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NEAR EAST/NORTH AFRICA REPORT

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ISRAEL

WATER SOURCES, THEIR USES IN JUDEA, SAMARIA

Jerusalem YEHUDAH VESHOMRON: PERAQIM BEGIOGRAPHIYA YISHUVIT [Judea and Samaria Studies in Settlement Geography] in Hebrew 1977 pp 34-38

/Article by Yohanan Boneh, hydrologist and lecturer in geography department at University of Tel Aviv, and Uri Baida, Israel Water Planning Authority/

/Text/ Introduction

The physical structure of Judea and Samaria -- mountainous arch (dolomitic chalk) which takes up most of the territory in the center; the low Jordan Valley in the east; and the hills of Samaria and the higher lowland in the west, determines in fact the character of the water sources, on the one hand, and the location of settlements in the region, on the other.

Like Mt Hermon, about which it is said "all of its best is at its base" so is this region of the country, where the water sources are found at the feet of the mountains. Some of the runoff water, which is called the "repeating refill," which penetrates the soil and reaches the aquifers of the subterranean water, finds its way back to the surface of the ground by way of various springs which flow from the foot of Mt Gilboa and the Beit-Shean Valley in the north, along the Jordan Valley and the coast of the Dead Sea in the east, to Rosh Ha'ayn and Nahal Hataninim (Crocodile River) in the west.

Most if not all of this water is used for irrigation, either directly from the springs themselves, or by means of drilling to draw it from the sources.

Most of the water sources found in the area of Judea and Samaria serve to water the lands of the Jordan Valley, and a lesser amount is used in the irrigated fields which are at the feet of the hills and the higher lowland in the western part of the region.

These water sources are available primarily at the foot of the hilly areas, but most of the people live on the top or slopes of the mountains. Because of the transition between the mountains and the desert, in general most of the large settlements have been located at the threshhold of the desert of Judea and Samaria, while the small and intermediate sized villages have developed in the center of the mountainous area and to the west.[1] The water sources on the top of the mountains are limited, and include primarily

wells which fill up with winter runoff water, local springs having a relatively small flow, and isolated drillings intended to supplement the minimal household consumption of drinking water for urban settlements, when other sources are insufficient for that purpose. With the rise in the standard of living and the growth in size of the population, there has been an increased demand for larger quantities of water for household use. As a result, the principal development of water sources in recent years has been directed to the creation or expansion of projects for supplying household water for the area's residents. In irrigation projects, the principal emphasis has been placed on increasing efficiency, and not necessarily on quantity.

This paper will be a survey of the water sources in the region, including a quantitative estimate and methods of exploitation.

HYDROLOGY

Precipitation

The average annual amount of precipitation in the region of Judea and Samaria for the years between 1931 and 1960 varied between 700 millimeters in the high mountains (the area of Ramallah) to 100 millimeters in the area of the Dead Sea. In general, the amount of rain declines from the mountain tops to the margins, and the differences are particularly sharp east of the water shed.

In addition to the decline in the amount of rain from west to east, the amount of rain also declines from north to south, and varies between 300 millimeters per year in the region of Bardala in the northern Jordan Valley to 100 millimeters along the coast of the Dead Sea. The changes in the amount of rain depend upon the location of the region, the elevation above sealevel, and the orientation. The slopes of the mountains facing the wind which brings the rain receive a larger amount of rain than the slopes which are protected from the wind.

The distribution of precipitation in the region is as follows: In the mountains of Samaria and the mountains of Judea -- an average of 600 millimeters; in the mountains of Beit El and the vicinity of Bayt-Jala and Betar -- about 700 millimeters; on the western slopes of the mountain bloc, the quantity of rain varies between 500-600 millimeters per year; on the other hand, the quantity of rain on the eastern slope gradually declines from 450 millimeters to 150 millimeters per year in the area of Jericho.

Snow which sometimes falls occurs primarily in the hills of Jerusalem, on the high Mt Hebron, and the height of Bethel, but is not significant in terms of the amount of water in them, compared to the general precipitation.

Upper Runoff

All of the streams in Judea and Samaria drain into one of the two drainage basins -- the Mediterranean or the Jordan Valley (Figure 1). In the drainage area to the west of the watershed are included the basins of the following streams: the Kishon, the Hadera, the Alexander, the Yarkon, the Shoreq, Lachish, Shaqma, and Bashor, in an area of 3,000 square kilometers.

The greatest drainage basin is the Yarkon, which drains the region of Judea and Samaria from the mountains of Bethel to the environs of Shechem (Nablus). The flowing waters of the western drainage area, from the Kishon in the north to the Bashor in the south, come from the region of Judea and Samaria to Israeli territory.

Because of the porous nature of most of the exposed areas above the basins, the upper runoff is quite small, and for the most part it does not exceed one or two percent of the total precipitation in the area, except for those places which are covered with chalky soil or chalk, where the upper runoff is greater.

Flow data from these basins in the area of Judea and Samaria do not exist. According to various estimates, the upper runoff is estimated to be 20-25 million cubic meters on a multi-year average. Some of this upper runoff is already exploited today in water projects, on the basin slope in Israel, or is included in development plans for additional water sources.

To the east of the watershed, the streams empty into the Jordan River or the Dead Sea. These streams constitute five primary drainage basins, in an area of about 2,500 square kilometers, according to the following distribution:

1. The northern streams of Samaria having a collection basin of 310 square kilometers. The principal streams are: Malih and Abu Sidra.

2. The basin of the Farah, with an area of 330 square kilometers.

3. The southern streams of Samaria having a collection basin of 620 square kilometers. The principal streams are: Akhmar, Mallaha, Awja, and Nu'eima.

4. The Kelt having a collection basin of 180 kilometers.

5. The northern streams of the Judean desert, including the Og, Qumran, Qidron, Darja, and Hazezon, with an area of 1,100 square kilometers.

Flow data does not exist at all for most of the principal streams which empty into the Jordan Valley, or there is very little data (such as for the Farah or Kelt (Qilt).

Throughout the year, there is a strong flow in the Par'o, the source of which is in the Par'o springs and Bidan springs, and the Maska springs; periodically, there also appear in it strong high flows. Even during the period of the mandate, attempts were made to measure the flow of floods in the stream. Later, the Jordanians set up a measuring station on the Par'o. Measurements made in the years 1944-1947, as well as in 1964/65, by the Jordanians indicated a range of flood flows from absolute zero up to 4.5 million cubic meters, with an estimated annual average of 2.5 million cubic meters.

The upper runoff appears in steams in the region of Jericho, especially in the form of short lived flood flows during the winter months. The flows in the Kelt (Qilt) have been measured for about 30 years -- during the mandate and afterwards -- by the Jordanians. But this data is scanty and inexact, and some of it is available only in Amman. The components of the flow in the Qalat are the high currents which occur after the strong rains in the hills of Jerusalem and the excess of the flow of Ein Fawar, beyond the carrying capacity of the canal.

We do not possess data on the high flows of the Nu'eima and the Awja, but in rainy years, flood flows have been created in them.

With the help of this scanty data, there was reconstructed at the Israel Water Planning Authority the high flows of some of the streams in eastern Samaria and the Nahal Qalat, in a general area of 600 square kilometers. The computation of the flow, which was based on the proportions of the rain runoff in the Kelt, the Farah, the Akhmar, the Malih, and Abu-Sidra, gave a figure of 15 million cubic meters per year, as a multi-year average. About 12 million cubic meters of this quantity flowed in the Kelt (Qilt) and the Farah.[2]

For the streams of the Judean wilderness, it is possible to get only a gross estimate, based on the percentage of the upper runoff computed from the Nahal Arugot, which is similar in its character to the other streams. On the basis of these estimates, a figure for the average upper runoff was obtained, and is about 5 to 10 million cubic meters per year for all of the streams of the Judean wilderness (beyond the "Green Line").

In light of these estimates, the total annual runoff for all of the drainage basins in Judea and Samaria is estimated to be 40 to 50 million cubic meters.

Subterranean Waters

The mountainous range which covers the anticlineal structures of Judea and Samaria constitutes the region of the natural recurring waters of a number of subterranean water basins, which are the largest and most important of western Israel.

The rains which run off on the exposed rock of the mountain filter down to various formations, which constitute the various kinds of aquafers, and in which the water flows, as subterranean water, to the north, south, east, and west.

Aquifers

The ridge of rock which is exposed in the mountainous bloc of Judea and Samaria is lower Cretaceous to eocene, and is built principally of limestone, dolomite, and marl. In certain places one can distinguish layers of sandstone, conglomerate, and clay.

In the internal valleys there appear alluvial and other deposits which are neocene to pleistocene. The Jordan Valley, which is located to the east of the mountainous bloc, is built of land and lake deposits which are neocene-pleistocene.

The range of various formations is divided into an alternating series of aqoifers and and aquicludes, as follows:

(at the base) -- a small aquiclude formation -- lower Cretaceous.

A lower cenozoic aquifer -- Judean group.

A "middle cenozoic" aquiclude or aquitard -- Judean group.

An upper cenozoic aquifer -- Judean group.

A filtering aquiclude -- Mt Scopus group.

An eocene aquifer -- Avdat group.

Local aquifers and aquicludes of neocene-pleistocene age.

The lower cenozoic aquifers include the formations of "Kefira," "Givat Ye'arim," "Shoreq," and "Qishon?" which constitute the principal aquifer on the ridge and eastern margins of the mountains. On the ridge of the mountain, the lower cenozoic aquifers are supported by the aquiclude of the "Ketana" formation. On the edges, the aquifer is generally locked in beneath of the aquiclude (or aquitard) of the formations of "Motza Marl" and "Beit Meir."

The upper cenozoic aquifer includes the formations of "Aminadav," "Kfar Shaul," (or "Ein Yeraq'am"), "Veradim," and "Ba'ana." On the mountain ridge the aquifers are supported, where they are located, beneath the subterranean water table, on marl or formations of "Beit Meir." On the edges of the mountainous bloc, the aquifer is locked in beneath the filtering aquiclude.

Eocene layers vary in their aquiferic character in various places throughout Judea and Samaria. In general, the eocene aquifer is supported on the filtering aquiclude, which is built of aquiferic limestone layers alternating with closed marl layers.

The neocene-pleistocene aquifers are essentially carse aquifers, and their principal importance is in the Beit-Shean Valley, the Farah Valley, and the South Jordan Valley, in the area of Awja and Jericho. (A geological cross-section of aquifers is found in Figure 2).

Collection Basins

The regional hydrology of the subterranean waters in the mountainous region of Judea and Samaria is absolutely determined by the geological structure and the stratigraphic column. In the Jordan Valley, the hydrographic character (upper) also has an important influence.

The anticlineal geological axes of Judea and Samaria determine in the mountainous region the principal subterranean watershed, which separates the eastern and western flow of the subterranean waters. The secondary axes and fault lines divide the region into secondary hydrological basins.

The western subterranean basins in the areas of the West Bank are:

Western drainage:

Yarkon -Taninim basin (Judea group).
Hebron-Beer Sheva basin (Judea group).
Sinclineal basin of Shechem-Janin-Gilboa (Avdat eocene group).
Revia-Gilboa-Ta'anakh basin (Judea group).

Eastern drainage:

Bardela basin (Judea + Tiberias group).
Malih-El Buqei'a basin (Judea group + Avdat group).
Farah basin (Judea group + Tiberias-Dead Sea).
Patsal-Awja basin (Judea group).
Ramallah-Jerusalem basin (Judea group).
Judean Wilderness basin (Judea group).

To the east of the mountain ridge stretches, from north to south, the pleistocene-neocene basin of the Jordan Valley, into which empties all of the water in the eastern drainage. [3] A detail of the location of basins is in figure 3.

Ground Water Potential

A computation of the water potential in the aquifers of the West Bank can be obtained by a hydrological calculation, i.e. the recurring quantity of water is equal to the total rainfall on exposed areas, minus the upper runoff, evaporation, evapotranspiration, and differences in ground moisture. This computation can also be done by hydrological methods related to the flow of springs and hydraulic constants of the aquifers; or by classical hydrological water balance, in which the recurring water quantity is calculated from pumping data and the change in water level, taking into account measured constants of the aquifer. A summary of the subterranean water potential in the various basins is found in Table 1. Estimates of the recurring quantity in millions of cubic meters per year were made by differing methods for different basins, in accordance with the data available in each basin.

