
Establishing An Environmental Information System for Palestine

Violet Qumsieh, Maher Owewi and Jad Issac

[Applied Research Institute-Jerusalem](#)
P.O. Box 860, Bethlehem, West Bank

*Paper submitted to the The sixth International Conference for the Protection
of the Environment Alexandria, Egypt
May 21-23, 1996*

Table of Contents

- [Abstract](#)
- [Introduction](#)
- [Building and Management of the EIS](#)
 - [Data Gathering](#)
 - [Design of the EIS](#)
- [Applications of the EIS](#)
 - [Site selection](#)
 - [Environmental Impact Assessment \(EIA\):](#)
 - [Modelling:](#)
 - [Landuse management:](#)
 - [Dissemination of Information:](#)
- [Conclusion](#)
- [Acknowledgement](#)

Abstract

This paper describes the process of establishing an Environmental Information System (EIS) for the Palestinian West Bank districts which was accomplished lately by the Applied Research Institute-Jerusalem. The EIS consists of an integrated environmental database with a Geographic Information System (GIS) system that allows easy access of information, data retrieval, data dissemination, data analysis and environmental modeling.

Introduction

The Palestinian environment has been subjected to severe deterioration as a result of the prolonged Israeli occupation. With the signing of the Oslo agreements between the Palestinian leadership and Israel and the beginning of

the implementation of these agreements, the Palestinian National Authority (PNA) started the formidable task of reconstruction and development of the Palestinian territory. An essential prerequisite for sound management of natural resources to ensure sustainable development is the availability of reliable Information on all environmental issues.

The Applied Research Institute-Jerusalem (ARIJ) is one of the Palestinian NGO's who recognize the importance of gathering data related to environmental issues. Since 1994, ARIJ has been working to build an Environmental Information System (EIS) for the West Bank. The EIS includes: gathering and storing information of socio-economic characteristics, atmospheric and climatic parameters, soil types, water resources and quality, landuse, industries and industrial waste, agricultural conditions, practices and waste production, domestic and hazardous waste. Information is organized in a computerized data bases and transferred onto a Geographic Information System (GIS). ARIJ intends as a next step to develop an Environmental Information System (EIS) for the Gaza Strip and integrate both systems to form a national (EIS) for Palestine in cooperation with the relevant Palestinian authorities dealing with the environment.

Building and Management of the EIS

In building the EIS of the West Bank, ARIJ followed the following steps:

1- Data Gathering

The most important step in constructing a comprehensive EIS of the West Bank is the data element. The data have to be accurate and comprehensive. To accomplish this task, several sources of data were used:

Literature review:

Publications on industries, human resources, soil classification, wildlife (flora and fauna), climate and water resources have been acquired and reviewed.

Base maps:

Different maps were used for this purpose such as:

1. Topographical maps with scales of 1:20,000 (British Mandate maps, 1942), 1:50,000 (U.S. Army Corps of Engineers, 1959), 1:100,000 (Israel Mapping Survey, 1993), and 1:50,000 (Israel Mapping Survey). Roads, topography, village and municipal boundaries and streams were determined through these maps.
2. Soil maps with scale of 1:250,000 (Survey of Israel), 1:150,000 (Ministry of Agriculture) were used to determine the soil patterns.
3. Geological, hydrogeological and hydrological maps with scale of 1:500,000 and 1:50,000 (geological survey of Israel) were used to determine the lithology, fault patterns, fold patterns, catchment areas, and groundwater basins.

Aerial Photographs:

Aerial photographs are considered to be one of the major data sources that were used. These photographs are obtained from an aircraft supplied with special aerial photographic cameras which produce overlapping photographs. Aerial photographs covering the West Bank, were taken in May, 1995 and have an overlap of 60 percent with a scale of 1:20,000. Ten major features were distinguished from the aerial photographs and were incorporated into the GIS as separate layers. Some of them have a sub-features which can be distinguished. The distinguished features (layers) are:

1. Urban areas: representing the built-up boundaries.
 - Palestinian built up areas
 1. Cities: The main cities in the West Bank which are Ramallah, Nablus, Jenin, Tulkarm, Qalqilya, Bethlehem, Jerusalem, Hebron and Jericho.
 2. Rural areas: All villages in the region.
 3. Refugee camps

