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# SOCIO-ECONOMIC IMPACTS OF SUPPLYING WATER AND ELECTRICITY TO THE GAZA STRIP REGION

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## Opening Remarks

The study presented hereby is a first step in an effort to propose an economic solution to a problem that has the potential of adversely affecting the Egypt-Israeli relations and the peace of the Middle East as a whole in the long run. The political solution to the status of the Gaza Strip is an essential part of a true normalization of the relations between Egypt and Israel.

At the moment the gravity of the political situation in the Gaza Strip is at least partially the result of its deploring economic conditions. Fitting a political solution to the Gaza Strip will be a much more feasible endeavor if the population will be satisfied and prosperous, at least in the economical sense.

This study is one part of a broader plan that envisages large scale co-operation between Egypt, Israel and the Gaza Strip. The cooperation is intended to revolve around the construction, operation and utilization of a large scale power plant that will produce significant amounts of electricity and desalinated sea water.

Succumbing to time and funds limitations we have decided to limit our study to the Gaza Strip, which is - in our opinion - the most immediate part of the problem, hoping to enlarge it to its full scale in the not too distant future.

It is quite obvious that the success of such a project is very much dependent on the open mind and the open hand of many who declare themselves as cherishing the peaceful coexistence of all countries in the region.

The European countries can add significantly to the success of the project by alleviating the protective barriers prohibiting agricultural products from this corner of the Middle East from entering their markets. The Gulf states could help their Palestinian brothers by opening their markets to the products of this new endeavor. In this way a project designed on economic criteria would become a probe to the willingness of various stakeholders to sacrifice, albeit moderately, for the quenching of the most burning issue on the way to a regional peace.

We have the pleasant obligation of thanking Mr. Fabian Kolker of Baltimore, Maryland for contributing generously to the funding of this study. Without this contribution the study would have never taken place.

[redacted]

Prof. Baruch Raz
Director of ICTAF

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**ACKNOWLEDGEMENTS**

The present study is first and foremost the outcome of an idea advanced by Prof. Baruch Raz and Prof. Gideon Fishelson from ICTAF. It could not have been realized without the foresight of Mr. Fabian Kolker, of Baltimore, who supported it morally and financially from beginning to end. The technical aspects of power supply and model planning relied on two excellent teams of researchers, one comprised of Shai and Ishai Sepharim (developers of the Morphologic Box model) and the other, an R&D team of the Israel Electric Corporation led by Dr. Dan Weiner and Dr. Adrian Biano. Chapter B of the present study is largely based on the IEC's paper (Annex I), and chapters C and D rely on the analysis in Ishai Sepharim's paper (Annex II). The IEC's paper was partially financed by the Armand Hammer Fund for Economic Cooperation in the Middle East. We were privileged to have the sound advice of Mr. Meir Ben-Meir, former Water Commissioner and Head of the Agricultural Research Authority at the Ministry of Agriculture who also did us the honour of writing the preface to this research. Last but not least, we are grateful to all the assistants and technical staff at ICTAF and the auxiliary teams for their invaluble help in all stages of this study.

## PREFACE

### Desalination - A Multi-Disciplinary Approach
### By Mr. Meir Ben-Meir

Water scarcity is not a new phenomenon in our region. We remember the Biblical story of the young bride, Achsa, daughter of Caleb who, after she and her husband Othniel received the gift of a field from her father, said to him: "Give me a blessing, for thou hast given me a south land (the Negev). Give me also springs of water. And he gave her the upper springs and the nether springs (Joshua 15, 18-19). In another Biblical story, it is said: "And all countries came to Egypt, to Joseph, to buy corn, because that the famine was so sore in all lands" (Genesis 41, 57).

The basic climatic conditions have not changed since those times, but one fact has: in spite of having built the Aswan Dam, Egypt is no longer the grain basket of the region.

Scarcity of water between the Mediterranean Sea and the Jordan River is already threatening the existence of agriculture there. The urban per-capita water consumption in Israel is approximately $100m^3$ per year. With the population of the area nearly doubling and the Palestinians' per-capita consumption nearing that of the Israelis, we may face a reality in which all the water potential will be required for urban use, and only reclaimed sewage will be available for agriculture. At such time, the more water being allocated to agriculture, the heavier the dependency will be on desalination for the provision of drinking water. Considering the length of time required for the transition to that reality, and the prospect of it happening sooner rather than later, now is the time to begin a pilot project.

The problem we are facing is neither solely economic nor solely technical. It is interdisciplinary, and a comprehensive approach has to be adopted for its solution. Had we faced a pure question of drinking water demand after having exploited our total resources for this purpose only, then the answer would have been simple. But since agricultural demand is involved and water allocation can be diverted from agriculture to drinking purposes, both the question and the answer become more complicated: Can we define desalination seperately from other economic aspects? Can we charge the agricultural sector with the alternative cost? The answer to both questions is negative. Desalinated sea water cannot be calculated seperately from other resources as an independent system.

The Gaza Strip presents a special set of problems which make it an outstanding case for a pilot project. First, the over-exploited aquifer has brought the level of water salinity to the verge of non-potableness. Therefore, if new resources are not developed agriculture there will have to be eliminated. Another problem in the Gaza Strip is the very high rate of unemployment which makes the present rate of labour costs very low. Based on these two phenomena, the study presented here is an attempt to illustrate how sophisticated agriculture based on desalinated sea water can, in spite of its high cost, provide sufficient value added to justify a desalination project. The success of a pilot-project combining water desalination and sophisticated agriculture will be a major breakthrough in solving the region's water problem. This could also prove to be a milestone on the way to an era, in which the sea will be used as the region's main water resource and thereby refute the thesis according to which water will be the cause of future wars in the Middle East.

## INTRODUCTION

1. Basic Premises

Many solutions have so far been proposed for the regional water problem in the Middle East, but no such solution came close to realization in a regional scope. Even national projects often run counter to the interests of a neighbouring country, and result in an escalation of political tensions. While some degree of tacit cooperation has been achieved between interested parties in the region, there has so far been no systematic approach to solving these problems.

The water shortage in the Gaza Strip is the most acute in the region, making the solution for this area more urgent than that of other areas in the region. It cannot be delayed to such a time as to devise an overall regional water plan.

The Gaza Strip is a well-defined stretch of land, with a relatively homogeneous population and a quantifiable economy. As such, it is appropriate as a testing ground for the application of rational and systematic planning of the water and electricity supply and its impact. It can be regarded as a microcosm, in which many of the region's problems are present in a concise and somtimes amplified way. We believe that a successful planning and forecasting venture in the dimensions of the Gaza Strip could serve as a model for larger scale projects on the national and regional level.

Since 1967, the economy of the Gaza Strip has been subject to Israeli control, with some cooperation from the local population. Recent reactions by Gaza Strip local leadership to Israeli development plans indicate a decrease of suspicion regarding the Israeli intentions, in view of the prospect of autonomy as a result of the peace process. This leads us to believe that the proposed project could also be welcome by the local leadership.

Having said that, it should be noted that the intention, in the present study, is to make it applicable to any future political solution, from total independence to total annexation. The political issue of the future of the occupied territories is beyond the scope of this study.

A further consideration is that, as part of their effort to enhance a political solution in the Middle East, foreign governments and international organizations are likely, and have already expressed intentions, to give support to regional development projects. As of late (November 1991), even Saudi leaders expressed their interest in financing joint projects including Israel, to the benefit of the Palestinian Arab population. The EEC commission allocated funds for similar purposes, and one of the study groups resulting from the current peace talks (Moscow Round) will discuss regional economic projects. Other interested parties, such as Japan and the World Bank, could be willing to support development ventures in the region, or be involved in them on a commercial basis.

## 2. Background

The idea of erecting a dual-purpose plant for the generation of water and electricity in the Gaza Strip regions is not new.

The scarcity of water there was identified by Israeli authorities in the aftermath of the Six Days War (June 1967), as a result of which the Gaza Strip became part of the Israeli economic structure (as did the Sinai Peninsula, now back under Egyptian control). The idea of a dual-purpose, Electricity Generation and Water Desalination Plant (EGWDP) in the Gaza Strip area was first raised and rejected, as were so many other useful ideas, mainly because of political reasons. At that time water shortage was far less acute, desalination technology much less developed and both sides much less mature than they are now, to accept new solutions to old problems.

3. Methodlogy and Expectations from the Study

The original idea for the project was the establishment of a large scale EGWDP in or near the tripartite border (Israel, Egypt, Gaza Strip) that would be beneficial to all three areas and serve as a typical regional cooperation project. However, preliminary inquiries ruled out, at least for the short term, linking Egyptian and Israeli electric power networks, due to technical incompatibility. Moreover, the three regions, namely the Gaza Strip, Northern Sinai and the Negev, are radically different in size, geography, economy and demography.

The above-mentioned factors led us to narrow the scope of the study to the Gaza Strip alone, with the assumption that whatever conclusions we reach could be relatively easy to apply to the adjoining regions.

The methodology we chose to use includes the following steps:

a. Evaluation of the present situation in the Gaza Strip in general, focusing on socio-economic aspects and especially emphasizing on the role of water and electricity.

b. Description of the concept of dual purpose water and electricity generation plants, including methods of power generation and water desalination and their combination (based on an IEC study).

c. Analysis of the project's application to the region, using the Morphologic Box Model (developed by Ishai Sepharim). This gradual approach assumes no drastic change in the Strip's economic structure in the short run and is based on an independent project, leading the way to the rest of the region.

d. Discussion of socio-economic and political aspects of the project as well as the international involvement needed to facilitate its realization in the Gaza Strip region.

