Environmental Profile For the West Bank

Volume 5

Nablus District

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List of Acronyms and Abbreviations

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CMR	Child Mortality Rate
DCO	District Coordination Offices
DEM	Digital Elevation Model
EC	Electrical conductivity
GDP	Gross Domestic Product
GIS	Geographic Information System
GNP	Gross National Product
HDIP	Health Development Information Project
IMR	Infant Mortality Rate
Mekorot	The National Water Company of Israel
NGO	Non-Governmental Organization
NIS	New Israeli Shekel
PARC	Palestinian Agricultural Relief Committees
PBS	Palestinian Bureau of Statistics
PCH	Palestinian Council of Health
PECDAR	Palestinian Economic Council for Development and Reconstruction
PNA	Palestinian National Authority
R.C.	Refugee Camp
R.H.	Relative Humidity
SAR	Sodium Adsorption Ratio
SAAR	Society for Austro-Arab Relations
UNRWA	United Nations Relief and Work Agency
WBWD	West Bank Water Department
NNE	North-North-East
NNW	North-North-West
SSW	South-South-West

Measuring Units

^{o}C	degrees centigrade
CM	cubic meter
m	meter
GWH/y	Giga Watt Hour per Year
km	kilometer
km^2	square kilometer
MCM	Million Cubic Meters
ppm	parts per million
Dunum	0.1 hectare
$Watt/m^2$	Watt per Square meter
m^3	cubic meter
MJ	Mega Joules
l/c/day	liter per capita per day

Introduction

The Applied Research Institute - Jerusalem (ARIJ) launched a two year project in July 1994 to produce a series of environmental profiles for each district in the West Bank. The aim of this project was to assess the status of the environment in Palestine and to reflect the special characteristics of the environmental problems and the measures required to safeguard and preserve our environment for the future generations. This project is supported and financed by the Federal Government of Austria, Department for Development Cooperation, through the Society for Austro - Arab Relations (SAAR). This volume is the fifth in this series. It describes the status of the environment in Nablus district.

The Nablus District Environmental Profile addresses the natural resources and describes the scope and extent of the environmental problems facing the district. Moreover, it provides data which are helpful for planning and initiating the needed projects to rehabilitate environmentally stressed areas and prevent future deterioration.

Information concerning land use, topography, climate, geology, soil, water resources, agriculture, wastewater and solid waste collection and disposal, air and noise pollution is presented in this profile. In addition, it covers the socio-economic situation and the existing historical and archeological sites existing in the district and their current status and state of repair.

As the extension of the flora and fauna are unrestricted to the boundaries of the district, they will be addressed collectively with those of the other districts in the Comprehensive Environmental Profile for the whole West Bank, at the end of the year 1996.

Most of the information and data used in this report were collected by the project team and based on primary field research, questionnaire, investigations, personal interviews and meetings with officials from municipalities, village councils, the United Nations for Relief and Work Agency (UNRWA), the agricultural institutions, weather station and hospitals. Maps and information related to land areas are all prepared by the Geographic Information System unit team ARIJ.

Chapter One
Location And Land Use

Location

Nablus district is located in the northern part of the West Bank. It is bounded by Jenin and Israel from the north, Tulkarm and Israel from the west, Ramallah and Jericho from the south and the Jordan River from the east.

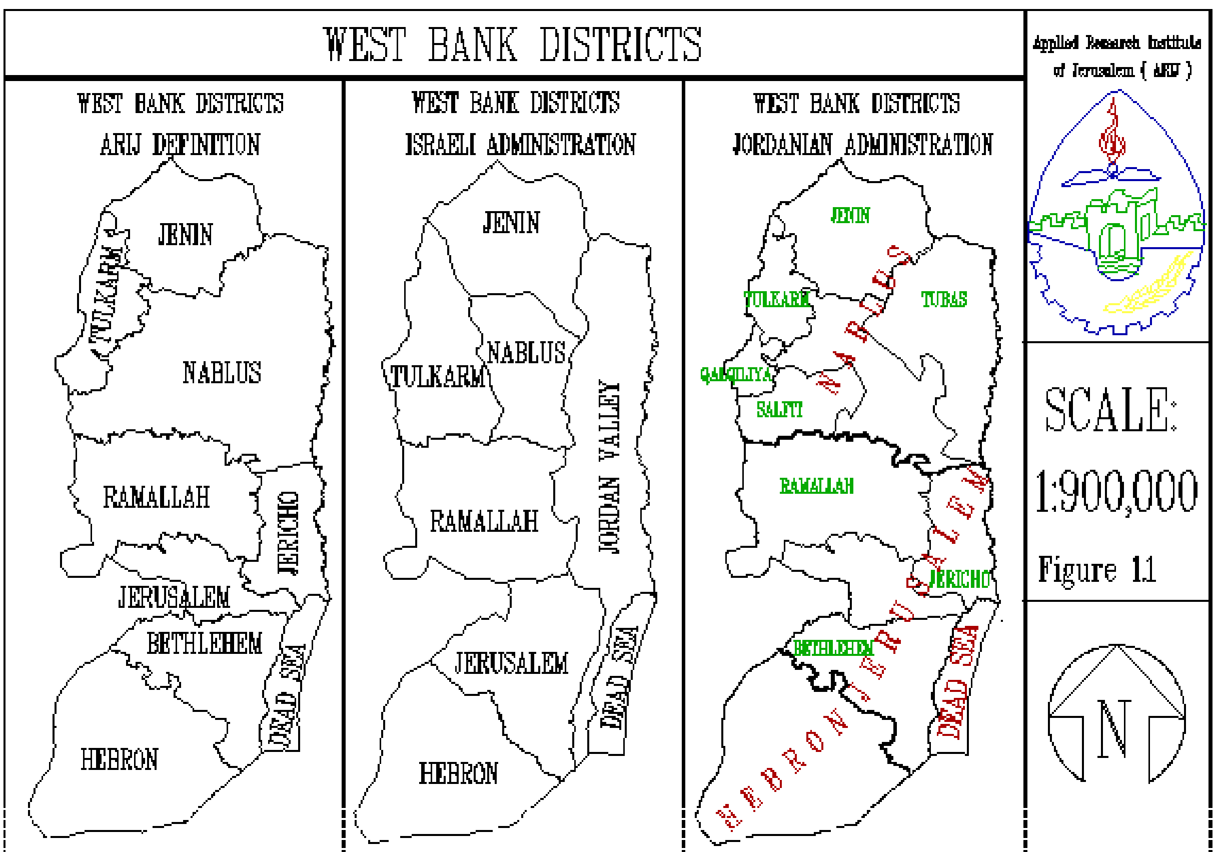


Figure 1.1

For technical reasons, the definition of the boundaries of Nablus district used by ARIJ in this profile is a combination of the pre-1967 Jordanian and the Israeli designation of the boundaries (Figure 1.2). The district is located between 349 m below sea level and 918 m above sea level.

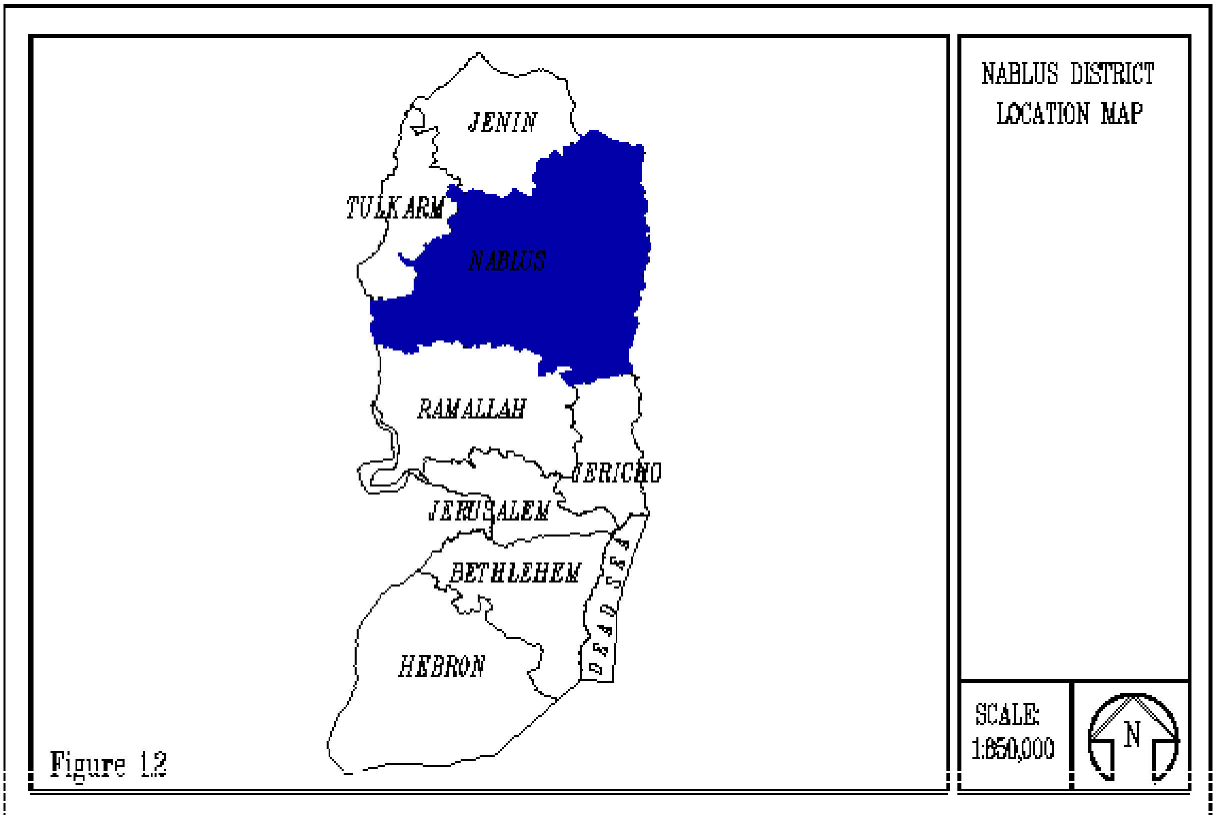


Figure 1.2

Nablus district, as the rest of the West Bank, was under Israeli occupation since 1967. Under the "Oslo II" interim agreement signed in Washington D.C., on September 28, 1995, autonomy for cities, villages, refugee camps and hamlets in the West Bank was agreed upon. This allows for self-rule in these areas, including the establishment of a Palestinian Administration. The end of the year 1995 witnessed a new stage in Nablus history, when the Palestinians forces entered Nablus city for the first time declaring it a liberated Palestinian city. On January 1996 the Palestinians experienced the election for the first time in their life, where several Palestinian candidates were elected to represent the Palestinian people in the Palestinian Legislative Council (PLC).

Land Use

Nablus district, with a total area of 158,022.4 hectares, has nine distinctive major land use. These include the Palestinian builtup areas, Israeli settlements, closed military areas and military bases, nature reserves, forests and cultivated areas (Figure 1.5 and Table 1.3). The Palestinian and Israeli built up areas make up 2.6% and 1.5% of the total area, respectively.

According to the "Oslo II" interim agreement between the Palestinian and Israel, the West Bank, will come under the jurisdiction of the Palestinian Council in a phased manner, except for issues that will be negotiated in the permanent status negotiations. In the "Oslo

II" interim agreement, the West Bank was divided into three main areas. These three areas in Nablus district are as follows: (Figure 1.3).

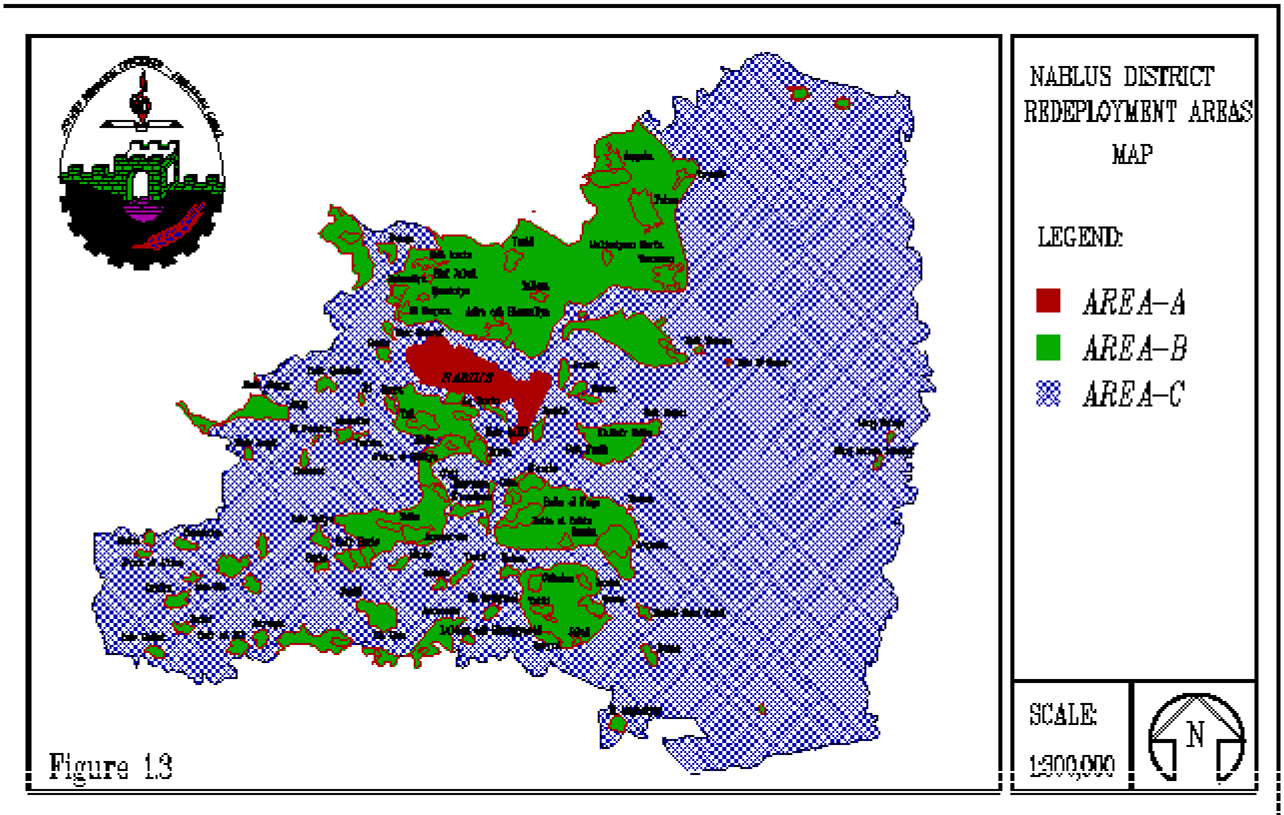


Figure 1.3

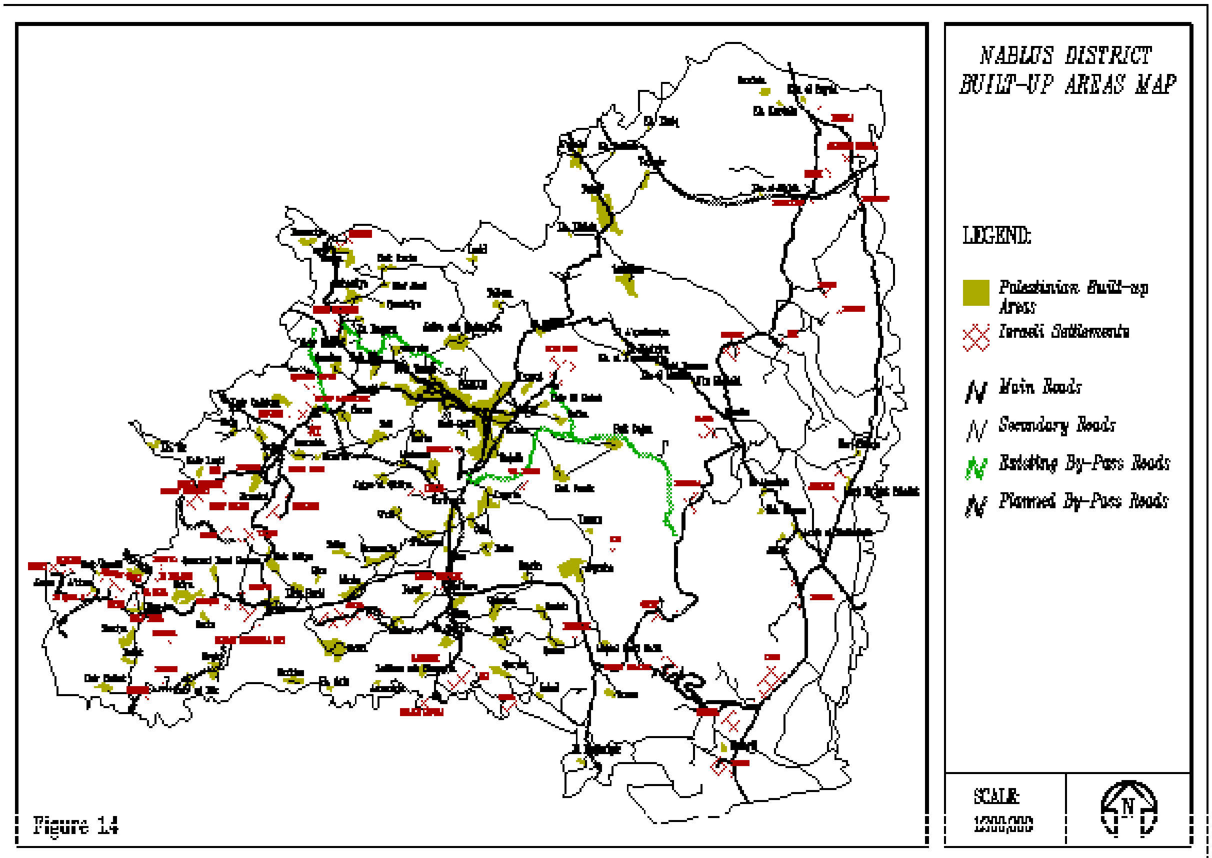

NABLUS DISTRICT
BUILT-UP AREAS MAP
LEGEND:
Palestinian Built-up Areas
Israeli Settlements
Main Roads
Secondary Roads
Existing By-Pass Roads
Planned By-Pass Roads
SCALE:
Figure 1.4
N

Figure 1.4

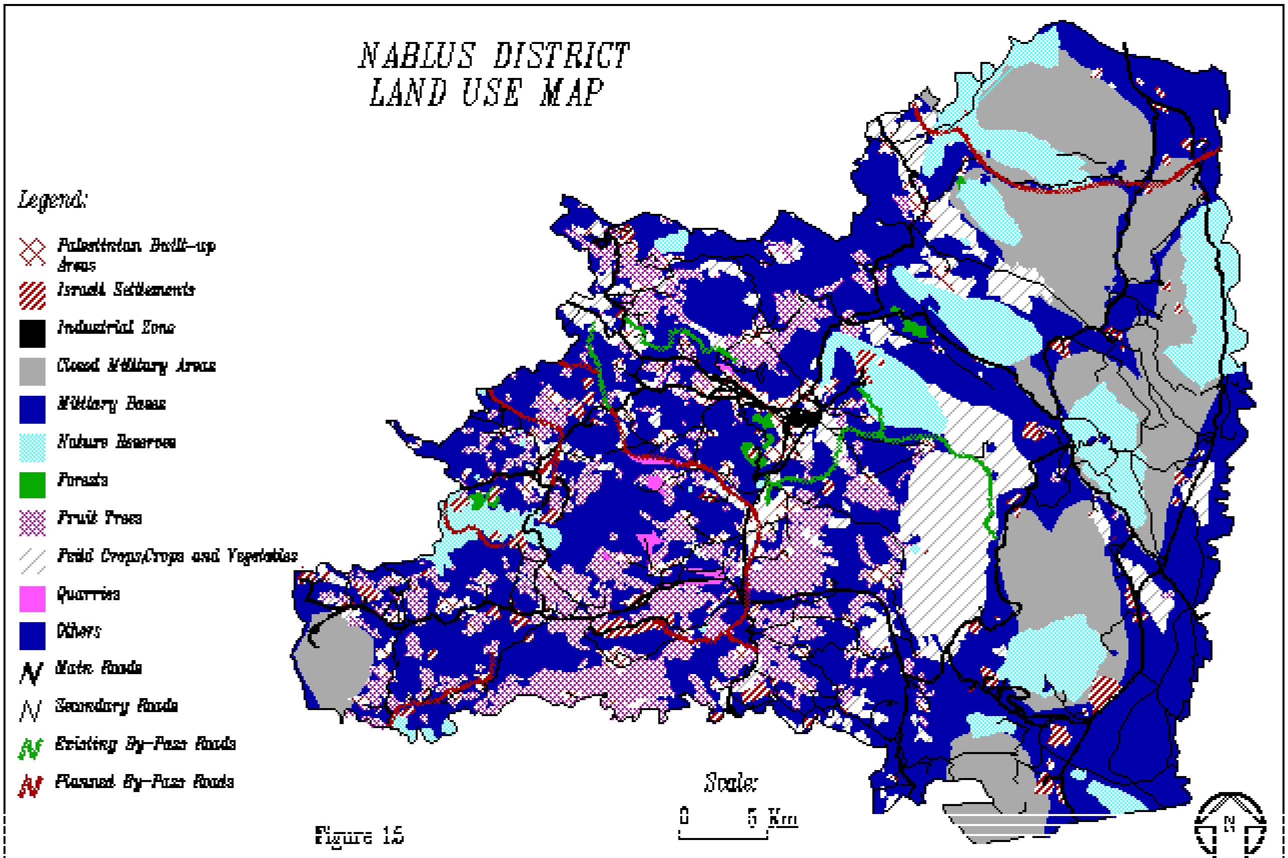


Figure 1.5

"Area A"
(2,426.6 hectares), which represents 1.5% of the total area of Nablus district, includes only Nablus city. In Area A, the Israeli army has pulled out fully, and all responsibilities for internal security and public order are held by Palestinians.
"Area B"
(32,335.4 hectares), which represents 20.5% of the total area of Nablus district, includes all villages and small towns. In this area, Palestinians have full control over the civil society and Israel continues to have overriding responsibility for security.
"Area C"
(123,260 hectares), which represents 78% of the total area of Nablus district, includes the unpopulated areas and the Israeli settlements and military outposts. Palestinians have responsibility for civil life such as economics, health and education, however, Israel retains full control of security and power related to territory.

Palestinian Builtup Areas

There are 116 Palestinian builtup areas in Nablus district. Nablus, Salfit, and Tubas are the only cities registered as municipalities. There are four refugee camps namely Balata, Askar, Ein Beit Elma and Al-Far'a camps, while the other built-up areas are administered by either village councils or village mukhtars (Figure 1.4 and Table 1.1). The built-up areas account for approximately 4,127 hectares and are located on the following soil associations:

- Brown Rendzinas and Pale Rendzinas Soils;
- Terra Rossa, Brown Rendzinas and Pale Rendzinas; and
- Grumusols.

These soil associations are considered to be the most suitable soil for agricultural purposes in the district.

Israeli Settlements

There are 58 Israeli settlements in Nablus district, in addition to two military sites. Figure 1.2 shows the distribution and names of these settlements, while table 1.2 list some information about most of these settlements. These settlements occupy approximately 2,427 hectares of land. They are located on the following soil associations:

- Brown Rendzinas and Pale Rendzinas Soils;
- Terra Rossa, Brown Rendzinas and Pale Rendzinas;
- Grumusols;
- Alluvial Arid Brown Soils;
- Regosols;
- Calcareous Serozems; and
- Dark Brown Soils.

These soil associations are also considered to be the most suitable soil for agricultural and grazing purposes in the district.

Closed Military Areas and Bases

Closed military areas take up approximately 41,624 hectares (26.3%) of the district. The Israeli army claims that these areas are important both as security zones and for military training purposes. In addition, there are 36 military bases, using a total area of approximately 554 hectares. The closed military areas are mainly concentrated in the eastern slopes of the district, while the military bases are distributed throughout district. The closed military areas and bases are located on the same soil associations occupied by Israeli settlements.

Nature Reserves

Currently, there are 26 nature reserves in Nablus district which have been unilaterally declared by the Israeli authorities. This area occupies a total area of approximately 16,661 hectares (10.5%), most of which are located within the declared closed military areas. Because of the Israeli government's history of confiscating Palestinian land through declaring an area as a nature reserve, there is doubt about the true environmental significance of the currently declared nature reserve areas.

Forests

There are 18 forests in the district with a total area of approximately 527 hectares. Most of these forests are located in areas of fertile soil types (Terra Rossas, Brown Rendzinas and Pale Rendzinas) and favorable climatic conditions for agriculture.

Quarries

There are 8 quarries in the district occupying a total area of approximately 300 hectares. They are located in the areas of Jammaa'in, O'rif, Yasuf, Mirda, Qira and Zeita.

Cultivated Areas

These are estimated at 28,992 hectares of Nablus district of which only 3,358 hectares are devoted to irrigated agriculture. The remaining agricultural areas of 25,634 hectares are cultivated with rainfed crops.

Roads

The roads system in Nablus district, as in the other districts of the West Bank, is divided into two categories, those mostly for Palestinian use and the others for the Israeli settlers living in the district. For the most part, the Palestinian road system has not been expanded or repaired for many years. There are 365.8 km of main roads and 313.2 km of secondary roads that connect Nablus city with its nearby villages. Since the signing of the second stage of "Oslo II" interim agreement (September, 1995), Israel has moved to put in an entire new "by-pass" road system connecting the settlements throughout the West Bank and therefore providing "safe passage" to settlers living in the West Bank. These roads required confiscation of thousands of hectares of Palestinian lands and they stretch over the rural and agricultural lands of Nablus district. The existing bypass roads have a total length of

39.699 km (until March 1996) and the proposed ones are expected to consume another 73.0 km.

Industrial Area

There is only one industrial area in Nablus district located near Balata town. It covers around 124.1 hectares.

Table 1.1: Palestinian built-up areas in Nablus district, 96 (PBS,94 & UNRWA, 94)

Location	Pop. #	Location	Pop. #	Location	Pop. #
Deir Ballut	2731	Iskaka	674	Nisf Jbeil	341
Kafr Ed Dik	3376	Salfit	6986	Ijnesiniya	456
Bruqin	2550	Yatma	1876	En Naqura	1131
Rafat	1126	Es Sawiya	1859	Yasid	973
Zawiya	3622	Luban Esh Sharqiya	1438	Zawata	1165
Sarta	1737	Ammuria	253	Beit Eiba	2258
Mas-ha	1303	Kh. Qais	251	Jeneid	231
Bidya	4809	Jalud	398	Beit Wazan	858
Sanniriya	2001	Qaryut	1951	A’zmut	1594
A’zun El A’tma	687	Talfit	219	El Badan	1354
Qarawat BaniHassan	2016	Qabalan	4015	Nablus	93139
Beit Amein	974	Osrin	817	A’sira Esharqiya	7736
Jinsafut	1558	Jurish	904	Talloza	4048
Kafr Laqif	625	Qasra	2469	Jiftlik	1866
Kh. Sir	636	Za’tara	29	Arab El Muthalath	N/A
Baqa	1221	El Maghaiyer	1280	Esh Shuna	N/A
Hajja	1819	Duma	1436	El Musafeh	N/A
Immatin	1626	Majdal Bani Fadil	1159	Marj Na’ajat	N/A
Fara’ta	440	Beita	5119	Marj Na’aja	818

A'sira El Qibliya	1280	A'qraba	4505	Farsha	N/A
Tell	2753	Fasayil	410	E'in Shalabi	340
Sarra	1667	Madama	1066	En Nasiriya	571
Jit	1694	Huwwara	4130	Kh. El A'qrabaniya	916
Kafr Qaddum	2793	Odla	531	El A'qrabaniya	1013
Deir Sharaf	2029	A'warta	3563	Beit Hassan	1086
Farkha	1011	Burin	2092	Kh. El Marsas	N/A
Haris	2072	Kafr Qallil	2093	Tammun	7608
Kafr Haris	1953	Yanun	79	Tayasir	1443
Qira	695	Beit Furik	6456	A'qqaba	3244
Mirda	1484	Beit Dajan	2560	Tubas	12861
Deir Istiya	3064	Salim	3288	Kh. Kishda	450
Zeita	3177	Deir El Hatab	1324	Kh. Salhab	30
Jammaa'in	4162	Askar R.C.	10361	Kh. Ebziq	171
O'rif	1433	Bazzariya	1460	Bardala	519
E'inabous	1381	Burqa	3315	E'in El Bayda	494
Quza	N/A	Beit Imrin	1956	Kh. Kardala	200
Yasuf	1174	Sabastiya	2332	Kh. El Maleh	93
Qussien	1281	Rujeib	2189	Balata R.C.	16094
Far'a R.C.	6345	Camp No.1 R.C.	5046		

Table 1.2: Jewish settlements in Nablus district, 1992 (Tufakji, 1994; Ester Goldberg,93).