Each area is categorized into:

 - high density
 - medium density
 - low density areas
 - Israeli settlements
2. Military bases: The closed military areas and the military bases.
3. Ponds: Small bodies of water that are categorized into:
 1. Fish ponds.
 2. Agricultural ponds.
 3. Swimming pools.
4. Industrial zones:
 0. Quarries
 1. Palestinian industrial zones
 2. Israeli industrial zones
5. Agriculture:
 0. Irrigated areas, such as plastic green houses
 1. Non-irrigated areas characterized into:
 - Crops which represent:
 1. field crops
 2. vegetables and others
 3. land that is plowed and not planted
 - Trees: Banana, fruits, olives and others.
 - Forests: crowded trees with dark green color.
6. Bare soils: Land that is not planted or not showing any sign of cultivation.
7. Bare Rocks: The rocky areas in the West Bank.
8. Transportation:
 0. Airports
 1. Roads which are classified into:
 - Main roads: (roads which have two lanes)
 - Secondary roads (single - lane roads)
 - Tracks
9. Wadis (dry river beds)

10. Public Places (parks, churches, municipal areas, universities, mosques,.. etc.)

Field work:

The field work was conducted to collect and validate data that are difficult to obtain through the base maps and aerial photographs. The field work was conducted on a district bases to cover the whole area of the West Bank. The following steps were conducted to complete the field work:

1. Field survey: Different questionnaires were prepared to cover the municipal solid and liquid waste generated from each Palestinian human built-up area. Another questionnaires for the industrial facilities and medical centers were also prepared to estimate the quantities, quality and methods of disposal of the industrial and medical waste. Field visits to the municipalities, village councils, different industries and medical centers were conducted.
2. Field check: Some of the features such as dumping sites, cisterns, wells and springs, industrial zones were very difficult to be distinguished from aerial photographs with a scale of 1:20,000. Intensive field checks using the Global Positioning System (GPS) were performed to determine the location of these items. Also, field checks were used to determine the location of the flora found in the West Bank.
3. Water sampling: Water samples from different wells and springs were collected to measure the physical and chemical analysis. Physical parameters such as temperature, conductivity and pH were conducted in the field while the major cations and anions were conducted at the laboratory.

2-Design of the EIS

In the design of the EIS, an integrated database and Geographic Information System (GIS) software were used.

- Database Software

The data base software FoxPro was used to develop the databases for wastewater, domestic solid waste, industrial waste and medical waste for each Palestinian built-up area. Figures [1,2](#) show examples of the wastewater and medical databases. Each sheet includes a description of the quality, quantity and disposal methods for each type of waste at the Palestinian built-up areas. The FoxPro was also used to construct the flora and fauna databases ([Figure 3](#)) . The flora and fauna databases include a descriptive sheet including morphological and physiological information for each endemic plant and animal. The scanner is used to insert photographs of each entry into both databases.

Microsoft FoxPro

File Edit Application Utilities Help

Wastewater in Palestine

Date: 05.07.95

Location:

Name: Ramallah

District: Ramallah

Population: 23314

Water Supply

Responsibility:

Municipality

Village council

Water authority

West bank water Dep.

UNRWA

Awqaf

% Connected: 99

Consumption: 60 L/Capita/Day

W. w. Disposal

Collection network

Traditional method

Collection Network

Responsibility: Municipality

% Connected: 70

W. w. flow rate: 2000 m³/day

Plans to expand the sewage network:

Exist

Type of w. w. enter the network:

Domestic

Industrial

Medical

Disposal of w. w.:

Treated and disposed to wadi

Storm water collection: Exist

Irrigation with w. w.: Exist

Types of Crops irrigated:

Traditional Methods

Ways of disposal:

Septic tanks

Cesspits

Open channels

Ways not connected to network: 30

Flow of waste during: Summer

Vacuum tanker capacity: 5 m³

Usage: 4-5 per day

Ownership: Private

Ways of disposal of w. w. from vacuum tanker:

Adjacent sewage network

Nearby wadi or an open area

Adjacent Setting Ponds

Figure 1: Wastewater database for Palestinian built-up area

Microsoft FoxPro

File Edit Application Utilities Help

Medical Waste

Name of Institution:

Location:

District:

Town:

Type:

Annual Number of patients:

Is there any Periodic inspection by the health Department?