Our hope is that this study will prompt an actual planning effort towards solving the economic, social and human problems in the Gaza Strip by providing its water and electricity requirements. Such a venture must be undertaken as soon as possible, in order for the region to benefit from the recent enhanced willingness to cooperate. We hope, too, that no unilateral projects will be initiated which do not take into account the economic and political needs, resources and prospects of the Gaza Strip.

## A. THE PRESENT SITUATION IN THE GAZA STRIP

### 1. Historical Summary

Economic cooperation beteen the Jewish and Arab populations existed until the establishment of the State of Israel in 1948, after which two separate economies developed. This situation prevailed until Israel occupied the West-Bank and Gaza Strip in 1967. Between 1948 and 1967, the 360 $Km^2$ strip was occupied, but not annexed, by Egypt. During this period, its population quadrupled due to the influx of refugees from the 1948 war. Unlike Jordan, which annexed the West Bank, Egypt kept the Gaza Strip at arm's length and did not integrate it into its own economy. Egypt's declared policy was to keep the Gaza Strip in trust for the Palestinians until the establishment of their own state. As a result, Egypt undertook no long-term economic projects there. The economy followed a "natural", unplanned low-key development, centered on agriculture. Industry played an insignificant role (accounting for 4.4% of the GDP in 1966), and this, mainly in small family-units rather than factories (in 1968 only 1% of industries had more than 10 employees).

#### a. Roots of the Economic Structure in the Gaza Strip

After the Six Days War in 1967, the territories under Israeli control gradually integrated into the Israeli economy. The unplanned, undirected process was the result of measures taken, when necessary, to meet Israel's needs and those of Israeli settlers in the Gaza Strip. The local Palestinian population indirectly benefited from this process. For example, the economic boom in Israel following the 1967 war required an addition to work force in Israel. This was readily available in the Gaza Strip and the West Bank, whose Arab population needed work to replace sources of income lost as a result of the severance of ties with Egypt (Gaza Strip) and Jordan (West Bank). Also, Jewish settlement in these areas created there a "dual economy", in which the Jewish sector was, and still is, a direct and integral extension of the Israeli economy (including government budgetary allocations, taxation, subsidies and services), whereas the Arab sector remained a semi-closed structure. Influenced by the prevailing Israeli economic and political develpoments, the Arab sector has nevertheless functioned, to all intents and purposes, separately, under the supervision of the Israeli Civil Administration (which served mostly as a coordinating and licensing body). The local economy was fueled by funds flowing in from Palestinian employees working within Israel and from abroad, with limited funds coming from Israeli authorities for local economic developemnt. Israel is Gaza's main export market for labour as well as products, and the source of most of its imports: In the 1970's and early 1980's, Israel accounted for over 70% of exports from Gaza the average exports from the Gaza Strip, and about 90% of its imports. On the other side of the balance, imports from the Gaza Strip made up less than 1% of Israel's total imports, and less than 4% of its exports. These imbalances very clearly show the economic dependence that developed between the Gaza Strip and Israel, although some economic ties existed between the Gaza Strip and the West Bank and Europe.

Table I

Sources of Income in the Gaza Strip

| Units % of GDP | Region: | Gaza Strip | | West Bank | Israel |
|---|---|---|---|---|---|
| Branch: | Year: | 1966 | 1985 | 1985 | 1985 |
| Agriculture | | 34.4 | 17.8 | 30.2 | 6.0 |
| Industry | | 4.4 | 8.7 | 7.9 | 25.0 |
| Construction | | 6.2 | 17.8 | 15.8 | 8.0 |
| Services incl. transport | | 55.0 | 55.7 | 46.1 | 61.0 |
| Total GDP: | | 100% | 100% | 100% | 100% |

Sourace: Bahiri (1987), Table 3.2 p. 63, Table 4.2 p. 65.

As can be seen from the data in the above table, the share of agriculture in the economic structure of the Gaza Strip dropped by 50% between 1966 and 1985, industry doubled, construction grew threefold and services stayed relatively stable. The economic structure of the Gaza Strip was still unbalanced in 1985, compared with that of Israel: the role of industry in the economy still accounted for less than 9% of GDP (25% in Israel) and production excluding services and construction (i.e., industry and agriculture) only 26% of GDP (31% in Israel). It is clear that the major imbalance in the economy of the Gaza Strip lies in the proportions between the three main production components, agriculture, industry and construction, and in the high level of dependency of the Gaza Strip on the Israeli economy and politics reflected in these proportions.

b. Socio-Political Implications of the Gaza Strip Economics

No explicit policy has been voiced advocating a deliberate discrimination against the economic development of the West Bank and the Gaza Strip. Some observers have, nevertheless, suggested that Israel's economic policy in these regions reflects an interest of keeping them underdeveloped, as markets for its own products and as sources of cheap labour. For Israeli settlers these areas were defined as "A-level Development Regions", eligible for the highest subsidies, tax exemptions and other forms of support. In contrast, in the Arab sector, direct and indirect barriers were reportedly set up by Israeli authorities in order to prevent the Arab economy of the West Bank and Gaza Strip from competing with the Israeli economy.

Whether or not this was a deliberate policy, the kind of symbiosis that evolved from the one-sided support by the government and the lack of possible markets for the Arabs in the West Bank and Gaza Strip, perpetuated this unbalanced situation. It could be argued that the political attitudes of the Arabs also played a role in the way things took shape, and that without their short-sightedness, such dependency would not have been so acute.

It seems, nevertheless, that the range of choice left for the Palestinian Arab population was rather narrow: they had to support their families by doing any job they could find, be it in Israel or in their own localities. The option of leaving the area altogether raised value conflicts. It seems that most of those who left did so, at least initially, on a temporary basis in order to send money back to their families before eventually returning. In the last few years, and more so since the Intifada began, the Arab population has become increasingly conscious of the political significance of their economic dependency. This marked a new stage in the community's self-awareness, characterized by a increasing willingness to make personal sacrifices rather than participate in the prevailing economic order according to the Israeli "rules of the game". This period has also witnessed an escalation in the level of violent disorders in the Occupied Territories and their repression. The political and military escalation was accompanied (if not instigated) by a process of radicalization and fragmentation within the Palestininan society. Although we know of no recent study linking all these factors, the bottom line is that there is at least a coincidence of political, security and social disintegration accompanied by an economic and local political decline. These developemnts can be explained, in part, by the intolerable socio-economic situation in the West bank and the Gaza Strip, coupled with the Palestinian Arab population's increased awareness of this reality and their willingness to change it.

2. The Requirements for Socio-Economic Takeoff in the Gaza Strip.

Four main conditions are necessary for economic takeoff:
a. Lifting direct and indirect barriers to development;
b. Investment in the infrastructure of the Gaza Strip;
c. Promoting technology transfer into the Gaza Strip;
d. Restructuring the Gaza Strip economy.

A commission set up by the Israeli Defense Ministry in 1990 uder the direction of Prof. Ezra Sadan, recommended the elimination of most political and administrative restrictions on economic development and entrepreneurship in the Gaza strip. These recommendations are now in the process of being implemented. A liberal policy could enable the Palestinian leadership to attract foreign investments (Arab, American, European and/or Japanese) for new business ventures and for the improvement of existing ones, on a purely commercial basis or as part of regional development aid programs.

