[illegible]	100	0	0	0
2009	250000	213239	100	0	0	0
2010	250000	213239	100	0	0	0
2011	250000	213239	100	0	0	0
2012	250000	213239	100	0	0	0
2013	250000	213239	100	0	0	0

Figure 3.13



Water Use and Abstraction Form

Well ID: 19-13/006

19-13/006
19-13/015A
19-13/018
19-13/020
19-13/021
19-13/027A
19-13/047
19-13/048

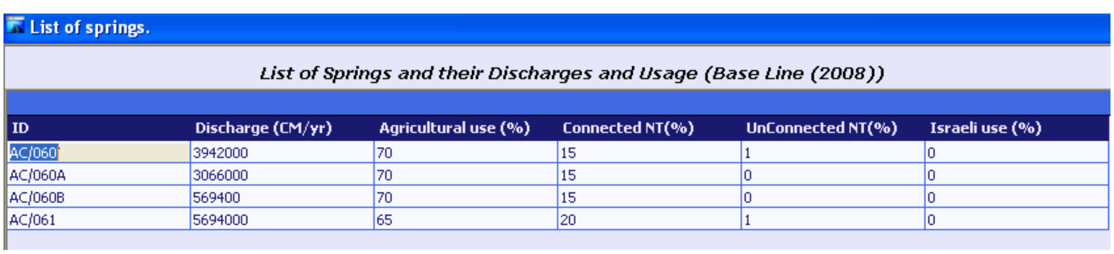
Year	[illegible]	[illegible]action(Cm/yr)	Agricultural use(%)	Connected NT(%)	UnConnected NT(%)	Israeli use(%)
2008	[illegible]	[illegible]	100	0	0	0
2009	[illegible]	[illegible]	100	0	0	0
2010	[illegible]	[illegible]	100	0	0	0
2011	300000	295970	100	0	0	0
2012	300000	295970	100	0	0	0
2013	300000	295970	100	0	0	0

Figure 3.14

3.2.3.3 Spring usage Plan

Figure 3.15

Like the groundwater wells, the springs usage plan is the list of all springs with discharge and usage. It can be edited, saved, change usage, calculate the budget... Etc.



List of springs.

List of Springs and their Discharges and Usage (Base Line (2008))

ID	Discharge (CM/yr)	Agricultural use (%)	Connected NT(%)	UnConnected NT(%)	Israeli use (%)
AC/060	3942000	70	15	1	0
AC/060A	3066000	70	15	0	0
AC/060B	569400	70	15	0	0
AC/061	5694000	65	20	1	0

Figure 3.16

You can select spring id from the drop list or use the arrows to move from one to another.

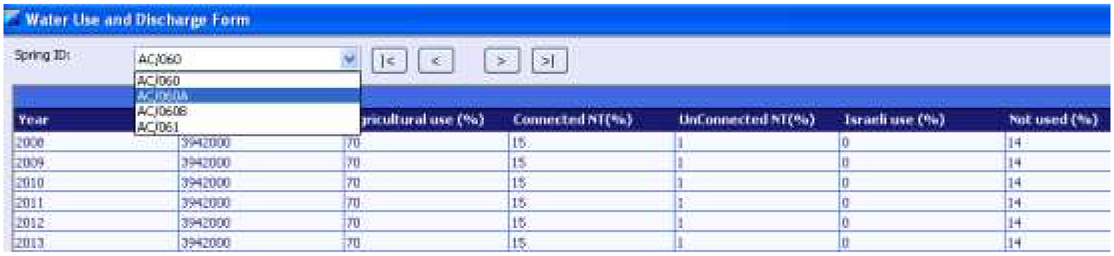


Figure 3.17

Also like wells you can use Editing tool to edit quantities, percentages, usage...Etc

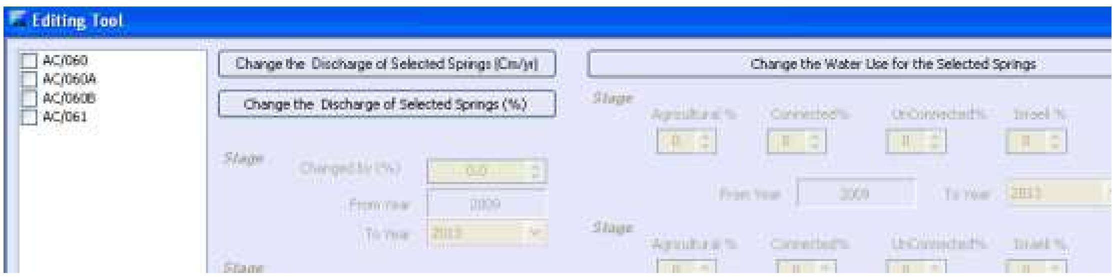


Figure 3.18

3.2.3.4 Purchased water from Mekarot

It is an option, but it is not enabled every time. It means to increase the available quantities purchased from mekorot for domestic use.

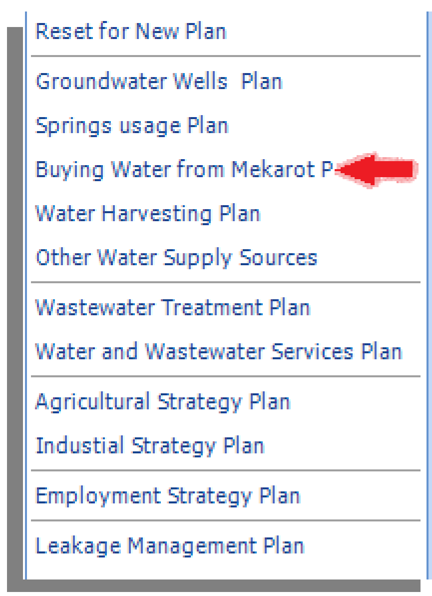
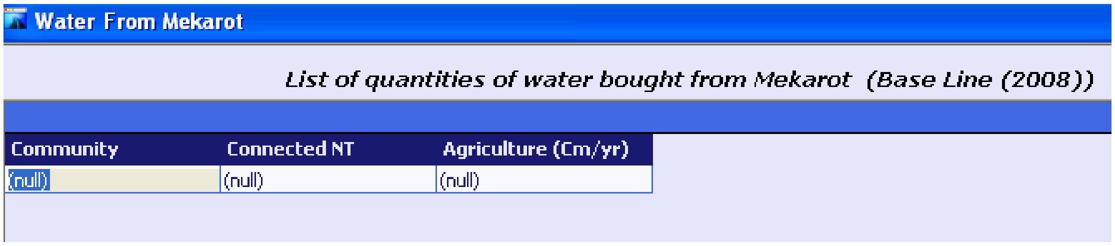


Figure 3.19

After clicking this command, the following form appears, to fill the purchased quantities.