Settlement	Date of Establishment	Number of Families	Proposed Number of Families
Mekhora	1973	30	80
Megdalim	1984	27	250
Nofim	1986	44	400
Oranit	1983	650	"2,800"

Arial	1978	2800	"20,000"
Argamon	1971	27	80
Barqan	1981	N/A	N/A
Beqa’ot	1972	30	80
El Qana	1977	480	"2,500"
Eli	1984	140	"6,000"
Elon More	1980	430	"6,000"
Ez Efrayim	1985	40	760
Gittit	1972	25	80
Hamra	1971	75	80
Homesh	1980	40	273
Kfar Tappuah	1978	45	780
Ma’ale Efrayim	1978	320	"5,000"
Ma’ale Levona	1984	48	124
Mehola	1969	46	80
Shamod Mehola	1979	40	80
Rotem	1984	N/A	N/A
Bitronot	1983	N/A	N/A
Hemdat	1982	N/A	N/A
Ro’i	1978	23	80
Massu’a	1974	25	80
Yafit	1980	22	80
Peza’el	1972	50	80
Tomer	1978	50	80
Shilo	1978	262	"5,500"
Tel Hayim (Itamar)	1984	52	2350
Yizhar	1984	45	360
Berakha	1983	50	2500
Sahve Shamron	1978	120	650
Qedumim Zefon	1982	N/A	N/A

Qedumim	1975	400	"6,000"
Yaqqir	1981	90	900
Netafim	1983	37	150
Qarna Shamron	1978	850	"5,200"
Ginnot Shamron	1985	N/A	N/A
Neve Oraanim	1991	N/A	N/A
Niriyya	1994	N/A	N/A
Sha'are Tiqva	1983	350	1020
El Qana D	1981	115	400
Yo'ezer	1982	65	"4,400"
Pedu'ea	1984	55	312

Table 1.3: Land use classification in Nablus district.

Land Use	**Area(Hectares)**	**% of Land**
Palestinian Built-up Areas	"4,127.10"	2.6
Israeli Settlements	"2,427.80"	1.5
Closed Military Areas	"41,624.30"	26.3
Military Bases	554.7	0.4
Nature Reserves	"16,661.20"	10.5
Forests	526.9	0.3
Quarries	300.9	0.2
Cultivated Areas	"28,992"	18.4
Industrial Areas	124.1	0.08
Others*	"62,683.40"	39.7
Total	158022.4	100%

"* Others represent either roads, unused land, or land used for grazing."

Chapter Two
Topography And Climate

Topography

A Digital Elevation Model (DEM) containing Z-value with pixel size of 100m is created for Nablus district. 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 2.1 represents the producing DEM, which is themed using the threshold table with an interval of 100m. Themes are colored values that give a quick and effective method for identifying features and areas that meet specified criteria. The threshold table is simply tells the GIS software which color to use when displaying certain pixels.

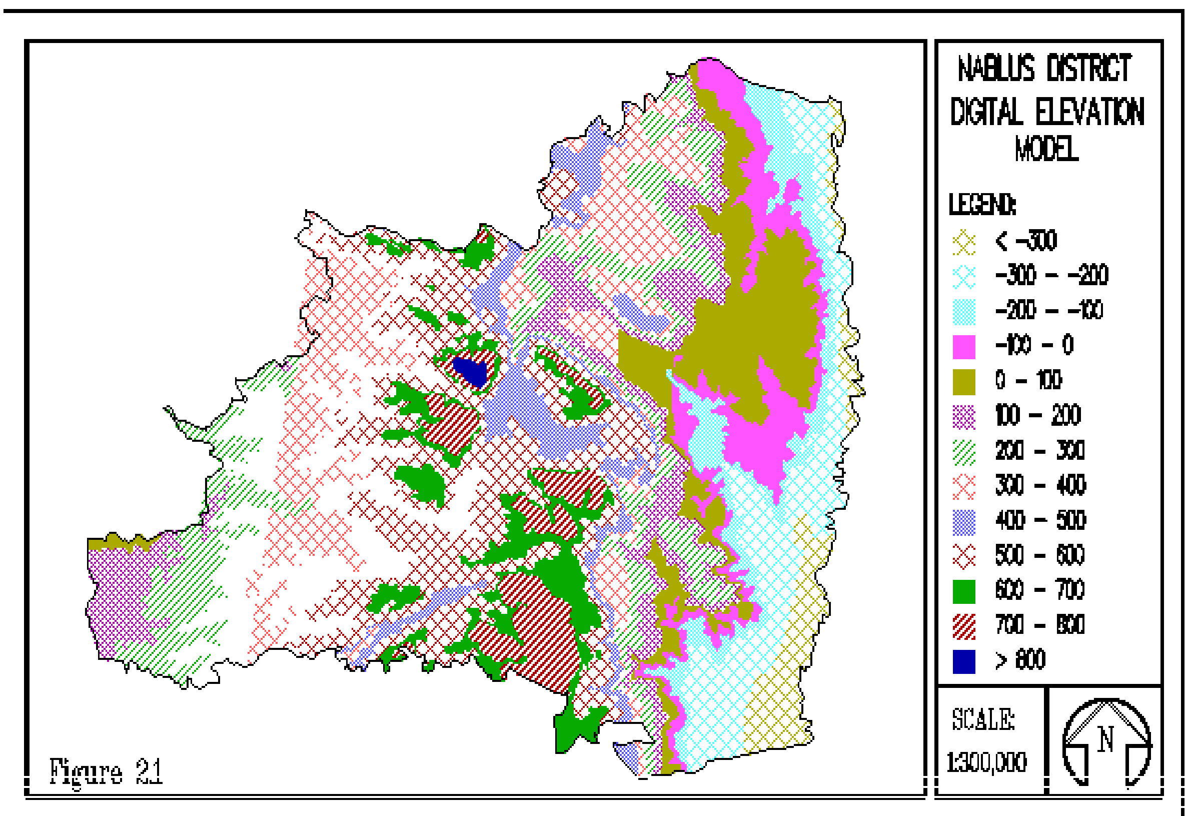


Figure 2.1

A contour map based on the created digital elevation mode is constructed with contour interval of 100m (Figure 2.2). The highest point in the district reaches 918m above sea level at Jabel 'Ibal, while the lowest elevation is 349m below sea level at the southeast corner of the district.

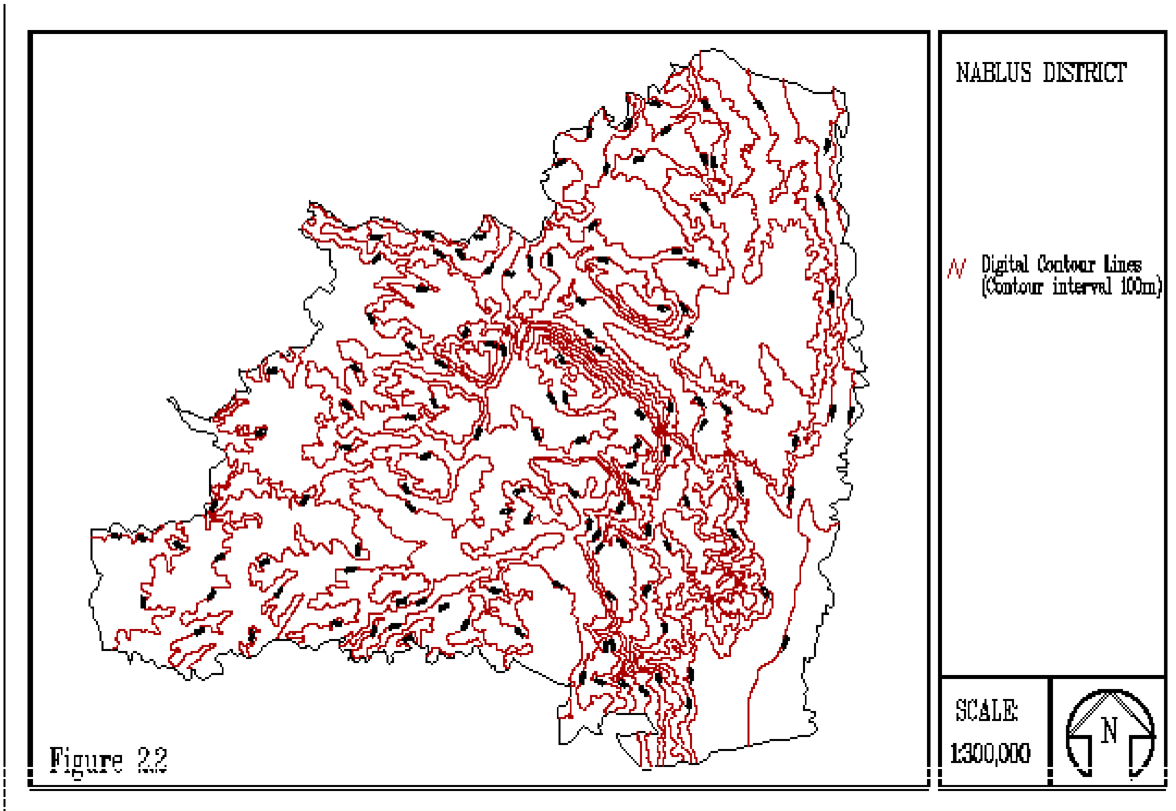
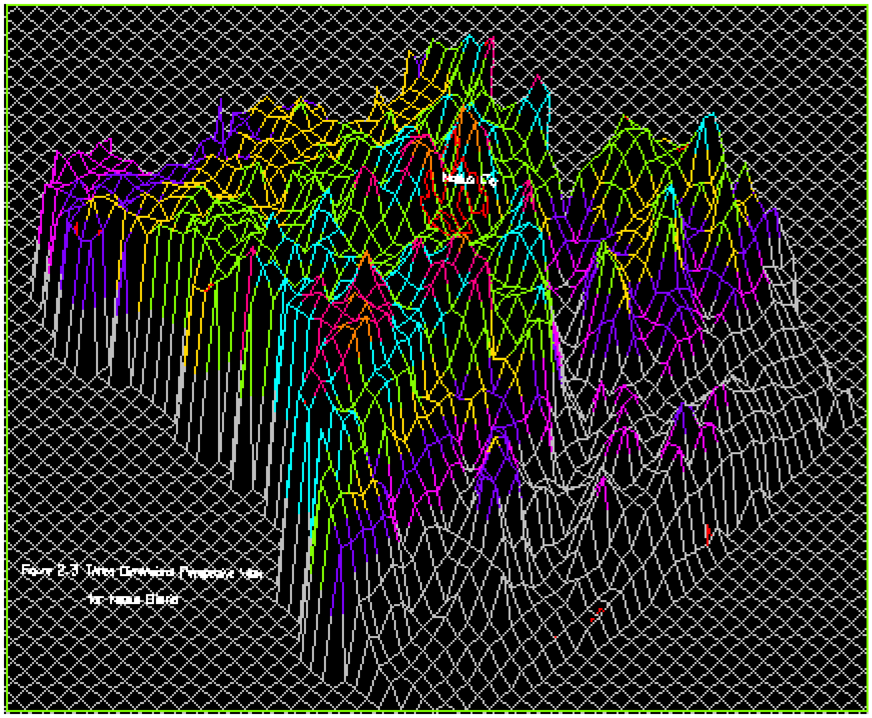


Figure 2.2

A three dimension model for Nablus district is created using the perspective model of the Pamap GIS software version 4.2 (Figure 2.3). The view is facing to south east and an exaggeration factor of 10 is used.



The topography of Nablus district can be divided into four parts: Jordan Valley, the eastern slopes, mountain crests and western slopes. The Jordan Valley is located between Jordan river and the eastern slopes with elevation ranges between 349m below sea level to 100m above sea level. The eastern slopes are located between the Jordan Valley and the Mountains. They are characterized by steep slope which contribute to forming young wadis such wadi El Badan. mountain crests form the watershed line and separate the eastern and western slopes. Elevation ranges on average between 750 and 800 meters above sea level. Western slopes, characterized by gentle slopes, with elevation ranges between 250500 meters above sea level.

Two main drainage systems are distinguished in Nablus district (Figure 2.4). The first system is run to the west such as wadi Qana, wadi Rabah, wadi Khalifa and wadi Mas-ha. While the second system is run to the east or south east, such as wadi el Maleh, wadi Dura, wadi el Far'a and wadi el Ahmar

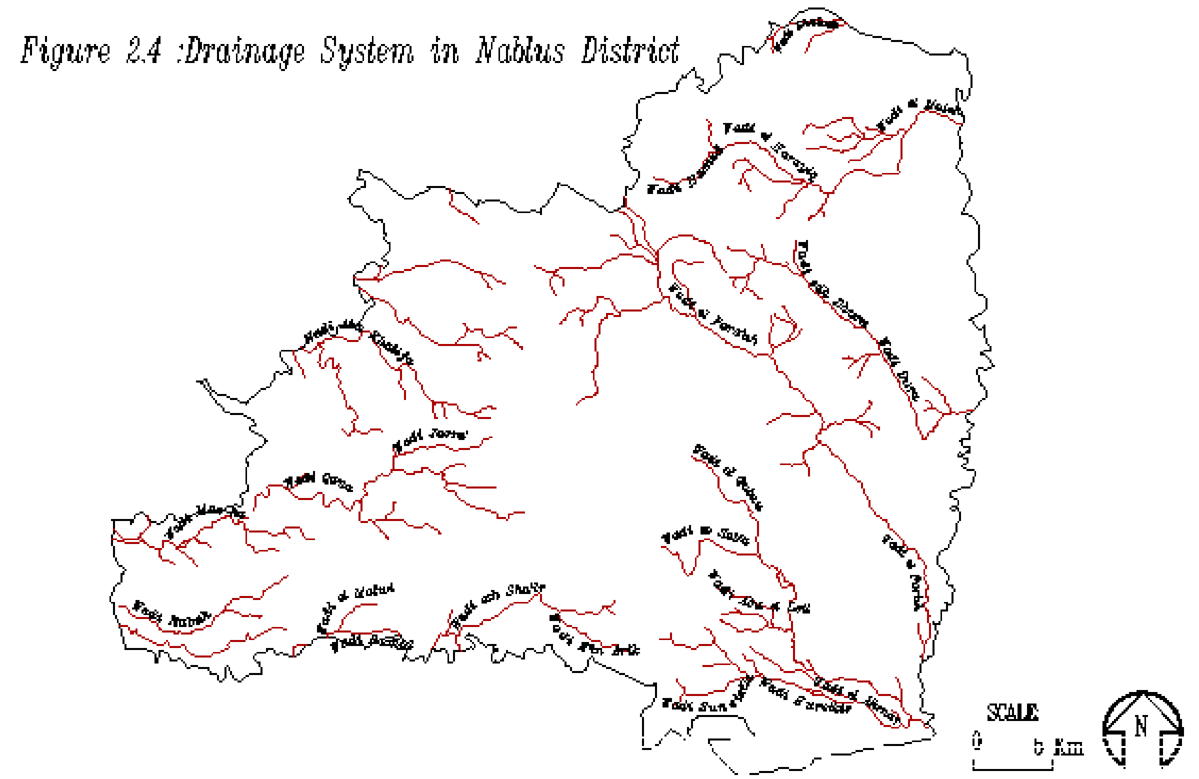


Figure 2.4 :Drainage System in Nablus District

Climate

Nablus district is located at the northern latitude earth grid 3213`, it has hot, dry summers and moderate, rainy winters. Table 2.2 shows the long term variation in different climatic parameters in Nablus district (1970-1992). This data was adopted from the Nablus Meteorological Station.

Table 2.1: Long term annual rainfall for the period 1970-1993.

Year	Rainfall (mm)	Year	Rainfall (mm)
1970-1971	633.2	**1982-1983**	1118.7
1971-1972	671.2	**1983-1984**	555.5
1972-1973	430.3	**1984-1985**	467.3
1973-1974	774	**1985-1986**	527.4
1974-1975	553.3	**1986-1987**	756.6

1975-1976	588.1	**1987-1988**	843.9
1976-1977	606.4	**1988-1989**	566.6
1977-1978	508.4	**1989-1990**	588.7
1978-1979	350.3	**1990-1991**	504.9
1979-1980	894.6	**1991-1992**	1391.5
1980-1981	643.3	**1992-1993**	816.4
1981-1982	653.2		

Table 2.2: Long term average of different climatic parameters in Nablus district, 1970-1992.

Month	Rainfall(mm)	Max. Temp(°C)	MinTemp	R.H. %	Wind (Km/day)	E. pan(mm/month)	Sunshine (hours)
January	148.38	13.08	6.21	67.21	209.19	49.6	4.7
February	144.04	14.4	6.72	67.25	226.81	67.2	4.75
March	101.26	17.21	8.77	62.25	240.39	99.2	6.4
April	32.38	22.15	12.04	53	244.06	149.1	8.16
May	6.77	25.73	14.87	50.72	257.19	202.7	8.9
June	0.15	27.88	17.37	54.96	288.1	225.9	8.36
July	0	29.07	19.26	60.65	298.71	237.9	9.6
August	0.09	29.36	19.54	64.83	281.47	218.2	10.9
September	1.68	28.42	18.53	64.43	247.01	177.6	10.16
October	18.53	25.84	16.24	57.43	183.82	131.1	9.83
November	67.02	20.22	12.14	57.32	186.17	74.4	7
December	143.29	14.62	7.83	67.26	183.82	48.6	4.76
Average	663.59	22.3	13.3	61	237	1681	7.8

Table Notes: "R.H: Relative Humidity," Max.: Maximum Min.: Minimum E.Pan: Pan Evaporation.

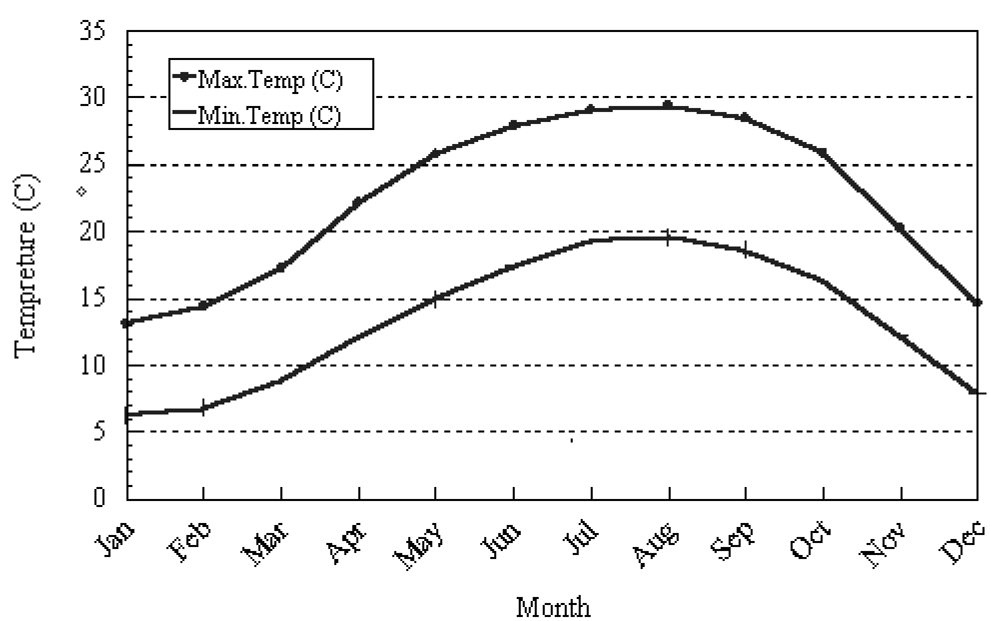
Wind:

The southwest and northwest winds are the prevailing winds in this area with an annual average wind speed of 237 km per day. During the summer, wind moves with relatively cooler air from the Mediterranean towards the north, with an average wind speed of 298.71 km per day in June. At night, the land areas become cooler, causing diurnal fluctuations in wind speeds due to the reduction of the pressure gradient. In winter, the wind moves from west to east over the Mediterranean, bringing westerly rain bearing winds of average wind speed 209.19 km per day in January.

The Khamaseen, desert storm, may occur during the period from April to June. During the Khamaseen, the temperature increases, the humidity decreases, and the atmosphere becomes hazy with dust of desert origin.

Temperature:

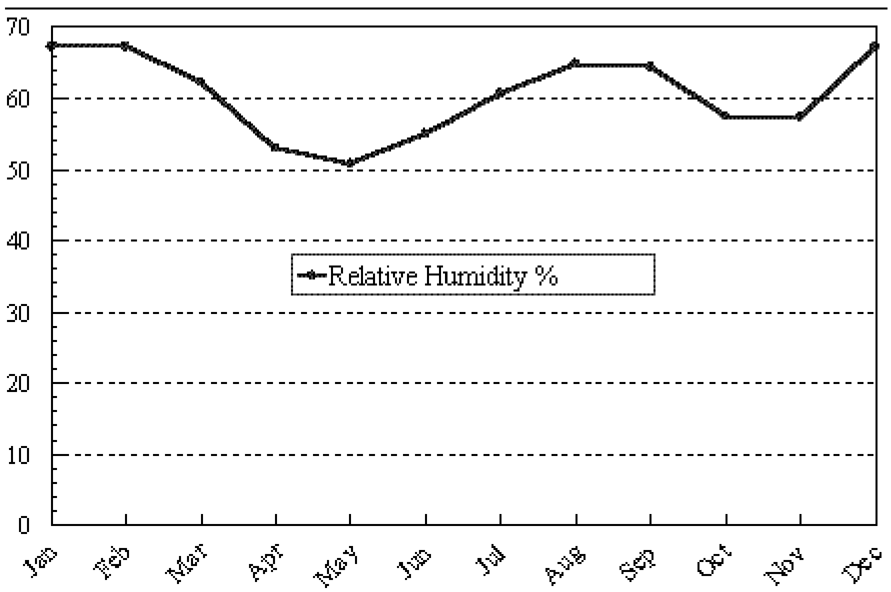
The geographical position of Nablus district in the northern part of the West Bank gives it a comparatively lower temperature range than the other districts. During January, the coldest month, the average maximum temperature reaches 13.1°C, and average minimum temperature reaches 6.2°C. During August, the hottest month, the average maximum temperature is 29.4 and the average minimum temperature is 19.5. Figure 2.5 shows the variation of maximum and minimum temperature during the period 1970-1992.



Humidity:

The mean annual relative humidity of Nablus district is 62%. During the Khamaseen period, the relative humidity decreases to reach its minimum value of 50.72% (in May).

Maximum humidity of 67% is usually registered in December, January and February. This value increases gradually at night, as shown in Figure 2.6.



Rainfall:

Rainfall in Nablus district is limited to the winter and spring months, from October to May. The annual mean rainfall is 663.6 mm. Figure 2.7 shows the variation in the average monthly rainfall for the period 1970-1992. In 1978/1979 rainfall reached only 350.3 mm while in 1991/92 rainfall reached a maximum of 1391.4 mm. Nearly 81% of the annual rainfall occurs between December and March, while July is totally dry. Some showers, however, were registered at Nablus Meteorological Station in June and August (Table 2.2). No data is available on hail or snow in Nablus district. It does periodically snow and hail, but these events are rare.

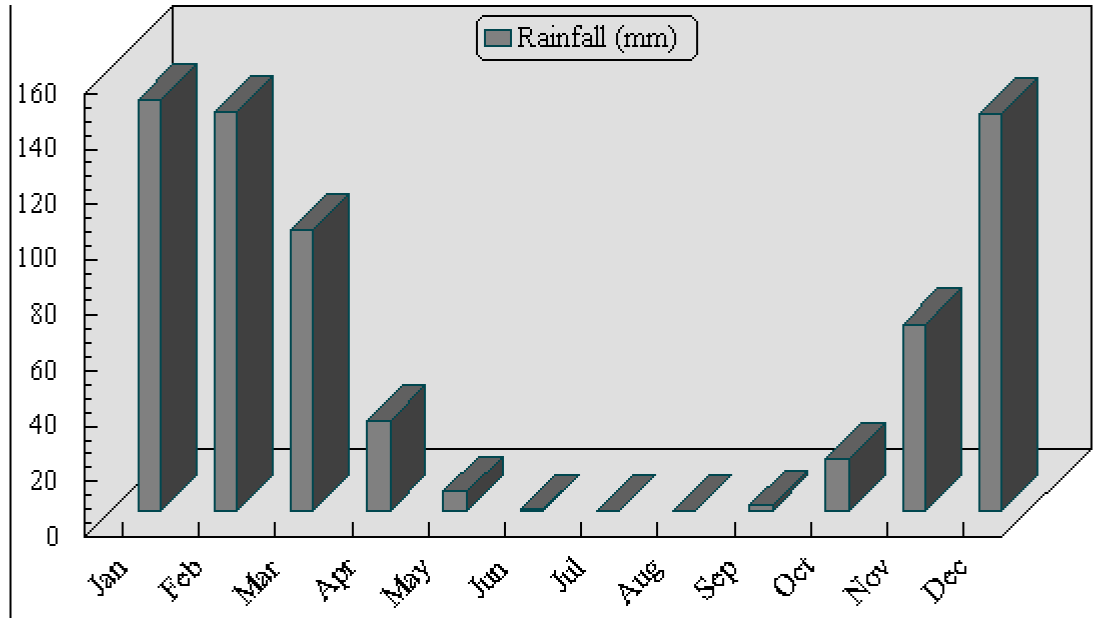
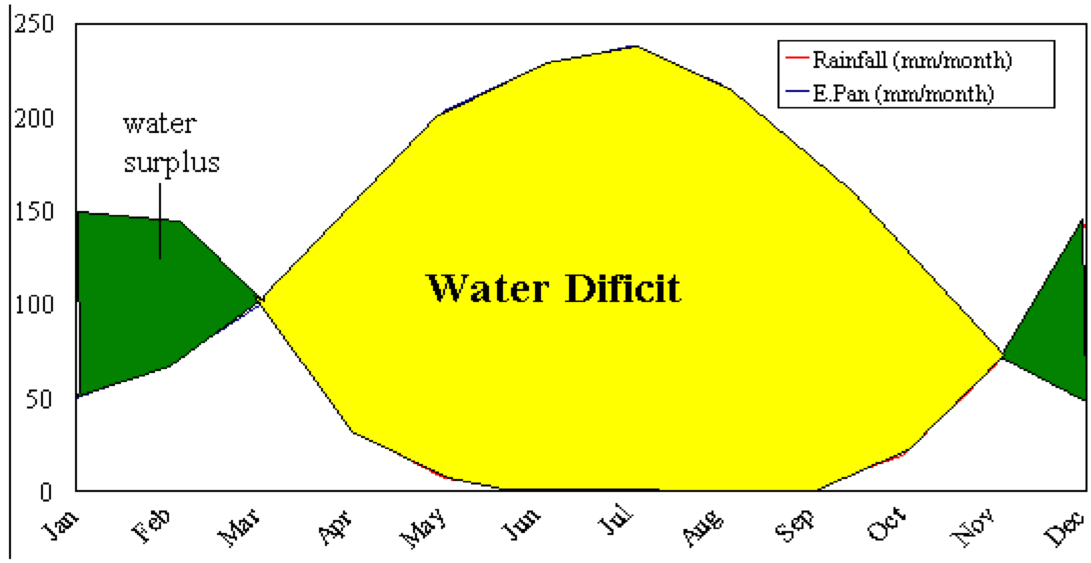


Figure 2.7: Long term average monthly rainfall for 1970-1992.

Evaporation:

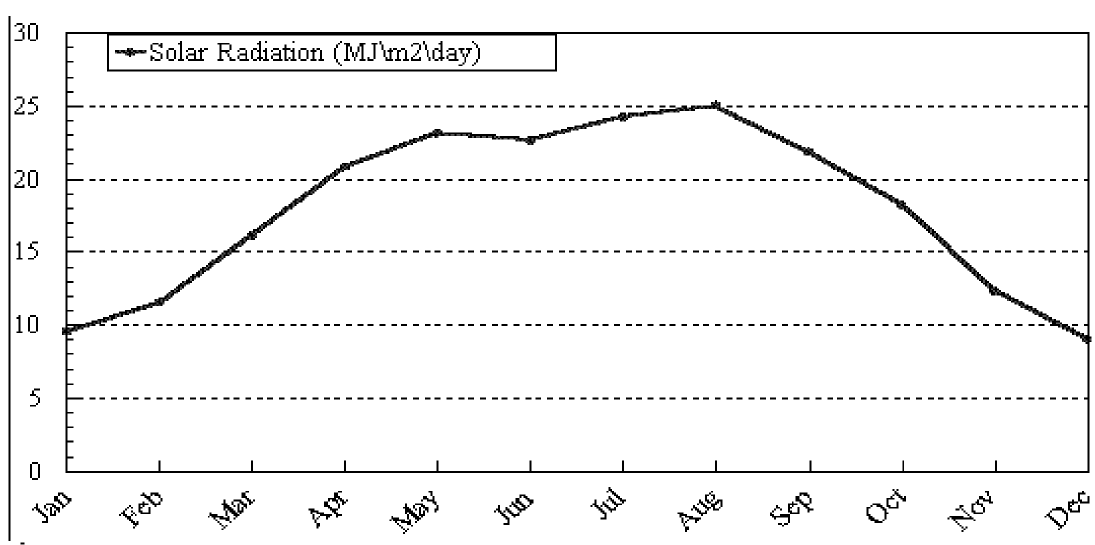
Pan Evaporation is used to reflect the evaporation rate in Nablus district. The evaporation rate is particularly high in the summer due to strong insulation. It can reach 237.9mm/month (July), while in the winter it reaches only 48.6mm/month (December). During the spring and autumn, the evaporation is 100-150 mm per month. In December, January, February and March, precipitation exceeds the rate of evaporation as shown in Figure 2.8.