3. Water and Electricity Requirements in the Gaza Strip

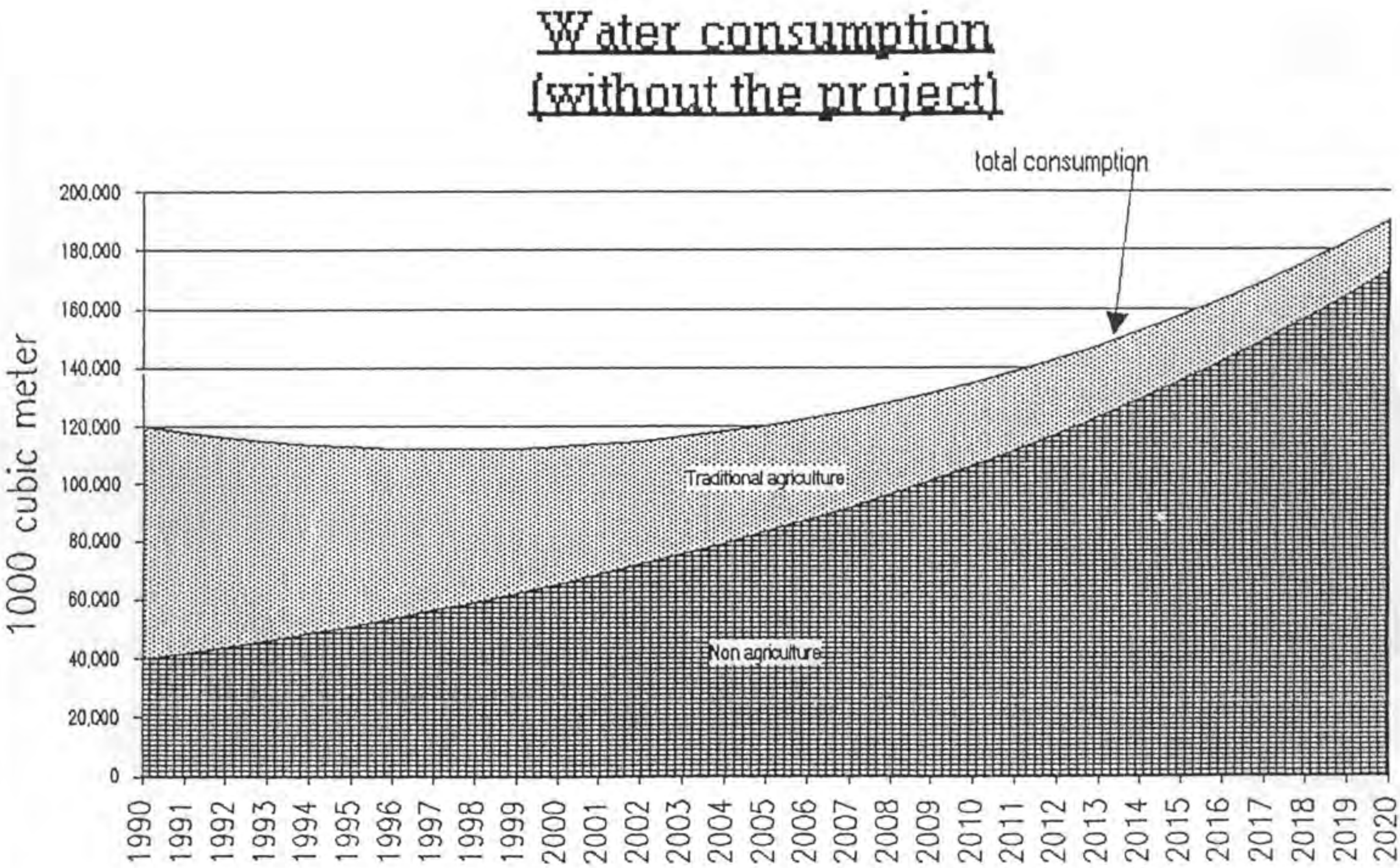
With hindsight it would seem now, that when the idea for the establishment of an EGWDP was first suggested in 1969, the scene was not quite ready for it: the needs for water and electricity were not sufficiently pressing, the technology was not fully developed, the policy makers were not ripe for the idea and the economic resources were not readily available. Since then all these factors seem to have changed, some very dramatically, such as demand for water and electricity. These are badly needed not only in Gaza and Northern Sinai, but also in Israel and in the West Bank. In Israel, major developments in supply and demand of electricity and water took place since 1969: the Hadera power plant came on line with a generation capacity of 1400 MW. South of Ashkelon, the Ruthenberg power plant was planned to be on line in 1991 with almost the same generation capacity. The National Water Carrier, completed in 1964, is used at full capacity with effective constraints of water availability in the north. A water pipeline carrying recovered water has been completed, leading to the Gaza Strip area, with a carrying capacity of about 100 million cubic meter per year (henceforth: $Mm^3/y$). After 1981 the Egyptians had extended a canal from the Suez to El-Arish with a carrying capacity of 30 $Mm^3/y$. Power lines were also built from Egypt to El-Arish. But all these are not sufficient to alleviate the pressure and needs for electricity and mainly for water in Gaza, Northern Sinai and the South of Israel.

Referring back to the Gaza Strip alone, the shortage in both commodities has been crucial to the rate and direction of economic development, and may be acute in the short to medium range, if no solution is found for it.

The use of water in the Gaza Strip outgrows its replenishment from natural resources, and the deficit has been steadily increasing. The result of the process is a net deterioratin in the quality of the water, drawing close to non-potablensess. The structure of local agriculture is still traditional and water-intensive. The availability of ground water of poor quality, but still suitable for watering orange groves and vegetable patches, gave local inhabitants no incentive to shift to less water-intensive cultures and industry.

The role of electricity in the Gaza Strip's economic dynamics is less visible. The fast population growth and gradual rise in the standard of living are a source of increased demand for electricity even before industrialization. When economic liberalization gains momentum and when funds become available for investment, demand for electricity will grow faster than at present. Without provision for additional electricity generation, the latent power shortage might become a stumbling block for the Gaza Strip's economic development.

Figure 1




Source: I. Sepharim, 1991 (Annex II)

## B. THE CONCEPT OF DUAL PURPOSE PLANTS

### 1. Methods of Water Desalination

#### a. General Information

Sea water or salt water desalination can be achieved by using either thermal or electric energy.

Two methods use thermal energy:

(1) Multi Stage Flushing (MSF) (56% of the market)

(2) Multi Effect Distillation (MED) (4.6% of the market)

The use of MSF has been declining since the early 1980's due to the high cost of construction materials and combustibles needed for reaching the high temperatures ($200^{o}C$) required by this method. MED requires lower temperatures ($70^{o}C$), costing less in combustibles and in building materials. Both methods depend on the adjacency of an electric power station with output adaptable to the volume of desalinated water.

Three methods use electric energy:

(1) Mechanical Vapor Compression (MVC)

(2) Reverse Osmosis (RO)

(3) Freezing (negligible)

Table II

Comparative Table of Technologies for Sea Water Desalination

| Desalination Technology | Low Temperature Multi-Effect Distilation LT-MED זר״ש | Mechanical Vapor Compression MVC דח״א | Reverse Osmosis אוסמוזה הפוכה |
|---|---|---|---|
| Design | Series of evaporative condensers and heat rejection condenser | Series of evaporative condensers and mechanical compressor in a heat pump cycle | Series of membranes, high pressure pumps Water pretreatment system |
| Application | Where low-pressure steam or low temperature heat source are available | Where electricity is available | |
| Capacity range [m³/day] in a single unit | 50 - 40,000 | 25 - 3,000 | 6,000 |
| Energy source for the process | Low pressure steam (0.2-0.4 atm) or hot water source at low temperature (up to 70°C) (power plant's condenser cooling water) | Electricity | |
| Typical product quality TDS [ppm] | 1 - 20 Can't be regulated | | 400 - 1000 Can be regulated |
| Water production [m³/year] | Depends on power plants' availability, operating load and regime | Depends only on the availability of electricity supply and operating regime | |
| Feed water pretreatment requirements | Low To control: precipitation (scaling) | | Very high To control: precipitation, biofauling, colloids, organics |
| Start up / Shut down time | 1/2 - 1 hr | Few minutes | |
| Availability [%] | 96 - 98 | 90 (compressors) | 90 (membrane deterioration, clogging) |
| Area requirements | Base | Lower | Lower depends much on water pretreatment system |
| Capital cost [$/m³/day] (for large plants 200x10³ m³/day) | 650 ÷ 750 | 850 | 850 ÷ 1,100 (for sea water) |
| Operating and maintenance cost | 1 (Base) | 1.5 ÷ 2 More maintenance because of large number of modules (compressors), more labour | 4 ÷ 6 - Membrane replacements - More chemicals - More labour |
| Specific electrical energy consumption [kWh/m³] | 2 ÷ 2.2 Not include power plant installed capacity losses | 7.2 ÷ 7.8 (Mainly for compressors) | 4.8 ÷ 6 (Mainly for high pressure pumps) Include energy recovery |
| Plant lifetime [years] | 30 | 30 | 30 |
| Plant location | Dictated by power plant location | - Free for selection - Can be closed to water consumer | |
| Plant in commission (after award of contract) for 200x10³ m³/day | 30 month | 29 month Construction and commission possible in stages | 33 month |
| Power plant installed cap. losses [MW] | Yes - in power plant modified for desalination | No | |
| Operating flexibility | High Following easily power unit load changes | High Easy shut down / start up | |

Source: IEC Report (1991) Annex I.

b. Technological Comparison of Desalination Methods

(1) Multi-Stage Flushing (MSF)

In this method pressure is applied to control the evaporation of pre-heated water in a vacuum container. Sea water is poured over, chills and condensates the vapors, which then turn into desalinated water.

(a) Advanteges of the MSF method: the method is already available, it uses a relatively simple unit and produces high quality water.

(b) Disadvantages of the MSF method: the method needs steam and an adjacent power station, its output water quality is not adjustable. It entails high construction and operating costs due to the need to reach high temperatures.

(2) Multi Effect Distillation (MED)

This process begins with flushing low pressure vapors into horizontal tubes, where condensation is achieved by pouring sea-water on the tubes to chill them after being heated in the process. The sea-water then flows into the tubes for evaporation and condensation in the next stage. In every stage the process is less efficient, as pressure and temperature are lower than in the previous stage.

(a) Advantages of the MED method: very high availability, relatively low capital costs, very high quality of output (desalinated) water, low requirements for quality of input sea-water.

(b) Disadvantages of the MED method: high dependency on the location of and constraints imposed by the need for an adjacent power-station, long construction time (two to three and a half years), output water quality not adjustable.

(3) Mechanical Vapor Compression (MVC)

This is the simplest and most effective process, requiring only basic hardware: a set of tubes, a mechanical vapor compressor, a heat convector and pumps. Sea water, treated against sedimentation, flows through the heat convector and absorbs the heat radiating from the separated water and brine, mixed with the recycled brine and sprayed over the horizontal heat-conductors.