Water From Mekarot

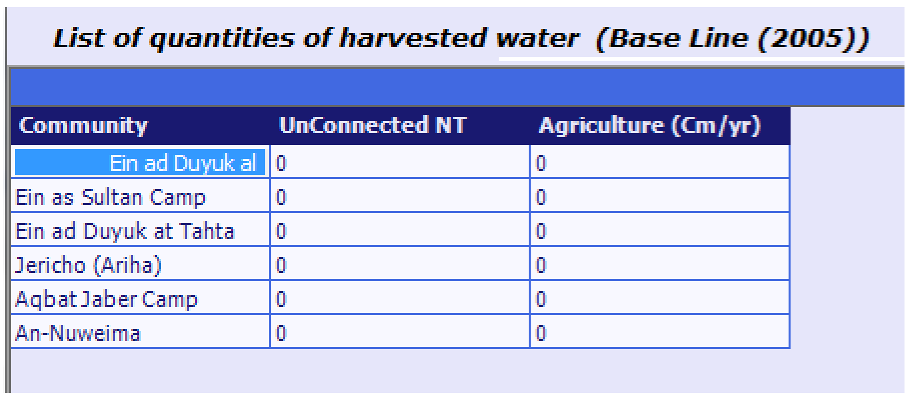
List of quantities of water bought from Mekarot (Base Line (2008))

Community	Connected NT	Agriculture (Cm/yr)
(null)	(null)	(null)

Figure 3.20

3.2.4 Water harvesting plan

After clicking Water harvesting plan from the menu the following form appears, to fill the harvesting quantities.


List of quantities of harvested water (Base Line (2005))

Community	UnConnected NT	Agriculture (Cm/yr)
Ein ad Duyuk al	0	0
Ein as Sultan Camp	0	0
Ein ad Duyuk at Tahta	0	0
Jericho (Ariha)	0	0
Aqbat Jaber Camp	0	0
An-Nuweima	0	0

Figure 3.21

The needed data to be filled are in the following table:

Field	Description
Community	
Unconnected NT	
Agriculture (cm/yr)	

Also like the previous forms you can use Editing tool to edit the values

3.2.4.1 Other Water supply Sources

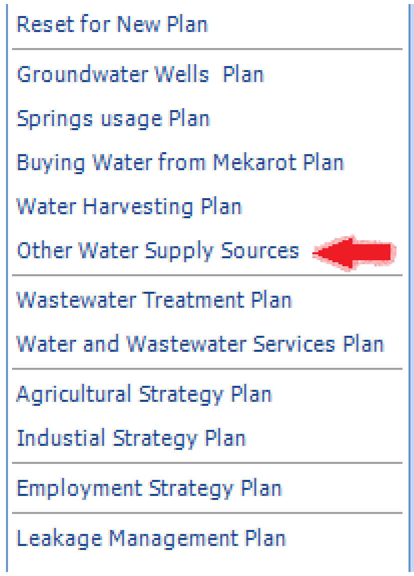
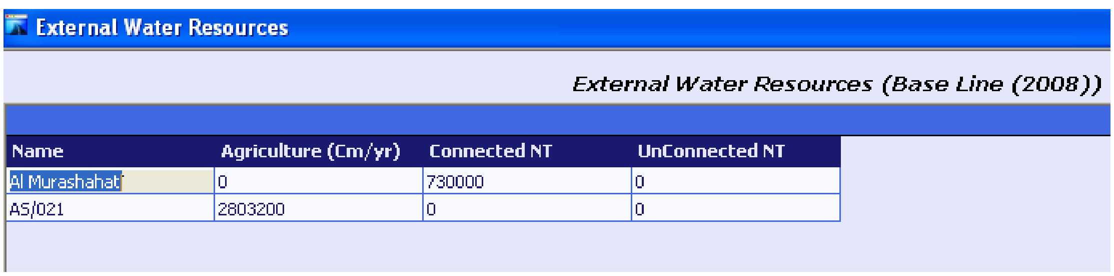


Figure 3.22

This is used as utilization of surface water, which can be considered as surface water harvesting.


External Water Resources

External Water Resources (Base Line (2008))

Name	Agriculture (Cm/yr)	Connected NT	UnConnected NT
Al Murashahat	0	730000	0
AS/021	2803200	0	0

Figure 3.23

3.2.4.2 Wastewater Treatment Plant

Figure 3.24

This option is used to utilize treated wastewater, Now, there is any treatment plant. As shown in the following:

Field	Description
Name	name of the treatment plant
External inflow	Is the total amount of influent wastewater to the treatment plant in cubic meter?
Outflow %	The percent of total effluent from the total influent? Normally the percent is approximately more than 95%.
Reused %	Is the percent of the reused treated wastewater from the total effluent?

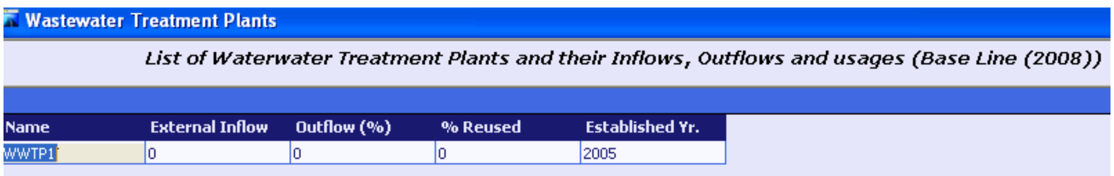


Figure 3.25

Creation of new treatment plant:

To enter new created or established wastewater treatment plant, the following form helps to enter the required data.

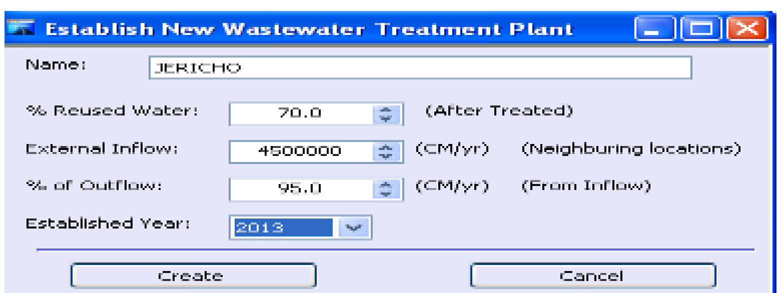


Figure 3.26

After filling all the required data press the create command to save the entered data. The following form shows the old and created wastewater treatment plants

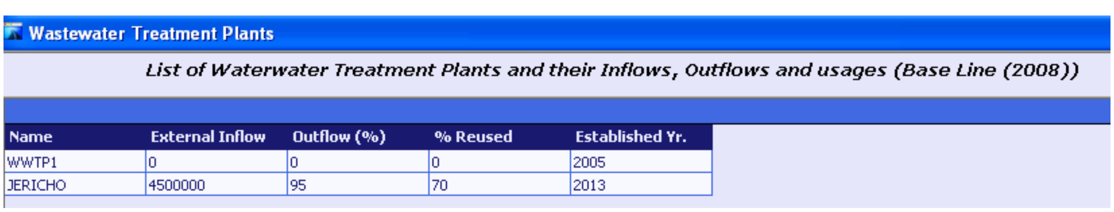
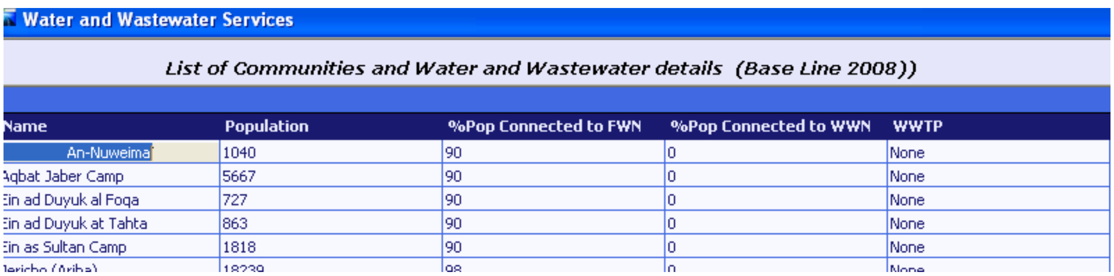