Sunshine Radiation:

The annual average solar radiation received in Nablus district is 17.8MJ/m^2/day (calculated by Penman method). During August, the district receives an average of 11 hours/day of sunshine, with an average maximum solar radiation of 25MJ/m^2/day. In December, the district receives an average of only 5 hours/day of sunshine and an average maximum solar radiation of 9MJ/m^2/day.

These values can differ from one place to another in Nablus district, depending on the cloud cover. The cloud cover in Nablus district is usually greatest around Burin village due to its position and altitude, therefore there is less sunshine and lower solar radiation. Figure 2.9 shows the variation of average monthly radiation from 1970-1992.



Chapter Three
Socio-Economic Characteristics

Demography and Population

The total area of Nablus district was approximately 2,474 km2 before 1967. In the year 1944, the total population of Nablus district was around 89,200 persons (Palestinian Statistical Abstract, 1984/86), later in the early 1960s, the total population reached 170,000 persons (Encyclopedia Palaestina, 1984).

According to official Palestinian statistics the estimated total population of Nablus district is 333,295 in 1994 including the four refugee camps: Balata, Askar, Ein Beit El Ma' and Far'a (PCBS, 1994 and UNRWA, 1994).

The population of the rural areas is approximately 182,463 representing 54.7% of the total population. The population of the four refugee camps is approximately 37,846 representing 11.4% of the total population. The population of urban and semi-urban areas is 112,986 representing 33.9% of the total population of Nablus district (PCBS, 1994 and UNRWA, 1994).

Nablus city is the only city in the West Bank where one can find the congregation of the three religions, Moslems, Christians and Samaritans live together. The Samaritans live in the south-western part of Nablus city. There are approximately 400 Samaritans living close to Nablus, 60% of them are below the age of 20 (Al-Awda, 1995). Over the years, the Samaritans have come to live as part of the Palestinian society. The Palestinian leadership recognized their rights to vote and to represent themselves in the Palestinian Legislative Council by assigning them one permanent seat in the council.


Photo 1: The center of Nablus city

Population Density

The population density of Palestine varies greatly between areas. The district of Nablus has a population density of approximately 211 people/km^2. In Nablus district, at least 70% of the land is still controlled by Israel and Palestinians are not allowed to live there. Therefore, in reality the population density is more like 700 people/km^2.

Economics

Most of the economic assets of the West Bank are concentrated in Nablus city. What distinguishes Nablus city from the other Palestinian cities is the type of land ownership. There are many families who held large tracts of land, while land is fragmented into small pieces in the other cities.

Major industrial activities in Nablus district include aggregate quarrying, stone and marble cutting and a wide range of manufacturing and processing industries. Processing and manufacturing industries include food products, clothing, leather products, furniture, printing, workshop fabrication, mixed concrete, terrazzo tiles and cement blocks. These industries are found in Nablus municipal industrial zones (Center for Engineering and Planning, 1993).

The unemployment rate in Nablus district for 1994 was approximately 23%. Due to the Israeli continuous closure of the West Bank and the limited opportunities for employment in the West Bank, the unemployment has increased significantly. Approximately 60% of the employed persons have permanent job, 20% have seasonal jobs and 20% have part-time jobs (PARC & Arab Thought Forum, 1994).

Infrastructural Services

The level and extent of infrastructure in the region vary between urban and rural areas. Nablus city and other secondary urban centers generally enjoy open access to internal road networks, relatively sufficient water and electrical power supply, and adequate municipal services such as waste collection and disposal. However, a large proportion of villages in the region suffers from lack of adequate infrastructure, particularly in the areas of sanitation and sewage, water distribution and regular electric power supply.

The district contains a large number of charitable and non-governmental organizations that fill the gaps in services that the formal institutions are yet unable to provide. Appendix 1 shows the major associations and institutions in the district.

Sewage Disposal Facilities

According to the survey which was conducted by ARIJ in November 1995, the wastewater network covers only 38% of Nablus district. Almost 70% of Nablus city is served by the sewage network. The remaining parts of the city use cesspits to dispose their wastewater, or simply drain the wastewater in the nearby wadis. Open sewerage channels are usually used in the refugee camps.

Piped Water Supplies

Approximately 75% of the population in Nablus district receive piped water supply. However, water supply is irregular and the network suffers from frequent dry periods which sometimes, especially during summer, last for several days or even months.

Solid Waste Disposal Services

The disposal of solid waste and its management is a crucial problem that is of great concern to the local authorities. Nearly 61.4% of the solid waste is collected in Nablus district, while 38.6% of the garbage is dumped randomly on the road sides, backyards and in the open spaces in the rest of the district. The Nablus municipality is responsible for collecting 23% of the garbage, while 22% of the solid waste is collected by the village council. Solid waste collection in the refugee camps is administered by UNRWA. Around 14% of the solid waste in Nablus district is collected by the UNRWA. The remaining 2.4% of the garbage is collected by several cooperatives in the district.

Electricity Services

In 1957, the Nablus Municipality Electricity Undertaking (NMEU) was established by the Municipality of Nablus. Due to the obsolescence of old generating units and inadequate maintenance of the new units, the NMEU is supplied by the Israeli Electric Cooperation (IEC) through two link-up points. One point is in the vicinity of the town of Anabta, while the second is near Askar refugee camp (Center for Engineering and Planning, 1993).

Nablus, Anabta, Beit Eiba, Zawata, Talloza, Askar, Balata Tell, Jeneid, Kafr Qallil, E'inabous, Quza and Huwwara are the only sites which are supplied by electricity through the NMEU. Other towns and villages in Nablus district which are not connected to the NMEU network are either supplied directly from the transmission lines serving the Israeli settlements in the region, or depend on local generators for providing minimal domestic requirements of electricity during a limited number of hours each day. These local generators are usually owned and operated by local village committees and cooperatives, or by private groups and individuals (Center for Engineering and Planning, 1993). Most of the electricity used in Nablus district is imported from Israel, this amount represent 108.8 GWH/y, while those generated is only 25.2 GWH/y. According to 1995 index, the price of electricity in Nablus district was 0.51 NIS/KWh which is the highest price of electricity in the West Bank (PERC, 1995).

Transportation and Communication

Nablus district is located on the major north-south road. From Nablus the road leads to the northern part of Palestine and the southern part through Jerusalem. The road system in Nablus district, as in the other districts of the West Bank, is divided into two categories, those mostly for Palestinian use and the others for the Israeli settlers living in the district. For the most part, the Palestinian road system has not been expanded or repaired for many years and is mainly classified into three main categories: paved roads with two or more lanes, single lane paved roads, and dirt roads. There are 365.8 km of main roads and 313.2 km of secondary roads that connect Nablus city with its nearby villages.

After the signing of the Oslo agreement, new road system was established to connect the settlements throughout the West Bank. Confiscation of thousands of hectares of Palestinian land was the negative consequence of this process. The new bypass roads have a total length of 39.699 km (until March 1996) and proposed bypass roads are expected to include another 73.0 km.

The Health Sector in Nablus District

Since the onset of Israeli occupation, the Israeli military authorities have implemented policies that neglected the existing governmental health services and led to the disintegration of health-care infrastructure in Palestine. The natural development of this sector was impeded by tight restrictions, including the denial of funds, the blocking of further development and the linkage of health-care institutions to their Israeli counterparts.

On 13 September 1993, a declaration of principles was signed by the Palestinian Liberation Organization (PLO) and the Israeli Government. As stipulated by this agreement, a transfer of authority took place from the Israeli Military Government and its civil administration to the authorized Palestinians. One of the areas that was transferred to the Palestinian authorities is the health sector.

Health care services are provided by the three main operators in the Palestine:

1. The public sector - The current organization of the public health care is similar to the previous situation with the important and fundamental exception, that the responsibility now lies on the Palestinian Ministry of Health.
2. UNRWAS's health department - mainly towards refugees.
3. Non-Governmental sector - involving local and international charitable organization, non-governmental organizations (NGOs) and private entrepreneurs.

Both the level and extent of health services need substantial improvements in order for the Palestinian to attain an acceptable level of health and enable them to participate fully and effectively in socio-economic development and reconstruction.

Primary Health Care Clinics

The primary health care in Palestine operates by public health offices. These offices supervise and are responsible for the preventive health services in the urban and rural areas. There are 53 primary health care clinics in Nablus district, which are distributed as follows: 19 clinics are operated by NGO's; 30 clinics are run by public sector; and UNRWA operates 4 clinics for the refugees (PCH, 1994).

Hospitals

There are four hospitals in Nablus district. Two are public hospitals with a total of 208 beds. The other two hospitals are operated by NGO's and have a total of 157 beds (PCH, 1994). There are four rehabilitation centers, one for motor rehabilitation, one for vision impaired, one for hearing disabilities and one for mental disabilities (PCH, 1994).

Medical and Health-Care Personnel

Nablus district possesses the highest rate of medical and health-care personnel among all the districts of the West Bank. The total number of human health resources in Nablus district is as follows.

- 282 physicians, representing 23.9% of the total physicians in Palestine (Medical Associations, 1996).
- 331 nurses, representing 15% of the total number of nurses in Palestine (PRC, 1993).
- 93 dentists representing 22.1% of the total dentists in Palestine (Medical Associations, 1996).
- 170 technicians representing 14% of the total number of technicians in Palestine (PRC, 1993).

The Education Sector in Nablus District

The education sector in Palestine has traditionally been subjected to numerous conflicting external factors. The early formulation of the present school system was established during the British mandate period. Since the end of the mandate period, and due to the political situation in the region, the Palestinian people have been deprived of their right to freely develop their education and culture. Between 1948 and 1967, the education received by the majority of the Palestinians in the West bank was influenced greatly by the Jordanian System. After 1967, the West Bank education system was altered and limited by the Israeli occupiers. In 1994, Palestine got, for the first time in the history, the right to define its educational curriculum. The United Nations Relief and Works Agency (UNRWA), which provided education services to the Palestinian refugees in Palestine and other Arab countries, formulated its own education system and structure.

In 1944, there were 9 government schools in Nablus district. By the school year 1966/67 the number of schools had grown to 29. The district had 3 private schools in 1944 and by 1966/67 the number reached to 16 private schools (Encyclopedia Palaestina, 1984).

Literacy rates of all the Palestinians are lowest among females in the West Bank, where 32% of women report that they are not able to write and only 8% of the men cannot write (FAFO, 1993)

Pre-School Education (Kindergarten)

There are approximately 71 kindergartens in Nablus district, all of which are supervised by the private sector. Around 5691 pupils are found in all kindergartens, 52% are males and 48% are females (PCBS, 1995).

General Education

According to the 1994/95 Palestinian statistics, there are now 245 schools in Nablus district, 136 are basic, 38 are secondary and the remaining 71 are kindergartens (PCBS, 1995). Around 148 schools are administered by the government, 16 by UNRWA, and the remaining 81 schools are owned and administered by the private sector (PCBS, 1995).

The total enrollment in all schools is estimated to be nearly 59,957 students. The number of students studying in the community colleges is around 661 pupils (PCBS, 1995). Table 3.1 shows the participation by males-females in the education system.

Table 3.1: Distribution of pupils by educational level and sex (1993/94)(PCBS, 1995).

	Kindergarten	Basic	Secondary	Colleges
Male	2968	25709	2293	331
Female	2723	24348	1916	330
Total	5691	50057	4209	661

A lower participation is seen among females in the secondary level of education, because some abandon schools to get married at this age. A lower result can be seen among boys in the higher education level, where most boys, after completing the secondary school, move to work to support their future financially or travel abroad to continue their higher education.

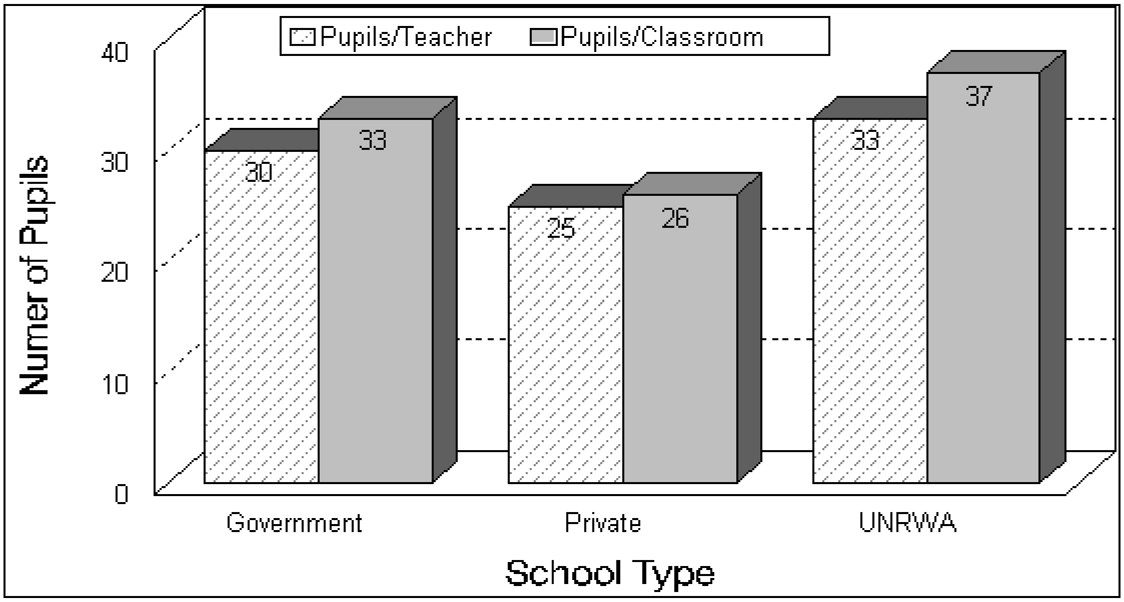


Figure 3.1 Average number of pupils/teacher and pupils/classroom in different school systems.

Although government schools which were established after 1967 comprise the largest sector of the school system in Nablus district, the educational system is in great need for attention and review. Overcrowding in classrooms greatly affects the levels of both education and literacy among pupils (Figure 3.1).

Higher Education

University Education

An-Najah National university in Nablus is one of the leading universities in the West Bank. In the year 1995/96 thus representing 18.5% of the total number of students in Palestine (The Council of Higher Education, 1995/96).

An-Najah National university provides Bachelor degrees in several subjects, such as Arts, Science, Economic, Education, Agriculture and Engineering. Recently, the university started to provide Master degrees' programs in water and environmental engineering, in addition to the existing Master programs in Art, Chemistry, Biology, Education and Business Administration.

Community Colleges

Community colleges are defined as colleges that offer programs at post-secondary level that lead to an intermediate diploma degree. According to the 1994/95 Palestinian statistics, there are 939 students studying in the two community colleges in Nablus district (Nablus Community Colleges and Modern Community Colleges) of which 447 are males and 492 are females (PCBS, 1995).

Chapter Four
Geology And Soil

Geology

Rock outcrops in Nablus area range in age from Cretaceous to Quaternery. Jurassic rocks also have limited outcrops. Cretaceous and Tertiary rocks are marked by marine carbonate sediments such as limestone, dolomites, chalks and marls (Rofe and Raffety, 1965). Table 4.1 shows the geological rock formations and the hydrostratigraphic units and their aquifer potentiality and lithology.

<table>
<tr><th colspan="3">Geological Time Scale</th><th colspan="2">Series</th><th>Formation</th><th rowspan="2">Lithology</th><th rowspan="2">Thickness Range (m)</th><th rowspan="2">Aquifer Potentiality</th></tr>
<tr><th>Era</th><th>System</th><th>Epoch</th><th colspan="2">Rofe and Raffety</th><th>Rofe and Raffety</th></tr>
<tr><td rowspan="6">C E N O Z O I C</td><td rowspan="3">Quaternary</td><td>Holocene</td><td colspan="2">Recent</td><td>Alluvium</td><td rowspan="2">"Marl, alluvium, gravel"</td><td rowspan="2">Variable</td><td rowspan="2">Good Aquifer</td></tr>
<tr><td rowspan="2">Pleistocene</td><td colspan="2" rowspan="2">Lisan</td><td>Gravel and fans</td></tr>
<tr><td>Lisan</td><td>"Laminated marl and gypsum, L.S."</td><td>200+</td><td>Good with soluble mineral content</td></tr>
<tr><td rowspan="2">Tertiary</td><td>Miocene Pliocene</td><td colspan="2">Bayda</td><td>Bayda</td><td>Conglomeratic rocks</td><td>200+</td><td>Good Aquifer</td></tr>
<tr><td>M.Eocene Palaeocene</td><td>B A Y D A</td><td>Jenin sub series</td><td>"Reef L.S numulitic L.S with chalk, chalk with numulitic L.S"</td><td>"Reef, L.S., bedded L.S., chalk with L.S., undifferentiated"</td><td>0 - 470</td><td>Aquifer in L.S. zones. An aquiclude in chalk zones</td></tr>
<tr><td>M E</td><td>EOUTA CECRS</td><td>Senonian</td><td colspan="2"></td><td>"Chalk, Cherts"</td><td>"Chalk, chert"</td><td>"0 - 450 ,0 - 40"</td><td>Poor aquiclude</td></tr>
</table>

SOZOIC	CRETACEOUS	Turonian			Ajlun	Jerusalem	L.S. and dolomite	50 - 100	Very good aquifer
		CENOMANIAN	Upper			Bethlehem	"Dolomitised L.S., dolomite, chalk"	30 - 115	Very good aquifer
			Middle	Upper		Hebron	"Limestone,dolomitic, cherts, chalky"	105 - 260	Excellent aquifer
				Lower					
			Lower	Upper		Yatta	"Dolomitic L.S.,marl, chalky,clay"	50 - 150	Poor aquiclude
				Lower					
						Upper Beit Kahil	"Chalky L.S., dolomite, organic L.S."	110 - 190	Good aquifer
						Lower Beit Kahil	"Dolomitised, marly L.S.,shale"	250 - 290	Poor aquiclude
		Neocomian - Albian			Kurnub	Ramali	"Sandstone, sandy lime"	260 - 290	Excellent
	JURASSIC	Bajocian - Bthonian			Zerqa	Upper Maleh	"Marl, chalky L.S."	190	Poor aquiclude
						Lower Maleh	"Limestone,oolitic L.S.,marl"	>55	Good
						Igneous	Basic igneous variable		

L.S. Lime Stone

Geological Formations

1- Jurassic Rocks:

They are exposed in wadi Maleh, and composed mainly of limestone. Jurassic rocks are divided into the following formations (Table 4.1)

- *Lower Maleh formation:* It consists mainly of limestone which is affected by instrustive basalt. The limestone is massive and it has a light-brown color which is due to limonate. The formation is marked with vertical joints.
- *Upper Maleh Formation:* The lower part of this formation is marked with marl and chalky limestone, while chalk and chalky limestone mark the upper part. The limestone of the lower formation is suddenly transformed from massive to a sharp topographic feature. Weathered limestone and Karst caves make the formation a minor aquifer.

2- Cretaceous Rocks:

They are divided into the following formations:

- *Ramali Formation:* The Ramali Formation, in Nablus area, consists of sandstone series occurring between the base of the Beit Kahil and the Maleh formations. The Ramali formation is exposed in the core of the Judean anticline in three distinct areas. The most extensive outcrop is in wadi Maleh area where the sandstone is the main component. The two other exposures of this formation are in wadi Far'a and Luhuf Jadir and are composed mainly of a prominent craggy limestone. Ramali formation is an excellent aquifer, the cemented sandstone is well jointed and the bulk of the sand is porous (Table 4.1).
- *Lower Beit Kahil Formation:* It forms the lower part of lower Cenomanian. The main outcrops are in wadi Far'a and in the north of the anticline axis area. The lower part of the formation consists mainly of thick, massive iron-stained limestone. The formation passes up through sandy marls and shales into thin-bedded porcellanous limestone. The formation has a thickness of 230 m (Table 4.1).
- *Upper Beit Kahil Formation:* This formation is considered to be as equivalent to the upper part of the lower Cenomanian. The main outcrops are in wadi Far'a and Beit Furik and in the core of Ein Qinya anticline. It consists of dolomitic and sometimes chalky, and marly limestone. This formation has a small outcrop area because of its steep dips. It has a thickness of about 120-250 m. The formation is marked by joints and includes Carvenous limestone, thus forming a good aquifer (Table 4.1).

- *Yatta Formation:* It forms the lower part of the middle Cenomanian and is exposed on both the east and west sides of the Judean anticline. This formation consists mainly of marl, chalky limestone, clay and thin interbedded dolomitic limestone. It has a thickness of about 150 m (Table 4.1).
- *Hebron Formation:* This formation is regarded as equivalent to the upper part of the middle Cenomanion. It is exposed in the west, southwest and southeast of Nablus district, and consists mainly of blue-green limestone and dolomitic limestone. The lower part of its outcrop is massive while the upper part is well bedded. The Hebron formation rocks have karst caves and joints, therefore it is an excellent aquifer (Table 4.1).
- *Bethlehem Formation:* It is approximately equivalent to the upper Cenomanian and is exposed on the flanks of both the Far'a and Anabta anticlines. The bottom of the formation consists of dolomite, limestone, chalk and marl. It has a thickness of about 30-100 m (Table 4.1) (Rofe and Raffety, 1963).
- *Jerusalem Formation:* This formation belongs to the Turonian period. It is exposed in the west along the axial area of the Anabta anticline and in narrow strips flanking the Far'a anticline. It consists mainly of massive limestone, dolomite and, sometimes chalk. The formation varies in thickness and lithology and has a thickness of about 50-100 m (Table 4.1).

3- Rocks of the Cretaceous-Tertiary Transition Chalk with Chert:

This formation is composed mainly of chalk and ranges in age from approximately Coniacian at the base to Palaeocene at the top. The chalk is usually cream, buff or white, and occasionally dark colored due to the presence of bituminous materials. In some places of the formation, the chalk is associated with chert, therefor it tends to be phosphatic with some fish remains.

4- Tertiary Rocks:

These consist of the following formations.

- *Jenin subseries:* It consists of Eocene aged rocks which are found in Nablus and Jenin areas. Outcrops are widely spread covering one third of the total area. Rocks of the Palaecene age consist mainly of chalk. In this formation, five facies of limestone and chalk have been described. These facies are chalk with minor chert, chalk with interbedded limestone, limestone with minor chalk, bedded massive limestone and Reef limestone. The total thickness of this formation is about 500 m. Rocks of the Jenin subseries are caved and have joints, therefore they are considered as a major aquifer (Table 4.1).

- *Bayda Formation:* It consists mainly of conglomerate resting on the exposed formations of the Cretaceous rocks. The formation is marked by rounded features. The area of Bayda was subjected to folding, faulting and uplifting. Recent erosion has cut down the solid rocks leaving capping on the interfluves (Table 4.1).

5- Quaternary rocks:

They are divided into the following formations :

- *Lisan formation:* It consists mainly of laminated marls and gypsum, marginally of gravels and poorly sorted pebble beds, occasionally calcareous and limestones. Total thickness is about 200 m (Table 4.1).
- *Alluvium:* This formation is composed of alluvium consisting of unconsolidated marls with some siliceous sand. The derivation of the alluvium from the limestone gives it the red color and fine texture (Table 4.1).
- *Nari formation:* It occurs over all rocks especially in areas of high rainfall, where the carbonate rocks are dissolved by percolating water penetrating the upper zone of the outcrops. It forms a thin coating over the limestone with a thickness of about l0 m.
- *Igneous rocks:* There was two periods of igneous activity. The first occurred between the Maleh and Ramali formation, at the end of the Jurassic to the early Cretaceous, and the second post-dates nummultic limestones of Eocene age. Outcrops are found in both wadi Far'a and wadi Maleh. In wadi Far'a basaltic layers are inter bedded with yellow-red sandstone.

Structural patterns:

Folds:

The following folds exist in Nablus district:

- ***Anabta Anticline:***

It extends to about 25 km, and trends north-south. Its northern part has southerly pitch but the southern part is broken by faults. The Anabta anticline is symmetrical in structure.

- ***Nablus-Beit Qad Syncline:***

It covers an area of about 1500 km. The axis trends NNE-SSW, but near Jammaa'in it bends sharply westwards. The northern part has a northerly pitch except for the last few kilometers where it tilts southwards. The syncline is symmetrical with a gentle dipping west limb and a steep east limb (Figure 4.1).

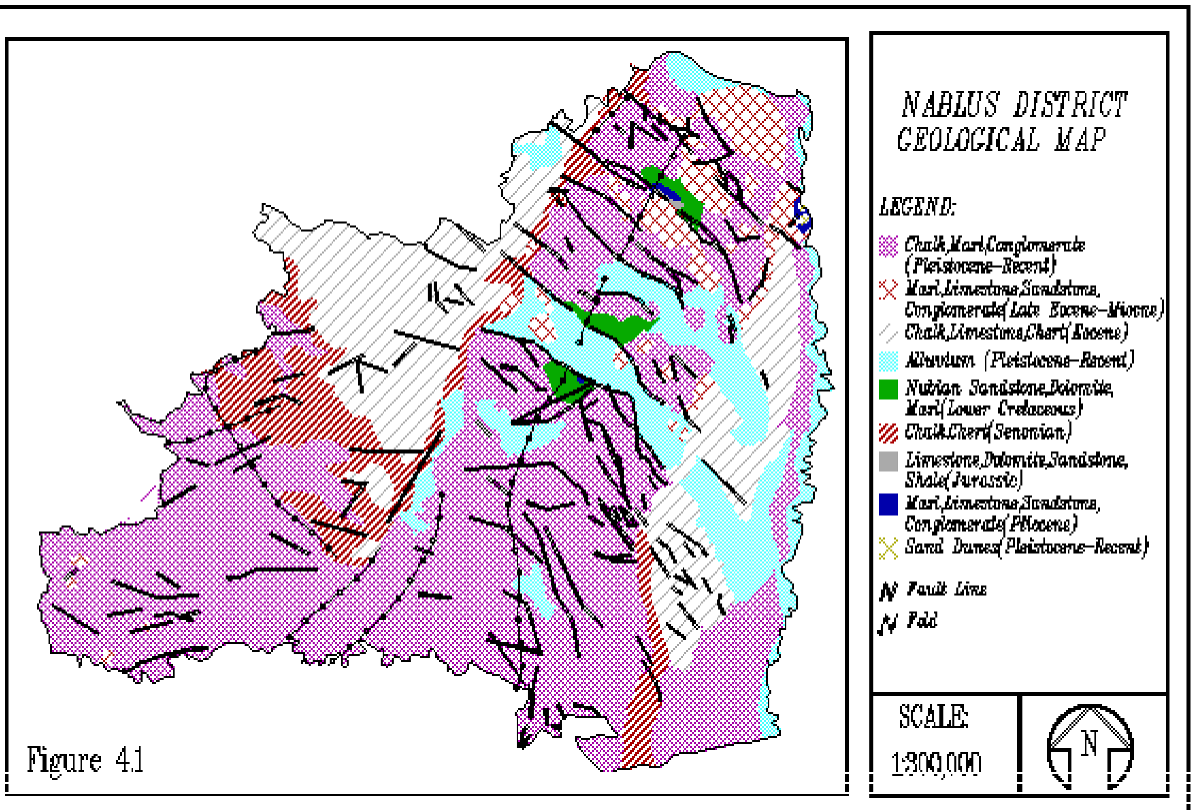


Figure 4.1

- ***Ein Qinya Anticline:***

It passes through the area around Deir Es Sudan, then swings sharply eastwards to pass through Khirbet Qeis. It trends NE-SW and it is symmetrical in structure (Figure 4.1).

- ***Far'a Anticline:***

It is considered as one of the main folds in Nablus district. It trends NNW and extends to about 10 km. The east and west limbs of the anticline form two minor folds, Rujeib Monocline and Khirbet Fasayil Monocline. It's board axial area is distinguished from the flanks. The anticline has a symmetrical structure (Figure 4.1).

Faults:

In Nablus district, the main depressed areas, like Far'a, Tubas and Tayasir Grabens are boarded by complex fault systems. Majdal Bani Fadil fault and Beit Furik fault also form major structures in the district. Most of faults trend NW - SE (Figure 4.1). Towards the west, the faults become more hummock and their impact therefore, becomes less visible.

Joints:

Joints and solution channels are best developed in the lower Maleh, Hebron, and Jerusalem formations, as well as Nummulitic limestone facies.

Earthquakes:

Several earthquakes happened during the last 2,000 years. Records show that about 500 persons were killed and more others injured. In Nablus district, at least 33 earth movements have been recorded, some of these earthquakes were severe, others are moderate or weak.

Soil

The soil characteristics and references to major vegetation were adopted from the document entitled, *The Soil of Israel (1976)*. The major soil associations found in Nablus district are as follows (Table 4.2 and Figure 4.2).