Table 1: Collection Basins of Subterranean Water and Estimates of Their Water Potential (In Millions of Cubic Meters per Year)

Basin	Aquifer	Exposed Area	Natural Recurring Amount	Present Exploitation (Drilling-Spring Flow)
1. Yarkon-Taninim	Judea group Upper cenozoic+ lower cenozoic	1,300	350-370	380-400
2. Hebron-Beer Sheva	Judea group Upper cenozoic+ lower cenozoic	300	16.6-21	20-21
3. Nablus -Jenin-Gilboa sinecline	Eocene Avdat group Judea group	500	80-95	92-114
4. Revia-Gilboa-Ta'anakh	Upper cenozoic+ lower cenozoic	--	40-50	35
5. Bardala	Judea group+ neocene	90	3-6	9-11
6. Wadi Malih-Buqei'a	Judea group+ Avdat group Judea group	66	2-3	2
7. Wadi Farah	Neocene+pleistocene	145	9-15	9-10
8. Patsal and Awja	Judea group Lower cenozoic+ Upper cenozoic	610	24-40	12.5-15
9. Jerusalem	--	610	50-70	25
10. Judean Wilderness	Judea group Upper cenozoic-lower cenozoic	590	35-40	6.2-6.7

USE OF WATER IN JUDEA AND SAMARIA

Water Sources Available for Exploitation

Water serving the population of towns and villages in Judea and Samaria comes from three principal sources: springs, wells, and cisterns. In the whole region there are about 300 springs. Most of the springs are small and spread out (villages are generally located around major flows), and are exploited as local water sources for drinking water and irrigation. These small springs drain local aquifers of limited importance.

In addition to the small springs, there are in Judea and Samaria about 60 large springs, for which the average annual supply of each one is more than 50,000 cubic meters. In terms of the subterranean basins which feed them, most of them belong to the eastern mountain basin; a minority belong to the western mountain basin (see Figure 1).

The large springs serve mostly for irrigation, and are concentrated in three areas in the Jordan Valley (Jericho, Farah, and Bardela). The remaining ones constitute the principal source for household water, through urban water companies.

The average annual supply of all of the fresh water springs in Judea and Samaria is about 50-60 million cubic meters. The flow of the brackish springs, which are not exploited, is about 40-50 million cubic meters per year.

In addition to the springs, there are today about 350 wells and drillings supplying water, and their output varies between a few cubic meters per hour to more than 250 cubic meters per hour (in isolated cases even more than 1,000 cubic meters per hour), according to the nature of the aquifer which the drilling taps.

Like springs, the water from drilling is used primarily for agriculture, especially in the regions of Qalqiliya and Tul-Qarm, Jenin-Qabatiyah, and in the Jordan Valley. [4]

Since the installation of water gauges for drillings is only in the early stages of implementation, there are no precise data on the quantity of water pumped in the region, but it is estimated to be 40 million cubic meters per year.

In Judea and Samaria, the upper runoff waters which drains into the many cisterns found in every settlement are also exploited. This water primarily serves household needs and livestock, but are also used as an aid in irrigation in small agriculture, located nearby.

Projects for catching the runoff waters and using it, on a large scale, such as is found in Israel, are almost non-existent. The few projects include the Solomon pools in Wadi Artas, which also collect flood waters in addition to spring water, and a number of small local dams which have been preserved from earlier periods. The reason for this is the high degree of permeability of the ground in the mountain region (except for limestone areas), the small amount of deposits to the east of the watershed, the relatively small drainage areas, and as a result the relative rarity of floods. In addition, there are also geo-engineering problems of locating such reservoirs.

As noted above, because of the lack of data, there is no possibility for determining the strength of currents, although early estimates of the amount of upper runoff, made on the basis of similar areas in Israel, indicate something on the order of 25 million cubic meters per year in the western basin and about 20 million cubic meters per year in the eastern basin, on a multiyear average.

Water Supply Systems and Their Maintenance

Today, there are more than 680,000 persons living in Judea and Samaria, with about 175,000 of them in cities, and the rest of them -- about 75 percent -- in 400 villages. This indicates the rural character of the region. Most of the population is concentrated along the mountainous bloc. The primary cities are located along the ridge, or near it, from north to south. They are: Hebron, Bethlehem, Ramallah, (Nablus), and Jenin. On the western slopes are the settlements of Qalqilyah and Tul-Karm, with Jericho in the Jordan Valley.

General exploitation of the water resources in Judea and Samaria is still undeveloped, and encompasses the use of only part of the available water. Just 30 years ago, most of the residents existed primarily on cistern water or poor springs, which supplied people and animals with drinking water, and only the leftover was used for irrigating limited areas. Today, there are dozens of water companies supplying household water in cities and large settlements. But the level of services in the region (such as water, electricity, and sewage) is still low, and even though in large cities are large segment of the population enjoys urban services, there are no such services in most of the villages of the area.

Organized irrigation systems exist only in three areas: in the Qalqilyah-Tul-Karm area; in the Dothan Valley (Jenin-Qabtiyah); and in the Jordan Valley -- between Bardala in the north and Jericho in the south.

The production of water and its distribution is regulated by water rights and various laws. The water laws which are in force in Judea and Samaria are Jordanian laws, and have not been changed. The origin of some of these laws is from the mandate period, such as the "Law for Protecting Public Water Works," from 1937, which was intended to protect designated areas for use of public water works, especially for household needs. Another law from 1938 is the "Law for Study of Water Resources" which enables the conducting of activities to discover water located "beneath the earth" and to even exercise eminent domain over land containing wells.[5]

Laws from the period of the Jordanian regime already deal with rules regarding the analysis of water, conducted according to special requests, but the implementation is not yet obligatory. As for supervision of the water supply, including the filing of petitions with the Minister of Public Works for a license to establish irrigation works, the law authorizes the minister to stop, change, or reduce the amounts of water for irrigation works, if there is insufficient water for the ordinary needs of the same region. Later laws (from 1966), whose purpose was to arrange "matters of natural resources" deal with the authority of the "Natural Resources Authority" to make decisions regarding everything related to allocation and use of subterranean and upper waters, and their development under the supervision of the Authority. Among other things, there is in the law a section prohibiting the "transfer of water out of a water basin," which means that the emphasis is on regional solutions only, in contrast to the Israeli conception of a national water system regulating the supply of water between regions, in accord with supply and demand.

The governmental authority is authorized to determine the maximum quantity of water to be supplied to land owners, in accord with the flow of springs and the scope of agriculture. The authority also has the power to supervise water, its supply, its distribution, and to fix its price, within the boundaries of regions and irrigation works, and to cut off the supply of water to agricultural units.

The requirment for the filing of a petition for a license to drill for and produce water from subterranean waters is found in the rules regulating subterranean waters from 1966. According to them, the deputy chairman of the Authority has the power to issue or withhold a license, in accord with his opinion as to the effect of the license on the subterranean waters, their quantity and quality, or if the license would impinge on the rights of other persons.

A special law was passed to regulate the supply of drinking water to the district of Jerusalem, from Ramallah in the north to Bayt-Sahur in the south. The purpose was to regulate water services for the residents of the district of Jerusalem of household use and urban needs.

To protect the quality of the water, a special law was passed prohibiting anyone "from polluting state waters or introducing into that water any polluting substance whatsoever, without written permission of ther authorities." [6]

In contrast to water law in Israel, in Judea and Samaria state ownership of water sources was never legislated. There is likewise no annual authorization of amounts of water to be produced, or limits on consumer use. At the same time, in recent years there has occurred an improvement in the Jordanian regime's supervision systems and measurement, without which there is no possibility of implementing the laws and regulations.

During the 1950's, the Jordanian regime conducted occasional measurements of larger springs in Judea and Samaria (in general, two measurements per year). In the early 1960's, with the increasing shortage of drinking water for residents of large cities -- Jerusalem, Shechem, Hebron, and Ramallah -- the Jordanian government began to conduct measurements with the aid of foreign factors, and to collect information on the upper and subterranean water sources in Judea and Samaria. For this purpose, the British engineering firm of Rofe and Rafferty C.W.A. of London was hired, and it conducted a survey of upper water sources, geological mapping, and hydrological studies for the location of subterranean waters. At the recommendation of this firm, since 1964 regular measurements have been made of the large springs with greater frequency (four times per year). There was also begun a measurement of the water table in wells, and a sampling of the water to test its quality. The output of large springs is now measured once a month by the Water Staff of Judea and Samaria. Water meters are also being installed now in all wells so that it will be possible to keep track of the amounts drawn from them. [7]

SUPPLY OF WATER FOR HOUSEHOLD CONSUMPTION

Household Rates of Consumption of Water

In eight cities of Judea and Samaria, and in a number of larger settlements, there are companies for supplying water, and they are generally owned by the municipalities. These companies are still supplying water to only a segment of the population, in spite of the fact that the number of consumers continues to increase.

Household consumption of water in Judea and Samaria is estimated today to be about 20 cubic meters per year, on the average, in contrast to 60 cubic meters per person in Israeli cities. The rest of the population obtains water for household consumption from cisterns or small springs found in settlements or nearby. Since there are gaps between the standard of living of the city and that of the village, there are substantial differences in the norms of consumption of the city and village. In 1968, consumption in the regions of Jenin and Qalqiliyah, where there are gardens next to homes, was estimated to be 80 literes per person per day, which is 28 cubic meters per person per year. In Hebron and Bethlehem, where there is much less intensive gardening, consumption was estimated to be 35-40 liters per person per day, which is 14 cubic meters per person per year. [8] In villages, consumption from bucket drawn wells was estimated to be 20 liters per person per day, which is about seven cubic meters per person per year. The estimated consumption per head of cattle is 25 liters per day, which is nine cubic meters per year, and 10 liters per head of sheep (about four cubic meters per year).

Since information on the development of consumption in the region is very limited, estimates and forecasts of the growth of consumption in villages are based on existing data from minority villages in Israel, while forecasts for cities are based on real current concumption there.

The growth of consumption depends upon both the natural increase of the population as well as the rise in the standard of living, which is expressed in the rise of the consumption per capita norms. Because of the similarity in the character of the populations, the level of services and the rate of natural increase, between the minorities of Israel and the residents of Judea and Samaria, it has been assumed -- for the purposes of forecasting levels of consumption in the region -- that the existing data in Israel can be adopted, both for population growth and consumption figures. In the five years of 1968-1973, the birth rate reached 2.8 percent in Judea and Samaria, and today it is 3 percent per year, as compared to 4 percent per year in Israel. [9] Since village consumption also includes agricultural consumption, the question arises as to how to determine what part is household consumption and what part is agricultural consumption.

Agricultural consumption of water in Arab villages in Israel is composed of two factors: one is the irrigation of cultivated land outside of the village, and the second is "Havarkir" which is the irrigation of plots next to homes.

On these plots, which are only a few dunams, the people raise primarily vegetables and fruit trees. Since the supply of household water also includes the water for the "khawakir," household consumption with the addition of the "khawakir" water in Israeli villages has reached, after 12 years, about 21 cubic meters of water per capita per year, or 60 liters per capita per day. The rate of increase of consumption in this period has reached 8 percent per year, on the average. From this, it can be concluded that in Judea and Samaria household consumption will increase, and within another 10 years it will equal 75 liters per capita per day, or 26 cubic meters per year.

In the cities of the region, the present average consumption is only 60 liters per capita per day. But on the basis of the linkage between the rate of rise in standard of living and the increased rate of consumption and the relation between these two factors in similar settlements in Israel, one may expect a twofold increase in consumption by 1985, or 120 liters per capita per day. It is on the basis of these assumptions that water works are being planned in Judea and Samaria today.

In spite of these forecasts, the data offered in Table 2 above shows that in the last eight years there has apparently been no per capita increase in consumption in Ramallah. In spite of the general doubling of consumption, it appears to have even declined a bit. On the other hand, losses in the water supply system of almost 25 percent of the supply have not been reduced. Since not all residents are hooked up to the urban water works, the computation has been made according to water measurements, and not according to population.