Figure 3.27

HOUSE OF WATER & ENVIRONMENT

Details of communities using the treatment plant: the needed data to be filled are in the following table:

Field	Description
Name	name of the community
Population	the current population in the base year
% pop connected FWN	percent of the population in the community connected to the water network in the base year
% pop connected WWN	percent of the population in the community connected to the wastewater network in the base year
WWTP	name of the treatment plant


Water and Wastewater Services

List of Communities and Water and Wastewater details (Base Line 2008))

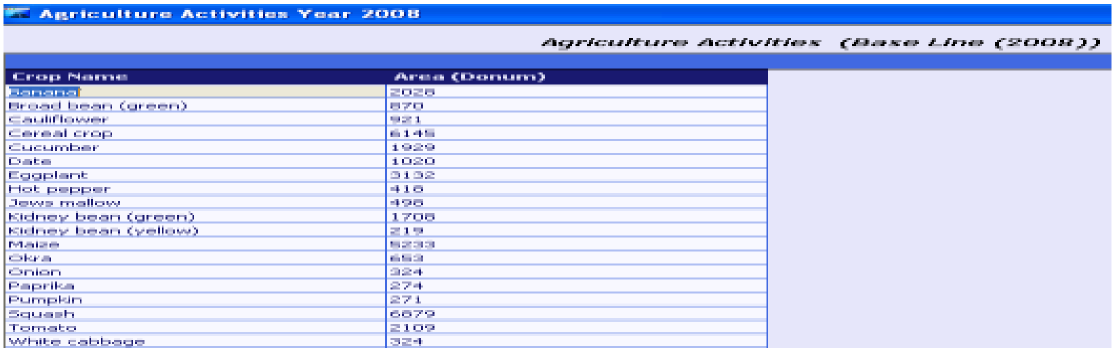
Name	Population	%Pop Connected to FWN	%Pop Connected to WWN	WWTP
An-Nuweima	1040	90	0	None
Aqbat Jaber Camp	5667	90	0	None
Ein ad Duyuk al Foqa	727	90	0	None
Ein ad Duyuk at Tahta	863	90	0	None
Ein as Sultan Camp	1818	90	0	None
Jericho (Ariha)	18239	98	0	None

Figure 3.28

3.2.4.3 Agriculture Strategy Plan

Figure 3.29

After clicking this command, the agricultural activities table appears that contain a list of all crops and areas in donums



Crop Name	Area (Donum)
Banana	2028
Broad bean (green)	870
Cauliflower	921
Cereal crop	6145
Cucumber	1929
Date	1020
Eggplant	3132
Hot pepper	418
Jews mallow	498
Kidney bean (green)	1708
Kidney bean (yellow)	219
Maize	5233
Okra	653
Onion	324
Paprika	274
Pumpkin	271
Squash	6879
Tomato	2109
White cabbage	324

Figure 3.30

Below the table there are some commands to help you to edit the crops and the values.

Edit Baseline values: this allows editing either the crops or the area. After editing you should press save edit or cancel.

After save and click next. The following table appears to show the activities and changes in the planning period.

By clicking the command "edit" below the table, you can change the areas for each crops in the planning period. It can be equal, less or greater than the base values, this depending on the planner's vision.

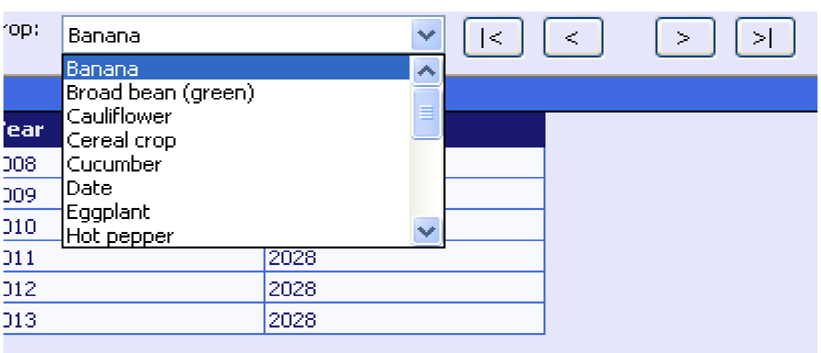


Figure 3.31

Also using the command "Add crop" enables to add new crops to the list as shown in the form below

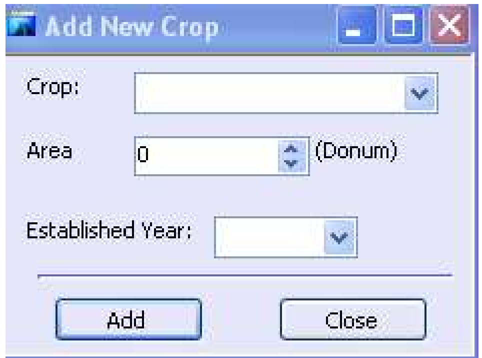


Figure 3.32

3.2.4.4 Industrial Activity Plan

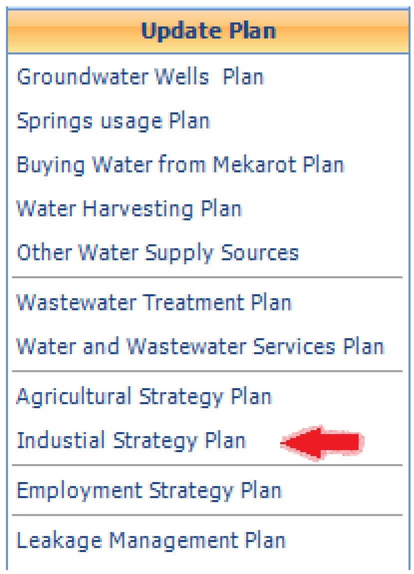


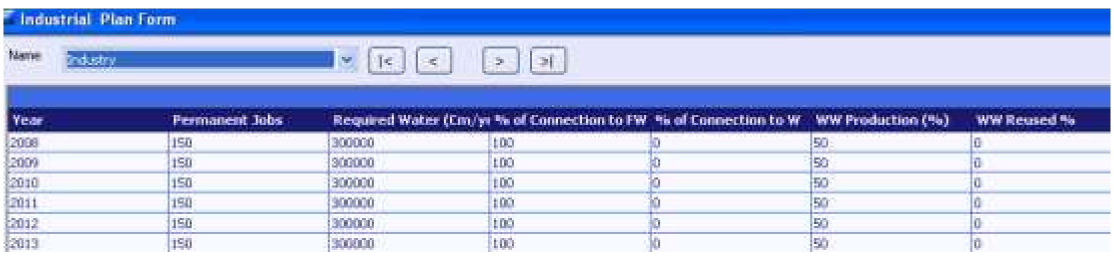
Figure 3.33

After clicking the industrial activity plan the following form appear

Figure 3.34

Field	Description
Name	Name of the industry or factory
Permanent Jobs	number of employees in this industry
Required water	the annual required water in cubic meter per year
WW production %:	percent of generated WW from the total consumed water
WW reuse %	percent of reused treated wastewater from the total generated WW

When finishing adding a new industry, save and click next, the following form appear to edit and save the data, the same as the other plans.