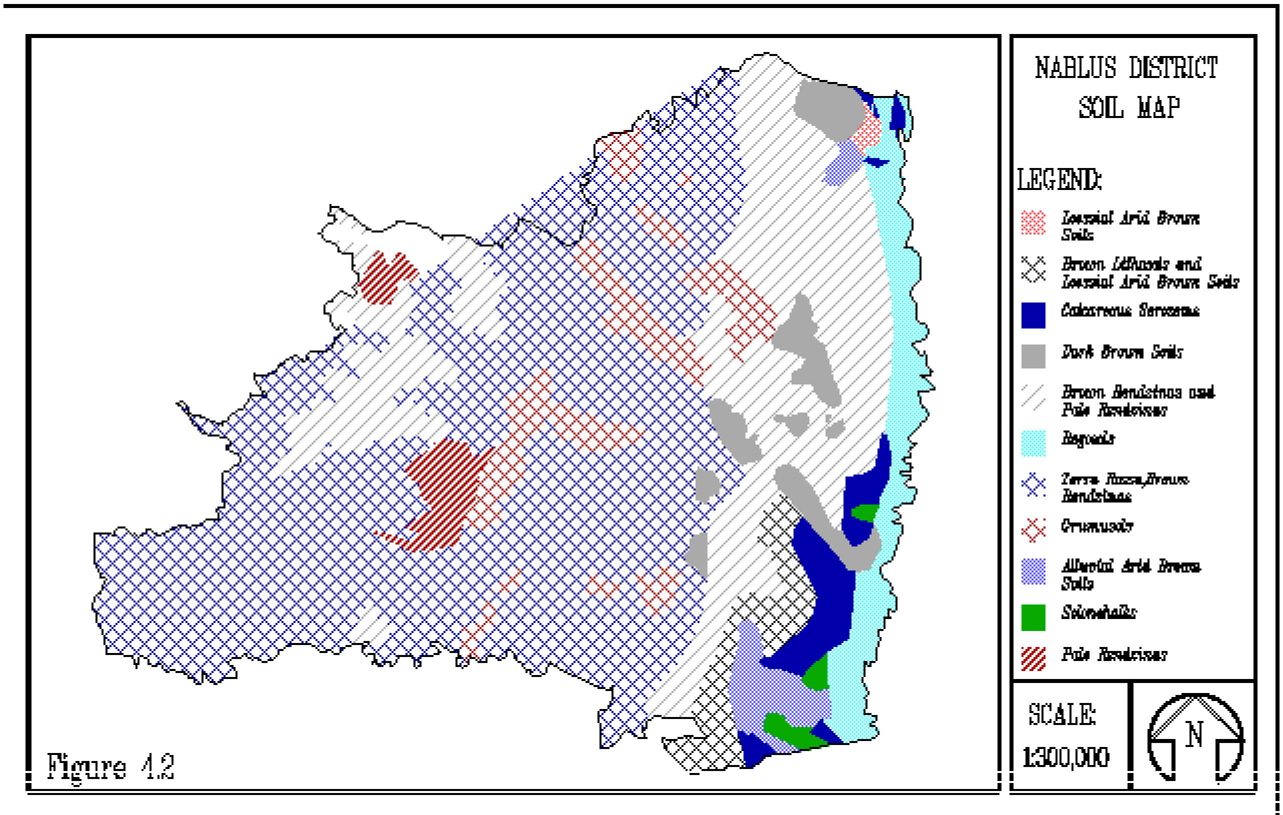

NABLUS DISTRICT
SOIL MAP
LEGEND:
Loessial Arid Brown Soils
Brown Lithosols and Loessial Arid Brown Soils
Calcareous Serozems
Dark Brown Soils
Brown Rendzinas and Pale Rendzinas
Regosols
Terra Rossa,Brown Rendzinas
Grumusols
Alluvial Arid Brown Soils
Solonchaks
Pale Rendzinas
SCALE:
1:300,000
N

Figure 4.2

Table 4.2: Major soil types and characteristics in Nablus district

no	Soil Association	Area Hectares	American Classification	FAO Soil Unit Classification	Location	General Characteristics	Natural Vegetation	Rainfall (mm)	Mean temperature (c)
1	Grumusols	"9,461.57"	Xererts	Vertisols	Area with smooth to gently sloping topography	Parent material are fine textural alluvial or aeolien sediments	Prosopis farcata-Scolymus maculatus	300-700	19-21
2	"Terra rossas, brown and pale rendzinas"	"78,409.75"	Xerochrepts Haploxerolls	"Luvisols, Cambisols, Lithosols, and Rendzinas"	central mountainsSmall plateau of the mountains	"Terra rossa type, the parent materials are dolomite and hard limestone, the soil depth varies from shallow to deep (0.5-2m) Xeric moisture regime, deep in hilltops and shallow in sloppy mountainous areas. Soil has a reddish brown color with subangular blocky structure. Same as Xerochrepts with the exception that it has a base saturation of 75%"	"Quercus calliprinos, Pistacia palaestina and Pistacia lentiscus. Pistacia atlantica, Amygdalus korschinskii and Pistacia palaestina."	400-700	15-20
3	Brown & pale rendzinas	"35,884"	Xerorthents	Rendzinas and Lithosols	Hilly slopes	"Xeric moisture regime, it has a reddish brown color. Soil structure is crumby. Texture is loamy or clay, about 30% is stony. Parent material is soft calk and marl."	Pinus halepensis and Pistacia palaestina.	600-700	15-19
			Haploxerolls		Valleys and depressions	Xeric moisture regime. It has dark reddish brown color with clay and with gentle slope. Parent rocks are marl and chalk.	"Quercus ithaburensis, Pistacia lentiscus, Ceratonia siliqua and Ballotetalia undulatae."	300-700	18-20
4	Brown lithosols & loessial arid	"5,052.81"	Haploxeralfs Torriorthents Xerochrepts	Lithosols and Xerosols	Eastern slopes	"marl, chalk, limestone and conglomerates parent rocks.Xeric moisture regime. the soil has ochric	"Ballotetalia undulatae, Artemisietea	200-350	19-21

	brown soils					surface epipedon with low organic matter < 0.6% and massive structure. Parent material is loessial sediments."	herbae-albae."		
5	Regosols	"11,427.86"	Xerochrepts Calciorthids Gypsiorthids	Regosols	Badlands along terraceescarpment in the Jordan Valley	"The soil has Pale brown color, loamy texture. Parent materials are sands, clays and loess."	"Anabasis articulata, Salsola vermiculata and Salsola tetrandra"	150-200	22-24
6	Dark Brown soils	"5,642.45"	Xerochrepts Haploxeralfs	Luvisols and cambisols	Slopy areas	"It is characterized by coarse textural residual dark brown soils. The parent rocks are aeolian sediments, calcareous sandstone and medium to fine textured alluvial deposits."	Prosopis farcata - Scolymus maculatus	350-500	19-20
7	Alluvial Arid Brown soils	"3,148"	Haplargids Camborthids	Xerosols	Alluvial fans and plains	Formed as a result of erosion of calcareous silty and clay materials.	Herbaceous vegetation of desert annual halophytes and glycophytes	150-200	23
8	Loessial Arid Brown soils	311.92	Palexeralfs Haploxeralfs Xerochrepts	Xerosols	Gently sloping plateau and dissected plateau	Parent rocks are conglomerate and chalk.	Achilleetum santolinae	150-250	20-21
9	Calcareous serozems	"4,571.20"	Xerochrepts Calciorthids Gypsiorthids	"Cambisols, Xerosols, Yermosols"	Flood plains	"The soil is highly calcareous with greyish-brown color. The texture is medium to fine. Parent rocks are limestone, chalk and marl."	Salsoletum villase	100-400	21-24
10	Solonchalk	"3,148"	Salorthids	Solonchalk	Occupy the drainage valleys and closed basins where the groundwater table is near the soil surface.	"Texture ranges from sand to clays, some cases is extremely saline, with up to 50% salts. The parent materials are recent alluvial deposits. "	"Tamarix, Suaeda and Nitraria"	50	23-25
11	Pale Rendzinas	325.83	Xerortherts Haploxerolls	Lithosols and Rendzinas	"Jammain, O'rif and Sabastiya(hilly slopes)"	It is a highly calcareous and greyish-brown alluvial soil. Parent material are soft chalk and marl	Pinus halepensis	600-700	15-19

1. Grumusols

This soil association covers approximately 9,461 hectares of the district. It is found in areas with smooth to gently sloping topography. The soil is originally formed from fine textured alluvial or aeolien sediments. Primary natural vegetation has been destroyed. Presently, what appears is segetal vegetation of the *Prosopis farcata-Scolymus maculatus* association. The use of this soil type for production purposes is currently limited to wheat cultivation. The American Great Classification that represents this soil is *Xererts.*

2. Terra Rossa, Brown and Pale Rendzinas

These types of soil associations occupy approximately 78,409 hectares, or 49% of Nablus district. Rock outcrops in these soils cover between 30-50%. The major native vegetation cover include *Quercus calliprinos, Pistacia palaestina, Pistacia lentiscus, Pistacia atlantica,* and *Amygdalus korschinskii.* The dominant land use pattern on these soils is the cultivation of field crops, mainly wheat, barley, grapes, olive and fruit trees, particularly on valley shoulders. The American Great Group Classification that represents these soil associations is *Xerochrepts* and *Haploxerolls*.

3. Brown Rendzinas and Pale Rendzinas

This soil association occupies an area of approximately 35,884 hectares. Similar to the previous soil types, rock outcrops in these soils are 3050%. Major vegetation cover includes *Pinus halepensis, Pistacia lentiscus, Pistacia palaestina, Quercus ithaburensis, Ceratonia siliqua* and *Ballotetalia undulatae*. On such areas, cultivation of grapes and olives, field crops (wheat and barley), and grazing are the main land uses, especially in shallow and steep sloping areas. According to the American Great Group classification, these soils represent the association of *Xerorthents,* and *Haploxerolls*.

4. Brown Lithosols and Loessial Arid Brown Soils

This type of soil association covers an area of approximately 5,052 hectares of Nablus district. It characterizes the southern parts of the eastern slopes of the district and is mainly found on steep to moderate rocky and eroded slopes. Brown lithosols are found in the pockets among the rocks. Loessial arid brown soils are found on flat hilltops, plateau and footslopes. The parent rocks of this soil association are chalk, marl, limestone and conglomerates. Major vegetation is *Ballotetalia undulatae* and *Artemisietea herbaealbae*. The American Great Classifications that represent this soil are *Haploxeralfs Terriorthents* and *Xerochrepts*

This type of soil association characterizes the eastern border of Nablus district. It is found as badlands along terrace escarpments in the Jordan Valley, covering an area of approximately 11,427 hectares. The soil parent materials are sand, clay and loess. The dominant vegetation found in this region are *Anabasis articulata, Salsola vermiculata* and *Salsola tetrandra*. The area is used for grazing. The American Great Group Classifications that represent this soil, are *Xerochrepts, Calciorthids* and *Gypsiorthids.*

6. Dark Brown Soils

This type of soil association covers an area of approximately 5,642 hectares of Nablus district. This soil is distributed as elongated polygons on the eastern slopes of the district. The parent rocks of this soil association are aeolian sediments, calcareous sandstone (Kurkar), and medium to fine textured alluvial deposits. Primary natural vegetation was destroyed in this area, except segetal vegetation of the *Prosopis farcata-Scolymus maculatus.* The American Great Group classifications that represent this soil association are *Xerochrepts,* and *Haploxeralfs*.

7. Alluvial Arid Brown Soils

This type of soil association is located mainly in the Fasayil area. It covers an area of approximately 3,148 hectares. It exists as an alluvial fans and plains, which formed as a result of erosion of calcareous silty and clay materials. This soil type supports herbaceous vegetation of desert annual halophytes and glycophytes, and responds well to irrigation, producing various crops, mainly subtropical and tropical fruits, such as citrus, bananas, and dates, as well as winter vegetables. The American Great Group Classifications that represent this soil association are *Haplargids* and *Camborthids.*

8. Loessial arid Brown Soils

This type of soil association is found on moderate slopes to the east of Kh. Kardala at the north-eastern part of the district. It covers an area of approximately 311 hectares. The soil was formed originally from conglomerate and/or chalk. The major vegetation type found in this region is *Achilleetum santolinae*, and the primary land use includes cultivation of various field crops and some irrigated horticultural crops. Wheat, barely, and sorghum are grown as dryfarming crops. The American Great Group Classifications that represent this soil association are *Palexeralfs, haploxeralfs* and *Xerochrepts*.

9. Calcareous Serozems

This type of soil association is found on the eastern slopes of Nablus district. It was formed mainly as a result of flooding of the Jordan River. The soil covers an area of approximately 4,571 hectares. It was originally formed from limestone, chalk and marl. The vegetation is restricted to *Salsoletum villase*. The current land use is restricted to winter grazing. The American Great Group Classifications that represent this soil are *Xerochrepts,Calciorthids* and *Gypsiorthids.*

10. Loessial arid Brown Soils

This type of soil association is found in the south eastern part of the district, covering an area of about 3,148 hectares. It occupies the drainage valleys and closed basins where the groundwater table is near the soil surface. The soil parent rocks are recent alluvial deposits ranging in texture from sand to clays. Major vegetation is halophytic with dominant species being *Tamarix, Suaeda,* and *Nitraria*. Some dates are grown on the periphery of the depressions, where the ground water is still relatively fresh. The American Great Group Classification that represents this soil is *Salorthids.*

11. Pale Rendzinas

This soil association covers the areas of Jammaa'in, O'rif, and Sabastiya, covering an area of about 325.83 hectares. It is a highly calcareous grey and greyish brown alluvial soil. Parent materials are soft chalk and marl. Major vegetation is Sponyaneous woods of *Pinus halepensis.* Various rainfed orchards are grown especially olives. Rainfed field crops are also widespread. The shallow soils are used for grazing. The American Great Group Classifications that represent this soil are *Xerortherts* and *Haploxerolls.*

Chapter Five
Water Resources

Introduction

Nablus city is the most populated area in Nablus district. Water supply was believed to be sufficient for human needs up to the end of the British Mandate of Palestine. In 1948, the Arab - Israeli war and the birth of the state of Israel, caused the problem of Palestinian refugees. The influx of refugees made the population of Nablus city to double in one year without any increase in water resources. After the Israeli occupation of the West Bank in 1967, Israel controlled all water resources. Only few new sources were developed for Nablus area, therefore the population continues to live with inadequate water supply.

According to "Oslo II" interim agreement, and in order to meet the immediate needs of the Palestinians fresh water for domestic use, both sides recognize the necessity to make available to the Palestinians during the interim period a total quantity of 28.6 mcm/yr. The allocation of Nablus district is about 3.7 mcm/yr in which:

The Israelis should provide an additional supply of:

- 0.6 mcm/yr to Salfit area, and
- 1 mcm/yr to Nablus area.

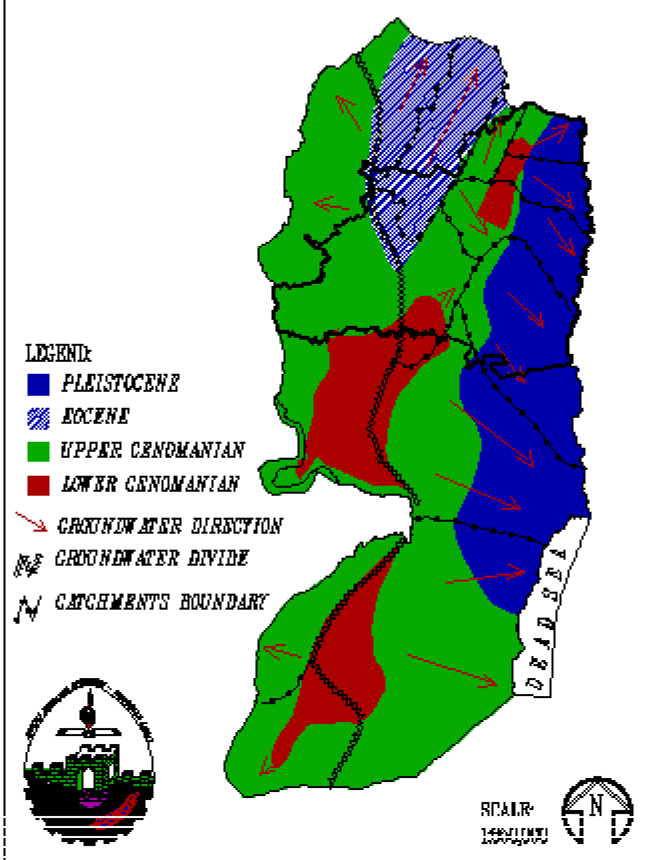
While, the Palestinian responsibility is to construct an additional well in Nablus area to produce 2.1 mcm/yr.

Hydrogeological Status

Groundwater aquifer

Figure 5.1 shows the different groundwater catchments and the exposed aquifer systems in the West Bank in general and those underlying Nablus district. The main aquifer system underlies Nablus district can be summarized as follows (Rofe & Raffety, 1965).

Figure 5.1: Groundwater Basins and the Exposed Aquifers in the West Bank



Nubian (Kurnub) Sand Stone Aquifer System

This aquifer system is of the Lower Cretaceous age, composed mainly of sand stone. It exists at a depth of more than 1,000 meters in some areas, although its depth fluctuates from western Nablus to the Jordan River. It is not exposed at any location in the study area and so it is a confined nonrenewable aquifer. It has an average thickness of 260-290m. There are no production or exploration wells owned by Palestinians tapping this system.

Lower Cenomanian Aquifer System

The Lower Cenomanian aquifer system constitutes the lower part of the Upper Cretaceous age. It is composed mainly of dolomitized limestone, marly limestone & shale, chalky limestone with organic matter, dolomitic limestone, marl, chalk, and clay, which is hydraulically connected with the overlying Upper Cenomanian aquifer system. This aquifer is composed of three main formations with a total thickness between 410 - 630m.

- Yatta formation, a poor aquiclude.
- Upper Beit Kahil, good aquifer
- Lower Beit Kahil, poor aquiclude

Upper Cenomanian - Turonian Aquifer System

This system belongs to the Upper Cretaceous age of the Upper Ajlun Group. It ranges between 185-375 meters and is composed mainly of limestone, dolomite, dolomitic limestone, chalk, and chert. This aquifer system includes three main aquifer formations, listed here from youngest to oldest.

- The Jerusalem Formation, is composed of limestone and dolomite with a thickness of 50-100 meters that forms a very good aquifer.
- The Bethlehem Formation, is composed of dolomitized limestone, dolomite, and chalk with a thickness of 30-115 meters that forms a very good aquifer.
- The Hebron Formation, is composed of limestone, dolomite, chert and chalk with a thickness of 105-250 meters that forms an excellent aquifer.

Tertiary Aquifer System

This aquifer system is represented in the study area by the following formations.

- The Jenin subseries of the Belqa Group of the Palaeocene (Eocene) age which is composed of reef limestone, bedded limestone, and chalk with limestone. Its thickness is between 0-470 meters forming a good aquifer in limestone zones and an aquiclude in chalk zones.
- The Bayda series of the Neogene (Pliocene & Miocene) age is composed of conglomerates with a thickness of 200 meters which forms a good aquifer.

Quaternary Aquifer System

This aquifer system is represented in the study area by the following formations.

- The Lisan and Gravel fans formations of the Pleistocene age which has a thickness which may reach 200 meters in some places and thus forms a good aquifer. Lisan formation - the lower formation - is composed of laminated marl and gypsum with limestone.

- The Alluvium formation of the Holocene age is composed of marl, alluvium and gravel with a variable thickness that forms a good aquifer. Most Palestinian wells tap this system which is located in the northern Jordan Valley.

Groundwater Basins

Three groundwater basins underlay the West Bank and the main groundwater divide is located on the anticline structure of the West Bank and extends to the south, Figure 5.1. Nablus district overlies parts of all three groundwater basins of the West Bank (Western, Eastern, as well as Northeastern basin). Each groundwater basin is divided into several underground catchments. Nablus district overlies seven such catchments, these are described in the following:

1. Western groundwater basin is represented in the study area by Auja - Tamaseeh underground catchment. It is located to the West of the regional groundwater divide. The main outcropping aquifer of this catchment is the Upper Cenomanian Eocene aquifer in addition to the limited exposures of the Lower Cenomanian Aquifer.
2. Northeastern groundwater basin which is represented by both Samarian & Nablus - Jenin as well as the upper Far'a, El Badan spring systems of the Eocene aquifer emerging from these catchments (upper Far'a).
3. Eastern groundwater basin is represented by four underground catchments which range from Jurassic into Pleistocene. These catchments extend from the north to the south Bardala, Buqei'a, Maleh, Far'a (Lower Far'a), and Auja - Fasayil.

Sources of Water

The main sources of water in Nablus district are surface and groundwater.

Surface Water

There are 2 sources of surface water in Nablus district, these are flood water and Jordan River bordering, Bardala, Ein El Bayda, Fasayil and Jiftlik. The source of floods is rainfall on Nablus highlands where runoff occurred through the main streams either to the east or to the west. The amounts of floods were not exactly measured in the area. Before 1967, the farmers of Bardala and Ein El Bayda were using Jordan River to irrigate their farms.

Ground Water

Groundwater wells

There are 79 Palestinian wells in Nablus district used for different purposes, (ARIJ Database).

Domestic Wells

There are four Palestinian wells used for domestic purposes, these include, the Tubas well which is owned by the Tubas municipality, along with Badan No.1, Badan No.2, and Deir Sharaf well No.2a, which are owned by Nablus municipality.

Irrigation wells

Palestinians have 75 privately wells which are used for irrigation purposes. These locations are described in Table (5.1)

Table 5.1: Location of Palestinian wells in Nablus district

Area	No. of wells
Gore El Far'a (Jiftlik+Fasayil+Froush Beit Dajan)	32
Upper Far'a (Ras El Far'a + A'qrabaniya + Nasiriya)	24
Zbeidat + Marj Na'aja	11
Bardala	8
Total	75
"Note: The 8 wells of Bardala dried up during the eighties and have been replaced by Mekorot which compensates the wells' owners with their quota with the cont price. In 1995, the water supply from Mekorot was about 3.8 MCM for both domestic and irrigation purposes (Mekorot, 1995)."	

[Figure 5.2](#) shows the location map of wells and springs in Nablus district.

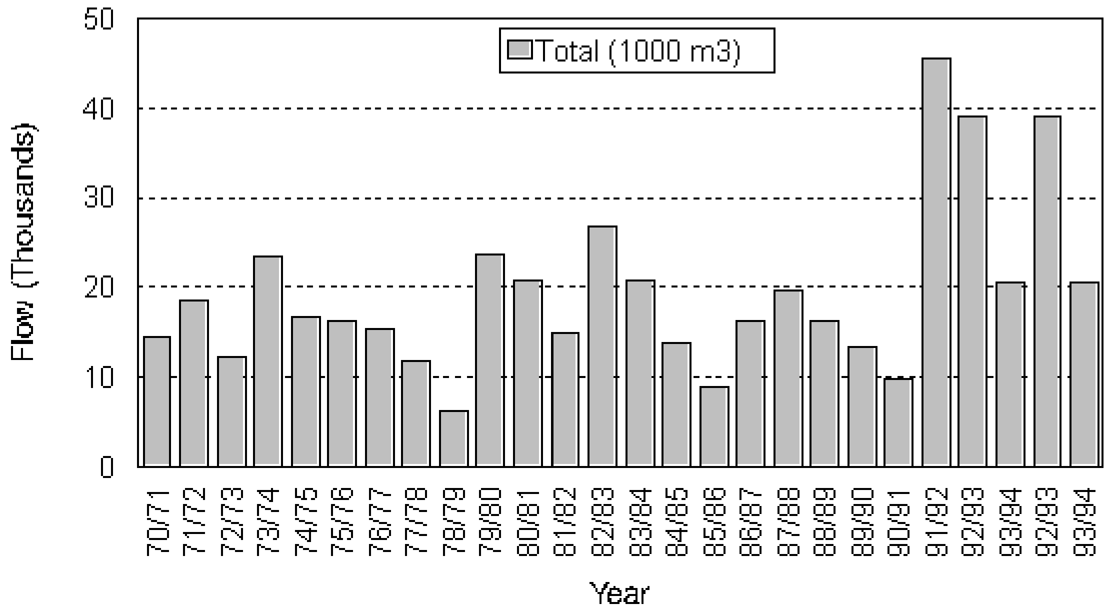


Figure 5.2

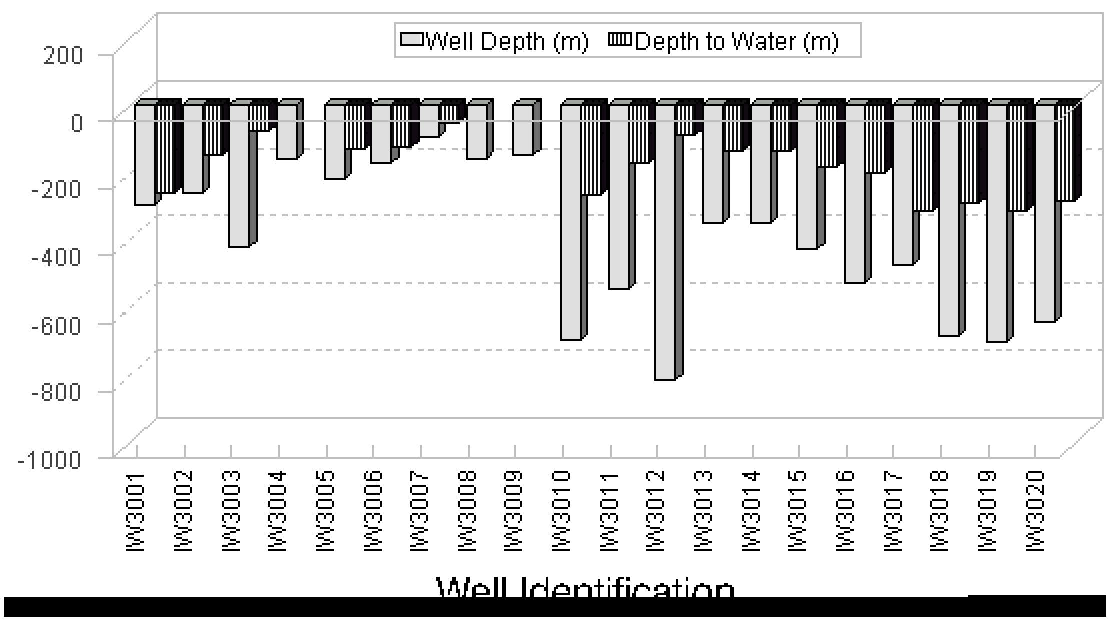


Figure 5.3

Mekorot Israeli Wells

There is no official Israeli reports about the exact number of the Israeli wells within the boundaries of the West Bank. The available information from the ARIJ water database indicates that there are 20 wells controlled by Israel through the Mekorot Water Company. Table 5.2 gives the basic information about these wells (Israeli Hydrological Services, 1995) and the location of these wells is shown in Figure 5.2.

Table 5.2: Basic data about Israeli wells in Nablus district (IHS, 1995).

Well Ident	Location	Well Name	Well Depth (m)	Water Level (m)	Water Depth (m)
IW3001	_	_	300	19.28	262.72
IW3002	_	_	265	299.7	150.3
IW3003	_	_	427.2	392.55	77.45
IW3004	_	_	164	_	_
IW3005	_	_	220	33.24	131.76
IW3006	_	_	172	25.06	129.94
IW3007	_	_	95	11.94	58.06
IW3008	_	_	160	_	_
IW3009	_	_	150	_	_
IW3011	_	_	700	67.75	272.25
IW3012	_	_	550	169.56	175.44
IW3013	Fasayil	Fasayil (1)	819	-85.2	91.8
IW3014	Fasayil	Fasayil (2)	351	7.9	137.9
IW3015	Fasayil	Fasayil (3)	351	43.1	142.1
IW3016	Fasayil	Fasayil (4)	432.5	110.6	187
IW3017	Fasayil	Fasayil (6)	532	134.74	205.74
IW3018	Fasayil	Fasayil (8)	480	365.82	315.82
IW3019	Fasayil	Fasayil (9)	684.5	303.35	293.35
IW3020	Gittit	Gittit (1)	706.5	389.6	320
IW3021	Gittit	Gittit (3)	646	308.99	289.78

Springs

There are 48 springs with a discharge flow exceeding 0.1 l/sec, as measured by West Bank Water Department of which 29 springs are measured and observed on a monthly basis. Table 5.3a and 5.3b show the names and annual discharge (1970-1994) of springs (Nuseiba and Nasser Eddin, 1995). Figure 5.4 shows the total annual discharge of these 29 springs and discharge variation during the period from 1970-1994 (Nuseiba and Nasser Eddin, 1995). Spring locations are shown in figure 5.2

Variation of the total discharge of main springs in Nablus district.