The compressor uses suction to create a lower pressure than that of the brine vapor pressure. The vapors, after passing through a drop separation device, are compressed into the horizontal pipes, where they release the heat required for evaporation. Large scale plants can contain 2-3 such cycles.

(a) Advantages of the MVC method: it is highly available, independent of specific power generation units, it requires a short construction time (if done in stages), needs less area than an equivalent MED plant, its output is adjustable, it has high operating flexibility (easy start-up/shut-down), and lower operating costs than RO.

(b) Disadvantages of the MVC method: higher operating costs than MED (maintenance and manpower) due to multiple modules, higher energy consumption than either MED or

RO, each module has a relatively low output and its output quality is not adjustable.

(4) Reverse Osmosis (RO)

This method is actually a separation of unorganic minerals and simple organic composites by applying pressure to solutions: the pressure of brackish water or sea water is scaled up above the osmotic pressure and passed through a semi-permeable membrane (permeable to water but not to soluble solid materials). Most RO plants are used for brackish water, and less frequently for sea water desalination.

(a) Advantages of the RO method: the technology is highly available and independent of adjacent power generation units, easily controls output and quality, relatively low energy consumption compared to MED and MVC, high operating flexibility (easy start-up/shut-down), adaptability to constraints in electricity supply, ("Peack-Shaving") it requires less space than MED, short construction time, is modular (can be installed in stages in small units), and is future-oriented (membranes are being improved continually).

(b) Disadvantages of the RO method: it has a relatively low output per module, a lower quality of output than MED and MVC (but within drinking water standards), achieving higher quality is costly, RO requires a high standard of input-water, relatively high capital investment and operational costs and long construction time for larger units.

2. Dual Purpose Production Units

a. Technical Considerations for Combining the Technologies

The combination of power generation and water desalination technologies ignited the imagination of engineers and planners many years ago. The utilisation of a single source of heat and the residual heat for producing both products offers a more effective use of resources and, under certain circumstances, a reduction of capital investments.

Electricity consumption surpluses cannot be stored. Therefore, power output must match power consumption. Water consumption, on the other hand, is more or less constant (with negligible seasonal fluctuations), and water surpluses can be stored. Therefore, water can be desalinated in a peak-shaving regime.

b. Possible Combinations of Technologies

(1) MED and coal-fueled power station

Such a combination is achieved by coupling the desalination unit to the power station's condensation device and passing the heat it radiates (part of the residual heat) to sea water, cycled between the condensator and the desalination unit. Another option of supplying heat for desalination is by directing steam from the turbine. The constraint of such methods lies in the need to operate the unit under higher pressure than is usually the case, thereby reducing its power production capacity and efficiency. The coupling requires special investments and about three months down-time for technical modifications. The water production capacity is limited by the availability of the power unit and its level of operation.

(2) MED and combined cycles

The coupling here is similar to that of a coal-fueled power station (see above). The combined cycles use both gas and steam turbine cycles. Exhaust gas from the gas cycle (at approximately $500^{0}C$) is directed to an unfired waste heat boiler, where steam is generatd to operate a steam turbine, thereby producing about 50% more electricity without burning additional fuel.

This process can be further improved by using either a supplementary waste heat-boiler (where additional fuel is injected into the gas channel) or a fired waste heat boiler (where exhaust gas from the gas turbines is used as a source of heat and air for the burning process).

(3) MSF/MED and gas turbine

Here too, the coupling is effected through a waste heat boiler. Gas turbines are used for relatively small production quantities, usually for additional consumption during peak demand. Their major advantage is the relatively low cost, short construction time and easy operation. Their disadvantage is in low efficiency and high cost of fuel. The use of gas turbines for desalination is limited by the fact that the energetic potential of the steam created in the boiler is much higher than that which is required for desalination. Its more efficient use is in power generation by steam turbines (combined cycles).

c. Operation Regimes of Dual Purpose Plants

(1) Heat generated desalination plants

In such units two options are available:

(a) Desalination volume follows the power according to power consumption.
(b) Desalination unit dictates full-volume power generation, according to water production demand.

This latter option might result in an over-generation of electric power, and requires coupling the desalination unit to a power station operating in a "base-load" mode (a reduction of production in other sites or even shutting units down in times of low demand). Such constraints require a solution for power storage and/or coupling the network with those of neighbouring countries. The IEC points to the fact that so far no power networks in the Middle East are coupled, and recommends the use of power generation as the constant and water as its function.

(2) Electric-power-generated desalination plants

In the IEC paper (annex I) on which this part of the present study is based, operation regimes for electric power generated desalination plants assume:
(a) operation about 6426 hours/year
(b) operation throughout the year.

In order to define an ideal operational regime, a complete system analysis must be conducted. Calculations should be based on the demand for marginal electricity consumption, relative to the total consumption volume, as well as its impact on water unit price. Desalination would be considered economically worthwhile if such calculations put the marginal cost of producing electricity at an equal or lower level than that of its marginal cost in intermediary production units.

d. Choice of Preferred Technologies

Short of conducting a full fledged techno-economic comparative analysis of all the alternatives, the IEC paper compared the short-listed technologies and concluded:

(1) The MSF industrial-gas-turbines combination is technically not recommended.

(2) Desalination by the MED method in existing power stations in the vicinity of the Gaza Strip (coal-fuled or combined cycles) involves a loss in the capacity of the power stations, with implications on the cost of desalination.

(3) Reverse Osmosis desalination units seem to be the better solution compared to other technologies, especially in view of the fact that the method is undergoing constant improvement.

(4) Preliminary calculations(1) put desalinated water cost in the preferred two options at:

(a) MED + Coal = US $ 0.84-0.91 per $M^3$ (2).

(b) RO = US $ 0.84-1.08 per $M^3$

(5) Production capacity of the two options:

(a) MED + Coal fueled power station with a capacity of 550MW: 50-53 $Mm^3/y$ (70% more if the same desalination unit is connected to another coal fueled power unit as backup).

(b) RO: 49-88 $Mm^3/y$, within the above-mentioned cost brackets.

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(1) At 12% discount rate.
(2) Estimated for coal plant originally not designed for dual purpose.

Table III
Considerations for Dual Purpose Units

| Technological Concept: | Water production defines power generation | | Water production follows power generation | | Using electric power for desalination |
|---|---|---|---|---|---|
| Type and size of proudction units | Industrial Gas Turbine 105 MW capacity | Combined Cycles 300 MW capacity | Existing Plant 2 x 550 MW capacity | Dual Plant 2 x 550 MW capacity | National network |
| Desalination capacity: ($Mm^3/y$)* | >50 | 150 | Calculated to minimize effect on power generation | to be calculated | 240 Mudular units |
| Location | Coastal (Gaza/ Israel) | Coastal (Gaza/ Israel) | Coastal | Coastal | Modular desalination in Gaza |
| Combustible | Natural gas/ Oil No. 2 | Natural Gas | Coal/Oil No. 6 | Coal/Oil No. 6 | - |
| Desalination method | MSF/MED | MED | MED | MED | RO/MVC |
| Operational | 2010-2015 | 2010-2015 | 2010-2015 | 2010-2015 | 2010-2015 |
| Source of fuel | Egypt/Market | Egypt/Market | Egypt/Market | Egypt/Market | - |
| Operational regime for power generation | According to demand for desalinated water | According to demand for desalinated water | + 6000 H/y No daily cycle | + 6000 H/y No daily cycle | According to demand for desalinated water |
| Plant factor | According to demand for desalinated water | According to demand for desalinated water Not above 0.8 | 0.6-0.9 | 0.6-0.9 | up to 0.9 |
| Discount rate | 12% | 12% | 12% | 12% | 12% |

* $Mm^3/y$ = Million cubic meters per year.

Source: IEC report (1991) Annex I

## C. APPLYING THE DUAL PURPOSE SOLUTION TO THE GAZA STRIP

1. Excluding the "One Unit For Four Regions" Option.

As stated before, the original idea behind this study was to supply sufficient water and electricity to cover demand in three or four adjoining areas: the Gaza Strip itself, Israel (the Negev), Egypt (Northern Sinai) and possibly also the southern part of the West bank (Judea). The advantages of such a project lie on the economic and (political level: a regional cooperation project involving Israel, Egypt and the Palestinians could attract substantial political support from Western, Arab and maybe Japanese sources, as well as favorable financing conditions from international organizations. Initial inquiries led us to doubt the feasibility, at least in the short run, of such a combined solution. The main obstacles are: a) the incompatibility of electric networks in Egypt and Israel; b) the dependence of water output on the amount of electricity produced, since electric power cannot be stored.

Unlike Europe and North America, the electric networks in the Middle East are not interconnected. The issue of interconnection of Arab electric networks was first suggested 1989. If and when realized, such intentions would link Europe and Africa, from Zaire and Morocco through Egypt to Turkey and Europe. These are long-term plans. In the short-to-medium range, the only plan that comes close to realization is that of linking the electric networks of Egypt and Jordan. Canadian and American companies have been contracted to consult on laying a 500 KW line under the Suez Canal and through the Sinai peninsula, and a 400 KW line under the Gulf of Aqaba. The earliest date forecast for the realization of the project is 1994.