Time periods if yes:

Gloves and masks are usually used while performing the medical tests and examinations.

Type of generated Waste

1- Amounts of contagious waste: 30 Kg/y

Ways of disposal:

Uncontrolled Dumping site

Sanitary landfill

Incineration

Burning

Autoclaving

Sewage Network

Adding septic solution

Deprivation then reused

Information not available

None

2- Amounts of Pointed and sharp objects: 3.2 Kg/y

Ways of disposal:

Uncontrolled Dumping site

Sanitary landfill

Incineration

Burning

Autoclaving

Sewage Network

Adding septic solution

Deprivation then reused

Information not available

None

3- Amounts of Biological waste: 2413 Kg/y

Ways of disposal:

Uncontrolled Dumping site

Sanitary landfill

Incineration

Burning

Autoclaving

Sewage Network

Adding septic solution

Deprivation then reused

Information not available

None

Figure 2: Medical waste database for Palestinian health centers

Applied Research Institute-Jerusalem	
FLORA DATABASE	
	Family name: Liliaceae.
	Scientific name: Urginea maritima
	English name: Squil white, squil.
	Arabic name: عنصل، بصيل، بصل الفار
	Growth habit: Bulb 5-10 (-18) cm in diameter, tunics thick and fleshy, white.
	Root:
	Stem: Scape 60-100 cm or taller, stout, purplish.
	Leaves: Leaves 10-20 cm, erect, broadly lanceolate, glaucous, hyst...
	Inflorescence: Raceme long, dense with 50 flowers or more. Bracts small, membranous, spurred below middle. Pedicels erecto-pater about 2-3 times as long as perianth. Perianth stellate-spread segments 7-9 mm., oblong, obtuse, white with a green or purple...
	Corolla: White with green midvien.
	Fruits: Capsule 3-gonous, obovate in outline.
	Seeds: Seeds 1-4 in each locule, black, glossy.
	Flowering period: July-October, before rain, leaves appearing in November-D...
	Habitat: Batha, fallow fields, field borders, Sharon plain, Philistean p...
	Active constituents: Bulb contain urginin, cardiotoxic glycosides, scillaren, muc...
	Medical uses: Expectorant, diuretic, emetic, cardiotoxic.
	Economic value:
	Toxicity: Poisonous, all parts are toxic.
	Abundance class: Very common.
	Location: Wadi El Nar Date: 05.07.1995
	References:

Flora.picture



Figure 3: Flora database for Palestine

The FoxPro software was also used to develop the agricultural database (Figure 4). It includes district by district estimates of cultivated areas, productivity and total production in the West Bank for several years. A computerized database is being developed containing the quantities of different types and groups of pesticides used in the West Bank.