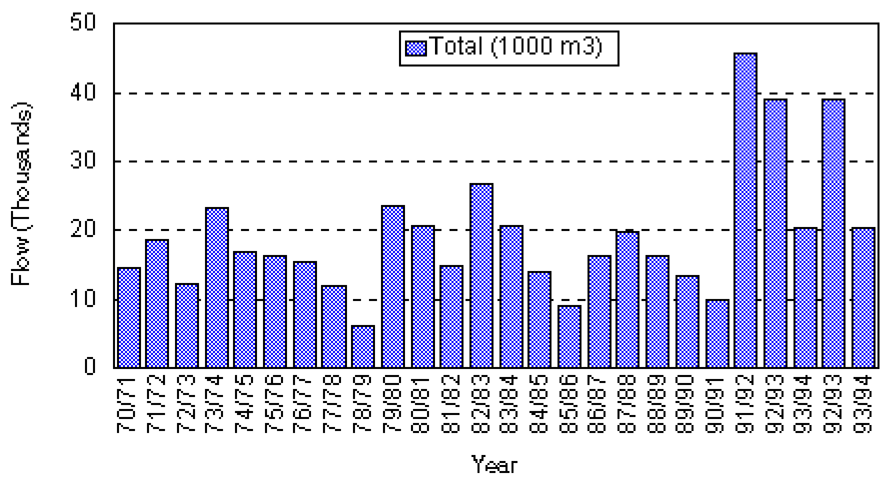


Figure 5.4

Table 5.3a: Variation of flow discharge of the main springs of Nablus district. Flow Discharge of the Main Springs of Nablus District (1000 m3)																
Year	**Ein Bayda**	**Eddeir**	**Shamsiya Tahta**	**Shamsiya Fouqa**	**Hammam Maleh**	**Shibli**	**Ein Miska**	**Far'a**	**Duleib**	**Qudeira**	**Hamad**	**Sedreh**	**Jiser**	**Tabbann**	**Subyan**	**Balata**
70/71	363	457	50	34		812	2197	4707	611		849	625		993	178	108
71/72	397	407	200	142		815	2047	4994	1133		1104	2239		981	186	131
72/73	339	152	215	121		807	1823	4428	596		823	0		1135	170	81
73/74	151	181	224	113		889	2036	6181	2359	1401	946	3616		1296	194	175
74/75	202	95	208	103		872	1729	5227	817	1359	820	581		1311	181	120
75/76	240	55	224	112	848	998	1981	4808	450	946	874	194	161	1307	187	102
76/77	189	53	223	126	707	1148	1714	4312	353	1005	837	229	181	1313	176	129
77/78	158	0	213	123	565	1141	1319	3673	126	255	494	0	150	1282	163	57
78/79	0	0	145	73	463	1032	484	1711	0	0	13	0	37	1196	137	69
79/80	50	0	87	46	313	996	1099	5556	1132	1897	794	2426	184	1409	176	331
80/81	76	39	97	45	447	1061	1666	6336	1023	2087	883	1104	161	1414	184	344
81/82	47	0	89	32	544	1004	1301	4922	342	1146	539	0	124	1464	189	197
82/83	166	110	97	39	731	1056	1742	6355	2426	1792	815	3409	171	1508	234	386
83/84	116	60	102	42	1143	1154	2205	6202	1043	1895	996	237	150	1692	215	97
84/85	0	0	21	0	941	1093	1240	4565	281	625	628	0	74	1579	215	105
85/86	0	0	0	0	604	941	431	2928	26	0	95	0	32	1587	197	49
86/87	0	0	0	0	431	899	231	4384	481	2473	941	670	81	1569	221	258
87/88	0	0	0	0	367	904	573	4746	1085	2445	849	2402	121	1436	218	281

88/89	0	0	0	0	453	909	594	5135	760	1869	952	187	132	1405	198	287
89/90	0	0	0	0	373	807	166	3974	399	1490	704	0	131	1254	202	200
90/91	0	0	0	0	263	707	18	2964	123	777	439	0	92	1450	192	107
91/92	242	833	81	21	1270	1121	1474	10525	8604	2328	1750	8115	231	1629	221	550
92/93	371	1088	66	108	2533	841	1971	10028	5385	1464	1267	5811	205	1493	221	376
93/94	197	581	26	37	2549	707	1569	6714	929	794	860	247	146	1390	201	166

Table 5.3b: Variation of flow discharge of the main springs of Nablus district. Flow Discharge of the Main Springs of Nablus District (1000 m3)

Year	Dafina	Fasayil	Ras El Ein	El Asal	Qaryoun	Shreish	Foad	Beit El	Zawata	Kfar Farat	Harun	Burqa Springs	Ein Matwi	Total (1000m3)a+b
70/71	90		498	153	597			556	278	59	187	62	87	14551
71/72	137		542	223	633			736	934	68	362	84	98	18593
72/73	63		315	111	412			339	96	35	117	50	72	12300
73/74	103		406	181	567			600	928	68	473	129	165	23382
74/75	90	806	388	162	136	239	108	532	253	57	211	88	104	16799
75/76	20	694	343	134	421	189	91	442	151	40	132	62	76	16282
76/77	15	565	321	113	391	181	89	412	300	61	169	71	61	15444
77/78	18	563	317	125	375	104	48	327	90	35	110	42	67	11940
78/79		533				73	50		47	17	72	20	52	6224
79/80	348	593	1180	528	1284	424	259	1189	836	75	309	95	107	23723
80/81	128	611	463	189	520	184	148	662	415	60	157	95	111	20710
81/82	125	573	424	134	622	124	120	485	109	26	132	58	86	14958

82/83	189	817	465	213	557	326	242	717	1819	8	252	102	181	26925
83/84	142	964	438	139	368	145	173	505	147	139	126	74	77	20786
84/85	110	775	221	95	273	118	179	392	89	29	108	63	63	13882
85/86	79	673	183	89	198	118	135	284	72	22	89	37	49	8918
86/87	142	604	612	152	612	244	126	665	137	66	208	100	63	16370
87/88	148	591	498	152	533	276	176	687	694	66	284	95	95	19722
88/89	163	555	457	163	523	163	132	675	201	47	172	81	86	16299
89/90	181	555	462	187	583	194	181	660	181	46	178	115	79	13302
90/91	121	470	363	147	434	183	139	473	120	35	126	66	63	9872
91/92	168	972	352	212	489	579	301	652	1906	103	499	143	252	45623
92/93	489	1093	364	242	508	442	255	635	1085	89	261	115	234	39040
93/94	158	978	335	182	497	198	139	489	134	32	132	50	89	20526

From a hydrogeological point of view, these springs emerge through 11 spring systems. These are Nablus, Sabastiya, Salfit, Qana, Far'a, El Badan, Fasayil, Miska, Maleh, Bardala, and Jordan Valley (Rofe & Raffety, 1965). The total area of all catchments, where springs of Nablus emerge, is about 3,866 km2, this includes 6 catchments as shown in Table 5.4 below:

Table 5.4: Surface catchment areas in Nablus district

Catchment Name	Area (Km2)
Lower Jordan catchment area	250
Northern Jordan catchment area	309
Far'a Jordan catchment area	330
Auja - Fasayil catchment area	618
Nablus catchment area	555
Auja - Tamaseeh catchment area	1804
Total	3866 Km2

Water quality

Water quality is the most important issue after water quantity, as it can determine the water use. ARIJ has conducted sampling procedure in order to evaluate water quality from both wells and springs. Sixteen of the 29 springs in Nablus district were tested as were 44 wells (18 wells in Nablus highlands and upper Far'a and 26 wells from Jiftlik and Ghor El Far'a). The total water samples represented both the highlands and lowlands of Nablus district were 60.

The chemical analysis was conducted in partial fulfillment to a current project on Developing the Irrigated Agricultural Sector in the West Bank, funded by International Development Research Center - Canada (IDRC). The physical parameters, temperature, electrical conductivity (EC) and hydrogen ion activity product (pH), were measured on site by using a portable meter. Calcium, magnesium, sodium, potassium, carbonates, nitrated and chloride was measured at Al-Quds University College of Science and Technology - Abu Dis.

The sodium adsorption ratio (SAR), hardness (Hr) and percentages of sodium (% Na) were evaluated using the Groundwater for Windows Software (GWW).

Tables 5.5, 5.6, 5.7 show the result of the physical, chemical water quality tests for these wells and springs in different regions of the study area. Figure (5.5) shows the Wilcox diagram for springs and wells in Nablus district. According to these results, the water quality from the wells and springs of the northern Jordan valley, are not well suitable for all of the crops planted in the area. Figure 5.6, 5.7, and 5.8 show the presentation of hydrochemical data on contour maps for nitrate, chloride and electric conductivity, respectively. Tests of the special wells and springs used for domestic purposes show good water quality with respect to drinking standards. However, the water quality drops from the west to the east.

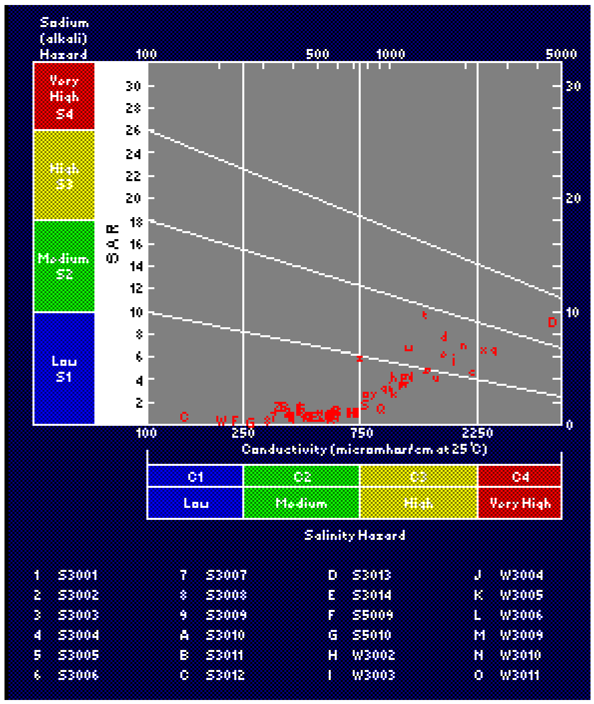


Figure 5.5

Table 5.5: Different water quality parameters of wells in wadi El Far'a area (ARIJ Water Database, 1995).														
Ident	**Ca**	**Mg**	**Na**	**K**	**HCO3**	**Cl**	**NO3**	**F**	**Temp**	**EC**	**pH**	**SAR**	**Hr**	**%Na**
W3002_____	125	15	45	0.5	63	61.7	12.78	_	19.3	694	6.8	1	374	24.5
W3003_____	125	20	48	1	236	50.5	12.96	_	18.7	725	6.8	1.1	394.5	25.2
W3004_____	91	15	30	1	_	36.2	4.35	_	19.5	527	6.8	0.8	289	22.6
W3005_____	107	14	24	1	246	36.3	7.91	_	21.8	562	6.8	0.6	324.9	17.1
W3006_____	83	12	28	1	63	16.1	2.04	_	20.4	485	6.8	0.8	256.7	23.3
W3009_____	60	37	31	1	240	34.9	3.1	_	16.6	577	7.4	0.8	301.7	24.8
W3010_____	86	54	51	1	180	60.4	2.53	_	18.8	678	7.2	1.1	436.4	27.1
W3011_____	62	38	48	2	270	50.8	3.29	_	20.3	585	7.2	1.2	310.8	33.3

W3012_____	60	34	31	1	251	40.3	3.5	_	18.8	490	7.2	0.8	289.4	25.3
W3013_____	107	59	77	2	75	91.8	9.35	_	21.1	903	7	1.5	509.4	32.2
W3014_____	49	31	43	2	174	55.7	4.92	_	19.1	603	7.2	1.2	249.6	36
W3016_____	114	23	80	2	241	89.6	0.3	_	19.9	786	6.9	1.8	379.3	37.4
W3017_____	62	42	31	1	241	54.2	3.64	_	15.8	463	7.3	0.7	327.2	23.5
W3018_____	62	42	31	1	241	42.9	12.65	_	15.8	463	7.3	0.7	327.2	23.5
W3019_____	55	40	34	2	244	24.9	1.98	_	19.7	510	7.1	0.9	301.5	27.5
W3021_____	43	40	17	1	249	31.4	1.6	0.15	5.5	203	7.3	0.4	271.5	17.8
W3023_____	65	12	34	2	188	18.1	9.42	_	12.3	375	7.7	1	211.7	31.8
W3024_____	78	42	39	2	104	38.5	3.87	_	19.5	566	7	0.9	367.2	25.4
Minimum	43	12	17	1	63	16.1	0.3	0.15	5.5	203	6.8	0.4	211.7	17.1
Maximum	125	59	80	2	270	91.8	12.96	0.15	21.8	903	7.7	1.8	509.4	37.4
Average	77	32.6	39.8	1.4	202.7	45.4	5.14	0.15	17.8	558.9	7.1	0.96	326.3	26.7

Table 5.6: Different water quality parameters of wells of the northern Jordan valley in Nablus district (ARIJ Water Database, 1995).

Ident No	Ca	Mg	Na	K	HCO3	Cl	NO3	F	Temp	EC	pH	SAR	Hr	%Na
W5054_____	43	15	47	3	133	61.8	6.83	_	_____	343	7.9	1.6	169	46.3
W5055_____	63	116	50	2	138	86.9	8.48	_	_____	439	7.7	0.9	633.1	22.5
W5056_____	50	20	41	2	124	69.1	7.9	_	_____	426	7.4	1.2	207	38.1
W5057_____	227	312	464	27	111	773.4	9.98	_	_____	2140	6.7	4.7	1846.7	47.7
W5058_____	129	59	425	38	151	632.5	4.35	_	_____	1656	6.9	7.8	564.4	71.1
W5059_____	129	44	332	24	147	565	8.71	_	_____	1640	7	6.4	502.9	67.3
W5061_____	157	159	281	22	238	489.8	6.28	_	_____	1127	7	3.8	1044.4	48.9
W5062_____	133	157	238	16	163	401.1	8.81	_	_____	932	7	3.3	976.2	46.7
W5063_____	70	47	191	15	120	392.1	7.54	_	_____	1027	7.2	4.3	367.7	63.8
W5064_____	125	149	242	17	135	283.8	4.2	_	_____	990	7.1	3.5	923.4	48.6
W5065_____	188	118	419	27	130	711.2	11.58	_	_____	1798	6.7	5.9	953.8	59.3
W5066_____	142	234	245	19	124	415.2	7.38	_	_____	1019	7	2.9	1314.4	41.2
W5067_____	122	126	287	33	102	551.7	4.28	_	_____	1216	7	4.4	821.6	56.4
W5068_____	96	73	242	30	126	429.5	8.78	_	_____	1149	7.1	4.5	539.3	61.7
W5071_____	221	83	488	33	215	822.7	12.8	_	_____	1987	6.8	7.1	892.8	63.1
W5073_____	108	86	163	7	298	212.5	7.61	_	_____	781	7.2	2.8	622.6	46.7
W5074_____	141	178	285	39	121	235.3	2.42	_	_____	1104	7	3.8	1082.3	50.4
W5075_____	306	263	668	42	126	915.6	5.04	_	_____	2630	6.8	6.8	1843.3	55.5
W5076_____	116	258	317	23	115	506.1	9.41	_	_____	1156	7.1	3.8	1347.8	47.6

W5077_____	80	130	317	20	168	_	_	0.7	5.5	1410	7.6	5.1	733	61.6
W5078_____	89	40	437	29	4	596.5	0.98	_	____	1365	7.4	9.7	386.5	78.3
W5079_____	148	297	398	20	93	523.9	9.88	_	____	1524	7.1	4.3	1587.7	48.4
W5080_____	80	130	317	22	168	416	6.44	_	5.5	1410	7.6	5.1	733	61.7
W5081_____	71	110	397	18	165	376.3	3.56	0.65	6.3	1170	7.9	6.9	628.5	69.6
W5082_____	156	300	615	33	209	687.1	12.61	0.6	6.6	2380	7.3	6.6	1620	58.7
W5084_____	148	22	143	6	122	355.4	9.7	_	____	856	6.9	2.9	460.2	46.7
W5090_____	76	26	239	20	130	_	6.48	_	____	748	7.4	6	296.6	71.7
Minimum	71	22	143	6	4	212.5	0.98	0.6	5.5	748	6.7	2.8	296.6	41.2
Maximum	306	300	668	42	298	915.6	12.8	0.7	6.6	2630	7.9	9.7	1843.3	78.3
Average	134.6	145.5	351.6	24.8	142.1	517	7.4	0.65	5.975	1394.2	7.2	5.2	933.1	57.6

Table 5.7: Different water quality parameters for springs in Nablus district (ARIJ Water Database, 1995)

Ident No	Ca	Mg	Na	K	HCO3	Cl	NO3	F	Temp	EC	pH	SAR	Hr	%Na
S3001_____	58	45	37	2	241	47.5	3.68	_	21.3	544	7	0.9	329.5	27.5
S3002_____	68	46	41	1	259	19.6	0.6	_	19	586	7	0.9	358.6	26.9
S3003_____	78	16	23	1	114	18.9	1.49	_	19.7	514	7.3	0.6	260.6	20.3
S3004_____	65	10	19	1	201	22.5	3.51	_	20.2	388	6.9	0.6	203.5	21.1
S3005_____	34	22	45	2	190	_	2.18	_	20.4	427	7.3	1.5	175.2	45.6
S3006_____	35	20	48	2	281	17.3	2.7	_	20.4	423	7.3	1.6	169.5	47.6
S3007_____	34	4	18	0.3	39	16.1	2.01	_	20.2	328	7	0.8	101.4	32.5
S3008_____	52	7	11	0.5	162	10.2	1.85	_	20.4	313	7.4	0.4	158.7	16.3
S3009_____	55	8	22	1	193	21.6	2.54	0.5	20.3	385	7.3	0.7	170.3	26.7
S3010_____	55	9	24	1	174	31.1	3.54	0.3	26.6	448	7.3	0.8	174.4	28.1
S3011_____	64	10	51	2	174	20.4	9.93	0.01	10.6	368	7.6	1.6	201	41.7
S3012_____	60	16	24	2	196	23.5	3.61	0.55	4.1	144	7.5	0.7	215.6	25.5
S3013_____	265	116	702	42	81	609.8	0.18	_	21	4600	7.9	9.1	1138.1	66.1
S3014_____	55	10	25	1	207	10.3	1.45	_	20.3	393	7.8	0.8	178.5	28.6
S4001_____	73	29	30	12	237	40.6	10.99	_	20.3	509	7.2	0.8	301.4	29.2
S5009_____	39	36	10	2	161	11	3.75	_	5.5	231	7.3	0.3	245.1	13.8
S5010_____	41	36	5	2	198	10.8	3.63	_	8.6	265	7.3	0.1	250.1	8.3
Minimum	34	4	5	0.3	39	10.2	0.18	0.01	4.1	144	6.9	0.1	101.4	8.3
Maximum	265	116	702	42	281	609.8	10.99	0.55	26.6	4600	7.9	9.1	1138.1	66.1
Average	66.5	25.9	66.8	4.4	182.8	58.2	3.4	0.34	17.6	639.2	7.3	1.3	272.4	29.7

The Badan and Far'a spring systems are of good water quality in the upstream areas, but the downstream at the conjunction between wadi El Far'a and wadi El Badan, the water is mixed with the untreated wastewater from the sewerage of Nablus city, thus subjecting the water stream to pollution. During water flow through the wadis, water recovers its good quality by aeration process.

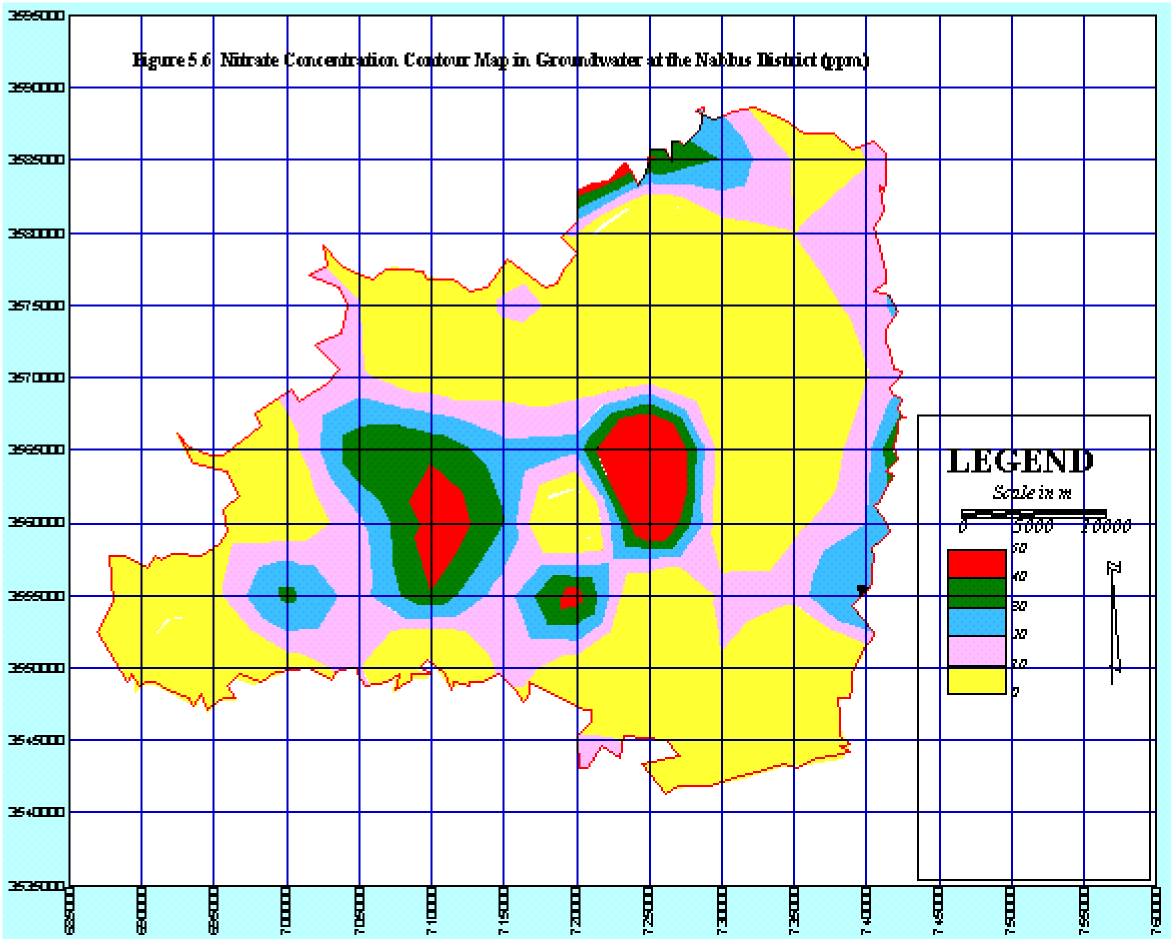
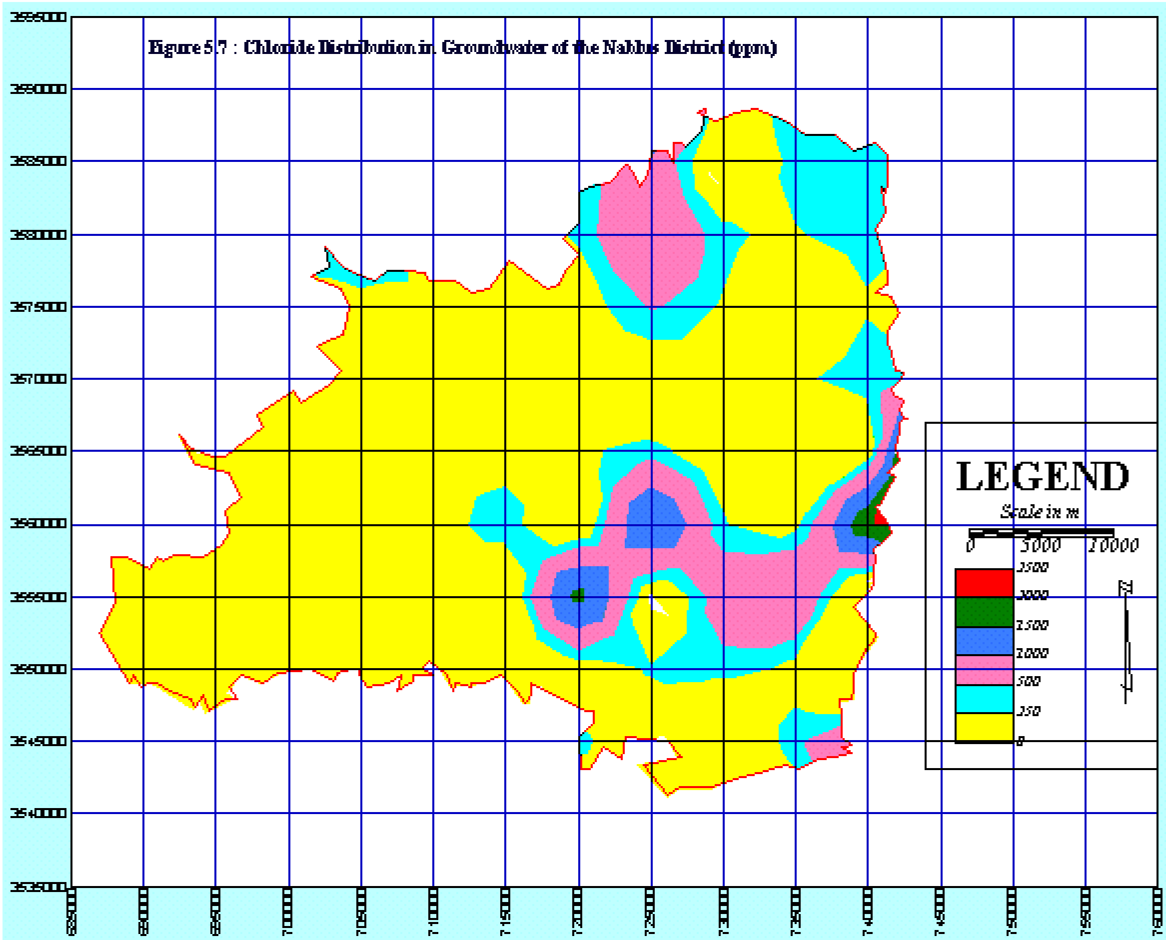
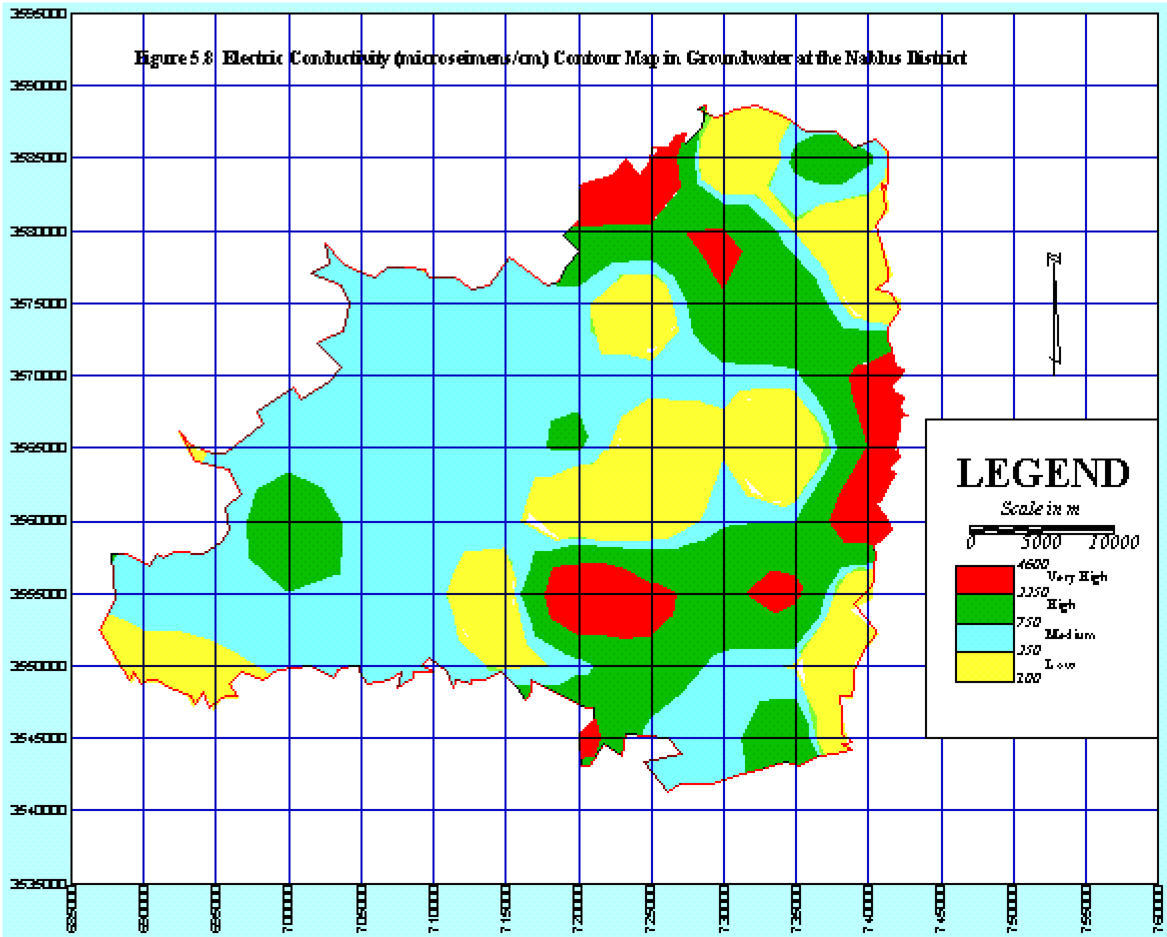


Figure 5.6 shows the nitrate concentration contour map of Nablus district, measured in parts per million (ppm). Its concentration increases in more populated areas, such as Nablus city, as a result of municipal sewage that pollutes the groundwater.