Informal assessments by IEC experts indicate that interconnecting the Israeli and Egyptian networks is not likely, at least in the foreseeable future, due to problems of technical incompatibility. In addition to that, it is hard to expect either Egypt or Israel to grant the other party control over the supply of a strategic commodity such as electric power. Even if the questions of compatibility and control are solved, it is still doubtful whether the market for electric power, in quantities and at prices provided by the dual purpose plants, would be large enough to include Egypt, with its own rich hydro-electric resources.

In view of these considerations, the project must be defined within the electricity consumption limits of the network to which it would initially be connected. Since out of the three or four areas in question, all but Egypt are now part of a single electric network, we proceeded with the evaluation of the project under the assumption that it would be located either in Israel or in the Gaza Strip, and be connectd to the Israeli network.

2. Strategic Planning of the Project

The choice of water desalination and power generation technologies must take into account a number of external factors. Such factors have to do with the expected impact of the supply of water and electricity to the region on issues such as employment, the agricultural and industrial portfolio of the region and socio-political considerations. The latter issue will be discussed in further detail in the next chapter, but the whole range of considerations calls for a strategic planning process using the water needs as its basic assumption.

As stated before, overall planning for the Gaza Strip is beyond the scope of the present study, and should be undertaken as its sequel. Nevertheless, within the limits of the project as defined, we chose to apply a strategic planning model, developed by Ishai Seharim ("Ecology of Technology", a doctoral thesis, 1991, Hebrew

University, Jerusalem) and adapted to the present project by Shai Sepharim. The model is called "The Morphologic Box" (MB).

a. Strategic Planning Using the Morphologic Box (MB) Method

The strategic planning of the project requires a model capable of integrating the following factors:

(1) Evaluating a wide range of technologies;
(2) Using a multi-period long-range planning horizon;
(3) Ability to define and relate to regional constraints;
(4) Timing the application of measures needed for water production and technology transfer;
(5) Designing and evaluating alternative plans (scenarios).

The MB provides a structured thinking and calculation process using disassembled available expertise to reconstruct and provide a wide range of planning options for the choice of the ones that are best suited to the goals and criteria of the interested party/parties, as well as to the environment (physical, economic and social) and its constraints. The model is a universal tool, not dedicated to any specific production process or environment.

The generic process includes ten steps:

(1) Define the problem.
(2) Identify all the tasks needed to solve the problem.
(3) List a wide range of alternative techniques for each task.
(4) Evaluate costs inherent to the application of each technique.
(5) Identify market niches and product pricing.
(6) Choose one technique for each task to form a complete solution with a feasible technology.
(7) Assess the performance of this technology.

(8) Back to (6) to form another technology.
(9) The model results in an evaluation for each technology.
(10) The decision maker chooses a solution which suits his/her targets and constraints.

b. The Regional Strategic Planning Process

The MB model allows us to analyse all available knowledge, use it to create a wide range of technologies and select the ones that are best suited to the physical, economic and social environment in a given region. The data, need not necesssarily be explicit and uniform, but, can be given in any way: quantitative data from empirical experiments, theory-based equations, simulation models, intuition and accumulated experience.

The MB model is not a tool for economic optimization, but rather enables us to make a reasoned choice of an acceptable plan by creating and evaluating alternative scenarios, measuring relevant indicators and selecting out of them those that are best suited to the socio-econonmic environment in the region and the client's goals. The model functions like a game of construction-blocks: first one defines the type of the desired building, the construction process and the tasks involved in its implementation. Then one produces the bricks for the construction: the techniques. These techniques are combined into a range of solutions, which in turn are tested and evaluated. The "reward" in this game is an economic evaluation of each solution within the socio-economic environment in a specific region.

The planning process includes three stages, in every one of which a Morphoplogic Box is used as the recombining and evaluating tool:

(1) Combining techniques into alternative technologies and/or production solutions and evaluating their respective degrees of adaptability to regional conditions. The result should provide the planner with a data-bank of existing and projected production activities in the region.

(2) Preparing a developemnt plan for every industry (including agriculture) on the basis of each chosen technology (solution). In this stage, the planner chooses activities out of the pool, defines the production level and time horizon for each of them and creates modules for various sectors: agriculture, industry, infrastructure, etc.

(3) Developing several alternative scenarios for the region and evaluating each of them. In this stage the planner defines regional constraints and arranges the modules according to resource and time-axes, thereby creating integrated regional plans for the region.

For each of the plans the model can provide the follwing:

(a) The composition of the product portfolio.
(b) By how much the plan exceeds regional limitations.
(c) The level of utilization of selected inputs.
(d) Business and economic indicators (NPV, PVI, IRR, PR).

This data is used for fine-tuning the respective plans.

3. Applying the Model to the Gaza Strip

a. General Considerations

The original assumption for the project was that each of the three areas concerned - the Gaza Strip, Northern Sinai and the Negev - would need about 80Mm$^3$/y desalinated water by the year 2010. This led to the idea of establishing one large scale dual purpose plant to supply 240Mm$^3$/y to the three regions and an equivalent amount of electricity for interconnected networks. The constraints described earlier and the prominence of the RO method in the IEC's study suggest that an incremental, modular approach may be more practical. The Morphologic Box model application reached a similar conclusion by a totally different approach: the use of RO permits the implementation of the project without resorting to the gigantic task of full regional planning and restructuring.

b. Assumptions for the Gaza Strip Environmental Scenarios

Three environmental scenarios have been constructed for the application of the MB model, "GOOD", "Bad" and "Very bad". Data from various up-to-date sources (such as The Central Bureau of Statistics and Civil Administration publications), and a set of assumptions were used for further extrapolation. Most of the assumptions are identical for all three scenarios, but some vary.

(1) Assumptions relating to labour:

(a) The Gaza Strip population will increase by 3% per annum (multi-year average).

(b) Work force will also increase by 3% p.a. (assuming no radical political changes).

(c) The number of workers from the Gaza Strip employed in Israel will decrease by 2% annually, independently of changes in population and work-force, mainly as a result of an Israeli policy of replacing Arab workers.

(d) The number of locally employed workers (excluding the present project) will increase by only 3% p.a.

(2) Assumptions relating to land:

(a) The composition of the Gaza Strip's area, cultivated (irrigated and non-irrigated) and non-cultivated (including dunes and urban area), will remain constant.

(b) The area irrigated for "traditional" agriculture will decrease by 5% annually, assuming a gradual shift to more up-to-date technologies (applies only to some scenarios).

(3) Assumptions relating to water:

(a) In all three scenarios, water consumption for non-agricultural purposes (i.e. drinking, industry and services) will rise by 5% annually, that is: above total population growth rate, mainly due to industrialization and the gradual rise in standard of living.

(b) In the "good" scenario, water consumption for traditional agriculture will decline by 5% p.a., in parallel to the reduction of traditionally irrigated area. In the "bad" scenario, the decrese will only be

3% p.a. and in the "very bad" scenario it will remain constant.

(c) Rain water contribution to the restoration of the aquifer will be constant ($60Mm^3/y$).

(4) Assumptions relating to new water resources:

(a) Sewage treatment units can be operational within 5 years. Their installation will be by increments of $20Mm^3/y$. In one scenario (in which using ground water for drinking is discontinued) 60% of water consumption can be provided from sewage water recycled for agricultural purposes.

(b) Desalination units can be operational within 5 years. Methods of desalination considered here are RO (Reverse Osmosis) of sea water, RO of salt water and MED (Multi Effect Distillation, indicated in the scenario tables by their hebrew acronym "Zeresh").

(c) Conditions resulting from the above assumptions:

(1) There is a high availability of labour. Work force available for the project is the total work force, minus workers employed in Israel, minus locally employed work force (the project not included).

(2) There is no land shortage. The area available for the project is the irrigated area at the beginning of the project minus the area cultivated by traditional methods, plus the non-irrigated area (assuming that it can be irrigated). In any possible scenario, such area considerably exceeds the requirements of the project.

c. Environmental Scenarios and Water Balance in the Gaza Strip.

As stated earlier, the scope of the project has been limited to solving the Gaza Strip's water deficit problem while contributing to other elements of the region's physical, demographic, economic and political environment. In that respect the Gaza Strip is the immediate environment in which the project is supposed to operate, and Israel and the rest of the world are the more distant environments.

The three environmental scenarios are intended to provide a quantitative evaluation of:

(1) The interaction between the Gaza Strip as a whole and the project, which refers to:

(a) The socio-economic environment: the use of water and labour and local markets.

(b) The physical environonement: the availability of land and water resources.

(2) The interaction between the Gaza Strip and the rest of the world, including Israel, which refers to:

(a) Importing material inputs and technologies;

(b) Markets for exports.

As we saw earlier, the availability of land and labour does not present a problem. Providing work opportunities can be regarded as a social resource. The questions relating to markets and sources of technologies will be discussed in the next chapter, but they do not seem to be problematic either. The size of the market is a major constraint for the proposed agricultural development, but the crucial point is the water balance and the choices available for its improvement. It can be seen from the following table, giving the data for each scenario, that their annual balance and cumulative balance are as follows:

Table IV
Water Balance

| Units | Scenarios | | |
|---|---|---|---|
| Mm3/y | "GOOD" | "BAD" | VERY BAD" |
| CURRENT (1) | | | |
| 1990 deficit | 60 | 60 | 60 |
| 2000 deficit | 53 | 64 | 85 |
| 2010 deficit | 75 | 90 | 126 |
| 2020 deficit | 130 | 145 | 193 |
| ACC.ADD. (2) 2020 | 2244 | 2600 | 3450 |

Notes to the table:

(1) Current deficit equals total water consumption in the Gaza Strip minus assumed rainfall contribution to the aquifer, under the assumptions detailed above and without additional water sources.