Table 2: Figures on Water Consumption in the Municipal Water Works of Ramallah

	Year	Total supply Cubic meters per month	Total consumption Cubic meters per month	Consumers Number of meters	Cubic Meters per consumer per month	Percent lost
1.	1966	52,000	40,000	3,000	13.3	23
2.	1974	105,000	80,000	6,500	12.3	24

Urban Water Works

Existing water works in the region are local and limited operations, generally for the primary cities and villages around them. These plants do not supply most of the consumption. In many parts of the cities and most of the villages supply still depends on cisterns and small springs.

In a survey made in July 1967 it was discovered that 95 percent of the consumers linked to the supply network were urban consumers and only five percent were village consumers. Since then, additional settlements have been linked to the network, but their number is still small.

Water works are distributed, geographically, into four secondary regions. These regions are different in their topographical character, in the spread of settlements, and in the direction of their roads. The character of the water sources also differs, accordingly, in each of the secondary regions as follows:

TABLE 3: OPERATIONS FOR SUPPLY OF WATER FOR HOUSEHOLDS IN JUDEA AND SAMARIA

Plant	Region	Year of Operation	Source of Water	Supply (cubic meters per hour)	Average annual supply (cubic meters)	Consumers	Notes
1. Samu'a	D	1964	As Samu drilling	35	150,000	Daharia, Samu'a, and Ya'ate	For the past three years, the Samu'a drilling has not been in operation, and consumers receive water from Hebron.
2. Hebron	D	1962	Three drillings at Al-Fawwar	150	850,000	Hebron, Halhul Kfar Etsion, Beit-'Gmar.	The operation was complemented for Hebron and Kiryat-Arba from the Herodion 1 and 2 drillings.
3. Bethlehem	F	1961	Bayt Fajjar drilling.	60	600,000	Bethlehem, Bayt-Sahur, Bayt-Jala	In summer, additional water is received from Jerusalem. The water is transferred through a 17 kilometer pipe.
4. Herodian	M	1968–1972	The two Herodian drillings.	240	250,000	Complements for Hebron, Kiryat Arba, and the region.	The two drillings belong to the government. In the winter only one drilling is operated. Output was doubled last year.
5. Ramallah	J	1964	Ain Samiya Ein Qinia, Ein Wadi-Dalba	200	1,250,000	Ramallah, Bira, Dir-Debuan, Silwad, Taiba, Ein Yabrud, Dir-Jarir, Ramon, Beit-Hanina, Beit Nabla, Bitin, Kfar Maliki, Jifna, Bir-Zeit, Bitunia, Jizlin, Ein-Suni'a.	Near the springs, in the vicinity of Ein Qinia, two wells were drilled, one deep and one shallow. Water is brought to settlements by mean os a long pipeline. A special law was passed by the Jordanians for the works, according to which it pays compensation to farmers for lost use of Ein Qinia water.

6. Shabtin	M	1933 1972	Shabtin drilling Ein-Zarqa	90 cubic meters/day 30	150,000	Shabtin, Shuqba, Budros Dir-Qadis, Kharbata, Qibia, Luban, Rantis, Abud, Dir-Abu-Mashal	Two of the works, Abud --Shabtin, operate together as a government company. Internal net-works distribute water among the villages. There are marked differences in water supply in winter and summer.
7. Abud	R	1960	Ein-el-Dilba Ein-el-Qartan	8-20			
8. Salfit	K	1968	Ein-el-Siba Ein-esh-Shamia, Ein Matri	15	50,000	Salpit	Drilling started in 1968.
9. Azzun	C	1964	Drilling	20	100,000	Azun	"
10. Qalqiliyah	J	1940's	Drilling	100	300,000	Qalqiliyah	"
11. Nablus	M	1962	Dir drillings Sharf 2,3.	120			
	Q	1971	Al-Badan drillings	200	600,000	Shechem and environs	Water is brought to reservoirs, and from there distributed by gravitation or pumps to homes.
	F		Ras-el-Ain, Ein-el-'Asal, Ein-Qaryun, Ein-Beit-el-'Alma, Ein-Difna	200			
12. Sabastiyah		1970	Ein-Naqura	15	50,000	Sebastia, Naqura.	
13. Anabta		1948	Two drillings	130	265,000	Anbata	The second drilling dates from 1975.
14. Burka		1964	Burka springs	10-15	50,000	Burka	Five springs whose water is collected in a cement reservoir, and from there distributed to homes in village of Burka.
15. Tulkarm	C	1930's	Three drillings	180	1,000,000	Tul-Kerm	The third drilling dates from 1975.

16. Tubas	J	1969	Par'o drilling 1	70	450,000	Tubas, Tiyasir, Tamun, Aqaba	
17. Dotan works		1974	Drilling	180	650,000	Jenin, Araba	Government operation supplying water primarily in summer months.
18. Jenin		1930's	Dug well	95		Jenin	
19. Ye'bad		1959	Drilling	13	50,000	Ya'abad	
20. Jericho	MG		Ein-Elisha (Sultan)	700 cubic meters/day	270,000	Residents of Jericho and environs.	The supply of 700 cubic meters per day is the same part of the flow designated for household consumption.

The Southern District: the hills of Hebron up to Jerusalem.

The Central District: the hills of Judea and Ephraim -- between Jerusalem and Shechem.

The Northern District: The hills of Samaria -- from Shechem in the south to the "Green Line" in the north.

The Eastern District: Jericho and the Jordan Valley.

A description of existing water works, their sources of water, their output, and the settlements linked to them, is presented in Table 3; their location is shown in Figure 4. In spite of the fact that there are no precise figures on the amounts of water supplied annually by each of the operations, it is estimated that they supply 6-7 million cubic meters per year. Likewise, it is difficult to estimate the number of residents linked to the supply network, and so it is impossible to estimate the percentage of consumers who enjoy the regular supply of water today. In order to estimate the present level of supply, one must compare the amounts supplied today according to estimates to the annual amount of 14 million cubic meters per year, which is the potential household consumption of the region, according to consumption norms in Arab villages in Israel, where there are water works which supply water to all residents.

It should be remembered that a large amount of water is still supplied today in the region from cisterns and small springs. But with the development of water supply operations, the use of cistern water is declining because their sanitary level is low. The principal use of cisterns occurs during the winter months and the beginning of summer. With the drying out of the cisterns in summer, the residents receive water from the supply system (in places where it exists). This situation causes insufficient use of the water works and high prices for water, because of the small number of hours of operation, and small output. For example: a cubic meter of water from the Ramallah water works costs the consumer 3.00 to 3.50 pounds (at 1974 prices).

AGRICULTURAL CONSUMPTION OF WATER

The region of Judea and Samaria is fundamentally agricultural, but because of the availability of water sources, which are relatively poor in quantity, their distribution over the territory, and the retarded development of the use of subterranean waters until recent years, irrigated areas are very limited -- only 100,000 dunams, or about 5 percent of the arable land, which covers 2 million dunams.

The primary crops grown under irrigation are citrus, vegetables, and bananas. Irrigation agriculture is concentrated in particular in the following areas:

Western Drainage Basin: Between Jenin and Qabatia, and in the Qalqiliya-Tul Karm district.

Eastern Drainage Basin: Jordan Valley, and the districts of Bardala, Par'o-Jiftlik, Awja, and Jericho.

About 50,000 dunams are irrigated from wells and 50,000 from spring water.

The irrigated areas which are concentrated in the western drainage basin are most if not all irrigated from wells only, while in the Jordan Valley there is a mix of spring water and well water.

Since there is no controlled measurment of consumption of water used in agriculture, obtained from wells and springs, the agricultural consumption of water can be estimated from the purpose of the water, the size of the irrigated area and the types of crops.

Estimates of the irrigation norms for a unit area, made on the basis of data from similar Israeli areas and on the basis of Jordanian data, are shown in Table 4, below:

Table 4: Estimate of Irrigation Norms According to Region(*) (Cubic meter per year per dunam)

Region	Citrus	Vegetables	Bananas	Deciduous Fruits	Vegetables Between Trees
1. Western drainage basin	800	600		800	1,000
2. Jordan Valley	1,000-1,500	700-800	2,000-2,100	1,300	

(*) These figures constitute the net consumption, to which should be added water losses, in keeping with the efficiency of the irrigation system.

Western Drainage Basin

In the regions of Qalqiliya-Tul Karm as well as northward in the region of Jenin-Qabatiya, the source of water for irrigation is almost exclusively from drillings which are fed by the upper cenozoic aquifer. These drillings produce about 120 cubic meters per hour, on the average. The principal crops are citrus, vegetables, and some bananas. The irrigated area in the western drainage basin is described in Table 5.

Table 5: Irrigated Area and Estimated Annual Consumption in the Western Drainage Basin

Region	Irrigated Area (in dunams) Citrus	Vegetables	Total	Estimated Annual Consumption (millions of cubic meters/year)
1. Attil, Zayta, Tul Karm, Qalqilyah Anabta	17,000	10,000	27,000	19.5
2. Jenin, Qabatiya	1,700	3,500	5,200	3.5
3. Total	18,700	13,500	32,200	23.0

Jordan Valley

The whole region of the Jordan Valley has been blessed with soil which is fertile and productive, and its water sources supply substantial amounts of water throughout the whole year, in a climate which is hot in the winter months. All of this has made the region a gigantic natural hothouse, which is especially suited to growing vegetables in the winter.

Region of Jericho

The irrigated area of Jericho is located in the southern portion of the Jordan Valley. The arable land is spread around the city itself, and close to the villages of Duyuk and Nu'eima. The boundaries of the district are: the Judean hills to the west; the Jordan River to the east; the Wadi Nu'eima to the north; and the Nahal Kelf (Qilt) on the south. The water sources include six springs which flow from a cenozoic aquifer, and supply water for the whole district. Two of them rise from the channel of the Nahal Qalat; one is Ein-Fawad, located about 10 kilometers west of Jericho, whose supply schedule is unstable. The second is Ein-Qalat, which rises about 7 kilometers west of Jericho. Their combined supply amounts to 3.5-4.0 million cubic meters per year, which is carried by canal to irrigate about 4,000 dunams of vegetables and bananas, to the south of Jericho.

In the area of Jericho, there are four springs, each of which supplies water for the agricultural land in its immediate vicinity:

Ein-Sultan -- it is the largest of the four, and it supplies drinking water for the residents of Jericho and vicinity, and its waters also irrigate about 3,500 dunams of land near the city. Its supply is rather stable throughout the year, and reaches 5.5 million cubic meters per year, on the average.

Ein- Duyuk -- it is the second largest spring, and its supply amounts to about 5 million cubic meters per year, on the average, and it irrigates about 3,000 dunams.

Ein-Nu'eima -- it is smaller than the preceding two and its output is about 2.2 million cubic meters per year, and it irrigates about 5,500 dunams, on a biennial cycle.

Ein-Shusha -- it is the smallest water source in the area, and its annual output is only about a half million cubic meters per year. Its water is used to irrigate a small area of 400 dunams, belonging to one man.

Additional sources of water in the area are from the subterranean waters, which are pumped from about 50 wells and drillings, belonging to private individuals, and are used to irrigate 4,000 additional dunams. All of the wells tap the pleistocene aquifer, and are no deeper than 100 meters. Their output varies between 20 and 70 cubic meters per hour. Their annual output of water is about 5 million cubic meters. Thus, all of the water available to this region from these sources amounts to 22 million cubic meters per year. [10]

The quality of the spring water is good for agricultural purposes, and for irrigating all types of crops, because their chlorine level does not exceed 30 milligrams per liter.

The area which is irrigated varies between 16,000 and 20,000 dunams, and it changes from year to year, in accordance with the cycle of cultivation. About 70 percent of the area is used for raising vegetables; about 25 percent for citrus, and about 5 percent for bananas and other trees.

The irrigation is based mostly on cement and dirt canals. The canal system, which is 110 kilometers long, is poorly maintained, and this causes the loss of substantial amounts of water, reaching 5-10 percent in the cement canals and 20-25 percent in the dirt canals. The total loss of water, from the spring to the cultivated land, can reach as high as 33-50 percent.