[Figure 5.7 shows the distribution of chloride in parts per million (ppm) in Nablus district. This increases towards the Jordan Rift Valley as a result of salt water intrusion from the Dead Sea water and low water recharges due to scarcity in rainfall.]()



[Figure 5.8 shows that the Electric Conductivity (EC) of groundwater measured in s/cm in Nablus district, which increases towards the Jordan Valley as a result of irrigation practices and the Dead Sea water intrusion into the fresh water.]()

Water Consumption:

Table 5.8 shows the water usage by Palestinians for different purposes in 1994. The total amount of water consumed by Palestinians for different purposes is about 39.7 MCM. About 7.8 MCM were utilized for domestic purposes while the other 31.9 MCM, were utilized for irrigation (WBWD, 1995). Those for irrigation (3.8 MCM/yr) come from Mekorot sources in Bardala and Ein El Bayda. Domestic water supplied by Mekorot for population of Nablus area is about (2.45 MCM/yr). In total, Mekorot shares by 6.25 MCM/yr for all purposes, while Palestinian sources share by 33.45 MCM/yr from wells and springs (Mekorot, 1995).

Table 5.8: Water usage in Nablus district (1993/1994)				
Water sources	**Water use**	**W. Nablus district + Gore El Far'a**	**Northern Jordan Valley**	**Total (MCM)**
Wells	Domestic	5.785	_	5.785
	Irrigation	2.7	10.63	13.33
Sub-total (MCM)		8.485	10.63	19.115
Springs	Domestic	2.007	_	2.007
	Irrigation	11.92	6.65	18.57
Sub-total (MCM)		13.927	6.65	20.577
Total (MCM)		22.412	17.28	39.692

The responsible bodies for water supply in Nablus district are:

1. Nablus Municipality which is responsible for providing Palestinians of Nablus city from Badan well; in addition to 5 springs (Beit El Ma, Ras El Ein, El Asal, Dafna, Foad).
2. Village councils: responsible for local springs of the villages surrounding Nablus city (Sabastiya, Ijnesiniya, Naqura....etc).
3. UNRWA : responsible for Ein El Far'a to supply Far'a refugee camp.
4. Private sector which is responsible for groundwater wells used for irrigation.

Water Distribution Network and Water Reservoirs

The total length of the distribution network in Nablus city at the end of 1995 was approximately 140 km and the water loss was estimated at about 30-35% (Nablus Municipality, 1995). There are no data about networks other than Nablus city. Nablus Municipality has 9 water reservoirs with a total capacity of 9,750 cubic meters. Table 5.9 shows the reservoir names and their capacities.

Table 5.9: Water reservoirs of Nablus city		
No	**Reservoir Name**	**Capacity (m3)**
1	Al - Qaryoun	"1,500"
2	Ein Beit Elma	"1,500"
3	Ein Dafna	"5,000"

4	Al - Hursh	150
5	Ras El Ein	300
6	Ein El Asal	150
7	Al - Janoubi	500
8	Al - Shamali	500
9	Al - Rahibat	150
Total		"9,750"

Recommendations

- Distributed drinking water should be potable and should meet the international drinking water standards.
- Periodic quality control of water in abstraction wells, cisterns and distribution networks is needed.
- Drinking water distribution networks should be rehabilitated and installation of new networks is very necessary in small and rural communities.
- Spring protection and management programs should be developed at both the national and local levels. An organizational structure should be created to implement these programs and coordinate activities of the various agencies.
- The water allocation to the Palestinians must be increased to reduce the severe water shortage in the district.

Chapter Six
Agriculture

Nablus district has varying agro-climatological zones, ranging from the Jordan Valley in the east which is as low as 250 meters below the sea level with only 244 mm average annual rainfall, to a mountainous zone in the central and western parts with an annual rainfall which reaches 663 mm (Meteorological Station in Nablus City, 1995).

Areas of Plant production

Depending on the agro-climatological conditions of Nablus district, the areas of plant production can be classified as follows.

The Mountainous Area

This area includes Nablus city and the surrounding towns and villages, and contains the fertile and the rainfed cultivated lands.

The Northern Part of the Jordan Valley

This area extends from Fasayil in the south to Ein El Bayda and Bardala in the north, and from Froush Beit Dajan in the west to the Jordan River in the East. Most of the agricultural lands in this area are recognized as flat or gently sloping towards the east. Soil of this area can be classified as sandy, clay, or a mixture of both. The soil formation in this region improves the cultivation conditions. The climate of this area is hot in summer and relatively warm in winter. Precipitation rates are low and the potential evaporation is high, thus rainfed agriculture in this part is not effective.

Ghor El Far'a

The agricultural land in this area is fertile, with good water quality for irrigation. Most of the cultivated areas are under irrigation.

Plant production

In the 1994 growing season, the agricultural land of the district was approximately 28,992 hectares. The area cultivated with rainfed crops was approximately 25,634 hectares, while the irrigated agriculture covered approximately 3,358 hectares. Rainfed agriculture produced 24,342 tons of cultivated crops, compared to 67,072 tons produced from the irrigated crops. Figure 6.1 shows the total cultivated areas and production for different cultivated crops (Department of Agriculture in Nablus, 1995).

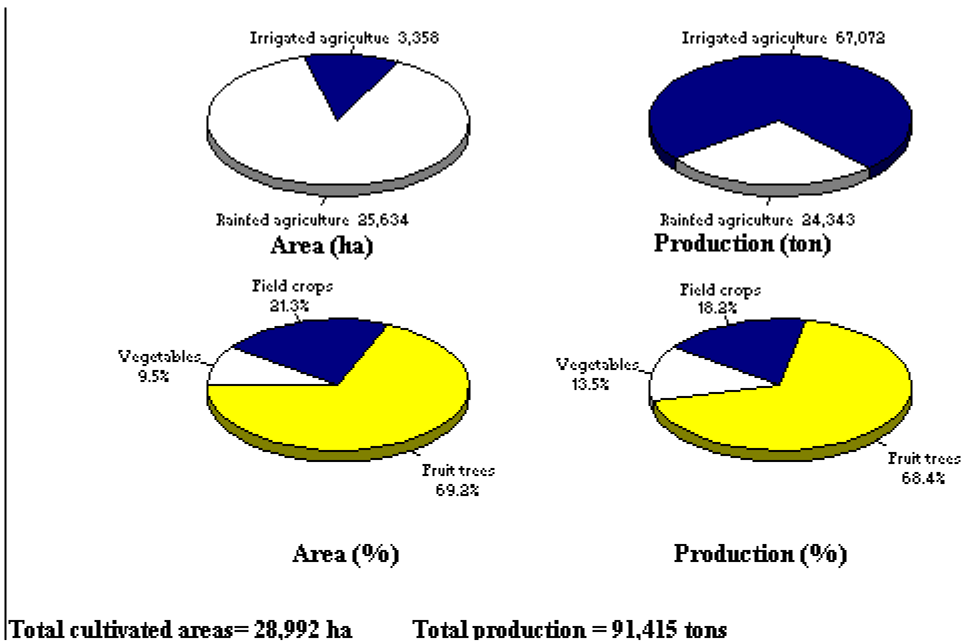


Figure 6.1: Total area and production of different crops in Nablus district for the 1994 growing season.

Fruit trees:

Fruit orchards cover a total area of approximately 20,062 hectares, with an average total production of approximately 28,267 tons in the 1994 growing season. Rainfed fruit trees are dominant in Nablus district, covering approximately 19,719 hectares. Only 341 hectares of fruit trees area is irrigated. Although irrigated trees have a limited area, they account for nearly 30% of the total production of the 1994 growing season, as shown in figure 6.2 (Department of Agriculture in Nablus, 1995).

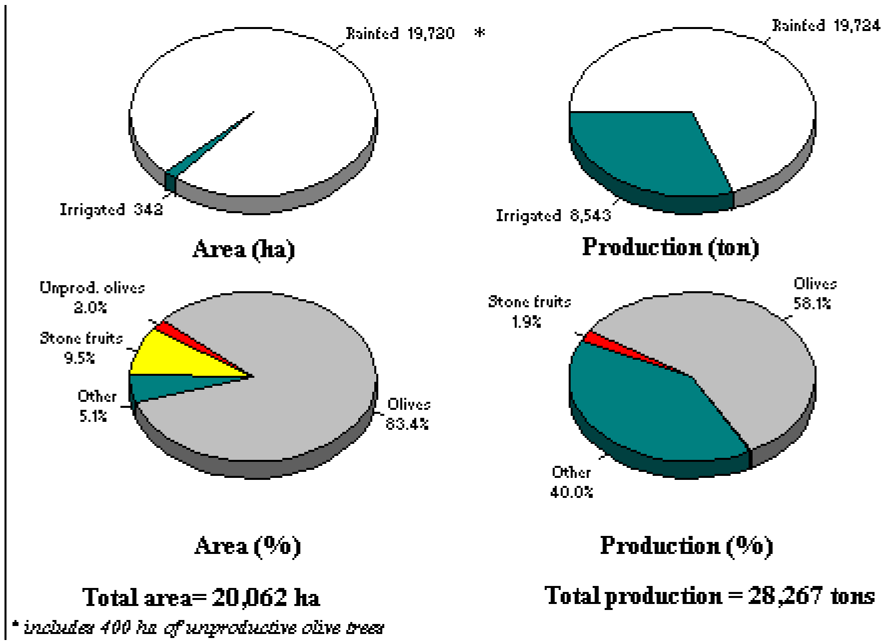


Figure 6.2: Total area and production of fruit trees in Nablus district for the 1994 growing season.

Olives trees cover approximately 85% of the total area for fruit trees. This area includes 400 hectares of unproductive olive trees and 16,718 hectares of productive olive trees under rainfed conditions, and only 15.4 hectares under irrigation. Olive trees contribute 58.1% of the total fruit production.

Stone fruit trees, including almonds, plums, and apricots are cultivated under rainfed conditions only. They cover approximately 1,903 hectares and produce about 530 tons/y. Almonds have the lowest productivity of 170 kg/hectare and plums have the highest productivity of 1,500 kg/hectare.

Fig trees make up a total area of approximately 5,174 hectares producing around 2,328 tons per year. These trees are totally cultivated under rainfed conditions. The average productivity of fig trees in the 1994 growing season was approximately 4,500 kg/hectare. Although the figures indicate that fig trees have a good productivity, applying improved methods of cultivation, picking, packaging and marketing may increase or double the productivity.

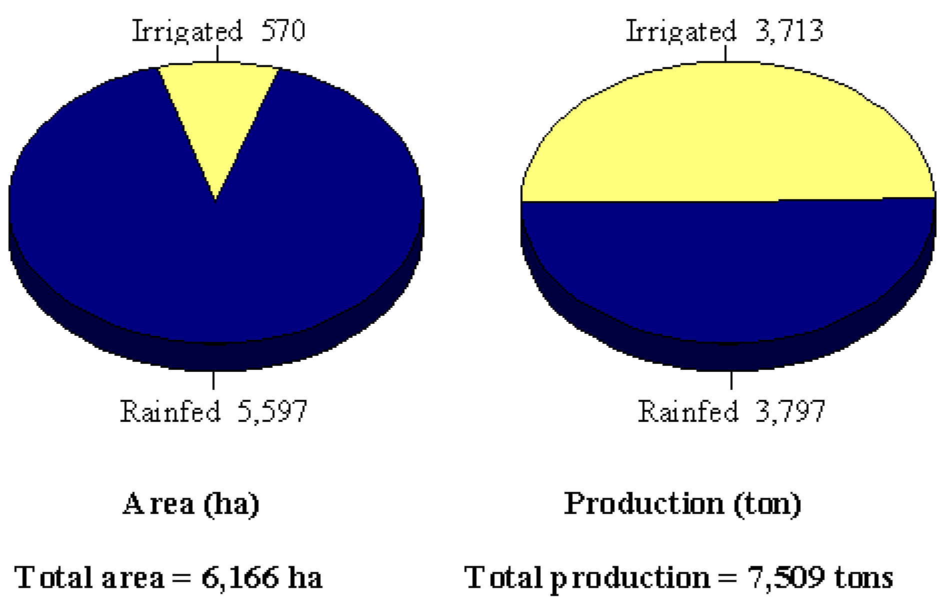
Rainfed grape vines cover approximately 113 hectares with total production of 283 tons. Irrigated grapes cover only 8.9 hectares and have a total production of 213.3 tons. Irrigated grape vines are mainly cultivated in the eastern part of the district.

In addition, there are 61.9 hectares planted with apples, pomegranates, and other fruit trees which are grown under rainfed conditions.

Irrigated fruit trees, which are cultivated in the lower eastern parts of the district, include citrus, bananas, olives, date palms, grapes and avocado orchards. There are 5 types of cultivated citrus trees that cover a total area of 276.8 hectares and produce 7,844 tons/year. The average productivity of the citrus trees in the 1994 growing season was 2.8 tons/hectare. There are different orange varieties (joint, Valancia, local or baladi, French, and Shamoti), which make up about 50% of the citrus area and 43% of its production. The remaining area of citrus trees is devoted to lemon, mandarin, clementine, and grapefruit.

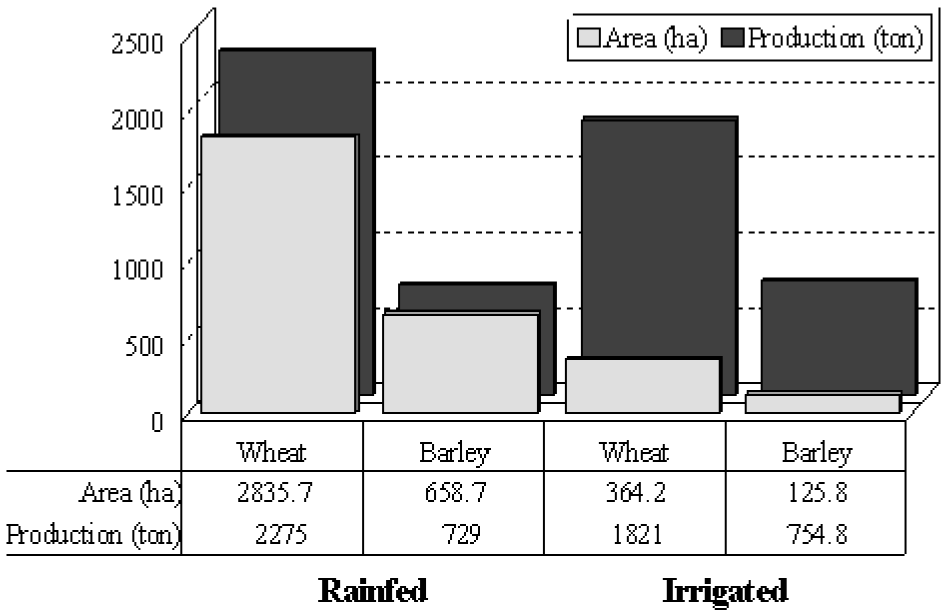
Field crops and forages:

In the 1994 growing seasons, the total area used for field crops in Nablus district was approximately 6,166 hectares (21.3% of the total cultivated area) with a total production of 7,509 tons. Rainfed field crops and forages cover an area of 5,597 hectares, while irrigated field crops and forages make up only 569.5 hectares (Figure 6.3).



Approximately 91% of total field crops and forages are cultivated under rainfed conditions. Most of planted rainfed field crops are located in the central and western parts of the district. Soil fertility decreases gradually from the west towards the east, and so does the average annual rainfall.

Wheat is the most prominent crop under rainfed cultivation, making up approximately 2,835 hectares (about 50% of the total area of rainfed field crops and forages) and producing 60% of the total yield. Barley, broom corn, bitter vetch, common vetch, chickpeas, lentils, dry broad beans, sesame, fenugreek and dill form the rest of the rainfed production. On average, barley has the highest grain yield ranging between 500 kg/hectare in the eastern parts of the district to 1,200 kg/hectare in the mountainous area of the district. This is followed by wheat producing 610-840 kg/hectare (Figure 6.4).



Irrigated field crops and forages are cultivated only in the eastern parts of the district. These include wheat, barley and green forages. In the 1994 growing season, irrigated wheat had the largest area (364.2 hectares), followed by barley (125.8 hectares). Barley has the highest grain yield (6,000 kg/hectare) followed by wheat (5,000 kg/hectare), while the planted crops that are used for green forages (e.g. alfalfa and Egyptian clover) produced 15,000 kg/hectare (Figure 6.4).

Vegetables

Vegetables cover approximately 2,764 hectares (9.5%) of the total cultivated area in the district. Irrigated vegetables have the largest area, approximately 2,446 hectares (88.5% of the total vegetables area), while rainfed vegetables cover only 318 hectares (11.5% of the total vegetables area). Almost 98% of the total vegetable production come from irrigated vegetables (Figure 6.5).

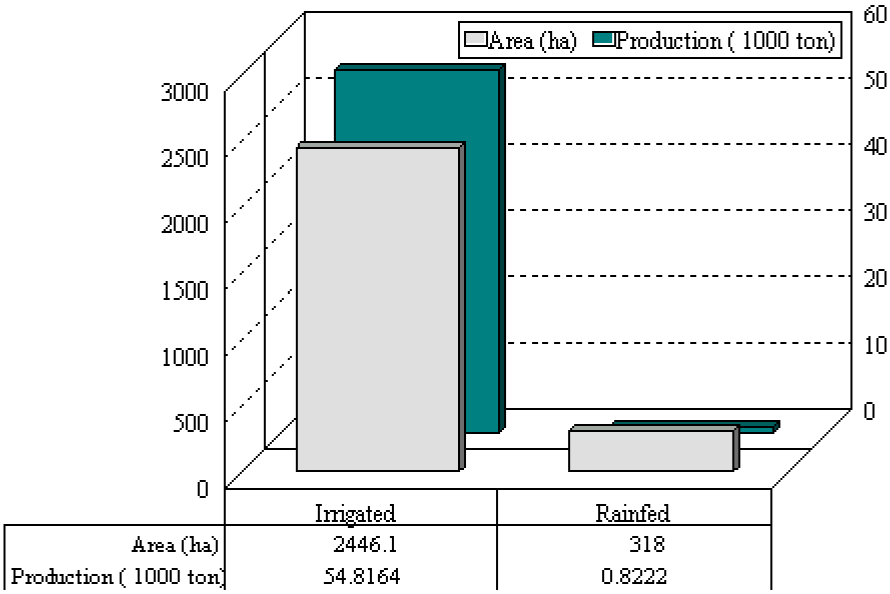


Figure 6.5: Area and production of different vegetable crops for Nablus district in the 1994 growing season.

Cultivation of the irrigated vegetables can be divided into three systems:

- vegetables cultivated under plastic houses, covering 0.6% of the area for irrigated vegetables;
- vegetables covered with low plastic tunnels, covering 17% of the total area for irrigated vegetables;
- and vegetables cultivated in the open field, covering 82.4% of the total area of irrigated vegetables.

Tomatoes, cucumber, green beans, and eggplants are the main crops cultivated under plastic houses. The average productivity differs for each crop: 150 tons/hectare for tomatoes; 70 tons/hectare for cucumber; and 30 tons/hectare for green beans.

Low plastic tunnels are usually used for early season planting, to protect the crops against low temperatures during winter. About 9 different crops are usually planted under low plastic tunnels. Tomatoes and squash are the main crops, occupying approximately 158 hectares and 141 hectares respectively. The average productivity, under low plastic tunnels, varies from 15.8 tons/hectare for squash to 6 tons/hectare for okra and pumpkin.

Twenty-five types of vegetable crops are grown using the irrigated open field system. Squash, cucumber, sweet maize, and tomatoes are the most dominant vegetables. The average productivity of the open field vegetables ranges between 30.6 tons/hectare for turnip and 7.3 tons/hectare for green beans (Figure 6.6).

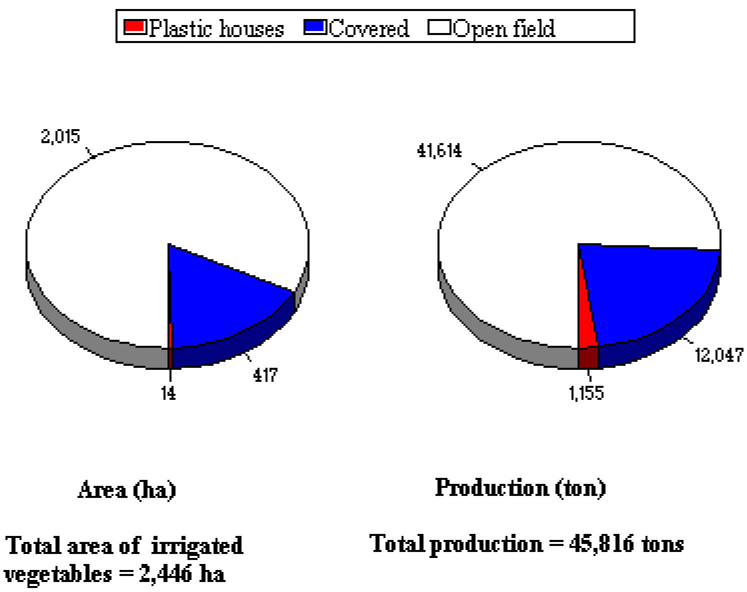


Figure 6.6: Total area and production of irrigated vegetables under different cropping systems in Nablus district for the 1994 growing season.

The variation in productivity between different cropping systems is related directly to the planting date, the duration of growing period, and the micro-climatic conditions existing around the growing plants. Most of the irrigated vegetables are planted in the eastern parts of the district, especially in Ghor El Far'a.

About 10 different vegetable crops are cultivated under rainfed conditions. Dry onions have the largest area, approximately 79 hectares, followed by snake cucumber using 76 hectares. Average productivity varies between 5 tons/hectare for muskmelon to 0.8 tons/hectare for garlic. Most of the rainfed vegetables are concentrated in the mountainous areas of the district.

Land Tenure

Most of the agricultural lands that are located in Ghor El Far'a and the northern parts of the Jordan Valley are owned by families from Nablus city. The majority of the local population work as employed farmers and utilize most of these lands through a sharing system. In other agricultural lands in the district, the farmers and their families own and cultivate their lands.

Irrigation methods

The currently used irrigation methods can be classified into ways:

1. Traditional methods, using furrows or basins. These have an efficiency rate of approximately 45%.
2. Modern techniques of irrigation, such as sprinklers or drip irrigation systems. The sprinkler system increases the water efficiency rate to 60-70%, and drip system has an efficiency rate exceeding 80%. Modern techniques minimize water losses through evaporation, seepage and deep percolation, and thus save 25-35% of the irrigation water.

The application of the above systems varies according to the crop type, soil texture, water quality and soil slope. Modern techniques are rarely used by local farmers for irrigating citrus orchards. On the contrary, traditional methods are more popular and used by all farmers. Modern techniques are, however, much more commonly used for vegetables and field crops.

Photo 4: Wheat field irrigated by Sprinkler at Jiftlik

Crop water requirements

Crop water requirement is defined as "the depth of water needed to meet the water loss through evapotranspiration (ET Crop) of a disease free crop, growing in large fields under nonrestricting soil conditions including soil water and fertility, and achieving full production potential under the given growing environment" (FAO, 1984).

ARIJ has conducted an evaluation of the crop water requirements for the different irrigated crops in different parts of the West Bank. Penman method was used in estimating the crop water requirement taking into consideration the following parameters:

1. Climatic data (rainfall, relative humidity, temperature, sunshine, and wind speed) was taken from Nablus Weather Station on a monthly basis to represent Nablus city and the surrounding towns and villages as well as Ghor El Far'a. While climatic data from Jericho Weather Station was taken to represent the northern part of the Jordan Valley.
2. Crop factors which include the planting date, type of the crop, and growth stages.

Table 6.1 shows the estimated water requirements for the main cultivated crops in open fields and under plastic houses in Nablus district.

Table 6.1: Crop water requirements (CM/Hectare) for the main irrigated crops in Nablus district.

Crop	Open Field	Plastic Houses
Tomato	"5,180"	"6,030"
Cucumber	"5,980"	"6,560"
Eggplant	"4,550"	"8,460"
Peppers	"4,990"	"5,070"
Green bean	"3,040"	-
Mallow	"4,280"	"5,000"
Citrus	"10,750"	-
Bananas	"10,450"	-
Date Palm	"7,000"	-
Wheat-eat	"4,230"	-
Barley	"2,500"	-
Maize	"3,800"	-
Green Forages	"7,000"	-

"Source: ARIJ Water Data Base, 1995."

When estimating the real of water requirements for irrigation, the following factors should be taken into consideration:

- Effective rainfall;

- Irrigation method efficiency;
- Soil texture and salinity; and
- Water quality parameters (including salinity, chloride, and sodium).

The quality of the applied water plays a major role in determining the quantities of water needed for irrigation. In Ghor El Far'a, Nablus city and the surrounding towns and villages, the quality of water is good for irrigation. As a result, adding additional water for leaching the salts from the root zone is not necessary. On the other hand, in the northern parts of the Jordan Valley, water which is extracted from wells, suffers from salinity problems as represented by high values of electrical conductivity and/or total dissolved solids, chloride, and sodium. Thus adding more quantities of water to leach the salts from the root zone is very much needed to maintain an acceptable crop yield. Table 6.2 shows the overall water required for irrigating different crops in Nablus district.

Table 6.2: Crop water requirements for different crops in Nablus district for 1994 growing season.

Type of crop		Area (Hectare)	Water requirement (MCM)
Vegetables	Open Fields	2015.2	8.47
	Low Plastic Tunnels	416.5	1.98
	Plastic Houses	14.4	0.86
Field Crops and Forages		**569.5**	**2.42**
Fruit Trees		**342.4**	**3.61**
Total		**3358**	**17.34**
"Source: ARIJ Water Data Base, 1995."			

The total quantity of water which was utilized for agricultural purposes reached about 31.9 MCM in 1994. Water which is extracted from wells reached about 13.33 MCM and water utilized from flowing springs was about 18.57 MCM.

Human-made Forests

Forested areas in Nablus district occupy an area of approximately 333.2 hectares, distributed over eight major locations. All these forests are human-made. Aleppo pine (*Pinus halapensis*) is the most dominant forest tree, followed by Brutian pine (*Pinus bruti*a), stone pine (*Pinus pinea*), and a limited number of cypress trees (*Cupressus sempervirens*) (Table 6.3).

Table 6.3: Areas and distribution of forested land in Nablus district.

Location	Planting Year	Planted By	Type of Planted Trees	Area (Hectares)	
				Areas A & B	Area C
Jerzeem	1945	Britain	Aleppo pine the main & limited pinea pine.	50	5
Ebal	1960-57	Jordan	Aleppo pine the main & and limited cypress.	--	30
A'sira Esh Shamaliya	1971	Israel	"Aleppo, canary, Brutia, and pinea pine"	10.2	--
"Khlet- Essa(Talloza, Al-Badan)"	1968	Israel	"Aleppo pine, and cypress"	29	13.6
Geser Al-Malaqi Project (At the Junction Of Al-Badan and Al-Far'a	1967	Jordan	Aleppo pine	25.9	11.1
A'zmut Project	1962-64	Jordan	"Aleppo pine is dominant, and little cypress "	70	30
Deir- Al-Hatab	1967	Jordan	"Aleppo pine is dominant, and little cypress "	--	35
Al-Tour	----	----		4.8	19.2
Total				189.3	143.9

Approximately 43.2% of the forested areas in Nablus district are located in "Areas C", thus being totally under the Israeli control. The 70 hectares of the forested area (Table 6.3) which are currently under Palestinian control, are located in steep and rocky areas. These areas have not received any maintenance or development (replanting, pruning, or protection) since 1971. The lack of management has made this area vulnerable to disease, insects, fire, and cutting, as well as natural destruction from heavy snow or high winds.

Pesticide usage in Nablus district

The total quantity of pesticides (excluding methyl bromide) used in Nablus district in 1994 growing season, was around 73.0 tons. The annual treated area with pesticides is 5,524 hectares, 43% of which is rainfed farming, and 57% under irrigated conditions. Irrigated agriculture forms about 81% of total pesticide consumption. Irrigated vegetables make up the largest percentage of treated area with 43%, and consumed up to 57 tons' pesticides, annually.

Livestock, Poultry, and Apiculture production Cattle

Over the West Bank, the largest number of cattle is found in Nablus district. There are approximately 2,239 dairy cows, of which 75% are of Friesian breed and the remaining 25% are local (Table 6.4). Natural range lands provide feed for nearly 60% of the local breed of cattle, usually for a period extending from the end of the summer to mid winter. Cereal grains are used as complementary feed when range pasture production is insufficient. Friesian cattle are usually fed cereal grains and forage crops in barns all year.

Table 6.4: Numbers of cattle in Nablus district according to sex and rearing stage, for 1994.

Breed	Cows	Heifers	Bulls	Calves
Local (Baladi)	535	146	195	93
Friesian	1704	296	250	88

"Source: Records of the Nablus Department of Agriculture, 1995."