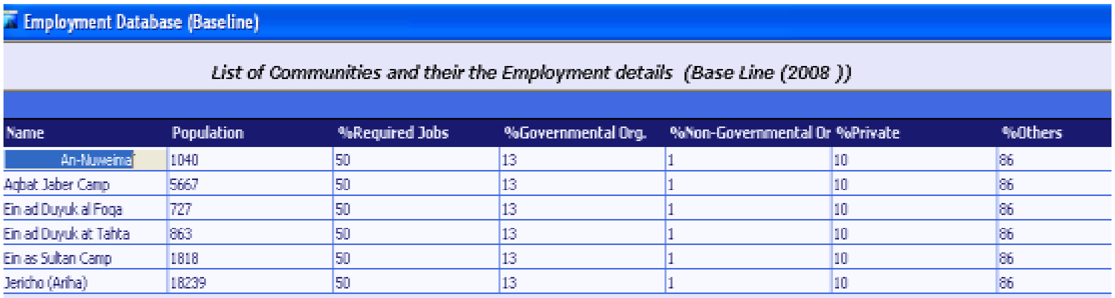
Year	Permanent Jobs	Required Water (Cm/yr	% of Connection to FW	% of Connection to W	WW Production (%)	WW Reused %
2008	150	300000	100	0	50	0
2009	150	300000	100	0	50	0
2010	150	300000	100	0	50	0
2011	150	300000	100	0	50	0
2012	150	300000	100	0	50	0
2013	150	300000	100	0	50	0

Figure 3.35

3.2.4.5 Employment Strategy Plan

Figure 3.36

After clicking the employment strategy plan the following form appears


Employment Database (Baseline)

List of Communities and their the Employment details (Base Line (2008))

Name	Population	%Required Jobs	%Governmental Org.	%Non-Governmental Or	%Private	%Others
An-Nuweima	1040	50	13	1	10	86
Aqbat Jaber Camp	5667	50	13	1	10	86
Ein ad Duyuk al Foqa	727	50	13	1	10	86
Ein ad Duyuk at Tahta	863	50	13	1	10	86
Ein as Sultan Camp	1818	50	13	1	10	86
Jericho (Ariha)	18239	50	13	1	10	86

Figure 3.37

The needed data to be filled are in the following table:

Field	Description
Name	name of the community
Population	number of the population in the base year
% Required job	percent of required jobs from the total population
% of governmental org	percent of required jobs in the governmental sector
% of Non-governmental org	percent of required jobs in the Non-governmental sector
% private	percent of required jobs in the private sector

To edit those values, click either edit to edit the values directly, or use editing tools to edit it according to stages you define.

3.2.4.6 Leakage management Plan:

This plan dealing with the leakage from the public network

Figure 3.38

After clicking Leakage Management plan from the main menu, the following form appears.

Leakage in Water System

Year	%Demostic Water-Conn	%Demostic Water-Not	%Agriculture Water
2008	40	45	10
2009	40	45	10
2010	40	45	10
2011	40	45	10
2012	35	45	10
2013	35	45	10

Figure 3.39

To edit those values, click either edit to edit the values directly, or use editing tools to edit it according to stages you define.

3.2.5 Reports

Report	Description
Wells	Wells abstractions report
Springs	Springs discharges report
External	External water supplies report
Harvested	Harvested water report
Mekerot	Mekerot water supply report
Agriculture plan	Agriculture plan report
Industrial plan	Industrial plan report
Treatment plan	Wastewater Treatment plan report
Community service plan	Community service plan report
Main crops	Main crops report

Report	Description
supply →Domestic	Domestic water sources by source report
supply →Industry	Industry water sources by source report
supply →Agriculture	Agriculture water sources by source report
supply →Unused	Unused water sources by source report
supply →Summary	Water supply summary report
Consumption	Water Consumption report

Demand	Water Demand report
Sup-Con-Dem-Gap→ Domestic	Supply ,consumption and demand gap for Domestic usage
Sup-Con-Dem-Gap→ Industry	Supply ,consumption and demand gap for Industry usage
Sup-Con-Dem-Gap→ Agriculture	Supply ,consumption and demand gap for Agriculture usage
Sup-Con-Dem-Gap→ Summary	A summary report for the supply ,consumption and demand gap
Supply demand gap	Supply and demand gap report
Domestic Consumption	Domestic water Consumption
Wastewater→Production	Wastewater Production report
Wastewater→Treatment	Wastewater Treatment report
Employment	Employment details report
Income	Income details report
Management options 1	A chart report for the economical ,environmental and social indicators
Management options 2	A detailed report for the indicators

3.2.6 Reports viewer

Reports Viewer is a component that previews the DSS reports and enables you to view and navigate to different sections and pages of the report.

The Reports viewer component includes the following sections as in **Figure 3.40.**