The distribution of water among farmers in the region is done according to a list of water rights, which are expressed in time units (hours and minutes). At Ein-Sultan, for example, there is an arrangement by which four farmers receive their water at one and the same time, with each receiving one quarter of the spring's output. At Ein-Nu'eima and Ein-Diyukh, each farmer gets his water supply according to the time allotted to him, in accordance with his rights.

Irrigation is done by means of meandering furrows. This method is the most used because of the manner of distributing water, which requires the farmer to absorb very large amounts (150-200 cubic meters per hour from Ein-Sultan and up to 700 cubic meters per hour from Ein-Diyukh). In order to control these quantities of water, he is forced to spread it out in a great number of long canals which are fed by the creation of meanders. This method is inappropriate for tilling land by advanced agrotechnical methods. The farmer receives a large supply of water in a relatively short period of time, and thus the efficiency of the irrigation is low. Also, the time between one watering and the next equals the length of a year, and is not based on a calculated water schedule, which depends on the season of growth and the needs of the plants.

An analysis of the water balance in the area indicates that in spite of the large quantities of water, there is insufficient water for agricultural needs throughout the whole year. The reasons for this are the poor condition of the canals; the varying consumption for crops while the supply by springs is fixed more or less, without any possibility for storage in reservoirs. [11]

In recent years, farmers have begun to use more advanced methods of irrigation, such as sprinklers or drops.

Irrigation Works of Awja-al-Tahta

About 10 kilometers north of Jericho is the neighboring village of Awja, in the heart of the Valley, which has been blessed with an abundance of water, fertile land, and a warm climate.

The water for irrigation in the village is mostly produced from the spring of Ein-Awja, and to a lesser extent from a number of privately owned drillings, from which small amounts are pumped to complement consumption during the peak months.

The annual output of Ein-Awja varies substantially from year to year, and ranges from one million to 25 million cubic meters. The average supply is 11 million cubic meters per year. Nine active drillings are fed from a pleistocene aquifer. The depth varies from 40 to 100 meters, and the output varies from 20 to 80 cubic meters per hour, with an overall production of about one million cubic meters per year. The chlorine content of the water ranges from 300 to 500 milligrams per liter. Out of a land potential of 15,000 dunams, only 4,000 dunams are tilled today, with the principal crops being vegetables (65 percent), bananas (25 percent), and citrus (10 percent). Water rights are divided according to the length of the flow in canals. Irrigation goes on day and night, and the water runs from one consumer to the next in a cycle of 8 days.

The undeveloped system of irrigation, which is mostly based on dirt canals, and to a small extent on cement canals, and which is poorly maintained, causes a loss of water and its inefficient use. Because of this, the amount of water is insufficient. The area under cultivation contracts and expands in accordance with the variations in supply by the spring. But the relatively small dimensions of the cultivated land are principally the result of neglect of the irrigation system, which todays losses about 50 percent of the annual supply of the spring. [12]

An additional source of water, which can help expand the irrigated area, is the surface water. According to reports by local residents, the stream carries large quantities of water in rainy years. But we possess no data on these amounts. Surveys made during the period of Jordanian control estimated the amounts of this water to be between 10 and 75 million cubic meters per year. On the basis of these estimates, the possibility was studied of building a dam on the stream channel, which would catch the flood waters on their way to the Jordan River and use them for an upper reservoir, or even a subterranean reservoir.

Because of the lack of geological and hydrological data regarding percolation, evaporation, the frequency of surface water, and the amounts of water, there is no possibility at this stage of determining the value of building the proposed dam.

Region of Nahal Farah and the Jiftlik

The region of Nahal Par'o, all along its length, is considered to be an agricultural region. In the irrigated fields of the upper springs of the region, in the area of the central springs (the vicinity of Al-'Aqrabania), in the small valleys of the banks of Nahal Farah, as well as in the wide valley of the region of the Jiftlik -- the principal crops today are citrus, vegetables, and bananas. In a survey of the irrigated fields of the Jordan Valley, which was made by means of aerial photography in 1967, it was found that all of the irrigated lands in the region -- about 24,000 dunams -- were watered by means of canals. [13] To

water the lands, the farmers of the Par'o use 19 million cubic meters of water per year, and this water comes mainly from springs (about 15 million cubic meters per year) and the rest from drillings.

The upper springs, Par'o and Bidan, are springs from the eocene level. The source of their water is the drainage of an aquifer of the Avdat group, which is in the sinclineal basin of Shechem. The average annual supply, inrecent years, from the Par'o springs has been about 8.5 million cubic meters per year, and from the Bidan spring about 4 million cubic meters per year. About 1.5 million cubic meters of this amount percolates in the upper part of the stream and constitutes part of the source of the water at the lower part. On the slopes of the valley, near the Nahal Par'o, there are four additional springs, which are fed by an aquifer of the Judea group. Ein-Abu-Salah, Ein-Maska, Ein-Shabli, and Ein-Ya'aqub constitute the natural exit for some of the subterranean waters which flow in the basin, and their general output is estimated to be 4 million cubic meters per year. In addition to these springs there are in this part of the valley another 20 drillings, which are fed from the aquifer of the Judea group. Their output ranges from 20 to 125 cubic meters per hour. The annual production amounts to about two million cubic meters. The quality of the water here varies from 40 to 150 milligrams of chlorine per liter. The irrigated area is 7,000 dunams, about 50 percent of which is used for growing vegetables and the rest for orchards and bananas.[14]

On the slopes of the basin, in the region of the Jiftlik, there are about 15 drillings, which draw from the eocene lime aquifer between 20 and 150 cubic meters per hour, or two million cubic meters per year. The quality of the water from the area of the Jiftlik varies from 120 to 140 milligrams of chlorine per liter in the north, to close to 1,000 milligrams of chlorine per liter in the south. The water from drilling is used to supplement the springs of the Par'o Valley, to irrigate 7,000 dunams of tilled land, mostly for vegetables and to a lesser extent for citrus and bananas.

Regions of Marj-en-Na'aja and Bardala

To the north of the region of the Nahal Par'o, there are another two regions of irrigated land. The southern one is the Marj-en-Na'aja, which includes about 5000 dunams of land for raising vegetables, and is watered by means of drillings which produce 2 to 3 million cubic meters per year. The more northern region of irrigated land in the Jordan Valley is the region of the Bardala, where there are 12 small springs whose output is 3 million cubic meters per year, with a quality of 60 to 120 milligrams of chlorine per liter. In addition to these springs there are another 10 wells whose annual output is about 2 million cubic meters. The water is used to irrigate 8,000 dunams in a cycle, mostly for vegetables.

Banks of the Jordan River

In addition to the areas mentioned above, there are spread all along the Jordan River, from north to south, irrigated fields of vegetables amounting to 10,000 dunams, which are irrigated directly from the Jordan River by mechanical means. The quantity of water pumped from the Jordan for this purpose is estimated to be 9 million cubic meters per year.

New Jewish Settlement in the Jordan Valley

In the Jordan Valley today there are 13 Jewish settlements -- some are still strongholds and some are agricultural settlements in the early stages of development. (see figure 4)

The water consumption of all of these settlements together is about 5 million cubic meters per year, and varies from 0.1 to 1.8 million cubic meters per year per settlement.

The water sources for these settlements are drillings which exploit the recurring annual inventory of water of the Jordan Valley. Today, there are no difficulties in supplying the consumption needs of the settlements, and there are still settlements which are unable to fully exploit the water potential which is at their disposal.

There are planned for this region 8 water supply plants, whose purpose will be to supply water for 13 existing settlement points and another 4 planned settlement points, or a total of 17 settlements. The irrigated area of these settlements is projected to be 53,000 dunams, of which 40,000 dunams have already been placed. The amount of water needed to irrigate these lands will be 53 million cubic meters per year, of which the plants will supply about 37 million cubic meters. [15]

The amounts of water and the irrigated land in the region of Judea and Samaria which are irrigated by various means, which have been established with the aid of surveys made over the last eight years, are shown in Table 6. On the basis of these figures it appears that 90 million cubic meters per year (without the water from the Jordan River), which constitutes 90 percent of all of the sweet water serving the general needs of the region, are being used in organized irrigation systems. As noted, the source of these quantities is the great springs of the Jordan Valley and the hundreds of drillings spread throughout the region. About six percent of this amount is devoted to household use, through urban waterworks, or through small springs which are used for both the household and for irrigating by traditional age old methods.

Table 6: Irrigated Areas and Agricultural Water Consumption in Judea and Samaria

Region	Source of Water	Estimated Consumption (cubic meters per year in millions)	Irrigated Areas (in thousands of dunams)
1. Jericho	Springs and wells	22	20
2. Awja	Spring	11	4
3. Farah Jiftlik	Springs and drillings	19	24
4. Marj-en-Na'aja	Drillings	3	5
5. Bardala	Springs and drillings	5	8
6. Jewish settlements	Drillings	5	5
7. Banks of Jordan	Jordan River	9	10
8. Jenin-Qabatia	Drillings	4	6
9. Tul Qabatiyah	Drillings	20	27

10. Total	98	109

(According to recent estimates by the Ministry of Agriculture, the irrigated land which is now under cultivation is no more than 80,000 dunams, and it no longer includes the banks of the Jordan River.)

SUMMARY

The use of water sources in Judea and Samaria still falls far short of the full exploitation of the water potential in the region. A large part of the population depends, even today, on cisterns and poor springs, which primarily supply water for people and animals, with what is left over being used for irrigation. The wells on the ridge of the mountains, where most of the population is concentrated, have always been very few because of the difficulties in digging and the relatively great depth of the water table. In fact, organized irrigation exists in only three regions: Qalqiliya-Tul Karm; between Jenin and Qabatiya; and in the Jordan Valley. In these regions, the surface of the subterranean waters is relatively high, and it is easier to use them. There are also springs there, and their supply is great and strong, throughout the whole year, so that they can be used for irrigation.

The amount of water in the whole region of Judea and Samaria which is available for efficient use today, from both springs and drillings, amounts to 100 million cubic meters per year. There is still potential to be tapped, principally in the eastern drainage basin, and it amounts to 150 million cubic meters per year.

In the western basin, the recurring inventory of water is mostly, if not completely, in Israeli territory, where it is exploited by means of many drillings and regional waterworks.

In Judea and Samaria, the development of water sources is directed mostly toward the expansion of urban waterworks, so that most of the population will receive its household water by means of these operations. On the assumption that the population will, in the next 10 years, grow to one million persons, a plan has been developed to expand the network of settlement waterworks. This will enable the maintenance of a level of supply suitable to the projected size of the population in 1985. The estimated amount of necessary water is 30 million cubic meters per year, which is almost five times the quantity supplied today.

An analysis of the situation of existing water sources shows that most of the supply machinery operates less than 22 hours per day, which means that they are being only partially exploited. There is also a substantial waste of water, because of the underdeveloped methods of irrigation used today, especially in the Jordan Valley. Thus, prior to developing additional water sources, there should be an effort to reach the maximal exploitation of existing water sources, including the efficient methods of irrigation.