(2) Accumulated additional deficit assumes no artificial enrichment of the aquifer during that period.

d. "Action" and "Reaction" Plans

Any possible reaction to any of the described scenarios must include three elements:

(1) Introducing new water resources.
(2) Transfer of agricultural technologies.
(3) Transfer of industrial technologies.

The issue of technology transfer will be discussed in the next chapter, as part of the socio-economic evaluation.

Improvement of the water balance can be achieved by introducing new water resources. The various options differ from one another in their technological complexity and in the cost of investment and operation.

They include, among others:

(1) Transporting water from a distance (e.g., from the Nile);
(2) Recycling sewage water for irrigation, in closed systems
or in open basins;
(3) Desalinating sea or salt (brackish) water, in any of the techniques discussed earlier.

The various techniques can be combined in a wide range of mixes, only some of which are applicable to the Gaza Strip. In order to narrow down the number of options to the ones which are most relevant to our case, nine "intervention" (or "action") options (numbered from A to H plus Option O, the only non-desalination option) were lined up to be used in different mixes.

[O] Recycling sewege water by units producing 20 $Mm^3/y$ introduced in years 2, and 20.

[A] A sea water desalination unit using the RO (Reverse method, investment in year 1, introductin in year 5.

[B] Idem, investment in year 5, introduction in year 10.

[C] Idem, investment in year 10, introduction in year 15.

[D] Idem, investment in year 15, introduction in year 20.

[E] Three salt water RO desalination units, invested in year 1, introduced (simultaneously) in year 5.

[F] Idem, investment in year 10, introduction in year 15.

[G] Importing water from the Nile, investment in year 5, introduction in year 10.

[H] MED desalination unit connected to a power station, investment in year 5, introduction year 10.

Seven water and technology transfer, or "reaction" scenarios (industries), numbered from #0 to #6, have been created on the basis of the above intervention options. (See tables Va-Vc pp. 46-54). It should be noted that: (a) the scenarios were aimed at a similar level of output, rather than at maximum output, and their differences lie in the utilization of the water; (b) every scenario responds to a particular environmental or other constraint, and simulates its implications in terms of the rate and composition of socio-economic changes.

(1) Reaction Scenario #0 combines intervention options A and B: Two sea water desalination units using the RO method, one invested in year 1 and operational in year 5, the other invested in year 5 and operational in year 10. In this scenario the accumulated production over 31 years amounts to 2,450 $Mm^3$, and current production is 0 in years 1-4, 50 $Mm^3/y$ in years 6-10 and 100 $Mm^3/y$ in year 11-31.

(2) Reaction scenario #1 combines intervention options 0 (Recycle) and A: Recycling sewage water by increments of 20 $Mm^3/y$ introduced in years 2, 12 & 20, and installing a sea water desalination unit using the RO method, invested in year 1 and operational in year 5. In this scenario the accumulated production over 31 years amounts to 2,590 $Mm^3$, and current production is 0 in year 1, 20 $Mm^3/y$ in years 2-4, 70 $Mm^3/y$ in years 5-11, 90 $Mm^3/y$ in years 12-19 and 110 $Mm^3/y$ in years 20-31.

(3) Reaction scenarios #2 and #2a combine intervention options C and E: one sea water desaslination unit using the RO method, invested in year 10 and operational in year 15 and one salt water desalination unit using the same method, invested in year 1 and operational in year 5. In this scenario the accumulated production over 31 years amounts to 2,186.5 $Mm^3$, and current production is 0 in years 1-4, 49.5 $Mm^3/y$ in years 5-14 and 99.5 $Mm^3/y$ in years 15-31.

(4) Reaction scenarios #3, #3a and #6 combine twice intervention option A: Two sea water desalination units using the RO method, both invested in year 1 and operational in year 5. In this scenario the accumulated production over 31 years amounts to 2,700 $Mm^3$, and current production is 0 $Mm^3/y$ in year 1-4 and 100 $Mm^3/y$ in years 5-31.

(5) Reaction scenario #4 combines twice intervention option A and once D: Two sea water desalination units using the RO method invested in year 1 and operational in year 5, and another one invested in year 15 and operational in year 20. In this scenario the accumulated production over 31 years amounts to 3,300 $Mm^3/y$, and current production is 0 $Mm^3/y$ in years 1-4, 100 $Mm^3/y$, in years 5-19 and 150 $Mm^3/y$ in years 20-31.

(6) Reaciton scenario #5 combines intervention options A, D and G: Two sea water desalination units using the RO method, one invested in year 1 and operational in year 5, and another one invested in year 15 and operational in year 20, plus a water import element of 90 $Mm^3$/y invested in year 5 and operational in year 10. In this scenario the accumulated production over 31 years amounts to 3,930 $Mm^3$, and current production is 0 $Mm^3$/y in years 1-4, 50 $Mm^3$/y in years 5-9, 140 $Mm^3$/y in years 10-19 and 190 $Mm^3$/y in years 20-31.

(7) Reaction scenario #5a combines intervention options A, B and H: Two sea water desalination units using the RO method, one invested in year 1 and operational in year 5, and another one invested in year 5 and operational in year 10, plus a MED ("Zeresh") sea water desalination unit producing 90 $Mm^3$/y invested in year 5 and operational in year 10. In this scenario the accumulated production over 31 years amounts to 3,550 $Mm^3$, and current production is 0 $Mm^3$/y in year 1-4, 50 $Mm^3$/y in years 5-9 and 150 $Mm^3$/y in years 10-31.

Referring to the three environmental scenarios, they reflect two sets of information, "environment" and "reaction", which are the raw material in the hand of the planner. The choice of mixes would be as follows:

(a) The "Good" environmental scenario can use any of the seven water supply scenarios, but scenarios #4 #5 and #5a would provide more than the required volume of desalinated water, and their choice could be reasonable only if other clients would buy the water (Egypt, Israel and/or the West Bank). Scenarios #2 and #2a run short of the current deficit most of the time. Only scenario #1 supplies additional water in years 1-4.

(b) The "Bad" environmental scenario could be solved by supply scenarios #1, #3, #3a and #6 in terms of the accumulated deficit, but scenario #4 could be more appropriate in terms or the current deficit.

(c) The "Very bad" environmental scenario would require resorting to supply scenarios #5 or #5a if the accumulated deficit is not to be increased.

The evaluation of each water supply scenario is only relevant in conjunction with the economic reaction scenarios. Together they could provide us with indications as to the overall water balance as well as the overall production data in different production and marketing combinations. We shall come back to this evaluation in the next chapter, within the framework of socio-economic and political considerations.

Following is the actual data for the environmental scenarios, collected and analyzed by Ishai Sepharim using the Morphologic Box Model (see Annex II).