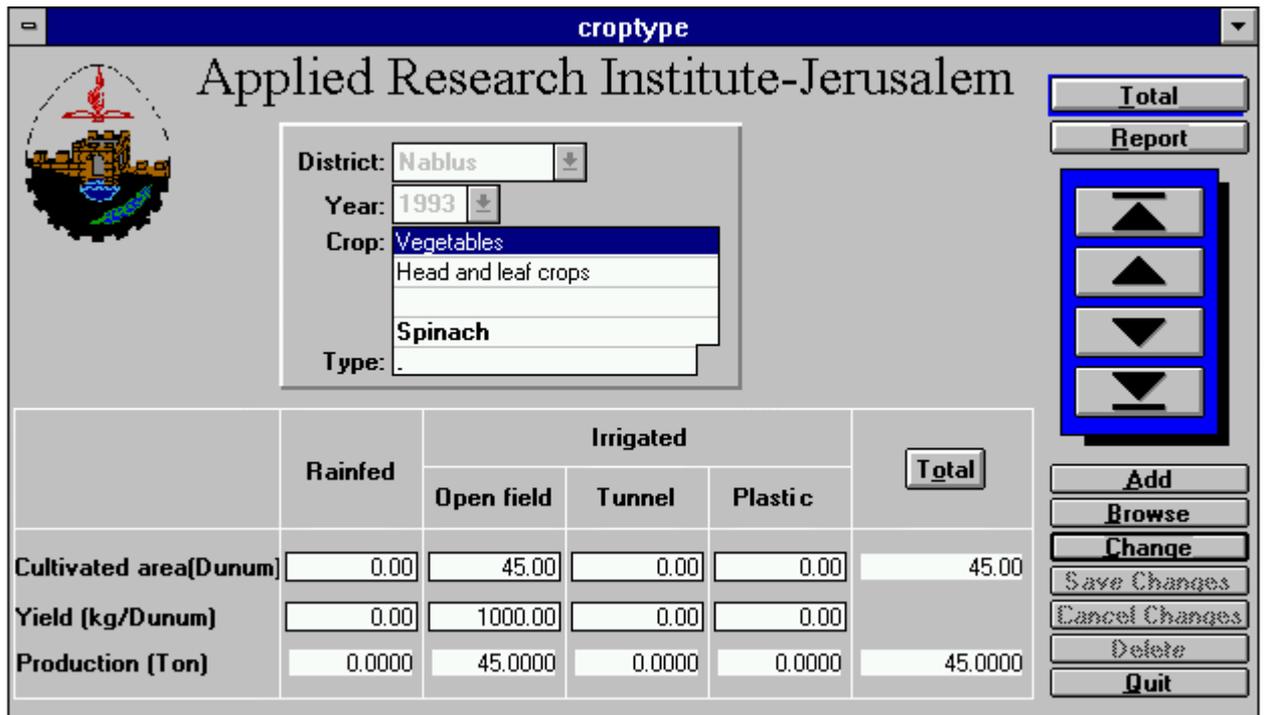


Figure 4: Agriculture database for Palestine.

As for the water database, Ground Water for Windows (GWW) software, developed by the UN, was used to produce the water database (Figure 5). The software was used to store, manage and process and interpret different water quality and quantity parameters.