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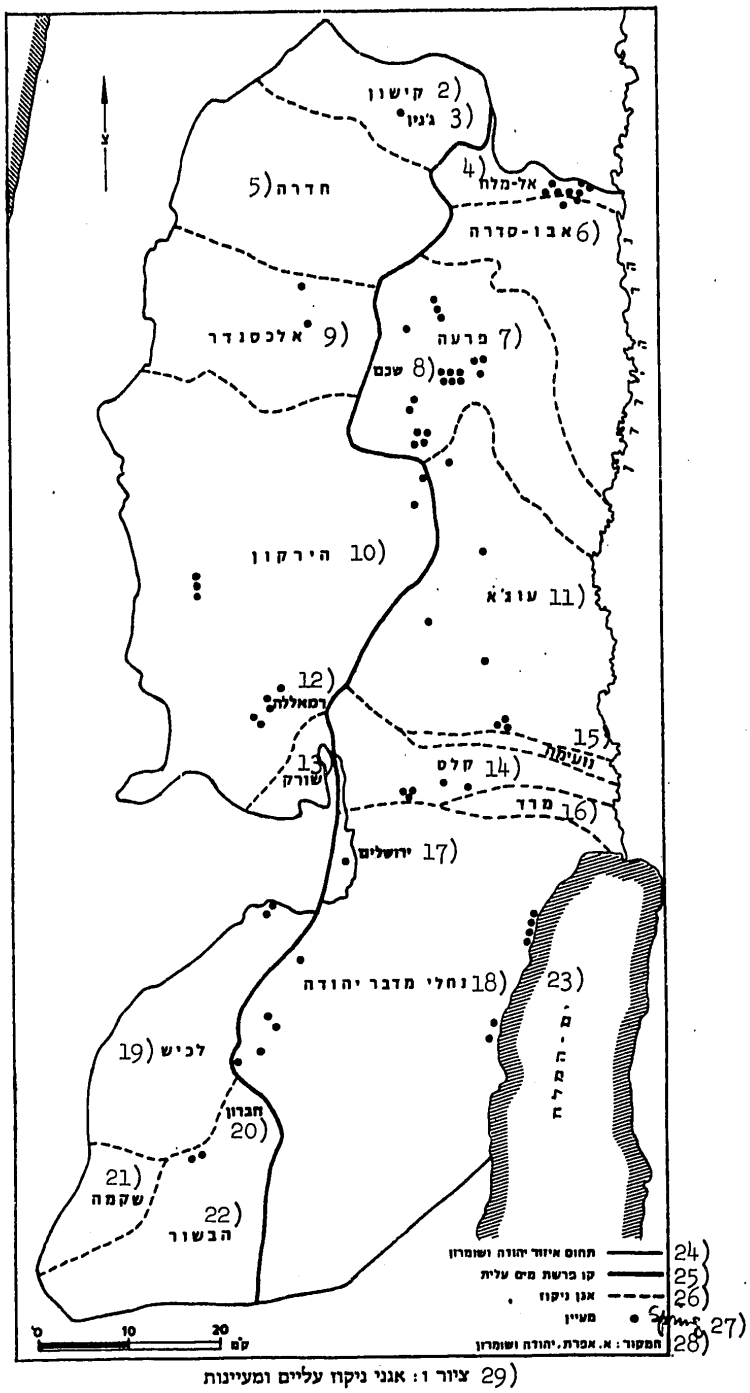
1) רקע פיסי והיסטורי



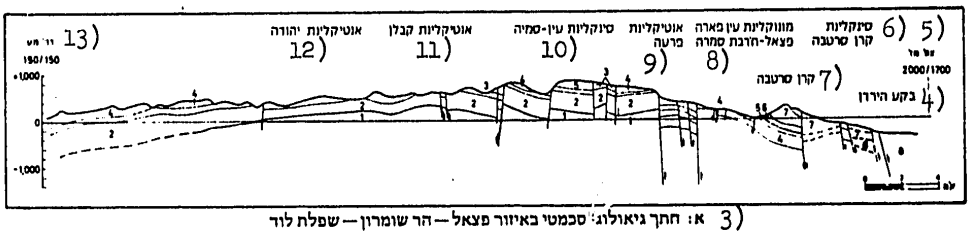
29) ציור 1: אגני ניקוז עליים ומעיינות

Key to Figure 1, page 35.

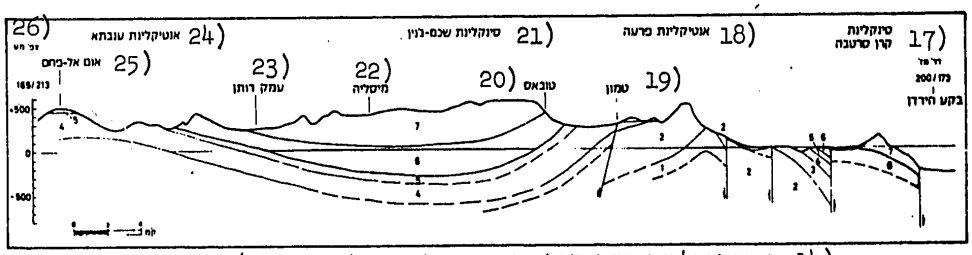
1. Physical and historical background
2. Kishon
3. Jenin
4. Al-Malakh
5. Khadera
6. Abu-Sadra
7. Par'o
8. Shechem
9. Alexander
10. The Yarkon
11. Awja
12. Ramallah
13. Shoreq
14. Qalat
15. Nu'eima
16. Marad
17. Jerusalem
18. Streams of Judean wilderness
19. Lachish
20. Hebron
21. Shiqma
22. Habasur
23. Dead Sea
24. Boundaries of Judea and Samaria
25. Line of upper water shed.
26. Drainage basin
27. Spring
28. Source: A. Efrat, Judea and Samaria
29. Figure 1: Upper Drainage Basins and Springs

2) רקע פיסי והיסטורי

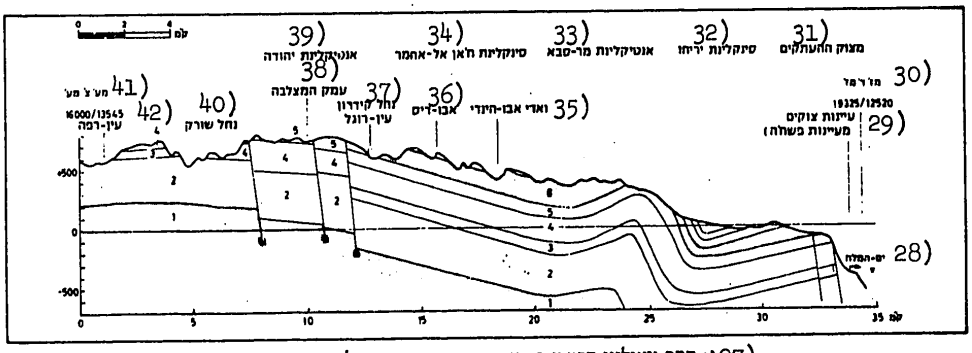
1) ציור 2: חתכים גיאולוגיים של האקוויפרים הראשיים



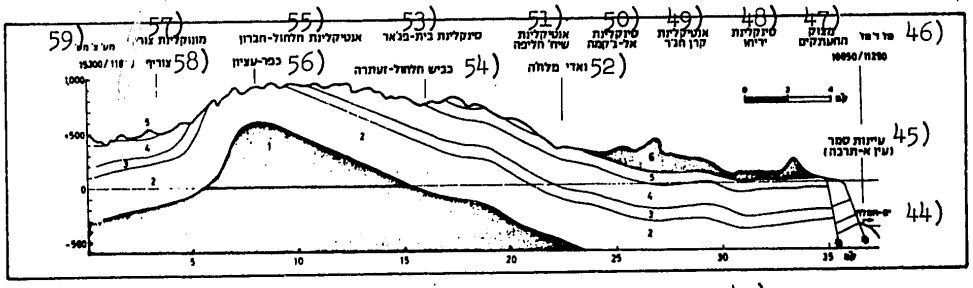
3) א: חתך גיאולוגי סכמטי באיזור פצאל — הר שומרון — שפלת לוד



14) ב: חתך גיאולוגי סכמטי באיזור עיינות צוקים — טובאס — עמק דותן — אום-אל-פחם



27) ג: חתך גיאולוגי סכמטי באיזור עיינות צוקים — ירושלים — עין רפה



43) ד: חתך גיאולוגי סכמטי באיזור עיינות סמר — כפר עציון — צוריף

60) מקרא

חבורת עבדת	8- קורטר — אקויקלוד או אקויפר מקומי	חבורת יהודה: 5- טורון — אקויפר; 4- קנומן עליון — אקויפר; 3- חוור מוצא•תצורת בית-מאיר — אקויקלוד
חבורת הר הצופים	7- איאוקן — אקויקלוד או אקויפר מקומי	
	6- סנון — אקויקלוד	חבורת כורנוב: 2- קנומן תחתון — אקויפר; 1- קרטיקון תחתון — אקויקלוד

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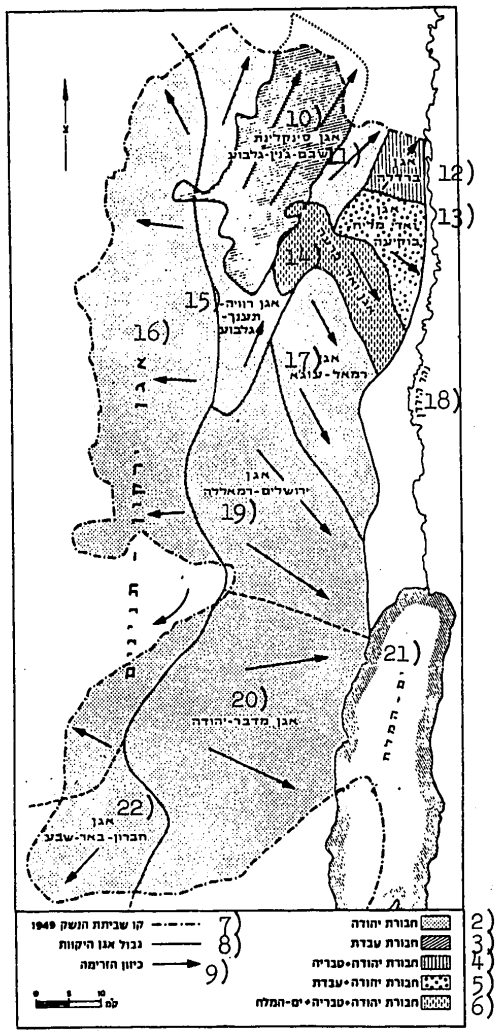
58. Tsureif
59. (cannot discern abbreviation)
60. Legend

	8- cretaceous-aquiclude or local aquifer
AVDAT GROUP	7- eocene-aquiclude or local aquifer
MT SCOPUS GROUP	6. filtration-aquiclude
	5. aquifer
	4. upper cenozoic-aquifer
JUDEAN GROUP	3. marl-Beit Meir formation-aquiclude
	2. lower cenozoic-aquifer
KURNUB GROUP	1. lower cretaceous-aquiclude



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17. Ramal-Awja basin
18. Jordan River
19. Jerusalem-Ramallah basin
20. Judean Wilderness basin
21. Dead Sea
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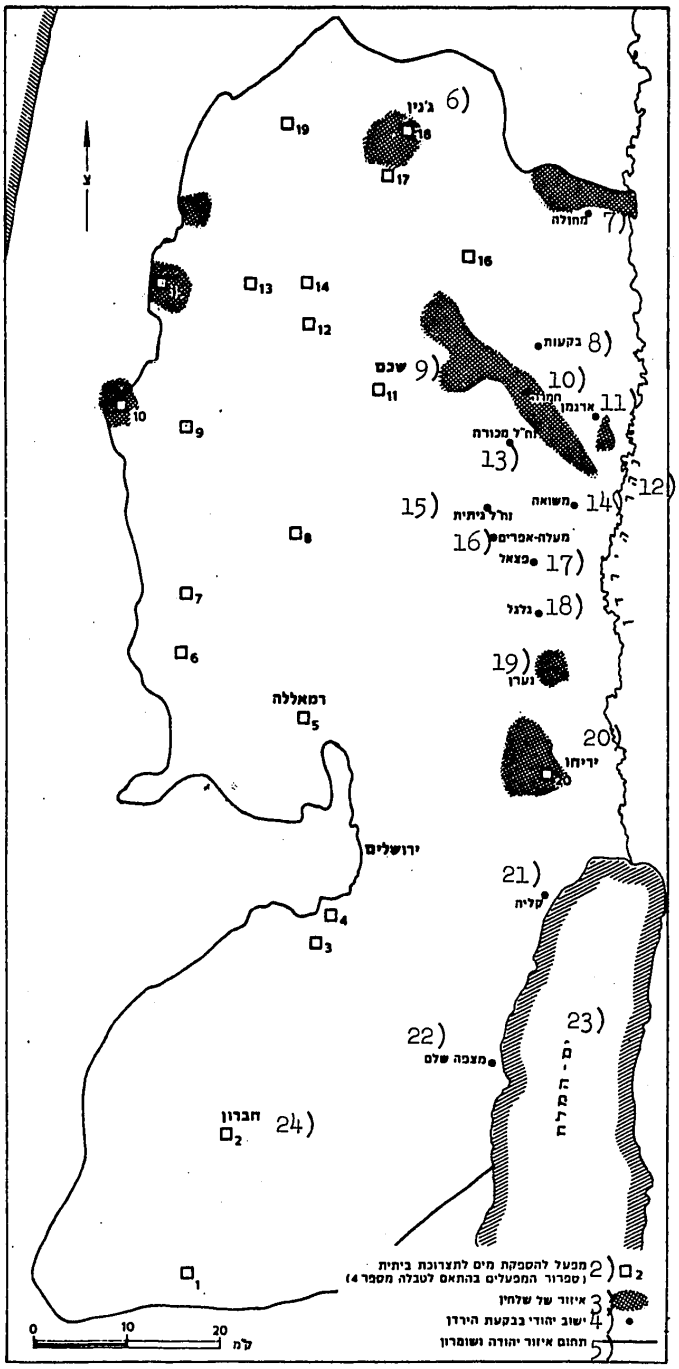