# Environmental Scenarios

## Table V a (p. 1 out of 3)

"Good" Scenario

| | Market for fruit & vegetable | | Electricity: | | | | | | | | Scenario: | Good | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local: 1 Ton | Export: $1000 | KWH | Mill. KWH | MegaW | | | | | Work force: 1 person | | | | | | Land: 1 dunam |
| Year | Local market | export market | consumption per person | Total consumption | peak consump. | Total Population | Total work force | Employed in Israel | Employed in gaza | Available for project | Total land | Not farmed | Farmed | Traditionaly irrigated | Not irrigated | Available for project |
| Increase | 3% | 4% | 1% | 5% | 5% | 3% | 3% | -2% | 3% | 10% | 0% | 0% | 0% | -5% | 0% | |
| 1990 | 130,000 | 20,000 | 363 | 236 | 54 | 650,000 | 105,000 | 45,000 | 50,000 | 10,000 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 1991 | 133,900 | 20,747 | 368 | 247 | 56 | 669,500 | 108,150 | 44,100 | 51,500 | 12,550 | 360,000 | 140,000 | 220,000 | 102,600 | 112,000 | 117,400 |
| 1992 | 137,917 | 21,521 | 374 | 258 | 59 | 689,585 | 111,395 | 43,218 | 53,045 | 15,132 | 360,000 | 140,000 | 220,000 | 97,470 | 112,000 | 122,530 |
| 1993 | 142,055 | 22,325 | 379 | 269 | 61 | 710,273 | 114,736 | 42,364 | 54,636 | 17,746 | 360,000 | 140,000 | 220,000 | 92,597 | 112,000 | 127,404 |
| 1994 | 146,316 | 23,158 | 385 | 282 | 64 | 731,581 | 118,178 | 41,507 | 56,275 | 20,396 | 360,000 | 140,000 | 220,000 | 87,967 | 112,000 | 132,033 |
| 1995 | 150,706 | 24,023 | 391 | 294 | 67 | 753,528 | 121,724 | 40,656 | 57,964 | 23,104 | 360,000 | 140,000 | 220,000 | 83,568 | 112,000 | 136,432 |
| 1996 | 155,227 | 24,919 | 396 | 308 | 70 | 776,134 | 125,375 | 39,863 | 59,703 | 25,810 | 360,000 | 140,000 | 220,000 | 79,390 | 112,000 | 140,610 |
| 1997 | 159,884 | 25,850 | 402 | 322 | 73 | 799,418 | 129,137 | 39,065 | 61,494 | 28,577 | 360,000 | 140,000 | 220,000 | 75,420 | 112,000 | 144,580 |
| 1998 | 164,680 | 26,815 | 408 | 336 | 76 | 823,401 | 133,011 | 38,254 | 63,339 | 31,388 | 360,000 | 140,000 | 220,000 | 71,649 | 112,000 | 148,351 |
| 1999 | 169,621 | 27,816 | 414 | 351 | 80 | 848,103 | 137,001 | 37,519 | 65,239 | 34,244 | 360,000 | 140,000 | 220,000 | 68,067 | 112,000 | 151,933 |
| 2000 | 174,709 | 28,854 | 420 | 367 | 83 | 873,546 | 141,111 | 36,768 | 67,196 | 37,147 | 360,000 | 140,000 | 220,000 | 64,664 | 112,000 | 155,336 |
| 2001 | 179,950 | 29,931 | 427 | 384 | 87 | 899,752 | 145,345 | 36,053 | 69,212 | 40,100 | 360,000 | 140,000 | 220,000 | 61,430 | 112,000 | 158,570 |
| 2002 | 185,349 | 31,049 | 433 | -401 | 91 | 926,745 | 149,705 | 35,312 | 71,288 | 43,105 | 360,000 | 140,000 | 220,000 | 58,359 | 112,000 | 161,641 |
| 2003 | 190,909 | 32,206 | 439 | 419 | 95 | 954,547 | 154,196 | 34,606 | 73,427 | 46,163 | 360,000 | 140,000 | 220,000 | 55,441 | 112,000 | 164,559 |
| 2004 | 196,637 | 33,410 | 446 | 438 | 100 | 983,183 | 158,822 | 33,914 | 75,629 | 49,279 | 360,000 | 140,000 | 220,000 | 52,669 | 112,000 | 167,331 |
| 2005 | 202,536 | 34,657 | 452 | 458 | 104 | 1,012,679 | 163,587 | 33,266 | 77,898 | 52,453 | 360,000 | 140,000 | 220,000 | 50,035 | 112,000 | 169,965 |
| 2006 | 208,612 | 35,951 | 459 | 479 | 109 | 1,043,059 | 168,494 | 32,571 | 80,235 | 55,688 | 360,000 | 140,000 | 220,000 | 47,534 | 112,000 | 172,466 |
| 2007 | 214,870 | 37,293 | 466 | 501 | 114 | 1,074,351 | 173,549 | 31,919 | 82,642 | 58,987 | 360,000 | 140,000 | 220,000 | 45,157 | 112,000 | 174,843 |
| 2008 | 221,316 | 38,686 | 473 | 523 | 119 | 1,106,581 | 178,755 | 31,281 | 85,122 | 62,353 | 360,000 | 140,000 | 220,000 | 42,899 | 112,000 | 177,101 |
| 2009 | 227,956 | 40,130 | 480 | 547 | 124 | 1,139,779 | 184,118 | 30,685 | 87,675 | 65,787 | 360,000 | 140,000 | 220,000 | 40,754 | 112,000 | 179,246 |
| 2010 | 234,794 | 41,628 | 487 | 572 | 130 | 1,173,972 | 189,642 | 30,042 | 90,306 | 69,294 | 360,000 | 140,000 | 220,000 | 38,716 | 112,000 | 181,284 |
| 2011 | 241,838 | 43,182 | 494 | 597 | 136 | 1,209,191 | 195,331 | 29,442 | 93,015 | 72,875 | 360,000 | 140,000 | 220,000 | 36,781 | 112,000 | 183,219 |
| 2012 | 249,093 | 44,794 | 501 | 625 | 142 | 1,245,467 | 201,191 | 28,863 | 95,805 | 76,533 | 360,000 | 140,000 | 220,000 | 34,942 | 112,000 | 185,058 |
| 2013 | 256,566 | 46,466 | 509 | 653 | 148 | 1,282,831 | 207,227 | 28,276 | 98,679 | 80,272 | 360,000 | 140,000 | 220,000 | 33,195 | 112,000 | 186,805 |
| 2014 | 264,263 | 48,201 | 516 | 682 | 155 | 1,321,316 | 213,443 | 27,710 | 101,640 | 84,094 | 360,000 | 140,000 | 220,000 | 31,535 | 112,000 | 188,465 |
| 2015 | 272,191 | 50,000 | 524 | 713 | 162 | 1,360,956 | 219,847 | 27,166 | 104,689 | 88,002 | 360,000 | 140,000 | 220,000 | 29,958 | 112,000 | 190,042 |
| 2016 | 280,357 | 51,867 | 532 | 745 | 169 | 1,401,784 | 226,442 | 26,613 | 107,830 | 92,000 | 360,000 | 140,000 | 220,000 | 28,460 | 112,000 | 191,540 |
| 2017 | 288,768 | 53,803 | 540 | 779 | 177 | 1,443,838 | 233,235 | 26,081 | 111,064 | 96,090 | 360,000 | 140,000 | 220,000 | 27,037 | 112,000 | 192,963 |
| 2018 | 297,431 | 55,812 | 548 | 814 | 185 | 1,487,153 | 240,232 | 25,589 | 114,396 | 100,277 | 360,000 | 140,000 | 220,000 | 25,685 | 112,000 | 194,315 |
| 2019 | 306,354 | 57,895 | 556 | 851 | 193 | 1,531,768 | 247,439 | 25,098 | 117,828 | 104,563 | 360,000 | 140,000 | 220,000 | 24,401 | 112,000 | 195,599 |
| 2020 | 315,544 | 60,056 | 564 | 890 | 202 | 1,577,721 | 254,863 | 24,597 | 121,363 | 108,953 | 360,000 | 140,000 | 220,000 | 23,181 | 112,000 | 196,819 |

Source: I. Sepharim, 1991 (Annex II)

<u>Table V a (p. 2 out of 3)</u>

"Good" Scenario

| Scenario: Good | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water balance: 1000 X cub. m. | | | | | | New water sources: 1000 X cub. m. | | | | | | | | | |
| | Consumption | | | | | | | Sea water osmosis in year: | | | | 3K salt water osmosis in year: | | Water Import | Zeresh |
| Year | Non Agri | Agri | Total | Rain | Deficit | Accumulated deficit | recycle | (1,5) | (5,10) | (10,15) | (15,20) | 1,5) | (10,15) | (5,10) | (5,10) |
| Increa | 5% | -5% | | | | | 60% | A | B | C | D | E | F | G | H |
| 1990 | 40,000 | 80,000 | 120,000 | 60,000 | 60,000 | 60,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 42,000 | 76,000 | 118,000 | 60,000 | 58,000 | 118,000 | 20,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 44,100 | 72,200 | 116,300 | 60,000 | 56,300 | 174,300 | 20,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 46,305 | 68,590 | 114,895 | 60,000 | 54,895 | 229,195 | 20,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 48,620 | 65,161 | 113,781 | 60,000 | 53,781 | 282,976 | 20,000 | 50,000 | 0 | 0 | 0 | 49500 | 0 | 0 | 0 |
| 1995 | 51,051 | 61,902 | 112,954 | 60,000 | 52,954 | 335,929 | 20,000 | 50,000 | 0 | 0 | 0 | 49500 | 0 | 0 | 0 |
| 1996 | 53,604 | 58,807 | 112,411 | 60,000 | 52,411 | 388,341 | 20,000 | 50,000 | 0 | 0 | 0 | 49500 | 0 | 0 | 0 |
| 1997 | 56,284 | 55,867 | 112,151 | 60,000 | 52,151 | 440,492 | 20,000 | 50,000 | 0 | 0 | 0 | 49500 | 0 | 0 | 0 |
| 1998 | 59,098 | 53,074 | 112,172 | 60,000 | 52,172 | 492,664 | 20,000 | 50,000 | 0 | 0 | 0 | 49500 | 0 | 0 | 0 |
| 1999 | 62,053 | 50,420 | 112,473 | 60,000 | 52,473 | 545,137 | 20,000 | 50,000 | 50,000 | 0 | 0 | 49500 | 0 | 90,000 | 50,000 |
| 2000 | 65,156 | 47,899 | 113,055 | 60,000 | 53,055 | 598,191 | 20,000 | 50,000 | 50,000 | 0 | 0 | 49500 | 0 | 90,000 | 50,000 |
| 2001 | 68,414 | 45,504 | 113,918 | 60,000 | 53,918 | 652,109 | 40,000 | 50,000 | 50,000 | 0 | 0 | 49500 | 0 | 90,000 | 50,000 |
| 2002 | 71,834 | 43,229 | 115,063 | 60,000 | 55,063 | 707,172 | 40,000 | 50,000 | 50,000 | 0 | 0 | 49500 | 0 | 90,000 | 50,000 |
| 2003 | 75,426 | 41,067 | 116,493 | 60,000 | 56,493 | 763,665 | 40,000 | 50,000 | 50,000 | 0 | 0 | 49500 | 0 | 90,000 | 50,000 |
| 2004 | 79,197 | 39,014 | 118,211 | 60,000 | 58,211 | 821,877 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49500 | 49,500 | 90,000 | 50,000 |
| 2005 | 83,157 | 37,063 | 120,220 | 60,000 | 60,220 | 882,097 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49500 | 49,500 | 90,000 | 50,000 |
| 2006 | 87,315 | 35,210 | 122,525 | 60,000 | 62,525 | 944,622 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49500 | 49,500 | 90,000 | 50,000 |
| 2007 | 91,681 | 33,450 | 125,130 | 60,000 | 65,130 | 1,009,752 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49500 | 49,500 | 90,000 | 50,000 |
| 2008 | 96,265 | 31,777 | 128,042 | 60,000 | 68,042 | 1,077,794 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49500 | 49,500 | 90,000 | 50,000 |
| 2009 | 101,078 | 30,188 | 131,266 | 60,000 | 71,266 | 1,149,061 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2010 | 106,132 | 28,679 | 134,811 | 60,000 | 74,811 | 1,223,871 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2011 | 111,439 | 27,245 | 138,683 | 60,000 | 78,683 | 1,302,555 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2012 | 117,010 | 25,883 | 142,893 | 60,000 | 82,893 | 1,385,448 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2013 | 122,861 | 24,589 | 147,449 | 60,000 | 87,449 | 1,472,898 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2014 | 129,004 | 23,359 | 152,363 | 60,000 | 92,363 | 1,565,261 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2015 | 135,454 | 22,191 | 157,645 | 60,000 | 97,645 | 1,662,906 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2016 | 142,227 | 21,082 | 163,309 | 60,000 | 103,309 | 1,766,215 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2017 | 149,338 | 20,028 | 169,366 | 60,000 | 109,366 | 1,875,580 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2018 | 156,805 | 19,026 | 175,831 | 60,000 | 115,831 | 1,991,412 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2019 | 164,645 | 18,075 | 182,720 | 60,000 | 122,720 | 2,114,132 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |
| 2020 | 172,878 | 17,171 | 190,049 | 60,000 | 130,049 | 2,244,181 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49500 | 49,500 | 90,000 | 50,000 |