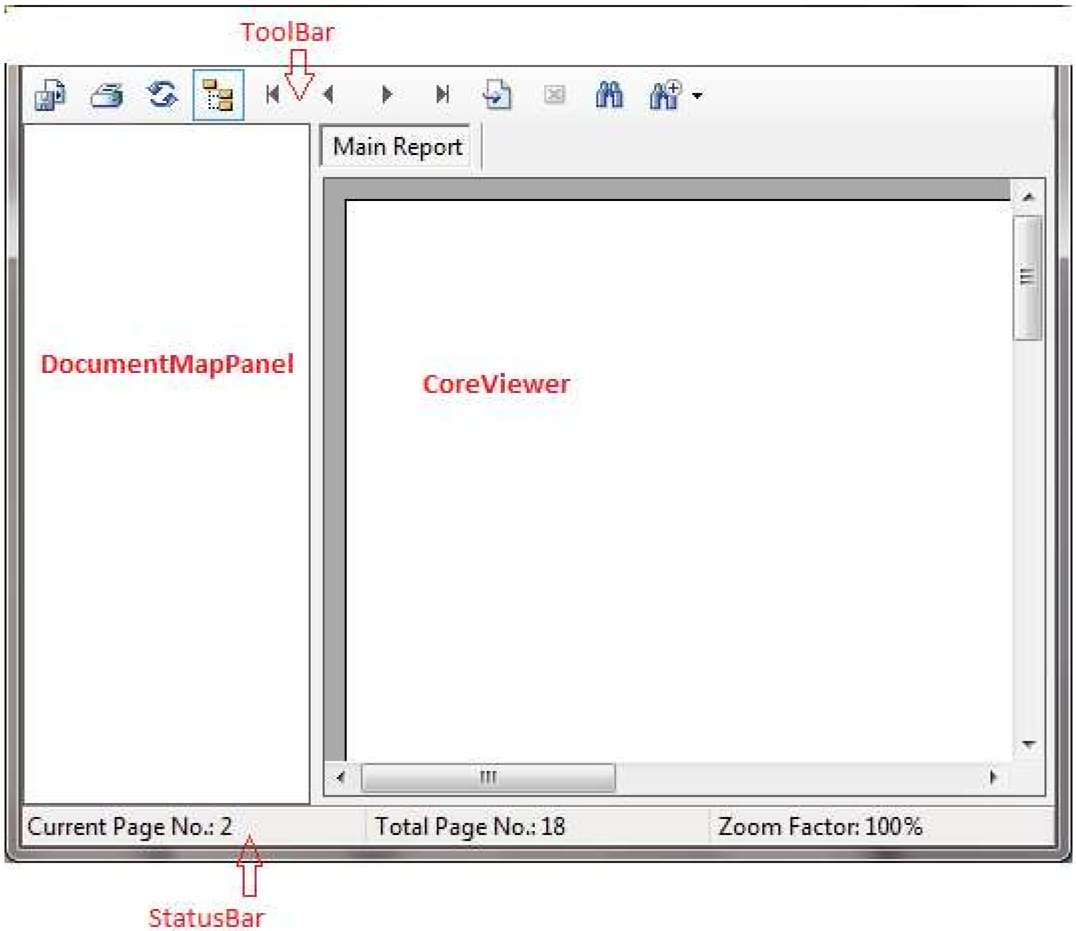


Figure 3.40

CoreViewer is the section that displays the current page of the report. It may also be used to display messages, such as "Loading report.

DocumentMapPanel is the basic Table of Contents (TOC) panel for document navigation. It displays the interactive document map as a tree view.

Toolbar is the basic toolbar that allows for interaction with the report through navigation, viewer modes, export options…etc. The toolbar contains the following buttons as shown in **Figure 3.41**:

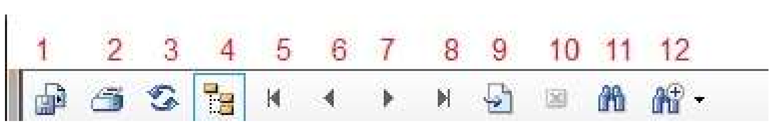


Figure 3.41

1. **Export** exports the report to the selected format :
    a. Crystal report: Exports to Crystal report format.
    b. Adobe Acrobat : Exports the report to PDF format
    c. Microsoft Excel: Exports the report to Excel format.
    d. Microsoft Excel Data Only: Exports the report to Excel format without the formatting.
    e. Microsoft Word: Exports the report to Microsoft Word document format.
    f. Rich Text Format: Exports the report to Rich Text format (rtf).

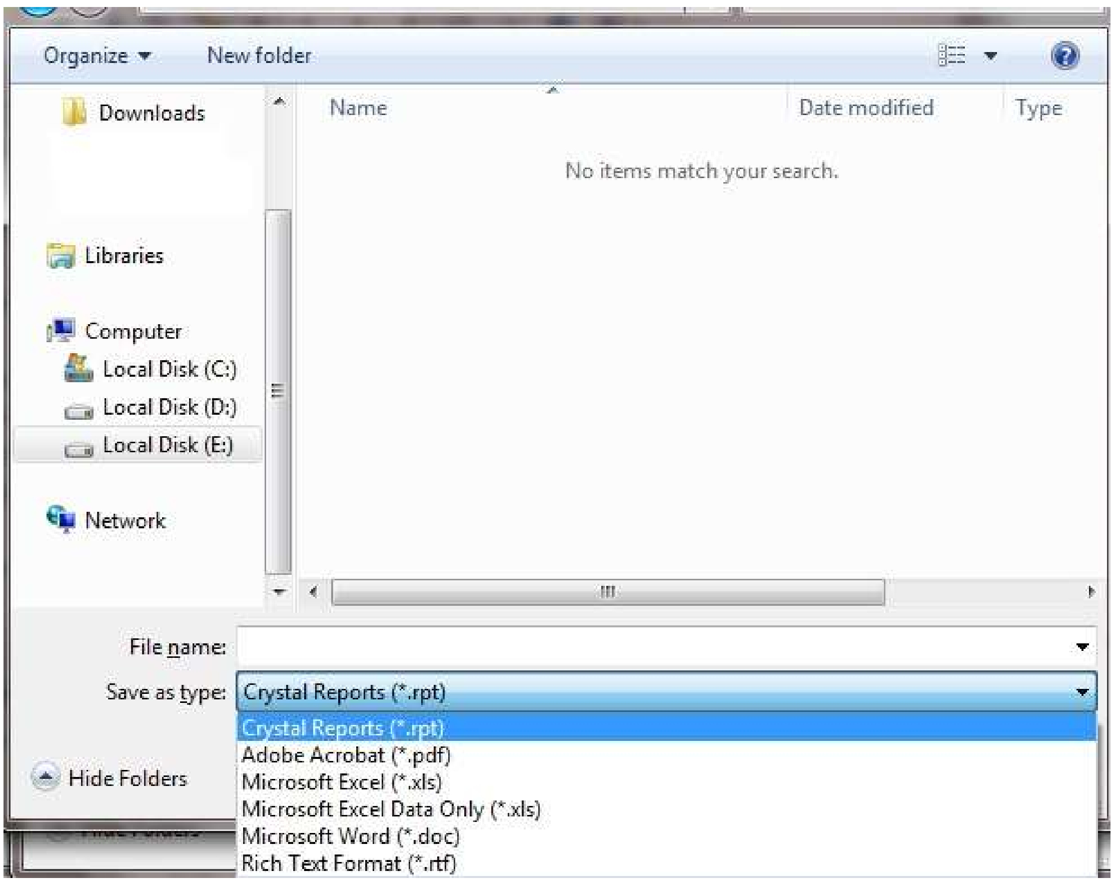


Figure 3.42

2. **Print** opens a print dialog with printer, print range, and page handling options.
3. **Refresh** the report and reset the changes as when it was loaded.
4. **Hide/Show Side Bar** allows the user to open or close the side bar where they can select from any of the panels that you have been added to the CoreViewer.

5. **Go to First Page** navigates to the first page of the report.
6. **Back** navigates to the page immediately prior to the current page. (This button is disabled when the first page of the report is in view.)
7. **Forward** navigates to the page immediately after the current page. (This button is disabled when the last page of the report is in view.)
8. **Go to End Page** navigates to the last page of the report.
9. **Go to** a specific page by showing a dialog form to enter the page.
10. **Close current view** closes the current view other than the main report view.
11. **Find Text** provides access to the Find Panel control which allows users to search the report for key words.
12. **Zoom:** Specify the zooming factor to be applied to the report.
13. **Status Bar** is located at the bottom of the report viewer window and indicates the current page number, the total number of pages and the current zoom factor.

CHAPTER (4):

Training & Workshop Report

4.0 Background and Objectives

The scope of this training was to introduce the concept of integrated urban water management by developing a Decision Support System for a case study in Jericho of Palestine. After the development of the water DSS for Jericho there was a need to apply it in hands-on experience approach for the stakeholders in the study area so that the participants will realize the capabilities of the DSS software that put together all water resources and their management options in one package. Before this DSS and its database all water resources and their management responsibilities were fragmented.

The objectives of this training were 1) to enhance the experience of the Jericho area planners, decision makers, farmers and the stakeholders in general by making them familiar with the developed DSS software package; 2) to discuss the concept of urban water management for Jericho in a holistic approach so that all uses of water are discussed by their stakeholders; 3) to make sure that the developed DSS for Jericho area is embedded within the management of urban water under the responsibility of Jericho Municipality.