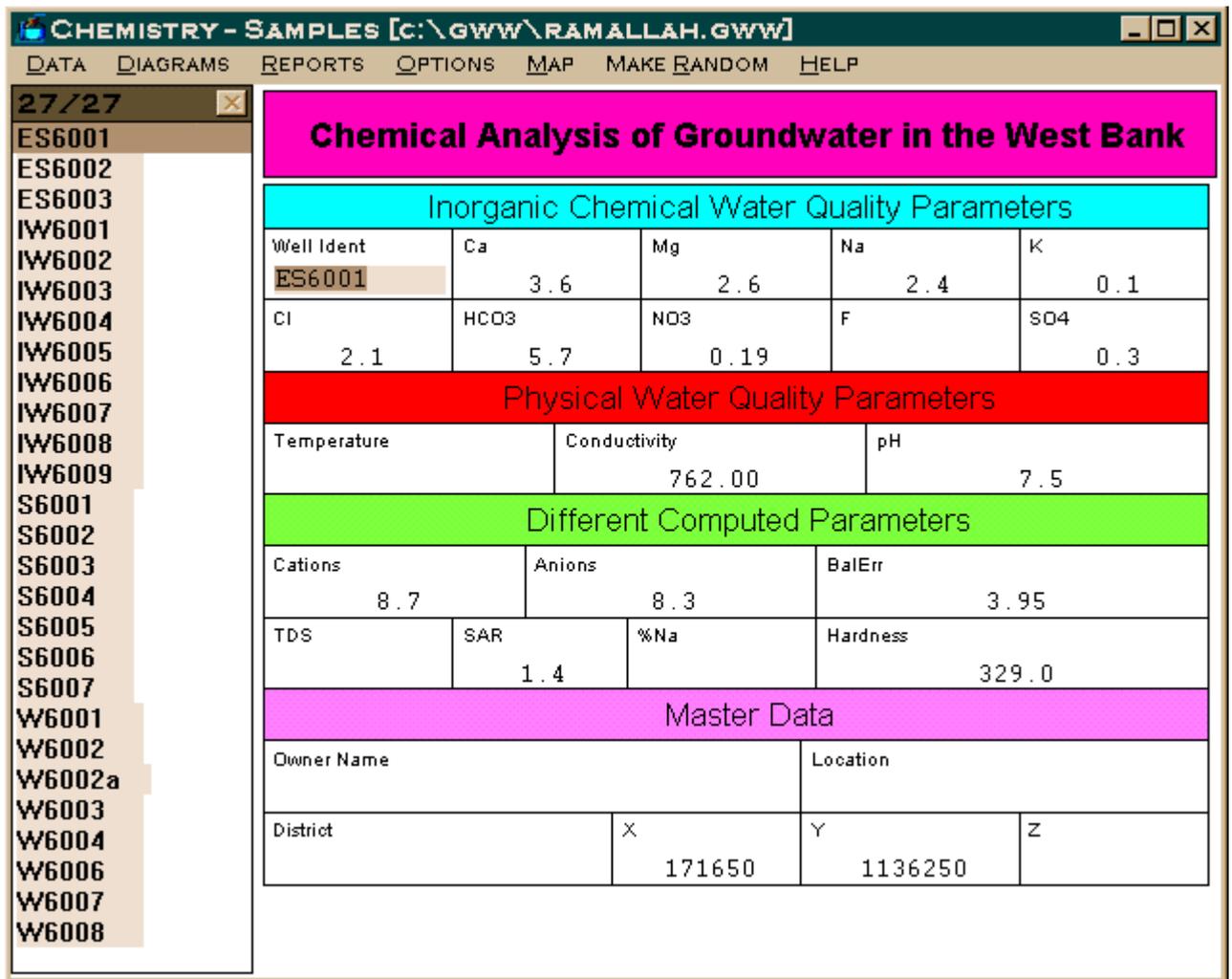


Figure 5: Water database for Palestine

- GIS Software

A geographic information system (GIS) is an organized collection of computer hardware, software and geographic data. It is designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information. The GIS based on ARC/info PC and Pamap softwares were used by ARIJ to create, process, analyze and model the different layers. Each layer is a map containing relevant information on one environmental issue.

- Linkage of database with GIS

One of the most valuable features of the GIS technology is the possibility to connect its proper internal data to any other external database. The information in the developed databases could be located, analyzed and manipulated in an integrated manner to provide real assessment and projections. Such a procedure will facilitate the assessment of environmental impact for any specific plan or project on the natural resources of Palestine, in addition to proposing solutions and measures for environmental protection in a particular defined zone

or in the whole area in general. Linkage of databases with GIS is a powerful tool that could help planners and decision-makers in the Palestinian National Authority in taking decisions on environmental issues.

For database management and application, a tagging procedure is conducted. For this purpose, the West Bank was divided into eight districts and given a code from 01 up to 08; each district is divided into village boundaries and coded from 01 up to 0n where n is an integral number dependent on the number of village boundaries; and in each village boundary the built-up areas are divided into Palestinian built-up areas, refugee camps, and Israeli settlements. The following example illustrate the tagging procedure:

0101020pv
01 : Hebron district
010 : Village boundary no. 10 at Hebron district
20pv: the Palestinian village no. 20 in the village boundary no. 10 at Hebron district.

In case one of the built-up areas is located in more than one village boundary, the area was given a village boundary code without a zero at the left. If the built-up area located in two districts, it was given a district code and a village boundary code without zeros at the left.

Linkage of the FoxPro databases to the spatial data (maps) using the tags-ID on the computer was conducted. A Simple Macro Language (SML) was created on the ARC/info PC software which allows the display of Palestinian built-up areas, Jewish settlements, refugee camps and village boundaries ([Figure 6](#)). The program has the capability to query the spatial data through the "Query" icon and can search for a certain built-up area by using the "Where Is" icon. Through this program one can also conduct simple modeling by using the "Define your Selection" icon, for example; one can search for built-up areas with a defined population density and percent of houses connected to a sewage network ([Figure 6](#)).