As for milk production, the Friesian breed of cows has a higher average daily milk production than the local breed and also has a shorter dry period. Whereas the local breed produces an average of 3.4 liters per day per cow, the Friesian breed produces as much as 26.9 liters per day per cow (Records of the Nablus Department of Agriculture, 1995; PARC and Arab Thought Forum 1994).

No factories for milk processing are located in Nablus district. Nearly 27% of the milk produced in the district is consumed fresh. The remaining quantities of milk are processed in villagers homes by traditional methods into yogurt (49%), cheese (22%), and Labaneh (2%). Most of these products are carried to Nablus city market without using coolers or special handling. Only 10% or so of milk products are sold in the villages' local market (PARC and Arab Thought Forum 1994).

Sheep and Goats

The total number of different types of small ruminants (sheep and goats) in Nablus district for 1994 was approximately 73,690 animals. The local breeds of sheep and goats are dominant in the district. The local breed of sheep, known as Awassi, makes up 65.5% of the total number of small ruminants. Goats account for nearly 27.5%, and hybrid Assaf only 7% (Records of the Nablus Department of Agriculture, 1995).

Although the local breeds are more adapted to the climate than other breeds, their milk and meat production, and twin bearing probability are lower than the hybrid breeds of Assaf sheep and mixed Shami goats.

Poultry

The total number of chicken produced in Nablus district in 1994 reached approximately 1,482,000 broiler and 96,000 layer chickens, of which 80% were old enough to produce eggs (Records of the Nablus Department of Agriculture, 1995; PARC and Arab Thought Forum 1994). There are about 286 farms of broilers and 39 farms of layers with varying bird capacities for each farm. Most of broiler farms follow four chickens rearing rounds per year.

Agiculture

Nablus district houses approximately 1,160 permanent beehives and 2000 seasonal ones. The seasonal beehives are temporarily moved to the Jordan Valley during the flowering season of citrus trees (Records of the Nablus Department of Agriculture, 1995).

The Italian breed predominates with approximately 61% of beehives in the district, 35% are of hybrid breeds, and the remaining 4% are of local breed, known as Baladi. On average, the productivity of honey for the different breeds of bees ranges between 11 kg/year for the local bees and 16 kg/year for the Italian bees, per beehive (PARC and Arab Thought Forum 1994).

Recommendations

The following recommendations may be important in contributing to the development of the agriculture in Nablus district:

1. Investigating the best methods to improve irrigated agriculture in terms of water use efficiency, environmental sustainability, productivity and marketing.
2. Improving the currently agricultural research and extension programs in the district.
3. Developing integrated pest management programs with farmers to help them manage agricultural pests without harming the environment, human health, or the market potentials of crops.
4. Establishing a Grading and storage center for surplus production should be constructed to meet the international standards of marketing and exporting for agricultural commodities.
5. Opening new markets for exporting the surplus agricultural production

Chapter Seven
Historical And Archeological Sites

Historical Background

Nablus is a Palestinian city located between Mt. Gerizim and Mt. 'Ibal. It is the site of an ancient city which was continuously occupied from Bronze age until the present.

Nablus city was built by the Canaanites on the remains of a Stone Age city. Its name was derived from the Canaanite word, Shekheim, which means a hilly area. Ruins of ancient Shekheim has been found on Tell Balata at Shekheim's east outskirts. Excavations have uncovered remains from the Chalcolithic to Roman periods, including city walls, towers and temples, a cuneiform Akkadian inscription and an Iron age seal (Encyclopedia Palaestina, 1984).

During the Canaanite period, prophet Abraham passed through the city in his way to Iraq. The Ya'coub well near Nablus, is the well which, Ya'coub, Ishaq's (Abraham's son) son bought when he traveled to Shekheim. Also it is the same well mentioned in the Bible, where Jesus spoke to the Samaritan woman (John, verse 4: 7-27).

Alexander the Great allowed a Samaritan temple to be built on Mt. Gerizim. In 129 BC, John Hyrcanus (Maccabean leader) seized Shekheim and destroyed the temple. In 72 BC Vespasian (a Roman leader) completely destroyed the old city and built a new city between Mt. Gerizim and Mt. Ebal, calling it *Flavia Neapolis* which means the new city (hence Arab name: Nablus). The Roman Emperor Zeno, built a church there and Justinian built several churches within the city proper (Encyclopedia Palaestina, 1984.)

In 636, the city was liberated by the Moslem commander 'Amr Ibn Al'as and became one of the most famous and richest cities in Palestine. Moslems called it the Small Damascus because it was a very fertile land with plenty of water. Near the church ruins, there is a mosque-cut-tomb called Sheikh Ghanam, named after Ghanam Ibn Ali, senior minister of Salah Al-din.

Historical Sites

1. Balata:

A Palestinian village located at the south east entrance of Nablus. The surrounding area of Balata has the following sites:

- *En Nabi Yusuf (Joseph's tomb)*: According to Islamic historians and travelers, Yusuf was buried in this area, and not in Hebron. A small dome was built in 1868 is a witness of the grave's site.
- *Ya'coub (Jacob) well*: A well located south east of Nablus near the foot of Mt. Gerizim and alongside the Burin plain. According to traditions, this well was dug by Ya'coub and thus called Ya'coub's well. It is a holy site for Christians and is called the Samaritan well, because it is the place where Jesus met the Samaritan woman and spoke to her. During the fourth century, Saint Helena built a church near the well but later it was destroyed. During the Ottoman period and after the year 1187, the Orthodox Christians rebuilt the church.
- *Tell Balata*: Situated in the northern part of the city. It has ancient remains dating back to 3500 BC. There is debris from a huge wall 3.5 meters wide. This wall, with its towers and gates, surrounded the ancient city on three sides.
- *Khirbet Theiyab (Ibn Naser)*: Located south east of Balata village. This site has remains of many structures including stone buildings, walls and a very ancient quarry.
- *Khirbet Al-O'kood*: Located north of Balata town, on this site there is an ancient hotel, remains of buildings and different sculptures rocks.
- *Tell er-Ras*: Situated southwest of Balata, and has remains of a rectangular structure and a trench. Shreds and other remains show habitation during the Iron Age, Byzantine Period, and from early Arab until Ottoman periods.

2. Askar:

A Palestinian village located east of Nablus, which contains several graves and sculpted vaults.

3. Deir el Hatab:

A village located 6 km east of Nablus. The name means monastery

of dry woods. Several ancient sites are found near this village:

- *Tell Misk*: A site located northeast of Deir el Hatab, near wadi Far'a. It contains remains of buildings, rock-cut cisterns, mosaic fragments and scattered stones.
- *Tell el Fukhar*: Situated between Tell Misk and Deir el Hatab village.
- *el Kharabeh*: A site which contains an old road, a pool, different structures and walls.

4. Salim:

A small village located 6 km east of Nablus. Its name is derived from the Aramae'an word "Salema" which means Idol. It contains structures, a ruined pool and several graves dug in rocks.

5. Beit Dajan:

A village located 10 km east of Nablus. It has remains of ancient buildings, caves, graves and cisterns. Nearby, the following sites are found:

- *Arafat Al-Sukoor*: Located in the southern part of the village.
- *Khirbet Ras Al-Dyyar*: A site located east of Beit Dajan. Remains of a ruined fortress and some graves are found there.
- *Khirbet Shweiha*: A site located north of Beit Dajan, where remains of an ancient well and structures are found.

6. Beit Furik:

Located 10 km south east of Nablus. It was built on the site of an ancient city during the Roman period called "Perekh" which means the "Plant Home". There are several ancient sites near Beit Furik:

- *Khirbet Tana el Fouka*: A site located 3 km east of Beit Furik village. It contains the remains of the Canaanite village which was called "Tanna Shelwa". Many structures, stone fragments and graves are witnesses to the Canaanite history of this village.
- *Khirbet Tana el Tihta*: A site located south east of Beit Furik. It has a large number of ancient structures. Two ancient springs are located in the village and are still used by shepherds in the region during spring time.
- *Khirbet Kufur Bitta*: Located northwest of Beit Furik. This site has shreds and remains of Mihrab.

7. 'Awarta:

A site located 8 km southeast of Nablus. It is thought to be the location of the Canaanite village of "Giba' Phinehas". Several graves, tombs and ancient dwelling places are found in 'Awarta mainly:

- *Al-Sheikh Al-Mansouri locality*: A grave located in the frontyard of the mosque.
- *Al-Sheikh el Muffadal locality*: A grave located in the northern part of the village.
- *Khirbet el Ras*: Has several ancient structures, rock fragments and sculptures.

- *Khirbet Hayyeh*: An ancient site located east of 'Awarta village which contains several shreds.
- *Khirbet Al-Shararbeh and Khirbet Sharab*: Both are ancient sites located northeast of 'Awarta village. Remains of old buildings are found.

8. 'Aqraba:

It is located on the site of the ancient Roman village "Acrabbein". A ruined fortress, a pool and several fragments bear witness to the ancient Roman civilization in that area. Within close proximity the following sites are found:

- *Khirbet el 'Orma*: An ancient site to the northwest of 'Aqraba village. It has a fortified top with a tower on the southern part. Also, several caves and pottery fragments are found at the site.
- *Khirbet el Kroom*: Located north of 'Aqraba village, and has ruined walls, scattered pieces, graves and caves.
- *Khirbet Maras el Dein*: A site located southeast of 'Aqraba village, contains ancient structures, water canals and caves.
- *Khirbet Abi Ghareeb or Kufur Ghareeb*: A site located south of 'Aqraba village. Discoveries include shreds and ancient structures.
- *Khirbet Sartaba or Alexandriom Castle*: This site was built on the ruins of an ancient castle. On the east steppe, several caves, a quarry and an old well exist.

9. Fasayil:

Is a village in the Jordan valley located 18 km north of Jericho and 250m below sea level. It was built by Herodotus (Roman Empire) and called "Phasaelis". In the northern part of the village, there is "Tel el Sheikh Theiyab", where remains of structures, ruined stairs and a water canal are found.

10. Beita:

A village located southeast of Nablus. Khirbet Rogan is found in the eastern part of Beita and contains ancient remains of shreds and structures.

11. Yatma:

A site 15 km south of Nablus. It contains the remains of the old Roman city "Yatma". Khirbet Abed el 'Aal is located in the northeast part of Yatma, and contains ruined walls, towers, rock arcs and caves.

12. Qasra:

A Palestinian village located 24 km southeast of Nablus. Remains of ancient structures and other rock fragments are found there. The following ancient sites are nearby:

- *Khirbet el Kreik*: A site located to the west of Yatma, where ruined walls and water canals dug in the rocks are found .
- *Khirbet Nabbouh*: An ancient site located southeast Yatma.

13. Qaryut:

It derives its name from the Canaanite word "Qaryut" which means the city. It is located 28 km southeast of Nablus. The following ancient sites are located in this area:

- *Khirbet Seylone*: This is the site of the Canaanite village "Shelwa" which means the rest. It contains ruins of a Christian church with mosaic-paved floor, rock-carved chimneys, a pool, caves, an olive press and an ancient road.
- *Khirbet Kufur Istona or "Stona"*: It is located between Qaryut and el Maghaiyer. It has ruins of an old gate, columns' crown, ancient structures and an old road.
- *Khirbet Sara*: A site located to the east of Khirbet Seylone. It contains ancient structures and several pieces and shreds of an old press.

14. Al-Maghaiyer:

A village located 34 km south east of Nablus. Nearby are two ancient sites:

- *Khirbet Jab'eet*: Ancient structures, rock-carved tombs and water canals are located at this site.
- *Khirbet el Marajem*: Located north of the village. This site contains a large number of rocks and remains of ancient structures.

15. Majdal Bani Fadil:

A village located 23 km southeast of Nablus. There are two nearby ancient sites in this area:

- *Khirbet Bani Fadel*: Contains ancient structures and caves.
- *Khirbet el Nejma*: Located in the north part of the village, and has several ruined walls.

16. Duma:

This village derives its name from the Canaanite word "Eduma" which means quiet. It contains the remains of a ruined church with a mosaic-paved floor, rock-carved graves, and water canals.

17. Rafedya:

A village built on Crusader settlement ruins. It has remains of building walls, foundations, a ruined church, a press and a cave.

18. Al-Jeneid:

This site is located west of Nablus, and has remains of a fortress and a grave called "Jenaid grave".

19. Kafr Qallil:

This village is located on the plain of Mt. Gerizim. Two ancient sites are located nearby:

- *Al-Sheikh Ghanem*: An ancient site on the top of Mt. Gerizim.
- *Khirbet Al-Qaser or Sareen*: It is the site of the Roman village of "Kufur Sireen" and contains remains of ancient walls, pools and rock-carved tombs.

20. Qussien:

It contains the remains of an enclosure and a press.

21. Huwwara:

A village located 6 km south of Nablus. There are two ancient sites close to the village, called *Khirbet Attaroat* ,and *Khirbet Beit el Khirbeh.*

22. Immattin:

A village located south west of Nablus, with the following ancient *Khirbet Ifqas,* and *Khirbet el Qustina* in the nearby.

23. Kafr Qaddum:

A village located 15 km west of Nablus. It has a site called "Tell" and contains ruined walls, a rock fence, tower and pottery fragments. The ancient sites of *Khirbet Pizin*s, and *Khirbet Beit Salloom* are nearby.

24. Deir Sharaf:

A village located north west of Nablus. It has the ancient sites *Khirbet Dweyer, Khirbet Qaboba.*

25. Sabastiya:

A Palestinian village located 15 km northwest of Nablus. It was built by Omari the sixth, between 885-874 BC and was called "Shamer" which means the "Guardian". Later, during the Greek time it was called "Samereia". The city became very famous during the Roman empire of "Herod the Great". While rebuilding the city, Herod built Roman structures which were very familiar to the Roman aristocratic life, such as a stadium and playing grounds. Also the city was surrounded by a wall 2.5 miles, long with towers. When Christianity became the official religion, Sabastiya became the Bishopric heart and five churches were built there. Sabastiya is distinguished by its rich and wide variety of ancient structures. It contains the ruins of the old city, old churches and a mosque, in addition to several tombs and graves.

[*Photo 5: The stadium in Sabasitya-Nablus*]

26. Beit Imrin:

A village located 18 km north west of Nablus. It has ruins of ancient walls, structures, pools and sculptured rock.

27. Bazzariya:

A Palestinian village located 20 km north west of Nablus. In the nearby, an ancient site called "El Minia" exists and contains ancient structures, pottery fragments and rock-carved canals.

28. Assira Esharqieh:

A village located 6 km north of Nablus and is separated by Mt. 'Ibal, where several shreds, rock-carved tombs and pottery were found.

29. El Badan:

It is located southeast of Talloza, and carry the same name since the Roman period, "Badan", although is known as "Khirbet el Farwa". Ruined walls, ancient structures, columns and an old road remain.

30. Far'a:

A village located 11 km northeast of Nablus, where the ancient site of "Burj el Far'a" and "Tell el Far'a". El Burj has ruined walls, a trench, a pool, caves and a mosaic-paved floor. Far'a was built on the ruins of the Canaanite village "Tirsa". Excavations reveal a large number of shreds and a pottery store from the old and middle Bronze age.

31. Tammun:

A village located 23 km northeast of Nablus, where the historical sites of *Khirbet Basaliyah,* and *Khirbet A'touf are found.*

32. Tubas:

A village located 20 km north east of Nablus, which was very famous during the Roman and Canaanite periods. Several historical sites are found in Tubas including.

- *Khirbet Ei'noun*: A site located east of Tubas, where remnants of a ruined village, walls, pools and carved rocks remain.
- *Khirbet Yarza*: Ruined walls, structures, shreds, caves and tombs remain.
- *Khirbet el Ghrour*: Remnants of a rectangle enclosure, a tower and a Roman road can be found here.
- *Tell el Radgha*: On a small hill, there are ruined wells and an olive press. To the west there is a Roman cemetery and rock-carved gate.
- *Khirbet Jabarees*: Located northeast of Tubas, and has ruined walls towers, ancient structures, columns, mosaic-paved floor and rock-carved tombs are found.

33. Jammaa'in:

A village located 16 km southwest of Nablus, where the following sites are found:

- *Khirbet Jar'ah*: Ruined structures and buildings, a mosque and a pool remain.

- *Khirbet el Roysoun or (Irosone)*: Located in the eastern part of Jammaa'in. It has ruined mosque with Byzantine column crowns and water canals.

34. Salfit:

A village located 26 km south east of Nablus, where there are remains of rock-carved tombs and water canals.

35. Yasuf:

Located 16 km south of Nablus, in this village, there are rock-carved tombs, a Roman road and a tower.

36. Es Sawiya:

A village located 18 km southeast of Nablus, where the following sites are found:

- *Khan el Sawiya*: Located in the eastern part of the village. It contains a rectangle structure and rock carved tombs.
- *Khirbet el Burkeet*: Located northeast of el Sawiya, it is the site of a ruined Roman village, where ruined walls and rock-carved tombs are found.

37. Zeita:

It is located 18 km south west of Nablus. *Khirbet el Housh*, north of Zeita, is an ancient site where a ruined fortress, trench and rock-carved water canals remain.

38. Deir Istiya:

This village located 25 km southwest of Nablus. It has a historical site called Khirbet Tafsa, where a ruined village, mosque, an olive press and rock-carved water canals are still found.

39. Qarawat Bani Hassan:

In this village which is located 3 km south west of Nablus, several old and ancient buildings exist including:

- *El Burj Building*: A Roman tower in the center of the village, whose walls are very thick, approximately 3 meters.
- *Dar el Darb*: Located southeast of Qarawat Bani Hassan, several columns, a big Roman cemetery and rock-carved caves remain.

40. Bidya:

A village located 32 km southwest of Nablus, where remnants of an ancient settlement, ruined tower, pools and rock-cut tombs are found.

41. Bruqin:

It is located 31 km south west of Nablus, the following historical sites are in the nearby:

- *Khirbet el Phakhakheer*: Also known as Khirbet Hamad. This site is located in the northern part of Bruqin. There are ruined buildings, the remainder of a squared structure with columns and rock-carved canals.
- *Khirbet Karkash*: In the eastern part of the village, are found remnants of ruined villages, a quarry, a pool and rock-cut tombs.

42. Kafr Ed Dik:

Located southwest of Nablus, and has remnants of a square tower, pools, rock-cut tombs and a decorated door's threshold. The following historical sites exist:

- *Khirbet Kisraya*: Located northwest of Kafr Ed Dik, and has ruins of a square building, olive press and rock-cut tombs.
- *Khirbet Dairya*: Located to the west of Kafr Ed Dik, and has shreds, stones, ruined wells and flint walls.
- *Khirbet Deir Qala'a*: Located to the east of Kafr Ed Dik, and has remains of a ruined church, caves, pools and rock-cut stairs.
- *Khirbet Deir Sama'an*: Located north of Deii Qala'a, where there are remains of a ruined church, rock-cut reservoirs and an olive press with a tank.

43. Deir Ballut:

A village located 41 km southwest of Nablus where ruined structures and rock-cut tombs are found. Historical sites nearby include the following.

- *Khirbet el Meer*: Located east of Deir Ballut, where ruined walls and rock-cut water tanks are still found.
- *Khirbet Ed Deweir*: Located southeast of Deir Ballut, where remains of ruined buildings, rock-cut water canals, decorated door's threshold and an old road are found.

Photo 6:The Ancient site of column street in Sabastiya-Nablus

Chapter Eight
Wastewater

Raw wastewater originates from domestic and industrial sources. The characteristic of wastewater is impacted by water consumption rates, population density, industrial practices, and habits of the population. The discharge of raw wastewater causes a major potential health hazard as it carries disease in the form of pathogens and toxic elements. Disposed raw wastewater mixes with seasonal surface water, percolates into the ground, and may contaminate the groundwater. In arid and semi-arid regions, treated wastewater is used for irrigation purposes.

Domestic Wastewater

Domestic wastewater is mainly discharged from residential and commercial buildings. In Nablus, the sewage network is a combined system for both sewage and rainwater. This causes floods and contamination of domestic water supply in some areas of the city during rainy days.

The quantity of domestic water being consumed is almost 16 mcm per year. This calculation based on a yearly per capita water consumption of 49 CM (Harvard, 1994).

The characteristics of wastewater vary depending on the daily activities and the per capita water consumption of the population. The wastewater in most of the West Bank contains more than 600 mg/l BOD, however, in most other countries BOD varies between 200-300 mg/l which means that BOD concentration in the West Bank is relatively high.

Table 8.1: The Characteristics of wastewater flowing east and west of Nablus city " (PECDAR, 1994)."

Parameter	Nablus (West)	Nablus (East)
PH	6	6.5
COD	954	1338
BOD	600	560
TSS	488	840
Chloride	1180	9300
Phosphate	62	47

Phosphorus	20.6	15.6
Nitrates	128.7	201.9
Nitrate N	29.3	45.9
Sodium	420	840
Nitrite	1.87	0.175

Industrial Wastewater

Industrial wastewater is the effluent discharged from various types of industries, it contains both organic and inorganic wastes. Due to the absence of treatment and control facilities in the West Bank, industrial effluent is discharged to cesspits or collection networks. In many cases this effluent is used for irrigation purposes.

The main industries in Nablus district, such as detergents, shoes making, and food industries, are located throughout Nablus city and the villages. Three villages (Beit Eiba, Deir Sharaf, and Zawata) in Nablus district are suffering from wastewater effluent discharges from the industrial factories adjacent to them. For instance, in Zawata, approximately 12.8 MCM/yr of industrial effluent is discharged from the industrial factories. This wastewater flows directly into wadi Nablus (the collection point of wastewater) and is then used by the mentioned villages to grow various kinds of crops. In addition, the springs in this area are directly threatened by industrial liquid waste discharged from the nearby industrial facilities.

Wastewater Disposal Methods

Wastewater which is discharged from different sites in Nablus district, flows without treatment into the wadis bringing with it harmful bacteria, viruses, heavy metals, and undesired micro-organisms which can cause environmental and health hazards to the aquifer, crops and drinking water. Wastewater disposal methods in the district include a sewage network, cesspits or septic tanks, and open channels.

Sewage Network

Nablus district sewerage system is a combined system functioning for collecting both of sewage and storm water. It is proposed to gradually modify this system into two separated ones. The present system consists of a total of 60 km of sewer lines (Nablus Municipality 1995). The wastewater network covers only 38% of Nablus district. Even where the sewerage network exists, it does not cover all the houses at that location. For instance, in Nablus city, the sewerage network covers only 70% of the city while the remaining parts dispose of the waste in cesspits which are discharged to the wadi. In Beit Eiba, the network covers only 40% of the village. Other villages, which are located near Nablus city, discharge their wastewater directly into wadi Nablus. Figure 8.1 shows the sewage network of Nablus city.

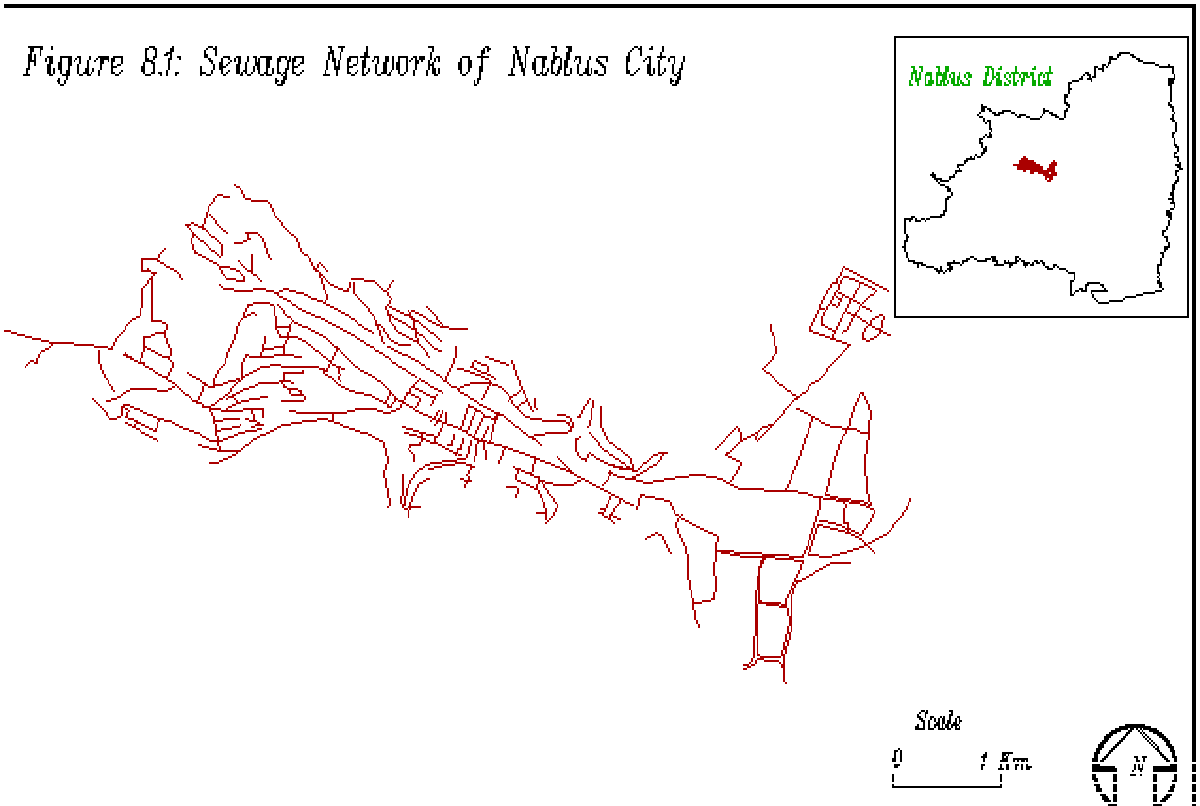


Figure 8.1: Sewage Network of Nablus City

The wastewater flows out of the Nablus city sewage network to the west and ends up in wadi Nablus. Thus, wastewater is either polluting the aquifer through percolation or is used in irrigation by the farmers in the adjacent villages.

The wastewater in the existing western sewage pipeline within the municipal boundaries dicharges into wadi Nablus. On the eastern side of the district, the present pipeline ends at a location near the slaughter houses where it is discharged into wadi Al-Sajoor. It then flows through wadi El Badan and to the Jordan Valley. Thus, the wastewater either pollutes the aquifer through percolation or is used by farmers for irrigation in the adjacent villages.

Cesspits and Septic tanks

Cesspits are one of the main methods presently used to dispose of wastewater in areas lacking sewerage networks. Cesspits are most commonly used in the villages and camps, thus covering approximately 62% of Nablus district. The use of cesspits has led to negative consequences, for example, cesspits often leak or overflow and their waste needs to be pumped out. Many villages like Ijnesiniya, Yatma, Jit, Qabalan, Es Sawiya, Odla, and others, are suffering from leaking cesspits which threating wells and springs. One of the most apparent problems is found in Burin, where cesspits are located mainly above an artesian channel that transfer water to the existing springs. This situation, along leakage in the existing sewer pipes could pollute the two major sources of drinking water in the village. In Beit Wazan the cesspits have not been emptied for a long time, causing increased pollution to the three springs found there.

Open Channels

Another alternative wastewater disposal method is open channels. Open channels are commonly used in refugee camps. Far'a camp is a good example, where the wastewater is collected in two open channels. The wastewater flows toward the southern part of the camp to 'Ein Shibli where it meets the wastewater discharged from Nablus city. At that location, the raw wastewater flows outside the camp boundaries to be used for irrigating various crops. Because the channels are uncovered, overflow of the drains is likely to occur during the winter.

Photo 7: Wastewater flow in the open channels at Far'a refugee camp.

Sewage Used in Agriculture

Many farmers in Nablus district irrigate their crops with raw wastewater. Approximately 66.7% of wastewater that flows in the wadis from the sewerage network, in addition to 4.4% of the wastewater pumped from the cesspits, is used for irrigation purposes. The wastewater is consumed raw and without being subjected to any type of treatment. Thus many problems are caused by irrigation such as, health hazards, salinity build up, and toxicity hazards (ARIJ Database).

Impacts of Wastewater

Surface water pollution

The disposal of industrial, municipal and domestic waste water directly into streams is a major source of water pollution in Nablus district, specifically in villages as Qussien, 'Asira Esh Shamaliya, Kafr Qallil, 'Asira El Qibliya, Nisf Jbeil, and Qaryut. In these villages, cesspits flood into the streets. This surface flow creates wet areas in the nearby lands which are hazardous for people living adjacent to them.

Pollution of ground water

The groundwater is exposed to the threat of pollution either by waste water flowing out of the sewerage network in the wadis, or by the wastewater percolating from the cesspits. For instance, 66.7% of the total generated wastewater flows towards the western groundwater basin through the existing sewerage pipe which ends in wadi Al-Toffah. From this, the wastewater flows down the wadi and seeps into the soil causing pollution to the aquifer, the only source of drinking water for the area. In the eastern basin, where the existing pipes end at a location near the slaughter houses east of Nablus, the wastewater flows out at wadi El Sajoor then to wadi El Badan and finally to the Jordan Valley. This contaminated wastewater is usually consumed for irrigation without prior treatment.