4.1 Trainers List

No.	Name	Institute	Position
1	Dr. Amjad Aliewi	HWE	Water management
2	Eng. Adel yasin	HWE	Water and Sanitation
3	Tareq Saleh	HWE	Programmer and System analyst
4	Eng. Jalal Basharat	Jericho Municipality	Operational engineer
5	Eng. Mohammad Najjar	HWE	Water Engineer

4.2 Participants List

No.	Name	Institution
1	Jalal Bsharat	Jericho Municipality
2	Basel Hijazi	Jericho Municipality
3	Ameena Saadah	Jericho Governorate
4	Jawaher Ka'abneh	Local National Committee
5	Farah Abu Rashad	Al Duk Al Tahta Association
6	Mohammad Azmouti	Jericho Municipality
7	Zahi Barahmeh	Jericho Municipality
8	Yasser Khader	Ein Al Sultan National Committee
9	Ali Adais	Engineering Association
10	Ahmed Adada	Jericho Municipality
11	Ghazi Al Naji	Jericho Municipality
12	Muath Abu saada	Hydrology Group
13	Fahmi Njoom	Jericho Municipality
14	Khamees Abu awad	Ein Al Sultan Water Committee
15	Sami Jalyata	Farmer
16	Sahker Balo	Jericho Municipality
17	Mohammad Afaneh	Jericho Municipality
18	Bilal Ammar	Local governorate Ministry
19	Mohammad Khatib	Local Governorate Ministry
20	Suha Sedaer	Local Governorate Ministry

4.3 Training Agenda

Jericho 27-29 Nov. 2010

Day1, Saturday , 27Nov. 2010		
9:00-9:20	Introduction: SWITCH project	Dr. Amjad Aliewi + Mayor of Jericho
9:20:10:20	Integrated water resources management: Concept and practices	Dr. Amjad Aliewi
10:20: 10:30	Coffee break	
10:30: 11:30	Water problems in Jericho/ the need to Jericho DSS	Eng Bsharat from Jericho Muni.
11:30:12:30	Governorance in Water Supply management	Eng. Adel Yasin
12:30-13:00	Discussions	Amjad Aliewi
13:13:13:45	Lunch Break	
13:45:15:00	Governorance in Urban Sanitation	Eng. Adel Yasin
15:00: 15:30	Discussion and conclusion	
Day 2, Sunday 28Nov. 2010		
9:00:9:20	WMRTPAL software: installation and hardware requirement	Tareq Saleh
9:20 : 10:00	Software components	Tareq Saleh
10:00: 10:45	Socio economical and environmental Indicators	Eng. Adel Yasin
10:45 : 11:00	Coffee break	
11:00 : 12:00	Building a case study	Tareq Saleh
12:00 : 12:30	Updating previous case study	Tareq Saleh
12:30: 13:00	Discussion	
13:00 : 13:45	Lunch Break	
13:45: 15:00	Practical case study by participants	
15:00 – 15:30	Suggestions and Recommendations and what next steps	
Day 3, Monday, 29Nov. 2010		
9:00 – 12:00	Field Trip	
	As-Sultan Spring, Brackish well – Arab Project, Aqbat Jaber Sand filter	Eng Mohammad Najjar
12:00 -12:30	Lunch	
	Finish the training	

4.4 Training sessions

Day(1), Saturday , 27Nov. 2010

Opening the Workshop

Mr. Hasan Saleh Mayor of Jericho & Dr. Amjad Aliewi Director General of HWE

Mayor of Jericho Speech:

- The mayor welcomed HWE and all participants.
- The mayor thanks HWE to consider Jericho as a case study.
- He said that there are a lot of problems related to water supply and demand in Jericho.
- Fresh water under stress, where more than 1.5 million tourist visiting Jericho annually.
- There is a real need for DSS to support planners in their plans.
- The master plan recently developed can be a base for Jericho DSS.

Director General of HWE Speech:

- DG of HWE Dr. Amjad Aliewi thanked the mayor and the participants.
- We did our best to develop this tool to help planners to manage the water sector.
- We cooperated with Jericho municipality to develop this tool to be used effectively.

Figure 4.1

Figure 4.2

Presentation (1): Integrated Water Resources Management: Concept and Practices

Dr. Amjad Aliewi Director General of HWE

Presentation Key Points:

- Definition of IWRM.
- Why IWRM.
- Principles.
- The user.
- The process.
- The policy.
- The institutions.

Figure 4.3

Presentation (2): Water Problems in Jericho

Eng. Jalal Bsharat

The Presentation Summarized the Water Problems as follows:

- Jericho depends only on one water source for domestic use.
- The present tarrif is very low and encourages the people to consume more water.
- The high variation in topography affected the equity in water distribution.
- The climate is often hot and humid so the water consumption is high for both showers and boilers for cooling.
- The demand exceeds the water supply.

Figure 4.4

Presentation (3 & 4): Water Governance in Water and Sanitation

Eng. Adel Yasin

Presentation Key Points:

1. Definition of water governance.
2. Principles of water governance.
3. Governance issues considered.
4. Trends in unsustainable development.
5. Water supply challenges.
6. Roles of policy makers in achieving water related MDG's.
7. IWRM applications.
8. Duplin Principles and Challenges.
9. Water demand Management principles.
10. Water conservation principles.
11. Water services goals.
12. Capacity building requirements.
13. Basic indicators for water supply and sanitation.
14. Lessons learned.

Figure 4.5

Day (2), Sunday 28Nov. 2010

Presentation (1): Socio Economic and Environmental Indicators Used in (WMRTPAL software)

Eng. Adel Yasin

Presentation Key Points:

- DSS concept.
- DSS structure.
- DSS components and tools.
- Management options used.
- Environmental indicators.
- Socio-economic indicators.

Figure 4.6

Presentation (2&3):How to Install DSS (WMRTPAL software) & Software Components

Mr. Tareq Saleh

Presentation Key Points:

- Hardware requirements.
- Software requirements.
- Steps to install.
- Parameters.
- Management options.
- Indicators.
- Access database.
- Scenarios.
- Calculations.
- Reports.

Figure 4.7

Building a Case Study

Mr. Tareq Saleh

Presentation Key Points:

- Base year
- New and update case study
- Data required for management options
- Values for indicators
- Run the model
- Preparing the reports

Figure 4.8

<table>
<tr><th colspan="2">Practical case study by participants</th></tr>
<tr><td>Some Participants Trained to Use the DSS.</td><td>
Figure 4.9</td></tr>
<tr><th colspan="2">Day (3), Monday, 28Nov. 2010</th></tr>
<tr><th colspan="2">Visit (1): Ein Al-Sultan Spring</th></tr>
<tr><td>Some Information about Ein Al-Sultan Spring:
Ein Al-Sultan is the only source for domestic water supply for Jericho City.
The discharge is about 600 m^3/hr.
48% of the total discharge used for agriculture.
It considers like private property, where the water is owned by families and the water is utilized according to quota.
The spring is vulnerable to pollution
The booster station capacity is not enough</td><td>
Figure 4.10: Outlet of Ein Al-Sultan Spring

Figure 4.11: Inside Ein Al-Sultan Spring</td></tr>
<tr><th colspan="2">Visit (2): Aqbat Jabr Sand filters</th></tr>
<tr><td>Some Information about Aqbat Jabr Sand filters:
Untreated water from Al Qilt wadi enter the plant through 13 km open channel.
The untreated water flows by gravity.
Gravel and sand filters used to treat the water.</td><td>

Figure 4.12: Aqbat Jabr Sand filters</td></tr>
</table>

• There is a chlorination unit for disinfection. • The water is used to feed Aqbat Jabr Camp by domestic water.	 **Figure 4.13: Inside the treatment unit.**

4.5 Recommendations

- There should be one utility in Jericho to be responsible to all water resources.
- Reallocation of fresh water from agriculture sector to domestic sector is a good solution to overcome the shortage in domestic water supply.
- Treated wastewater should be considered as an important source of water for agriculture.
- The DSS must include the quality parameters, where most of the agricultural wells are brackish.
- The DSS should be linked with GIS to show urban and agricultural areas, water resources, etc.
- There should be more training for the professionals to well utilize this important software.