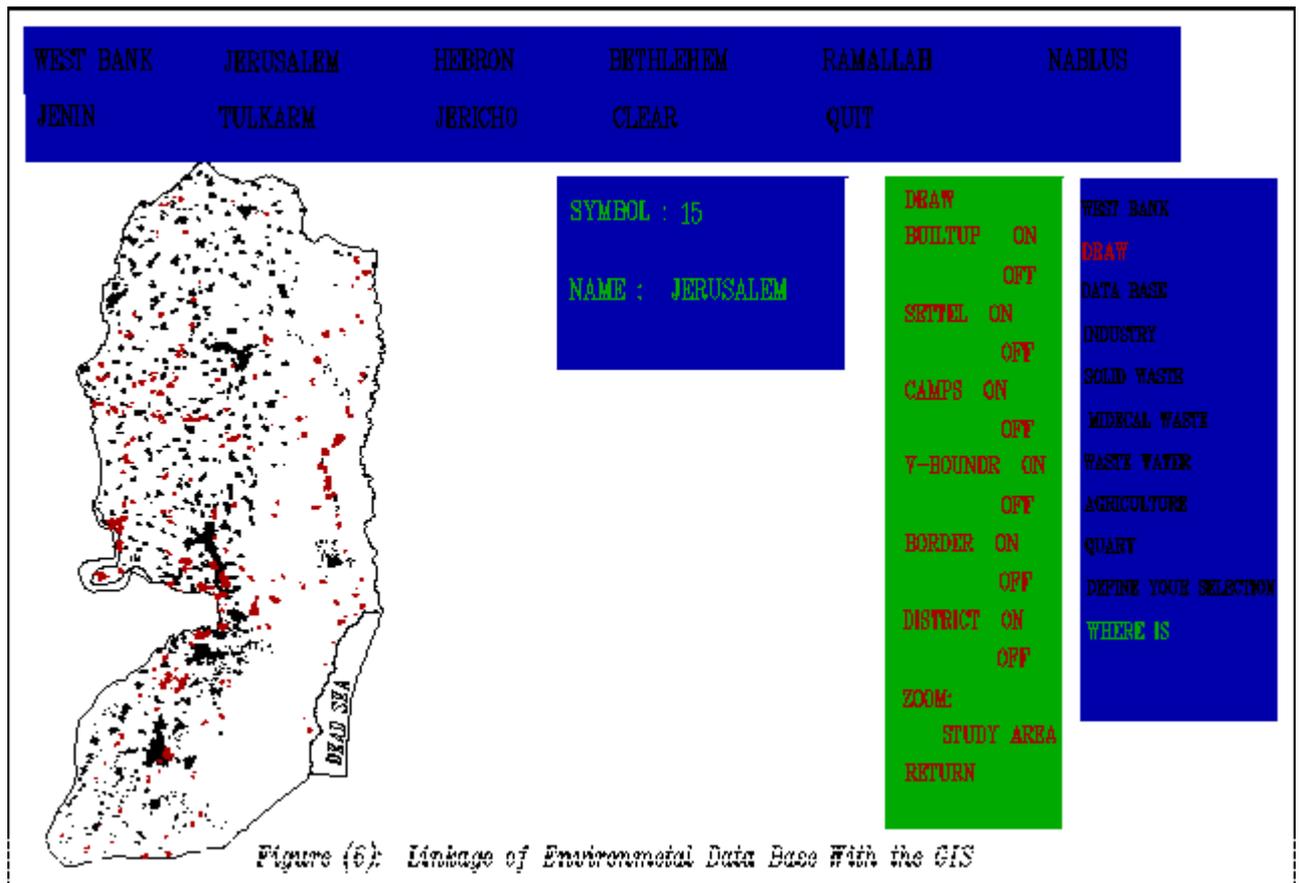


Figure 6: Linkage of Environmental Data Base with the GIS.

Applications of the EIS

The EIS is a powerful tool that can be used by planners and decision-makers. It has a wide array of applications that could make their work easier and more accurate. Some of the EIS applications are highlighted below:

1-Site selection

The GIS is a technology which can contribute a great deal to site selection for waste disposal and treatment facilities. It can be used to determine the suitable sites for dams, landfill sites or a wastewater treatment plant. To select a site for a specific object, the first stage in the selection process is to define different criteria relative to the siting. Then, different layers related to each criteria are overlaid to compare maps and locate areas which confirm to criteria. The final map reveals the land that meet all of the required criteria. The GIS can handle several overlays and can accommodate varying degrees of constraint by generating a final map with all parameters.