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18. Gilgal
19. Na'aran
20. Jericho
21. Qaliya
22. Mitspe-Shalem
23. Dead Sea
24. Hebron
25. Jerusalem
26. Ramallah

CSO: 4805

ISRAEL

PLANNING, DEVELOPMENT OF JEWISH SETTLEMENT IN JORDAN VALLEY

Jerusalem YEHUDAH VESHOMRON: PERAQIM BEGIOGRAPHIYA YISHUVIT [Judea and Samaria Studies in Settlement Geography] in Hebrew 1977 pp 630-638

/Article by Nahum Markovski of settlement unit of the Zionists Histadrut/

/Text/ Introduction

Presented in this article is a survey of Jewish settlement in the region of the Jordan Valley, and its composition. For the purposes of this survey, we define the Jordan Valley as a long and narrow strip of land stretching from the Beit-Shean Valley in the north to Ein Gedi in the south. The eastern border of the region is the Jordan River, and the western border is the line of the slopes of the mountains of Judea and Samaria, which on the east have almost no Arab settlement. This describes a region of very sparse population.

For purposes of regional planning, which is being done by the World Zionist Histadrut, the region (as defined above) is divided in two: the sub-region of the Adam district, including the area of the valley from Beit-Shean to the road between Jerusalem and the "Hugim" Bridge (Abdallah), and the sub-region north of the Dead Sea, which stretches from this road to Ein Gedi. This division is made because the character of the regions differs in terms of ecology, geology, climate, as well as the regional affect of "external" influences, such as Jerusalem and the Dead Sea. Since the planning of settlement for the two sub-regions is being done in relation to the two districts within the region of the whole Jordan Valley, the settlement will be discussed according to this division of the region.

BACKGROUND FOR SETTLEMENT

Entry into the Jordan Valley after the Six-Day War opened the way to the settlement of the region, which was sparsely populated but in the past had been settled. The settlement institutions began the task of planning settlements with the goal of populating the whole region with a Jewish population by means of establishing a system of rural agricultural settlements which

would be based on the ecological advantage of the comfortable winter climate, which permits the raising of winter crops without the necessity of protection or artificial care.

A rural agricultural settlement system depends by necessity on the traditional means of production -- land and water. Therefore, the spread of this system throughout the region depends first and foremost on the location of concentrations of land and the ownership of land, and to a lesser extent, of water resources. In addition, there are considerations of creating a network of settlements which avoid the creation of isolated blocs, or of settlements too far from one another. These considerations are the basis for the final decision on the location of settlements. In addition to determining the location of settlements, there is the necessity of determining the scope and spread of various basic systems (water projects, electric and telephone lines, roads, and the like). The quantities of land and water available for exploitation determine the potential of agricultural production of the region. A given number of family units for a settlement, and the quantities of land and water necessary to support such a unit bring into consideration the size of the settlement, and thus is determined the number of settlements to be created and developed in the region.

POTENTIAL OF THE AGRICULTURAL PRODUCTION SYSTEM IN THE REGION OF THE VALLEY

The process of settling the Valley is the result of a number of stages of planning. In actuality, the process of planning continues along with the implementation of plans. The development program for the district north of the Dead Sea was published in the spring of 1974, and the program for the Adam district was published in the spring of 1976. The significance of the development process for the scope of planned settlement in the region, and its composition, was that the estimates of the existing potential in the region changed in light of practical experience in the field, and so influenced the next stage of planning.

Areas of Cultivation

The land potential of the region is presently estimated to be 66,000 dunams owned by the state and suitable for cultivation. That is out of 150,000 dunams suitable for cultivation, located in the whole region (encompassing a total of 1.5 million dunams). It is not enough to locate the cultivable lands, but they must also be concentrated into contiguous blocks which can be cultivated by modern methods. Arable lands marked on the maps are contiguous blocs which can be agriculturally exploited, in accordance with the considerations listed above. Units of land which are cultivable in the Adam district are much larger than the concentrations of land in the district north of the Dead Sea. Of the total of 66,000 dunams, only 6,000 dunams are located in the district north of the Dead Sea. This is due to the physical structure of the district, where there is an extremely narrow strip of land along the coast of the sea, which is limited on its western side by the slopes of the Judean Desert (at a height of 250 to 375 meters above sea level).

There are larger concentrations of land in the Adam district. So, the location of settlements is influenced by the special factors of this district. The Adam district stretches from the Beit-Shean Valley to the approaches to Jericho. It is characterized by axis which run parallel from north to south: the Valley itself (between 200 and 250 meters below sea-level) and the slopes of the mountains of Judea and Samaria (between 0 and 400 meters above sea-level). These two longitudinal axes cut across an east-west axis which is the Nahal Tizah (Wadi Far'o). North of the Nahal Tirzah, the Valley is very narrow, while on the mountain slopes there are valleys which contain large blocs of arable land; the Buki'a is the largest of them (about 40,000 dunams). South of the Nahal Tirzah, the surface of the Valley widens, especially where the Nahal Tirzah empties, and in the Fasal Valley, as well as in the regions of the Nahal 'Aujah and Jericho. On the mountain slopes south of the Nahal Tirzah there are only isolated blocs of arable land, and they are relatively small. Most of the arable land in the Nahal Tirzah itself belongs to Arabs.

Water

The influence of water sources in the Jordan Valley on the location of settlements is less than the influence of land concentrations, because of the technical ability today to transfer water by means of pipelines from the source to the land to be cultivated. Yet the location of water sources (especially drillings) can affect the scope of the necessary basis for water projects, in order to bring water from the source to the field.

The water potential in the Jordan Valley is determined by the estimate of the recurring annual amount of water minus the amount of water used by Arab agriculture. The remainder available for use by Jewish agriculture is estimated at 42 million cubic meters per year. This is a conservative estimate, but it is the best estimate available today. The distribution of the water potential between the two districts is not equal; about 36 million cubic meters per year are located in the Adam district, while only 6 million cubic meters per year are found in the district north of the Dead Sea. Also, the quality of the water north of the Dead Sea is lower because of the higher level of salinity, in comparison to the Adam district.

In order to convert the potential of the agricultural means of production into settlement potential, one should examine the economic imperatives of the quantities of land and the water necessary for an economic (family) unit, and the social imperatives of the number of units necessary to maintain a settlement at a reasonable level of community life and public services.

To maintain an economic unit in the region, about 30 dunams of land are required, and about 30,000 cubic meters of water, on the mountain slopes, as compared to 35,000 cubic meters per year within the Valley (because of the higher evaporation within the Valley). Therefore, according to the existing quantity of land, it is possible to develop about 2,000 agricultural units, and according to the quantity of water about 1500 agricultural units. Because of the desire to spread out in the region to the maximum extent, settlements are being planned of a minimal size -- about 80 agricultural units per settlement. Given this data, it will be possible to develop within the region between 18 and 25 agricultural settlements, the low number based on the water potential and the high number in light of land potential.

This data shows the decisive limitation of developing a system of rural agricultural settlements in the Jordan Valley -- namely the factor of water. As long as it is not possible to increase this potential, the scope of development will be minimal. Today, a plan is being developed for exploiting the waters of the Jordan River, as well as drillings in areas which have not yet been investigated. But, for the realization of the program, it will be impossible to plan more than 18 settlements in the whole region.

SYSTEM OF SETTLEMENTS

In the analysis of the potential of the means of production, it was determined that it is possible to develop a system of 18 settlements which would be located near concentrations of arable land. Most of the points planned for settlements are today populated by Nahal settlements or by the first cadres of permanent settlements. Because of the unequal distribution of means of production between the two districts, about 15 settlements are planned for the Adam district with only three settlements planned for the district north of the Dead Sea.

The form of the settlement (kibbutz, moshav, or cooperative moshav) is determined by the character of the conditions of the land and water at each point, as well as the position of the settlement movement which is about to establish a settlement at the place. It should be kept in mind that while the settlement unit plans and develops the settlements, the settlement movements actually enlist the settlers. Therefore, the movements and the first cadres have a significant influence on determining the character of the settlement and the ways in which it will develop.

The settlers in the region are partly one time city dwellers, partly raised on agricultural settlements, and graduates of settlement youth movements. All of them are young couples, mostly with children, although there are almost no new immigrants in the settlements of the Valley. Most of the settlers on workers' moshavim in the region are people who were raised in agricultural settlements or having an agricultural background (agricultural school graduates), while on the cooperative settlements there are a larger number of settlers with no agricultural background.

Most of the sources of employment in the region are related to various branches of agriculture. On cooperative settlements there will also be industrial projects, crafts, and services, which is usual for veteran cooperative settlements in the rest of the country. The industrial development is intended to complement the income of the settlements and to supply complementary employment during the slow season (summer). In the future, settlements in the district north of the Dead Sea will engage primarily in tourist and recreational services. This is because of the limited potential of the agricultural means of production in the area, and because of the potential of the sea and its coast for the development of tourism. The average income per family is planned to be 60,000 pounds per year gross, at April 1978 prices.

The organizational models of the settlements, and their economic structure more or less overlap the recognized models in the rest of the country, even though in the future there will be plans for less conventional settlements in the region, such as industrial villages. Since agriculture is seasonal, and the scope of employment varies, employment in settlements can be planned by the addition of industry or crafts which will absorb the settlers who are temporarily laid off od agricultural work.

System of Settlements in District North of Dead Sea

The planning data and the development potential of this district differ from that of the Adam district. This district has a lower potential in terms of arable land and water. Yet, the Dead Sea itself has a great potential for the development of tourism and recreation.

Today, in the whole district there is one Nahal settlement -- Mizpeh-Shalem. Recently, kibbutz Almog was established, to replace Nahal Qaliya, and another kibbutz is planned. Mizpeh-Shalem, which is today a military settlement, will become a civilian permanent settlement.

Below is a summary of the planned development of the district north of the Dead Sea:

a. three agricultural settlements having at their disposal a total of 5,000 dunams of land and six million cubic meters of water per year; they will be based on animal husbandry, tourism, and recreation.

b. two tourist centers on the shore of the Dead Sea: one at Qaliya, and the second at the point where the Nahal Daraja empties (a tourist and health center). These two points will include a great variety of activities and tourist and recreational facilities, beginning with a nature preserve and ending with a concentration of hostel facilities and accompanying services of a high quality.

c. the establishment of a residential and service center which will include public service facilities for the settlement, and housing for those employed in the tourism and recreation enterprises of the district.

d. The development of a system of hiking trails on the level of those in the Judean Desert and the Hyrcania Valley.

e. The development of a regional base, including electricity, telephones, water, and roads, to make possible the application of the overall development plan.

f. a district population planned to be 450 families in three kibbutzim and 1,600 families at the Daraja center. In all there will be 10,000 persons. About 600 workers will be employed in agriculture, while 4,500 workers will be employed in regional services, tourism, and recreation.