CHAPTER (5):

Evaluation of the Workshop

5.1 Evaluation Form

Title of the training: Sustainable Water Management Improved Tomorrow's Cities' Health, Jericho City as a case study.

Venue: Jericho Municipality
Date: 27-29/11/2010

Evaluation

Dear Participant
Your opinion is crucial for House of Water and Environment.
Name (feel free to leave out): ………………………………………………………
Profession/ position (feel free to leave out): ……………………………………….

1. Are you leaving this training with relevant insights into the Integrated Urban Management ?

- ☐ Yes, definitely
- ☐ Only some new insights.
- ☐ No, not really

Remark:………………………………………………………………………………
…………………………………………..

2. Has there been a specific **issue** (or several issues) that you expected to be addressed in this training session but has not been sufficiently discussed or which was lacking altogether?

- ☐ No
- ☐ Yes, namely

(Please name the action) ………………………………………………………………

3. Has this workshop or training session inspired you to take any particular action in the area of urban management about which you have not thought before?

- ☐ No
- ☐ Yes, namely

(Please name the action) ………………………………………………………………

4. Have you been satisfied with your involvement in the discussions and other activities?

☐ Yes, definitely
☐ Only partly
☐ No, not really

Remark:………………………………………………………………………………………

5. Please rate the following activities according to their usefulness for you:

A- Highly useful
B- Very useful
C- Useful
D- Not really useful
E- Useless

☐ Activity 1
☐ Activity 2
☐ Activity 3
☐ Activity 4
☐ Activity 4

Remark:………………………………………………………………………………………

6. In general: how do you rate the materials that were distributed during the workshop?

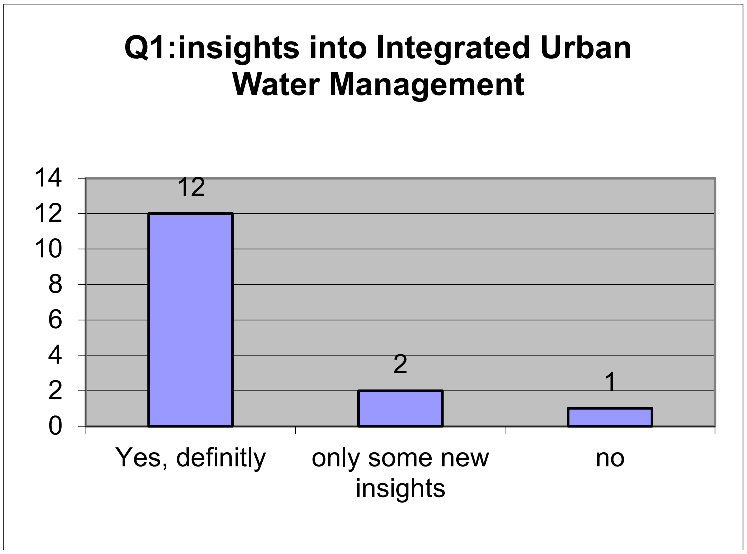
A- Highly useful
B- Very useful
C- Useful
D- Not really useful
E- Useless

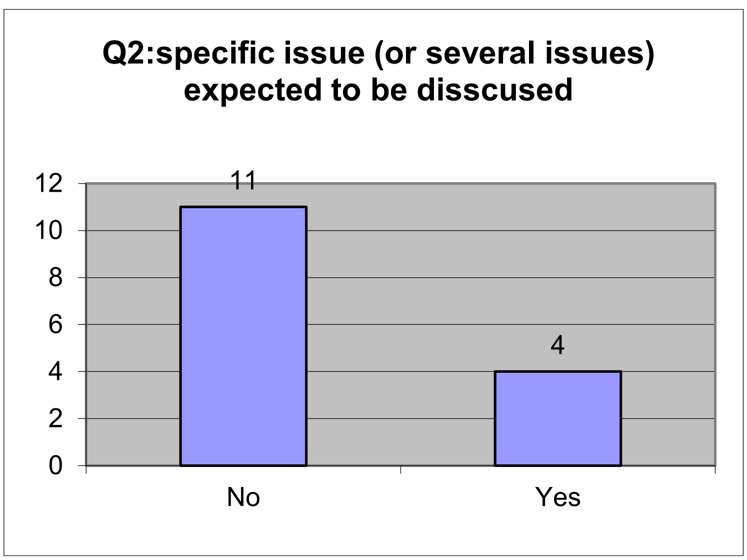
Please name the material/s that have been most useful for you……………………………………………………………………………………
………………………………………………………………………………………………

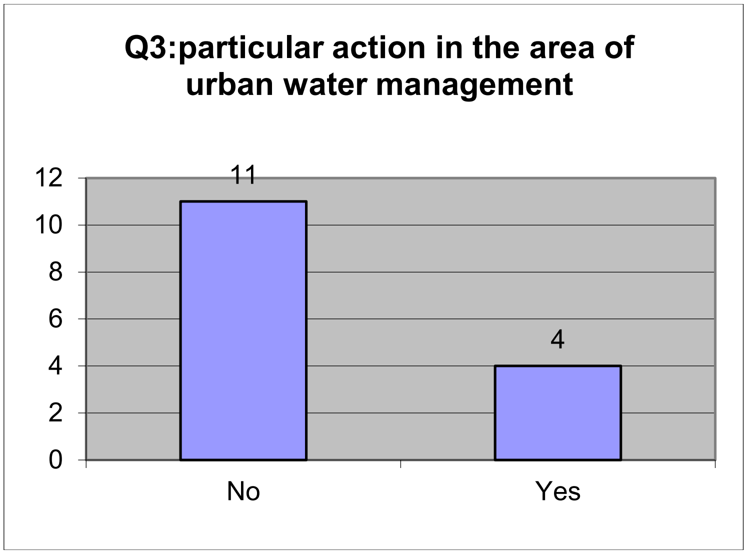
Any other remark or suggestion concerning the materials?...