For example, ARIJ was asked to choose a suitable site for a wastewater treatment plant for Taffuh village. Layers on geology, topography, groundwater basins, water resources, roads, built-up area, soil and cultivated areas were overlaid on top of each other and a final map was produced representing the site that confirms all the required criteria (Figure 7).

Figure 7: Selection of Wastewater treatment plant site at Taffuh village using GIS

2- Environmental Impact Assessment (EIA):

A study of the environmental impact assessment of existing and proposed projects can be easily conducted by using the EIS. e.g. the effect of industrial wastewater disposed without treatment on the groundwater can be studied. In Hebron area, the leather industries produce large quantities of industrial wastewater containing Cr. Using the EIS can study the effect of such a waste on the groundwater.

3- Modelling:

Building a Digital Elevation Model: A Digital elevation model involves the processing and graphic simulation of elevation data. DEM analysis software functions usually work with topographic data, in which an elevation or Z-value is recorded at each x,y location. DEM analysis functions are not restricted to topographic data, any series of values such as population densities, groundwater pressure values, magnetic and gravity measurements and chemical concentrations may be used.

Topographic data are essential for studies of traffic, route design, non-point source pollution, intervisibility, siting of recreation areas, etc. The following include some of the useful products that can be derived from topographic data:

1. Contour lines: Creation of contour lines is usually used to represent elevation and any Z-value data such as cost, mineral content or temperature.
2. Slope: The slope at every point in the terrain can be calculated from the elevation model and can be stored in either degrees, fraction or percentage. The resultant model can be used in diverse applications such as forestry, soil erosion, terrain analysis, road networks design, and land and resource management.
3. Aspect: The DEM can calculate the aspect which shows the prevailing direction that the slope faces at each point of the model. Aspect is useful in the field of land use planning.

A digital elevation model (DEM) containing Z-value with a pixel size of 50 was created for the West Bank. This model was constructed using the finite difference technique of the Topographer Model of the Pamap GIS software version 4.2. The finite difference technique is considered to be suitable for using trend data as the input data. The trend data represents the overall shape of the terrain. It is usually contour lines but can also be three dimensional lines with varying elevation.

[Figure 8](#) represents the produced DEM, which is themed using the threshold table with an interval of 100 m. Themes are colored values that give a quick and effective method for identifying features and areas that meet specified criteria. The threshold table simply tells the GIS software which color to use when displaying certain pixels. [Figures 9,10](#) and [11](#) show contour, slope and aspect maps based on the created digital elevation model.