Table 1: Settlements in the Adam District in the Jordan Valley Region

Settlement	Stage of Development	Form of Organization	Notes
1. Makhula B	Planned	Workers moshav	Land has not yet been concentrated, and water not yet supplied.
2. Makhula	Existing	Collective moshav	Presently 40 families and a metal working plant.
3. Beka'ot B	Planned	Collective moshav	Land has not yet been concentrated, and water not yet supplied.
4. Beka'ot	Existing	Workers moshav	There is a need for added land and water.
5. Khamra	Existing	Collective moshav	Large concentration of land around settlement.
6. Argaman	Existing	Workers moshav	First 20 houses under construction.
7. Makhora	Planned	Workers moshav	Nahal settlement.
8. Mashu'a	Existing	Workers moshav	Temporary buildings.
9. Gitit	Planned	Workers moshav	Nahal settlement. There is a need for additional 500 dunams of land.
10. Patsel	Existing	Workers moshav	40 permanent houses under construction.
11. Tomar	Planned	Workers moshav	Planned settlement.
12. Gilgal	Planned	Kibbutz	Temporary structures and an assembly plant for water sprinklers.
13. Nativ-Hagdud	Existing	Workers moshav	Under construction.
14. Kibbutz B	Planned	Kibbutz	Will be based on existing Nahal Na'aran.

REGIONAL SERVICES AND INTER-VILLAGE SYSTEM

Regional services include community services (such as education and health), consumer services (such as shops and a market), and economic services (such as agricultural projects, supply of materials, cultivation, and marketing of produce). In the rural agricultural area, this matter is of the highest importance, because the settlements have a small population which is unable to supply the services and installations at a level which is worthwhile (in terms of the level of efficiency of the installation in relation to the consuming public). Therefore, service facilities which cannot be located within settlements will, because of their high value, be located at inter-village centers, which serve as both physical focii as well as focii for activities, and constitute the whole basis of the inter-village system of the region. In the Valley, there is a need for planning such settlements as these.

The types of services and installations needed within the rural settlement system, according to the level of supply of services, and in accordance with the threshhold of worth, are presented in Table 2, below:

Table 2: Distribution of Communal and Consumer Services According to Their Area Hierarchical Level (Function Which is Planned to Exist At This Level)

Service	Level of Settlement	Level of Bloc	Level of Region
1. Kindergarten	x	-	-
2. Primary education	-	x	-
3. Secondary education	-	-	x
4. Nursing and child care	x	-	-
5. Physician and general clinic	-	x	-
6. Ambulance	x	-	-
7. Cultural hall	-	x	-
8. Sport clubs and fields	x	-	-
9. Market	x	-	-
10. Shops and workshops	-	-	x
11. Administration	x	-	x

In general, there will be included within the settlement itself the public services which require a high level of accessibility, and which in terms of their size have a low level of efficiency. Because of this, day care and kindergarten centers will be established within the settlements. Within the settlement there will be a need for a nursing room to deal with emergencies and to engage in daily medical care at the instruction of a physician. Youth clubs and sport fields, a market and secretariat, all of these are services needed at the level of the isolated settlement, because of the great need for these services as well as because of their low threshhold of value.

At the level of the settlement bloc, there is a need for primary educational services, a clinic, and a cultural hall. According to the norms of the Ministry of Education, an optimal elementary school contains three parallel classes for each of the grades, which are six, yielding a total of 18 classes. According to the norm of an average of 30 pupils per class, the elementary school would serve a population of 540 children. In the Israeli village, the age group of the elementary school comprises 16 to 25 percent of the total population. There would thus be needed a population of 2,000 to 3,000 persons in a settlement bloc of five to seven settlements.

At the level of the settlement bloc, it will also be necessary to supply the services of a physician and a clinic. According to the norms of the Ministry of Health and Kupat Holim, one physician is needed for every 2000 people. In general, a physician in a bloc clinic is assisted by a nurse and two aides. There are two methods for supplying health services at the bloc level. One is the network method -- where the physician and his aides visit the settlements within the bloc at regular times. The other is the concentration method, where residents of the bloc visit the physician at the clinic in the center of the bloc.

Additional health services, such as radiology, will in general not be supplied at the regional level, but rather in a nearby city. The gynocologist is an exception, since in general there is a constant need for his visits, once or twice a month, at the bloc clinic.

Secondary educational services, administration (regional council), shops, and workshops, etc are, to a certain extent, exclusive services appropriate at the regional level only. A secondary school is planned to serve a population of 5,000 persons, and can serve up to 10,000. Thus, this service is needed only at the regional level.

Types of economic services needed according to the appropriate level of supply are presented in Table 3, below:

Table 3: Distribution of Economic Services According to Hierarchical Level

Service	Level of Settlement	Level of Bloc	Level of Region
1. Fertilizer and seeds	x	-	-
2. Mixture	-	-	x
3. Fuel	x	-	-
4. Citrus packing house	-	-	x
5. Date packing house	-	-	x
6. Thatching	x	x	-
7. Garage	x	-	-
8. Tractor and tool repair	-	x	-
9. Administration	-	-	x
10. Gas station	-	-	x

In contrast to public services, most economic services should be supplied at a level above that of the settlement, especially at the regional level. At the same time, there are a number of services, such as thatching and repair of tools which are needed at the bloc level. In reality, it is more difficult to determine the appropriate level of supply of economic services as opposed to the level of community services, since there is no agreement by the experts in this area, as there is in the area of community services. There is no doubt that economic service installations are needed even at the regional level, and that the regional level is preferable, in general, in terms of both the consuming public as well as the scope of necessary investment. The reason for the lack of agreement lies, to some extent, in the dynamic of technology and the differences between the needs and competitions of various economic units.

LOCATION OF SERVICE INSTALLATIONS

The most desired location of service installations, from the point of view of the settlers, is within each of the settlements. Yet, in terms of efficiency, it is necessary to concentrate these services at centers. Therefore, the solution to the problem of location is a compromise between high accessibility for settlements, in terms of travel time, and the number of centers which can be developed in accordance with the efficiency of the services which they must supply.

Adam District

The determination of the number of centers necessary for the Adam District, and their location, is a very complicated problem in comparison to the district north of the Dead Sea, because of the larger scope of settlement in the Adam District.

Because of the scope of settlement, there is justification for establishing in this district a bloc center for settlement concentration of five to seven settlements. In light of the plan to establish 15 settlements in the Adam District, two bloc centers are needed, in which will be located agricultural, consumer, and economic services. Other regional services beyond the bloc level will be located at one regional center. At the same time, one must take into account a number of compelling factors which will influence the location and development of inter-village centers:

a. The desire to save high expenditures in establishing a foundation.

b. The desire to avoid the development of "silent" centers instead of populated centers, so that the center will not be abandoned at night and so that the foundation will be fully exploited.

c. A solution in finding housing for those service workers who are not members of settlements.

d. Determining the location of the center in relation to the settlements which it serves.

e. The location of the center at a point where the climate is comfortable, especially in regions where the harsh climate constitutes an important factor in daily life and activities.

f. The need for services in the early stages of development does not suit the final distribution planned for needed services at the stages of complete development.

g. The desire to prevent ecological problems created by the location of economic facilities next to residential concentrations, or non-economic facilities.

The solution to the problems of location, while dealing with the factors listed above, was achieved by building a simple gravitational model, which enabled the quantitative handling of data and compelling factors, and led to a general solution of the problem.

The process of planning and the details of the model will not be outlined here. They appear in "The General Regional Development Plan for the Jordan Valley Region," which was published in the spring of 1976 under the aegis of the Settlement Unit of the World Zionist Histadrut.

The planned inter-village system of centers according to this model appears on the map of the regional system. The planned inter-village centers in the region are:

a. Community and consumer services center at Ma'ale-Efraim, which will serve as a regional center and a bloc center for the southern half of the Adam District.

b. The center for economic services, close to the monument for the IDF fallen in the Fatsel Valley, which will serve as a regional center and a bloc center for the southern half of the Adam District.

c. A bloc center for community and economic services near the moshav Khamra, which will serve the northern half of the Adam District.

d. A residential concentration at Ma'ale-Efraim, intended for those employed in regional services, who are not members of settlements.

This solution is outstanding in the number of characteristics which coordinate the planning data and the compelling considerations, as follows:

a. Only three, instead of the proposed four, centers will be developed.

b. The Ma'ale-Efraim center will be populated, and the two "silent" centers will be close to populated settlements.

c. The residential concentration for those employed in services, at one point will lead to the creation of an additional settlement of the size of an agricultural settlement.

d. The separation of economic service installations from community and consumer service installations will avoid ecological problems.

e. The regional community service installations and the limited bloc installations for these services will be located at a point 400 meters above sea-level, in a place where the climatic conditions are good, relatively, in comparison to other points in the region. The location of the residential concentration for service employees allows a comfortable climate and the separation of economic service installations.

f. The marginal added cost of locating centers slightly to the south of the geographical center of the region is more than covered by the benefit of locating the point where climatic conditions are more comfortable, the savings in foundation, and the separation of public, consumer, and economic services.

g. Because of the more rapid rate of development forseen for the southern half of the Adam District, it will be possible to develop there installations for bloc services which will serve the whole district, until the population of the northern half of the district will increase to a size which will justify development of the Khamra center.

The District North of the Dead Sea

Location of the service center in the district north of the Dead Sea is simpler than in the Adam District, because of the smaller number of settlements planned for this district and because of the greater population concentration planned for the residential center, intended for tourism and recreation workers near the Nahal Darja. The general service center will be located near this residential center, to ensure at least community and consumer services.

It is assumed that the inclination of kibbutzim to develop a substantial part of the economic service installations among farming enterprises will motivate them to do this as well in this district. Services which cannot be developed in the isolated settlement, because of the high cost, will be taken up by kibbutzim outside of the region -- in the Jerusalem region, the Arava region, or the Adam District in the Jordan Valley.

THE REGIONAL FOUNDATION

Today in the Jordan Valley there is a developed network of roads which will be appropriate to the needs of the region even in the stages of full development. At the same time, the link between the region and the national road system should be improved, and the settlements of the region should be linked up to the national electrical and telephone grids. Additional water projects will be developed (in particular by drilling), in order to supply water for agricultural and household needs. It is to be noted that the high tension line has already been strung along the Adam District, and the highway on the slopes from Khamra south to the Jerusalem highway to Jericho was, at the time of this writing, in the stage of implementation.

NATURE, LANDSCAPE, AND ANTIQUITY SITES

The image of the Jordan Valley as a wilderness is not in accord with reality. In the Jordan Valley there is an abundance of unique flora and fauna. There are also in the region many beautiful landscapes and many antiquity sites which attest to the ancient settlement of the region.

In addition to the development planned for the region north of the Dead Sea which will be based on the Dead Sea and its coast, there is also a proposal to declare a number of nature and landscape preserves and to establish animal and bird sanctuaries throughout the region. The development of nature and landscape sites will attract tourists and hikers to the region and create additional sources of employment at the tourist and recreational installations planned for the Dead Sea coast. The proposed preserves are shown on the map of the regional system and the use of lands.

Summary and View of the Future

The new Jewish settlement in the Jordan Valley region is a return to a region which in the past was a focus of an active and vibrant Jewish settlement. The settlement system, both existing and planned, will encompass a population of 20,000 persons -- half in the Adam District and half in the district north of the Dead Sea. The agricultural development of the Jordan Valley will contribute to the independence of the Israeli economy in food production and will enable the export of agricultural produce which ripens early in the mild winter of the region. The development of tourism will attract many tourists and hikers to this region which is rich in historical sites and beautiful landscapes.

The Jewish settlement of the Jordan Valley will create a continuity between the northeast and the center and south of the country. This will increase the accessibility of the center to regions which were far from it in the years before 1967. Added importance of Jewish settlement in the Jordan Valley is that it will create a Jewish buffer between the two large concentrations of Arab population in the hills of Samaria and Judea and the Transjordan. Two international roads pass through the region of the Valley and link the two concentrations of Arab population on both sides of the Jordan: Shechem-Nahal Tirzah (Wadi Pharoah), the Adam bridge and the Jerusalem-Khugim Bridge (Abdallah).

These facts are of very great political and security significance. The new reality in the Jordan Valley enables the creation of a contact between the activities of the Jewish sector and those of the Arab sector, a contact which in the future will contribute to peace and progress throughout the whole area.