Most important, sewage sludge contains traces of many pollutants, toxic materials, organic waste material, pathogenic bacteria, viruses and protozoa along with parasites, all of which could bring potential harm to human health, ground water as well as plants and animals. Table 8.1 shows the characteristics of wastewater that flows west and east of Nablus city.

Photo 8: Cultivated areas irrigated with raw wastewater, A'zmut-Nablus.

It should be noted that sewage use for irrigation should be first subjected to biological, chemical or thermal treatment, long-term storage or another appropriate process to reduce it's fermentability and decrease its potential health hazards before being applied. Moreover, care is needed to prevent wastewater from running off on the roads or adjacent land.

Photo 9 : Horses drinking wastewater in A'zmut-Nablus

Current Development Projects

As mentioned before, local aquifers in Nablus are exposed to a pollution danger as the inadequate sewage collection network discharges wastewater into nearby wadis. Preservation of the local aquifer is the aim of a project to be implemented by Palestine Economic Council for Development and Reconstruction (PECDAR) which will work to reduce the disposal of raw wastewater into local wadis. The project will address the environmental protection needs of managing the domestic and industrial effluent from the sewered areas in both collection basins. This project is expected to be supported by the German Government and implemented by Nablus Municipality. The project will receive technical assistance from GTZ.

The project will be constructed for these locations.

* *Eastern Catchment area*: A'zmut, Salim, Deir El Hatab, and Beit Furik.

* *Western Catchment area*: Ramin, Deir Sharaf, Beit Eiba, Zawata, Beit Wazan, and Qusin.

The city's sewage collection network is currently being extended by some 22,000 m. The refugee camps within the municipal boundaries have been served by sewers with funds being supported by the UNDP.

Recommendations

- Installation of a separate drainage system for storm water which discharges to a controlled and protected area is recommended. This will help recharging the aquifer and/or be used for irrigation.
- Industrial wastewater should be treated before being disposed out the sewer network.
- Open channels should be replaced by closed collection systems.
- The sewerage collection network should be rehabilitated, and developed to cover more areas.
- An awareness program concerning care of cesspits should be implemented.

Chapter Nine
Solid Waste

Wastes range from the materials which are discarded in household dustbins to the by-products of industrial, chemical and agricultural activities. Public awareness of the dangerous effect of these wastes in human health and the environment has increased efforts to control waste disposal and management. Unfortunately, these efforts have not begin in the West Bank.

Proper solid waste management is one of the biggest environmental problems in the district. For example, types of refuse produced in Nablus city are brought to an uncontrolled dumping, located in an industrial area approximately 6.5 kilometers from the city.

Domestic Waste

The quantity of solid waste collected from houses, communities and markets varies from 0.9-1.0 kg per person every day. This estimated amount is based on normal values of many countries of the Mediterranean region. Sources of solid waste other than municipal waste may include wrecked cars, metal materials, demolition and construction waste, gardens refuse and other various materials. There is no accurate information regarding the composition of the solid waste generated in Palestine. However, an approximate estimation of the composition is shown in Table 9.1.

Table 9.1: Solid waste composition

Material	Organic mater	Paper & Carton	Glass	Plastic & Nylon	Iron	Textile	Leather	Wood	Soil	Aluminum
Percent (%)	87	1.5	0.5	4.5	1.5	0.5	0.5	1	3	0

"Source: Nablus Municipality, 93."

Clearly, solid waste contains a large amount of organic material. There is little glass and aluminum as these are often sorted out or sold before reaching the dumping site.

Collection Service and Responsibility

Collection of domestic waste in Nablus district is either the responsibility of the municipalities, village councils, associations, the refugee camps administration (UNRWA). Several areas have no party responsible for waste collection, where most of the waste is dumped randomly. ARIJ survey of solid waste practices in the West Bank shows the distribution of responsibilities for domestic waste collection and disposal as in the following table.

Table 9.2: Responsibility for domestic waste collection and disposal (ARIJ Database Survey, 1995) " Responsibility Percentage of Collection & Disposal of waste

Municipalities	**23**
Village Councils	22
UNRWA	14
Associations	2.4
No (Randomly)	38.6

According to ARIJ survey, 60% of the waste is disposed of in public dumping sites, while 40% of the solid waste is disposed of randomly near houses, or in open spaces on road sides. Often the waste dumped at designated dumping sites or random sites is burned without control.

Collection containers and vehicles currently used by the municipalities, village councils, and UNRWA, vary in number and size. There are approximately 829 collection containers in Nablus district, of which 94% have a capacity of 1.0-4.9 CM and 6% of the containers have a capacity of 5.0-10.0 CM. Vehicles which are used for collection in Nablus district, include 49 hand carts, 16 agricultural tractors and 14 trucks..

Photo 10:The main uncontrolled dumping site of Nablus city

Waste Disposal System

The solid waste produced in Nablus city is brought to a dumping site located in the industrial zone, approximately 6.5 km from the center of the city (Figure 9.1). The diverse solid waste produced in Nablus city can be classified as follows:

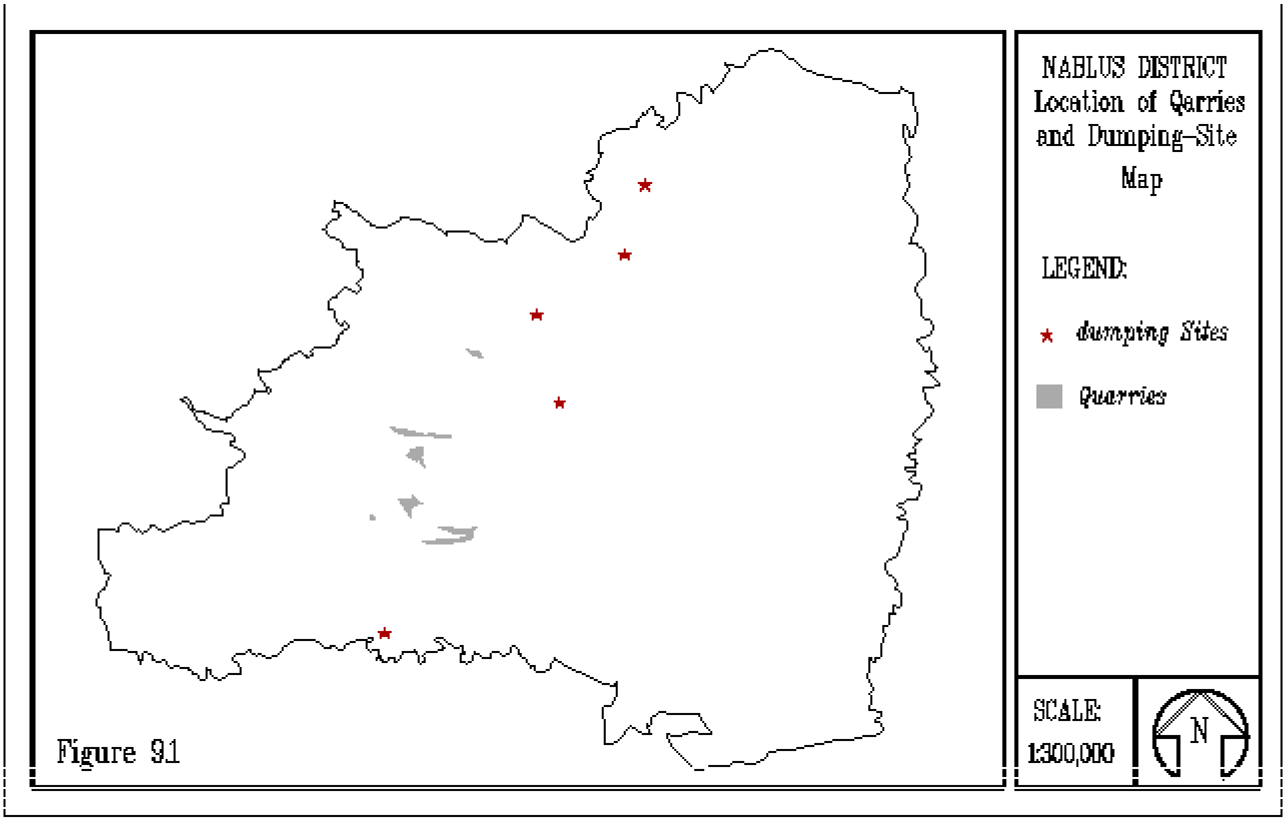


Figure 91

- Refuse from houses, restaurants, hotels and businesses;
- Refuse from hospitals, clinics and laboratories; and
- Demolition, construction debris, wrecked houses, old cars and refrigerators.

Presently, no efforts are made in the West Bank to prevent air pollution from solid waste disposal. Unloaded refuse is burned in the open air. Air pollution created from burning could cause enormous dangers to the health of the citizens, in particular for those people living close to dumping sites.

According to a survey conducted by the World Service in November 1994, 8 cases of lung cancer were discovered among the inhabitants of the Beit Dajan village, the nearest village to the existing dumping site. It is expected that the lung cancer is due to air pollution from open burning (Nablus Municipality, 1994). Dumping sites are not adequately designed to protect surface ground water. Often waste is dumped into wadis and leachate then percolates to the water system below. Also, the existing dumping sites are not fenced so stray animals are continuously scavenging in the site. More information is given in Appendix 2.

Industrial Waste

Major industrial activities in Nablus district include sweet factories, lathes and blacksmiths, shoes factories and workshops, textile, stone-cutting facilities and quarries, vegetable oil, ghee and detergents industry. There is no separate system for collecting or disposing of industrial wastes, hazardous or nonhazardous.

Around 49 olive mills, either old or semi automatic are operating machines in Nablus district. Four mills are single-lined fully automatic and 6 are double-lined fully automatic. These olive mills play an important role as supplier for the soap and detergent industries, as these consume most of the olive pulp which is generated from the milling process. All generated wastes are discarded on vacant lands or road sides. The rest of the olive residues (pulp) are either reused by people for heating, burned or discarded in nearby spaces.

According to the survey conducted by ARIJ, around forty-five percent of the industrial facilities in Nablus district are located in industrial areas, 28% are located in residential areas, and 27% are located in commercial areas. The quantities of solid waste generated from the industrial facilities surveyed by ARIJ (excluding quarries and stone-cutting facilities) are shown in table 9.3.

Table 9.3: Quantities of the generated industrial solid waste (ARIJ Survey, 1995 & Palestinian Directory for Industry, Commerce and Services, 1995).

Industrial Facility	No. of Factories Surveyed	Total No. of Factories	Solid Waste Tons/yr
Food & Beverage	40	45	5593
Fodder	7	7	137
Textile	6	9	71
"Plastic, Rubber & Shoes"	29	N/A	148
Chemicals	16	34	299
Metallic	36	45	206
Carton & Paper	2	3	214
Clothing	18	147	65
Paints	1	2	N/A
Construction	26	26	4406
Printing	6	10	214
Glass	1	2	120
Wood & Bamboo	10	26	3.8

"N/A: not available data, N: negligible."

The generated solid waste is either produced during the production process or during packaging. Usually factories use carton, metal, plastic, and wood for packaging.

Based on the surveyed industrial facilities throughout Nablus district, the generated industrial solid waste is disposed of by different methods, as shown in table 9.4.

Table 9.4: The disposal methods of industrial waste in Nablus district (ARIJ Survey, 1995)

Methods of Disposal	Percentage of Disposal Method
Municipal waste containers	42
Reused	29
No waste	13
Road-sides dumping	9
On-site burning	2
official dump + reused	2
Reused + incinerated	3

Eighteen out of 31 Quarries and stone cutting facilities in Nablus district produce approximately 40,384 tons/yr of solid waste and approximately 13,486 tons/yr of solid waste mixed with a large amount of water. Forty-two percent of the solid waste is randomly dumped, negatively affecting both the human and the environment. The remaining 58% of the generated solid waste is reused as building material in constructions. Table 9.5 shows the amounts of solid waste and wastewater generated by quarries and, Figure 9.1 shows the location of quarries in Nablus district. Liquid wastes, either the slurry or sludge, are usually not treated before disposal. Moreover, some farmers believe that adding slurry to olive trees will improve the soil texture.

Large amounts of dust are released daily from several industrial facilities. Usually, all dust is emitted directly into the air, neglecting the harmful effect that may have on both human health and the environment.

Photo 11:Slurry from stone-cutting facilition near Olive trees,Qira-Nablus

Medical Waste

Most of the medical waste generated from health institutions in Nablus district ends up in the municipal garbage. Little of the generated medical waste is treated before disposal, thereby causing a threat to the human life.

Any proposed project to reduce the threat from medical waste must manage the waste safely from production to final destruction. This means, the surrounding environment should not be polluted and the risks of infection for the people taking part in handling and disposing hospital waste should be minimized.

Four hospitals and twenty-one laboratories were surveyed by ARIJ. Based on the survey results, approximately 42% of the medical centers are located in residential areas and 58% are located in commercial areas.

None of the surveyed medical centers had any adequate treatment system to get rid of the medical waste. Most of the waste is mixed with the municipal garbage in collection and disposal. For example, 64% of the surveyed medical facilities disposed of the blood samples directly into the garbage without any previous treatment, 12% of the facilities incinerate the blood samples, 16% sterilized blood by autoclaving, and 8% sterilized blood samples by adding chlorine or alcohol (chlorination method).

Transmission of pathogens to people is most likely to happen when handling sharp objects. Approximately 64% of all the surveyed medical centers dump their sharp objects without any proper treatment. This increases the risk of infection for the people who are collecting and handling the garbage.

Most of the medical centers use septic solutions for cleaning bed sheets. But, only a few of them isolate the sheets and the instruments used by patients with infectious diseases from the rest.

All the surgery wastes from the hospitals are held in plastic bags and disposed of in the domestic garbage bins. Most of the lab technicians in hospitals, clinics and laboratories do not use safety tools such as gloves or masks.

During the 28 years of Israeli occupation, the Health Department did not perform any periodical inspection for the medical and health centers. For example, approximately 52% of the medical centers had never been subjected to any kind of inspection.

Recently, the Palestinian Ministry of Health took over the health issues and started to conduct a periodical inspection to all medical centers in the West Bank.

Recommendation

- The collection system needs to be upgraded to eliminate random dumping of wastes.
- A modern sanitary landfill should be constructed for Nablus district, taking into account environmental impacts on the site and leachate monitoring and control.
- A composting program should be established to use the large percentage of organic matter.
- Waste materials should be reused and recycled to the largest degree possible.
- Medical waste and industrial hazardous waste should be properly controlled to protect human heath and the environment.
- Public awareness about proper solid waste management should be increased.

Chapter Ten
Air And Noise Pollution

Air Pollution

Some air pollutants are formed and emitted through natural processes, however, near cities and in populated areas, more than 90% of the volume of air pollution is a result of human activities. The main sources of air pollution are, energy production, transportation and industry. Nablus district has a fairly dense population and an active industrial sector; these factors play a significant role in increasing air pollution. Dust levels are naturally high in Palestine, where hot and dry sand storms from the eastern desert (Khamaseen) occur frequently.

Residents of Nablus district own 17.6% of the of the vehicles in the West Bank. These vehicles (totaling 19,275), including cars, buses, trucks, motorcycles and others, emit pollutants such as carbon monoxide, sulfur oxides, nitrogen oxides and particulate matter. A high percentage of the vehicles is more than 15 years old.

Table 10.1: Types and numbers of transportation vehicles in Nablus district

Type	Private	Commercial	Bus	Taxi	Truck	Motorcycle	Other	Total
Number	"14,313"	"2,702"	134	248	525	83	"1,270"	"19,275"

"Source: Transportation Officer, West Bank Department for Vehicle Licensing, Beit Eil."

The district lacks a developed urban road system and the management of traffic is ineffective, causing increased vehicle emissions. Dense vehicular traffic causes air pollution problems mainly in the center of Nablus city where it is very crowded. Black soot emitted from diesel-powered vehicles is the cause of visible changes in the buildings such as soiling, discoloring or darkening of the surface. As the rate of motorization increase, air quality may further deteriorate. The following table shows the contribution of vehicles to air pollution.

Table 10.2: Transportation air emission inventories.

Year of Production	Engine Capacity	Unit(u)	CO (kg/u)	SOx (kg/u)	NOx (kg/u)	VOC (kg/u)	Pb (kg/u)
up to 1971	< 1400 1400-2000 > 2000	1000	45.6 45.6 45.6	1.9 2.22 2.74	1.64 1.87 2.25	3.86 3.86 3.86	0.13 0.15 0.19
1972-1977	< 1400	1000	33.42	1.66	1.64	3.07	0.11

	1400-2000 >2000		33.42 33.42	1.92 2.2	1.87 2.25	3.07 3.07	0.13 0.15
1978-1980	< 1400 1400-2000 > 2000	1000	28.44 28.44 28.44	1.39 1.68 2.13	1.5 1.72 1.97	2.84 2.84 2.84	0.09 0.11 0.14
1981-1984	> 1400 1400-2000 > 2000	1000	23.4 23.4 23.4	1.39 1.68 2.13	1.58 1.92 2.57	2.84 2.84 2.84	0.09 0.11 0.14
1985-1992	< 1400 1400-2000 > 2000	1000	15.73 15.73 15.73	1.27 1.62 1.85	1.5 1.78 2.51	2.23 2.23 2.23	0.09 0.11 0.14
"Source: World Health Organization, Geneva, 1993"							

Rough calculations show that the annual emission of air pollutants due to gasoline combustion is close to 0.6 tons per vehicle. Furthermore, an estimated 9,020 tons of CO, 647 tons of SOx, 740 tons of NOx, 1,094 tons of VOC and 42 tons of Pb are emitted each year in the district due to local driving only.

Political changes in the region are expected to increase the traffic volume in the district. Higher usage of buses, taxis, trucks and rental vehicles will contribute to higher emission of gases into the atmosphere, and will demand new programs in traffic management and control to reduce congestion and emission of poisonous gases. The new autonomy will hopefully allow for changes which will protect the air quality such as a regulatory program for emissions, vehicle inspection and establishment of a traffic management program using traffic lights (banned under Israeli military occupation) and traffic police.

Fixed sources of air pollution are primarily from industries, such as quarries and stone cutting facilities, that release large quantities of particulate matter and dust into the atmosphere. Most industries lack necessary air filtration systems for collection of dust and particulate.

Most building materials, namely sand, and both coarse and fine aggregates, are dumped and left uncovered on the road sides. These materials are often left at the construction site for extended periods of time and contribute to the particulate matter carried in the atmosphere. Strict construction laws and regulations should be established which limit the amount of particulate matter. Obtaining a building permit should be made conditional upon the adherence to these regulations. The planting of trees in front of buildings should be encouraged as it will moderate the atmosphere and filter pollutants.

A high level of air pollution negatively impacts both humans and the environment. High lead concentration in the air can affect the blood system, the nervous system and the renal system. Vegetation could be damaged from dust and polluted rain (acid rain) and may sometimes leave residues on the produce. Impact on wildlife can be through their consumption of polluted vegetation and water.

Raw data on air quality, atmospheric dispersion conditions, the impact of Israeli's traffic and industrial activities are lacking for the West Bank. An air monitoring system will provide the needed data for the establishment of regulations and standards for air quality. In the near future ARIJ will conduct a study on air quality, monitoring system will be installed to cover most of the West Bank to serve the national goals and research requirements.

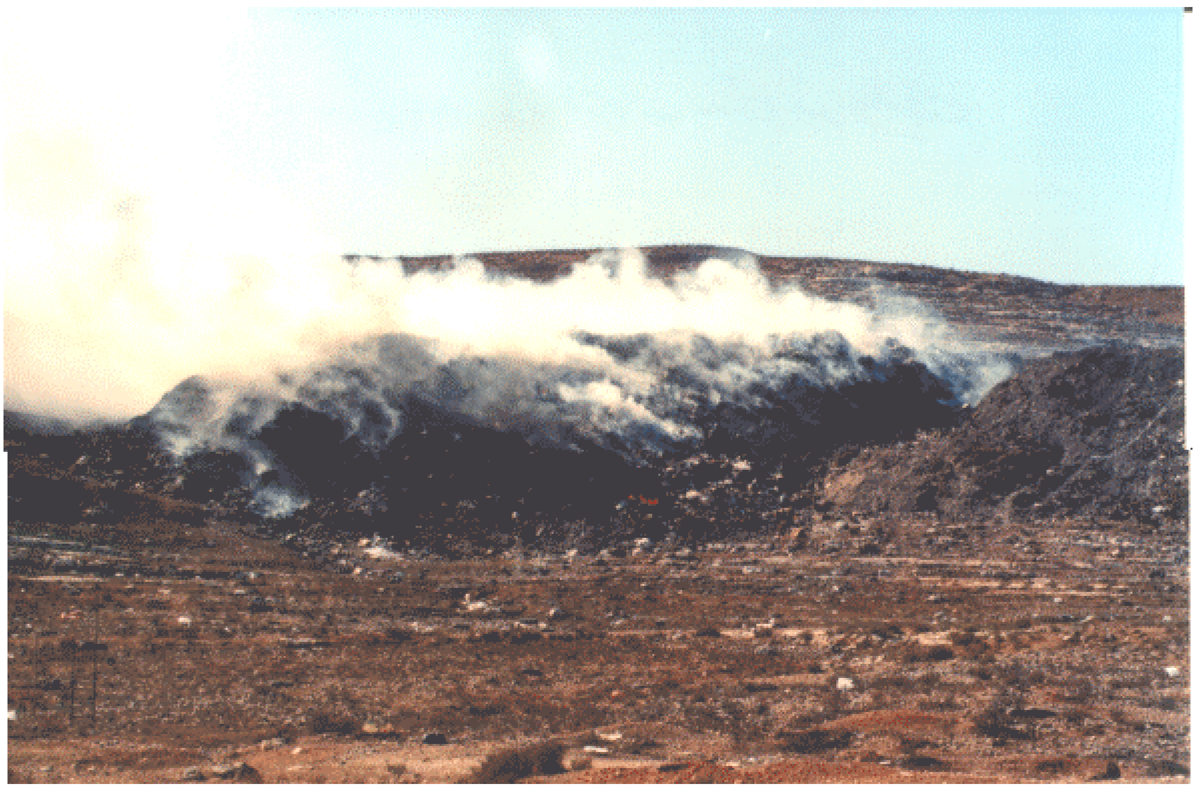


Photo 12:Air pollution caused by the burning in the dumping-site,Beit Furik-Nablus

Noise Pollution

Noise, an output of urbanization and industrialization, is increasingly recognized as an environmental pollution affecting basic human health and well being. The sources of noise pollution in urban areas are: traffic and motor vehicles, road construction and buildings, and industrial activities. The level of noise is affected by the type, age, maintenance level and quantity of vehicles and the location of industrial activities. In rural areas of the district, noise is mostly caused by Israeli military aircraft and military training activities. Noise pollution has not been studied in Palestine. Scientific measurements and data about noise levels are not established. However, field observations give an idea about different noise sources and levels that are commonly found in the district. The main sources of noise are: low flying Israeli military aircraft, especially when breaking the sound barrier producing sonic booms, roadway traffic, especially in the center of Nablus city where frequent traffic jams occur, construction noise, and stationary sources such as stone cutting facilities.

The need for well enforced regulations specifically addressing noise pollution is justified by the fact that sustainable loud noise may cause problems for human hearing and nervous systems. Moreover, it may interfere with the work environment, normal speech, communication, sleep, inter-room privacy, as well as being an annoyance. In addition to its effects on the wildlife and their habitat.

Recommendations

- Research on air pollution control and air quality monitoring should be launched.
- An air quality monitoring system should be established to cover all the Palestinian areas.
- A national center for air quality data collection and analysis, based on data obtained from the proposed regional monitoring network, should be established.
- Air quality standards for vehicles and industry should be established and be in accord with international requirements.
- Regulations to prohibit burning of waste at disposal sites are needed.
- Old vehicles, including buses, trucks, taxis and private that are not able to meet an emission standard, should be taken out of service. Importation of old vehicles should be regulated.

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Appendix 1
The Institutions in Nablus District

Institutions

Hospitals + Clinics + Medical centers

- Al-Ittihad hospital
- Al-Watani hospital
- Evangelical hospital (St. Luke's hospital)
- Rafedya hospital
- Arab Medical Society (family planning)
- Palestinian Union of Health Care Committees
- Patient's Friends Soceity
- Rahmeh Clinic
- Red Crescent Society
- Society for the Care of Blind

Associations

- Agricultural Cooperative Associations
- General Federation of Labor Unions in the West Bank
- Palestinian Council for Emergency Medical Services
- Chamber of Commerce & Industry-Nablus District
- Palestinian Housing Council

Universities, Colleges, Training Centers and Libraries

- Najah National University
- Open University
- Najah National Community College
- Rawdah College for Applied Science
- Nablus Public Library

Media

- Eibal Press Office
- Nablus Press Office

Religious Forum

- Islamic Waqf
- Islamic Court
- Zaka Committee

Research & Cultural Centers

- Center for Documentation Publications and Manuscripts
- Center for Palestine Research and Studies
- Research Studies Center
- Rural Research Center
- British Council-Nablus Office
- Farah Cultural Center
- Cultural Social Sports Club

Charitable Societies and Organization

- Arab Women's Union Society
- Palestinian Women's Academic society
- Child Care & Maternal Guidance Center
- General Union of Palestinian Women's Committees
- General Union of Palestinian Women's Committees for Social Work
- Hawwa' (Eve) Center
- Jordan Family Planning & Protection Associations
- Modern Women society
- Salfit Women's Charitable Society
- Union of Palestinian Women's Work Committees
- Women's Affairs Center
- Women's vocational Training Workshop Society
- Source: Palestinian Directory, 1995

Appendix 2

Solid Waste management and estimated generated waste in Nablus district

Zone	Population	Quantity (Tons/day)	Number of Vehicles	Number ofLabors	Suggested number of Labors	Number of Container	Annual Fee (J.D)	Community Served %	Disposal Sites	Distance Between Dumping Site & Center of Town (km)
A'qraba	4505	4.5	1 A.T.	3	11	0	4	86	P.D.in Nablus	9
A'sira Esh- Shamaliya	7736	7.7	1 T	2	19	0	15	90	L.D.	4
A'skar R.C.	10500	8.4	1 T	14	26	7 (8 CM)	no fee	100	P.D. in Nablus	2
Balata R.C.	16094	12.9	1 T	22	40	10 (8 CM)	no fee	100	P.D. in Nablus	1.5
Bazzariya	1460	1.3	1 A.T.	2	4	0	15	85	Vacant land	1.5
Beit Eiba	2258	2	1 A.T.	2	6	0	-	94	L.D.	0.5
Beit Wazan	858	0.7	1 A.T.	3	2**	0	no fee	100	P.D. in Nablus	10
Beit Imrin	1956	1.8	1 A.T.	3	5	0	15	100	L.D.	5
Beita	5119	5.1	1 T	3	13	60 (1 CM)	15	40	P.D.inNablus	17
Bidya	4809	4.8	1 A.T.	3	12	0	15	90	L.D.	2

Burqa	3315	3.3	1 A.T.	2	8	0	15	91	Vacant Land	0.5
Ein El Ma' R.C. (Camp No.1)	5100	4	1 T	8	13	5 (10 CM)	no fee	100	L.D.	3.5
El Far'a R.C.**	5500	4.4	1 T	11	14	7 (8 CM)	no fee	100	P.D. in Nablus	8
Huwwara	4130	4.1	1 T(Q)	3	10	32 (1 CM)	9	90	P.D. in Nablus	8
Ijnesiniya	456	0.4	1 A.T	2	1	0	6	90	Vacant land	1
Jeneid	231	0.2	N**	4**N	**N	5 (1 CM)	10	100	P.D.in Nablus	6.5
Kafr Laqif	625	0.5	1 A.T.	3	2	0	6	90	P.D.in Jayous	4
Kafr Qaddum	2793	2.5	1 A.T.	2	7	0	9	100	L.D.Wadi	4
Kh. Sir	504	0.4	1 A.T	2	1.5	0	12	92	P.D. in Jayuos	5
Nablus	55319	66.4	6 T	124	*	600 (1CM)50 (3CM)	10	100	P.D.inNablus	6.5
Qabalan	4015	4	1 T	3	10	27 (1.2CM)	9	70	P.D.inNablus	19
Rujeib	2189	2	1 T(Q)	3	5.5	20 (1 CM)	no fee	80	P.D. in Nablus	3
Sabastiya	2332	2.1	1 A.T.	2	6	0	6	100	L.D.	2
Salfit	6986	7	1 T	7	17	6 (5 CM)	10	96	L.D.	1.5
Sanniriya	2001	1.8	1 A.T.	3	5	0	15	-	L.D.Wadi	3
Sarra	1667	1.5	1 A.T.	3	4	0	15	100	L.D.Wadi	4

Tubas	12861	12.8	1 A.T.	3	32	0	15	91	L.D.	4

T(Q): The Truck from Qabalan Village Served two Villages (Huwwara & Rujeib) in addition Qabalan Village & They Take 60 NIS for each Container from the two Villages.
*** : population are taken from ARIJ survey.**
N: They are served by Nablus Municipality.**
T: Truck
A.T.: Agricultural Tractor.
CM: Cubic Meter.
L.D.: Local Dump.
P.D.: Public Dump.

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