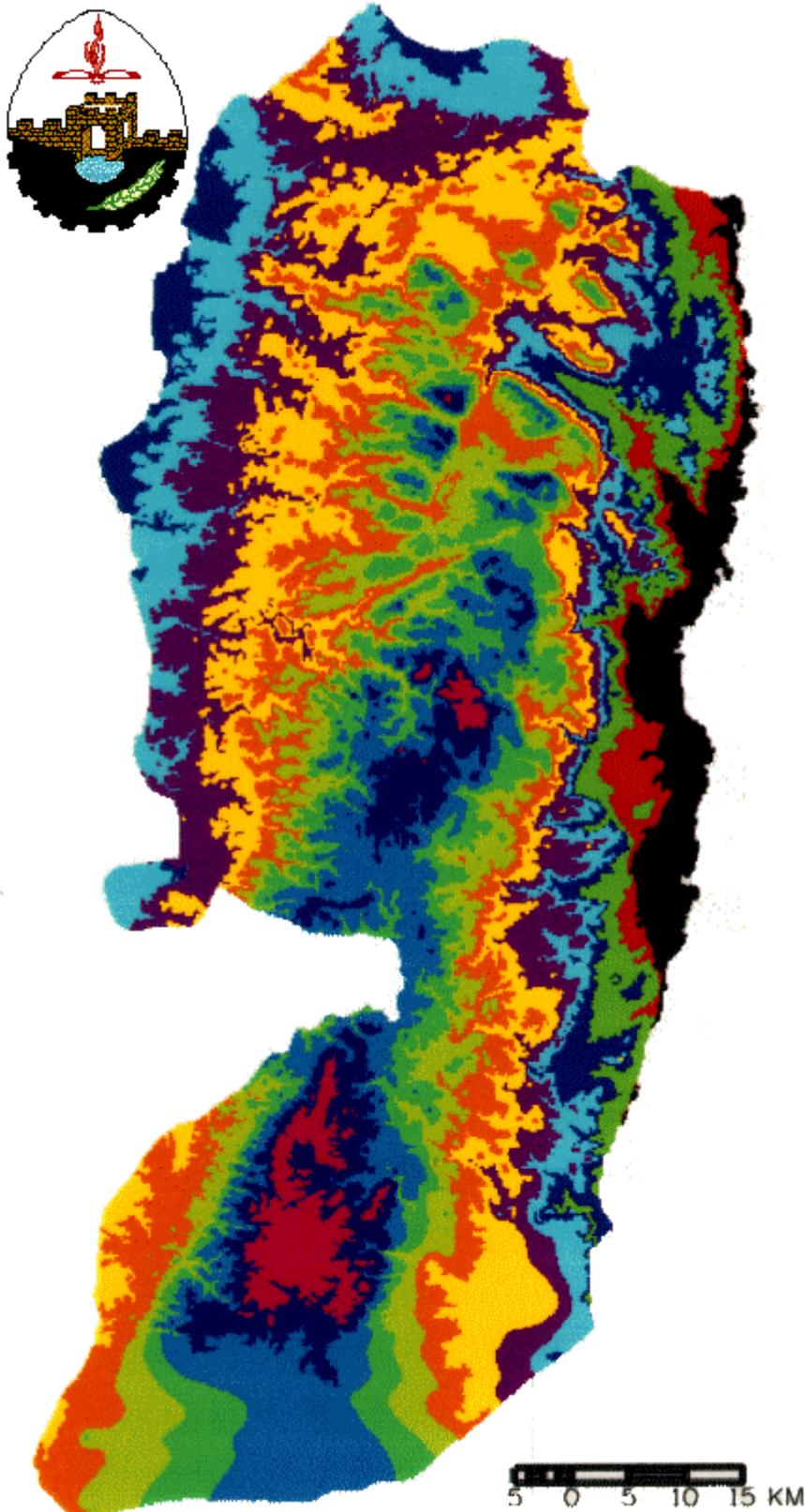


Figure (8): DEM for the West BANK

Figure 8: DEM for the West Bank.



Figure (9): Contour Map for the West Bank

Figure 9: Contour Map of West Bank.



Figure (10): Slope Map for the West Bank

Figure 10: Slope Map of the West Bank.



Figure (11): Aspect Map for the West Bank

Figure 11: Aspect Map of the West Bank.

4- Landuse management:

Land use management was conducted for the West Bank in order to perform the optimal use of the land. The management was based on different layers of rockiness, soil, cultivated areas, built-up areas, roads, water resources, touristic areas and topography,...etc.

Dissemination of Information:

In an effort to describe the status of the environment for the public, the gathered data were used to create environmental profile for each district in the West Bank. In each profile, there is a wide range of information, including information on: physical feature in each district, water resources, land use, agriculture, industry, social and physical infrastructure, population, estimates of sources of solid waste and toxic waste. The final output will be a comprehensive environmental profile of the West Bank. This profile will include in addition to the information included in the district's profile, information on flora and fauna throughout the West Bank will be incorporated into the final profile.

In its effort to disseminate environmental data to international community, ARIJ had used the Internet utilities in communication, and constructed homepages on the World Wide Web (WWW). All the environmental profiles and the EIS will be included in the homepage.

Conclusion

For the past two years, ARIJ has embarked on executing an EIS for the Palestinian West Bank districts. During this period, ARIJ has successfully used the EIS for providing services to the relevant Palestinian Authorities about site selections for water wells, industrial zones, waste water treatment, ground water pollution, extent of desertification and other issues. The next phase is to use EIS for environmental impact assessment and environmental planning.

Acknowledgement

The authors would like to thank all the staff of the Applied Research Institute-Jerusalem for their contribution to the establishment of EIS. This project was executed through a generous grant from the Austrian Department for Development Cooperation through the Society for Austro-Arab Relations (SAAR). The water database was supported by a grant from the International Development and Research Center (IDRC).