APPENDIX A

CONSIDERATIONS IN DETERMINING CENTERS

Stage A Solution - Regional

The central places in the whole region, according to the length of an average trip in minutes (at a speed of 60 kilometers per hour) are:

Place	Length of trip	Deviation from average (%)
1. Khamra	22	52.3
2. Mashu'a	19	31.0
3. Patsel	18	56.1
4. Tomar	19	61.1
5. Netiv-Hagdud	20	61.9
6. Hajiftliq	20	26.8
7. The monument	18	24.0

Thus, the most central spot in the Valley is the monument to the IDF fallen, near the moshav Patsel.

Stage A Solution - Bloc

The central places in each of the two blocs are:

Khamra bloc: Moshav Khamra - a trip of average length of 7 minutes.

Patsel bloc: the monument; (Shlomit) Patsel, Tomar, Netiv-Hagdud -- a trip of average length of 11 minutes. Thus, the optimal center location for the Khamra bloc is nearby moshav Khamra. In locating the center of the Patsel bloc, the monument was preferred, in light of considerations mentioned above.

Stage B Solution - Khamra Bloc

After determining the most central point in the Khamra bloc nearby moshav Khamra, in light of considerations noted above, the installations for bloc communal and economic services were then located there.

Stage B Solution - Patsel Bloc

The central place in the bloc -- the monument -- meets all of the criteria for the bloc center of the Patsel bloc, as well as those of the regional center. But the climate is harsh. Therefore, the community service installations for the Patsel bloc and the whole region were not located there, but should be located at a community service center in a more comfortable place. In spite of this, the monument is the appropriate place for the economic center for the Patsel bloc and the whole region.

Stage C Solution -- Patsel Bloc and Regional Center for Community Services

Alternative points in the center of the region, where the climate is more comfortable, are noted in the following table:

Place	Average length of trip	Grading	Deviation from Average(%)	Grading	General Grading
1. Khamra	22	1	52.3	4	5
2. Mekhora	26	4	38.7	2	6
3. Gitit	24	3	35.3	1	4
4. Ma'ale-Efraim	23	2	45.5	3	5

Of the settlements listed above, Mekhora should be removed, because the traveling time to it is the greatest. Gitit is closer to Ma'ale-Efraim and there is almost no difference in these points. The choice remains between Khamra and Ma'ale-Efraim-Gitit. It is clear that Khamra cannot serve as the bloc center for the Patsel bloc. Ma'ale-Efraim is more central to the settlements of the Patsel bloc than Gitit, and thus it is chosen as the center for community services for the Patsel bloc and for the regional level of the region as well. This center will be populated, and will include the housing for those persons employed in regional services, so as to provide them with comfortable climatic conditions in proximity to their place of work.

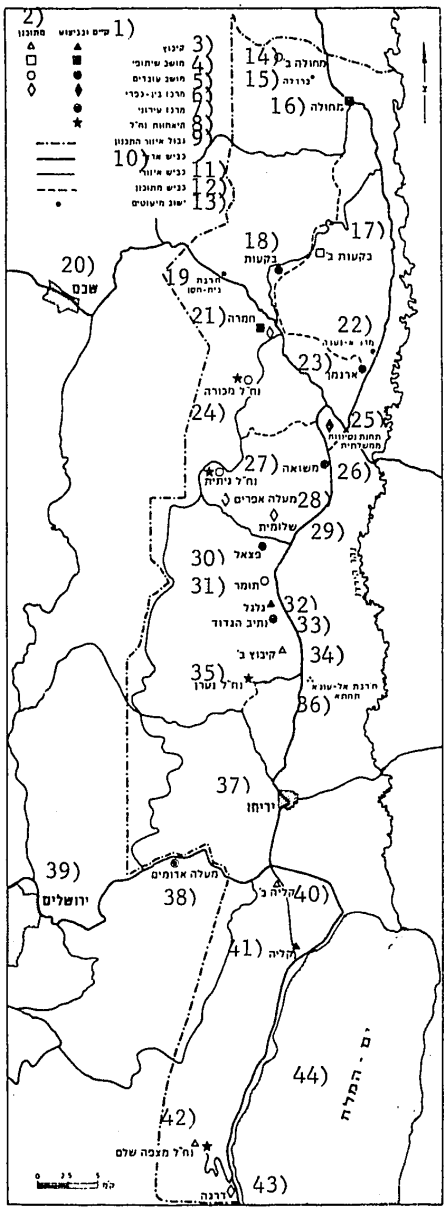
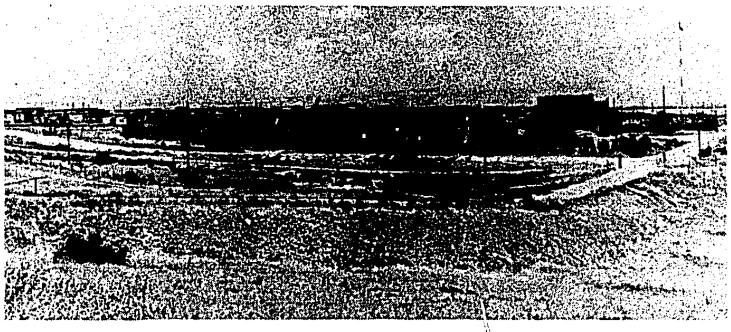


Figure 1: System of settlements in Jordan Valley

[Key on following page]

Key:

1. Existing and in execution
2. Planned
3. Kibbutz
4. Cooperative moshav
5. Workers moshav
6. Inter-village center
7. Service center
8. Nahal settlement
9. Planned regional border
10. National highway
11. Regional highway
12. Planned highway
13. Minority settlement
14. Mekhola B.
15. Bardela
16. Mekhola
17. Beka'ot B
18. Beka'ot
19. Khirbet Beit Hasan
20. Shechem (Nablus)
21. Khamra
22. Marg-ez-Za'ana
23. Argaman
24. Nahal Mekhora
25. Government Experimental Station
26. Masho'a
27. Nahal Gitit
28. Ma'ale-Efraim
29. Shlomit
30. Patsel
31. Tomar
32. Gilgal
33. Nativ-Hagdud
34. Kibbutz B
35. Nahal Na'aran
36. Khirbet el-'Auja Takhta
37. Jericho
38. Ma'ale-Adumim
39. Jerusalem
40. Qaliya B
41. Qaliya
42. Nahal Mizpe Shalem
43. Darja
44. Dead Sea



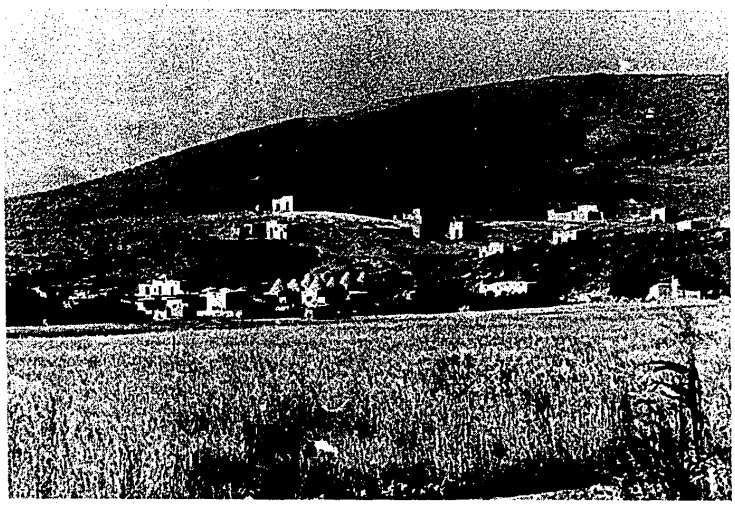


Figure 2 - Mekhola - General view
Figure 3 - Mekhora - General view
Figure 4 - Marj-en-Na'aja

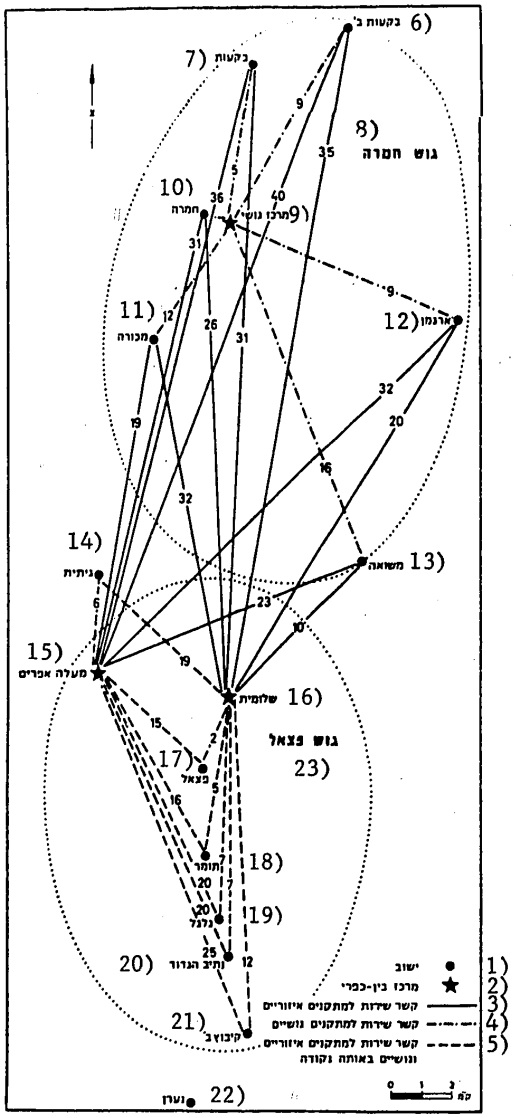


Figure 5: Khamra-Ma'ale-Efraim-Shlomit Bloc Center

[Key on following page]

Key:

1. Settlement
2. Inter-village center
3. Service link to regional installations
4. Service link to bloc installations
5. Service link to bloc and regional installations located at same point.
6. Beka'ot B
7. Beka'ot
8. Khamra bloc
9. Bloc center
10. Khamra
11. Mekhora
12. Argaman
13. Mashó'a
14. Gitit
15. Ma'ale-Efraim
16. Shlomit
17. Patsel
18. Tomar
19. Gilgal
20. Netiv-Hagdud
21. Kibbutz B.
22. Na'aran
23. Patsel bloc.

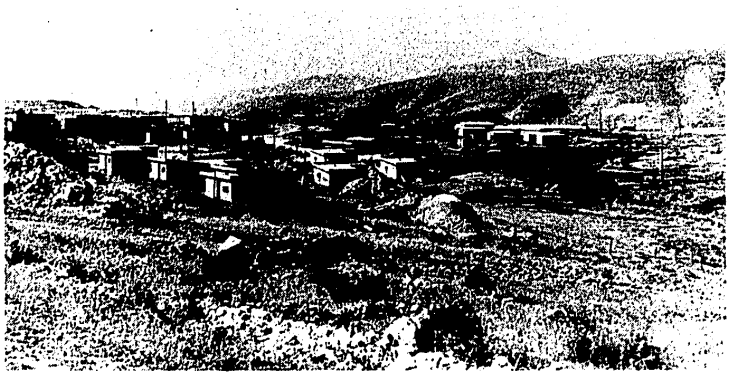


Figure 6:- Duma - a typical mountain village on approach to Samaria

Figure 7: Argaman - general view

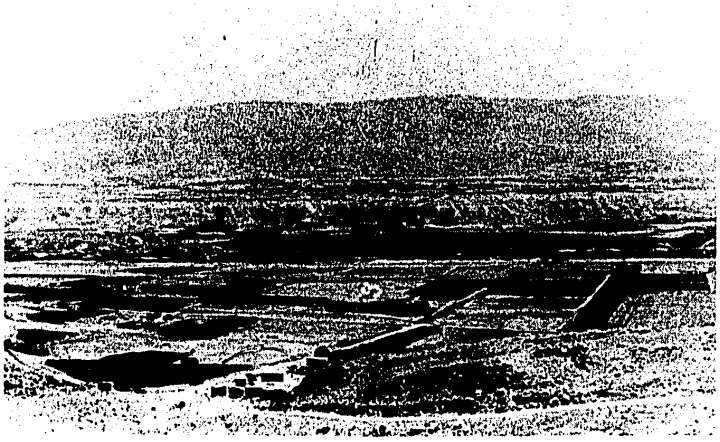


Figure 8: Argaman - View of the fields, from west to east

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