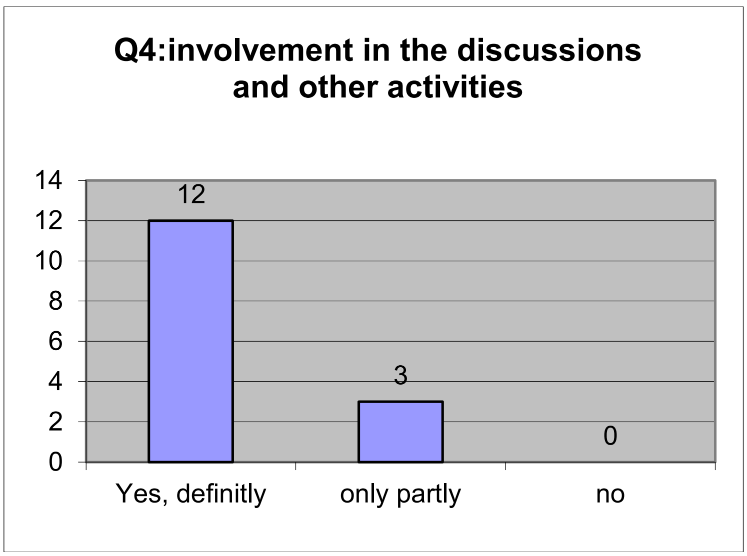
Thank you for your cooperation

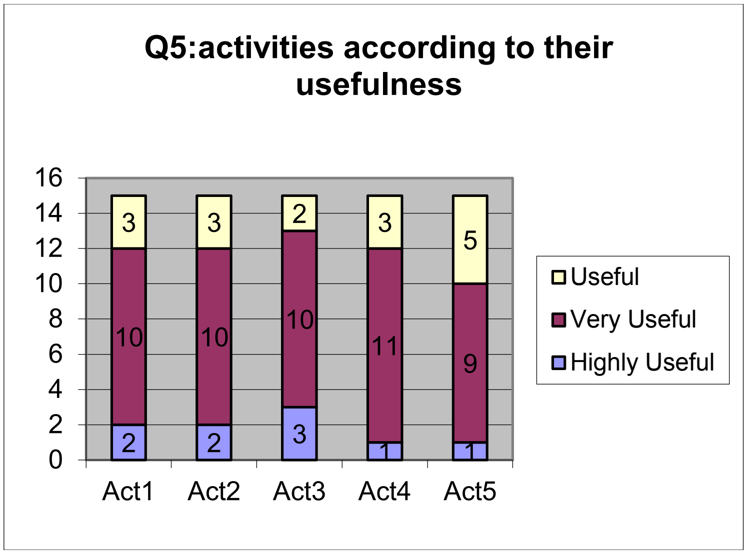
5.2 Evaluation Results



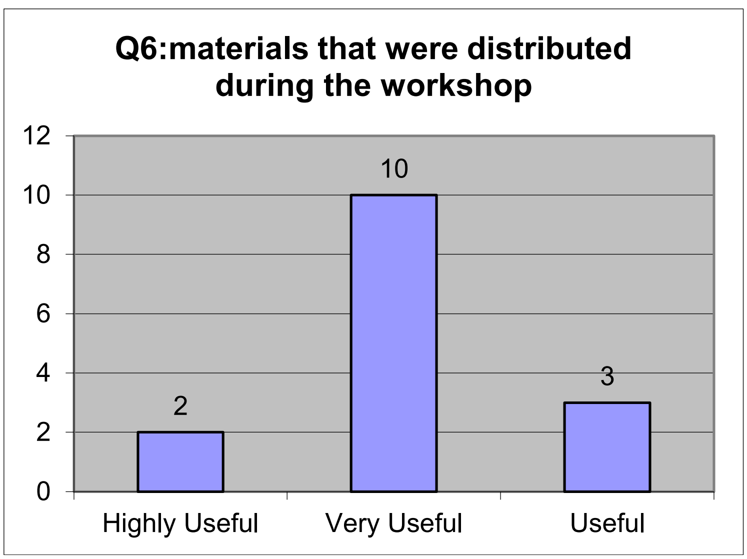



Q3:particular action in the area of urban water management
12
10
8
6
4
2
0
11
4
No
Yes


Q4:involvement in the discussions and other activities
14
12
10
8
6
4
2
0
12
3
0
Yes, definitly
only partly
no



Act 1: IWRM concepts
Act2: governance in Water supply
Act3: governance in urban sanitation
Act4: Socio economical and environmental Indicators
Act5: WMRTPAL software training



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Appendix

Appendix A-1: Water quality data for the springs in the Jericho region

Name	Code	Location	EC µS/cm	TDS mg/L	pH	Ca^{+2} mg/L	Mg^{+2} mg/L	Na^{+} mg/L	K^{+} mg/L	HCO_3 mg/L	Cl^{-} mg/L	NO3 mg/L	Fecal C Col/100 Ml	Total C Col/100 ml
Duyuk	AC060	Jericho	702	376	8.00	98.7	11.4	21.5	2.7	285.9	44.1	35.3	86	104
Nueima	AC060A	Jericho	700	375	7.00	95.9	13.6	21.5	2.5	288.2	45.1	35.1	14	32
Shosah	AC060B	Jericho	701	376	8.00	95.9	13.6	21.5	2.5	288.2	45.1	35.1	36	67
Sultan	AC61	Jericho	486	261	7.71	39.7	16.3	30.6	4	180.1	39.7	22.7	1000	1000
Sultan	AC61	Jericho	622	345	7.48	91.9	8.3	20.6	5.2	261	44.1	20.5	10	120
Sultan	AC61	Jericho	626	339	7.78	75.9	22.7	17.3	2.1	283.3	39.2	20.9	30	50
Sultan	AC61	Jericho	710	378	7.62	97.7	12	21.5	2.6	288.2	45.1	35.5	26	92
Sultan	AC61	Jericho	674	350	8.00	64.2	31.4	21.4	2.9	312.6	30.5	18.5	30	200
Sultan	AC61	Jericho	650	337	7.85	70.9	15.5	33.3	2.4	266.7	43	22.7	70	135
Qilt	AS20	Qilt	571	318	8.45	65.3	12.7	33.3	2.6	231.5	40.8	34.7	120	680
Qilt	AS20	Qilt	545	290	7.87	57.1	5.7	38.1	2.5	180.5	41	40.4	100	250
Qilt	AS20	Jericho	598	318	8.03	71	18.5	22.2	2.6	252.7	50	22.2	90	145
Fawwar	AS21	Qilt	591	310	7.34	74.6	12.5	22.2	4.8	236	48.3	21.5	15	120
Fawwar	AS21	Qilt	760	410	8.00	70.6	21	52.5	6.5	330.5	49.2	26.5	20	150
Fawwar	AS21	Qilt	681	362	7.74	74.5	22.5	29.6	2.6	291	51	25.2	125	220
Fawwar	AS21	Qilt	1031	557	8.10	80.5	23.5	89.5	13.4	308.6	115.9	8.9	1000	1000
Fawwar	AS21	Qilt	593	312	7.49	74.6	1.3	35.7	4.8	205	50.8	28.8	320	710
Fara	AS22	Jerusalem-Alon	925	552	8.23	130.2	6.6	47.5	8.1	254.9	89.4	120.6	200	450
Fara	AS22	Jerusalem-Alon	555	296	7.49	63.8	18.1	19.8	1.7	219.5	51	22.7	26	70
Fara	AS22	Jerusalem-Alon	379	210	7.87	49.5	4.7	21.5	0.3	114.3	35.8	19.9	370	790
Fara	AS22	Jerusalem-Alon	546	284	7.34	66.9	15.9	16.5	1.4	211.5	46.7	20.1	12	35