Source: I. Sepharim, 1991 (Annex II)

Table V a (p. 3 out of 3)

"Good" Scenario

"Available for project"

*Scenario:* Good

| Year | #0 | #1 | #2, #2a | #3, #3a, #6 | #4 | #5 | #5a | Local market | Export market | Work force | Land |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water production scenarios (1000 X cub. m.) | | | | | | | (1 ton) | ($1,000) | (1 person) | (1 dunam) |
| Incred | A+B | recycle+A | C+E | 2A | 2A | A+G+D | A+B+H | | | | |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130,000 | 20,000 | 10,000 | 112,000 |
| 1991 | 0 | 20,000 | 0 | 0 | 0 | 0 | 0 | 133,900 | 20,747 | 12,550 | 117,400 |
| 1992 | 0 | 20,000 | 0 | 0 | 0 | 0 | 0 | 137,917 | 21,521 | 15,132 | 122,530 |
| 1993 | 0 | 20,000 | 0 | 0 | 0 | 0 | 0 | 142,055 | 22,325 | 17,746 | 127,404 |
| 1994 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 146,316 | 23,158 | 20,396 | 132,033 |
| 1995 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 150,706 | 24,023 | 23,084 | 136,432 |
| 1996 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 155,227 | 24,919 | 25,810 | 140,610 |
| 1997 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 159,884 | 25,850 | 28,577 | 144,580 |
| 1998 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 164,680 | 26,815 | 31,388 | 148,351 |
| 1999 | 100,000 | 70,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 169,621 | 27,816 | 34,244 | 151,933 |
| 2000 | 100,000 | 70,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 174,709 | 28,854 | 37,147 | 155,336 |
| 2001 | 100,000 | 90,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 179,950 | 29,931 | 40,100 | 158,570 |
| 2002 | 100,000 | 90,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 185,349 | 31,049 | 43,105 | 161,641 |
| 2003 | 100,000 | 90,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 190,909 | 32,208 | 46,163 | 164,559 |
| 2004 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 196,637 | 33,410 | 49,279 | 167,331 |
| 2005 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 202,536 | 34,657 | 52,453 | 169,965 |
| 2006 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 208,612 | 35,951 | 55,688 | 172,466 |
| 2007 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 214,870 | 37,293 | 58,987 | 174,843 |
| 2008 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 221,316 | 38,685 | 62,353 | 177,101 |
| 2009 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 227,956 | 40,130 | 65,787 | 179,246 |
| 2010 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 234,794 | 41,628 | 69,294 | 181,284 |
| 2011 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 241,838 | 43,182 | 72,875 | 183,219 |
| 2012 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 249,093 | 44,794 | 76,533 | 185,058 |
| 2013 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 256,566 | 46,466 | 80,272 | 186,805 |
| 2014 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 264,263 | 48,201 | 84,094 | 188,465 |
| 2015 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 272,191 | 50,000 | 88,002 | 190,042 |
| 2016 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 280,357 | 51,867 | 92,000 | 191,540 |
| 2017 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 288,768 | 53,803 | 96,090 | 192,963 |
| 2018 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 297,431 | 55,812 | 100,277 | 194,315 |
| 2019 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 306,354 | 57,895 | 104,563 | 195,599 |
| 2020 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 315,544 | 60,056 | 108,953 | 196,819 |
| | 2,450,000 | 2,590,000 | 2,186,500 | 2,700,000 | 3,300,000 | 3,930,000 | 3,550,000 | << Total production | | | |

Source: I. Sepharim, 1991 (Annex II)

Table V b (p. 1 out of 3)

"Bad" Scenario

| | Market for fruit & vegetable Local: 1 Ton Export: $1000 | | Electricity: KWH | Mil. KWH | MegaW | | | | | Work force: 1 person | Scenario: | Bad | | | | Land: 1 dunam |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Local market | export market | consumption per person | Total consumption | peak consump. | Total Population | Total work force | Employed in Israel | Employed in gaza | Available for project | Total land | Not farmed | Farmed | Traditionaly Irrigated | Not irrigated | Available for project |
| Increa | 3% | 4% | 1% | 5% | 5% | 3% | 3% | -2% | 3% | 10% | 0% | 0% | 0% | -3% | 0% | |
| 1990 | 130,000 | 20,000 | 363 | 236 | 54 | 650,000 | 105,000 | 45,00 | 50,000 | 10,000 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 1991 | 133,900 | 20,747 | 368 | 247 | 56 | 669,500 | 108,150 | 44,10 | 51,500 | 12,558 | 360,000 | 140,000 | 220,000 | 104,760 | 112,000 | 115,240 |
| 1992 | 137,917 | 21,521 | 374 | 258 | 59 | 689,585 | 111,395 | 43,28 | 53,045 | 15,132 | 360,000 | 140,000 | 220,000 | 101,617 | 112,000 | 118,383 |
| 1993 | 142,055 | 22,325 | 379 | 269 | 61 | 710,273 | 114,736 | 42,38 | 54,636 | 17,746 | 360,000 | 140,000 | 220,000 | 98,569 | 112,000 | 121,431 |
| 1994 | 146,316 | 23,158 | 385 | 282 | 64 | 731,581 | 118,178 | 41,97 | 56,275 | 20,396 | 360,000 | 140,000 | 220,000 | 95,612 | 112,000 | 124,388 |
| 1995 | 150,706 | 24,023 | 391 | 294 | 67 | 753,528 | 121,724 | 40,86 | 57,964 | 23,884 | 360,000 | 140,000 | 220,000 | 92,743 | 112,000 | 127,257 |
| 1996 | 155,227 | 24,919 | 396 | 308 | 70 | 776,134 | 125,375 | 39,88 | 59,703 | 25,818 | 360,000 | 140,000 | 220,000 | 89,961 | 112,000 | 130,039 |
| 1997 | 159,884 | 25,850 | 402 | 322 | 73 | 799,418 | 129,137 | 39,06 | 61,494 | 28,577 | 360,000 | 140,000 | 220,000 | 87,262 | 112,000 | 132,738 |
| 1998 | 164,680 | 26,815 | 408 | 336 | 76 | 823,401 | 133,011 | 38,28 | 63,339 | 31,388 | 360,000 | 140,000 | 220,000 | 84,644 | 112,000 | 135,356 |
| 1999 | 169,621 | 27,816 | 414 | 351 | 80 | 848,103 | 137,001 | 37,58 | 65,239 | 34,244 | 360,000 | 140,000 | 220,000 | 82,105 | 112,000 | 137,895 |
| 2000 | 174,709 | 28,854 | 420 | 367 | 83 | 873,546 | 141,111 | 36,78 | 67,196 | 37,147 | 360,000 | 140,000 | 220,000 | 79,642 | 112,000 | 140,358 |
| 2001 | 179,[illegible]50 | 29,931 | 427 | 384 | 87 | 899,752 | 145,345 | 36,03 | 69,212 | 40,108 | 360,000 | 140,000 | 220,000 | 77,253 | 112,000 | 142,747 |
| 2002 | 185,349 | 31,049 | 433 | 401 | 91 | 926,745 | 149,705 | 35,32 | 71,288 | 43,105 | 360,000 | 140,000 | 220,000 | 74,935 | 112,000 | 145,065 |
| 2003 | 190,909 | 32,208 | 439 | 419 | 95 | 954,547 | 154,196 | 34,86 | 73,427 | 46,163 | 360,000 | 140,000 | 220,000 | 72,687 | 112,000 | 147,313 |
| 2004 | 196,637 | 33,410 | 445 | 438 | 100 | 983,183 | 158,822 | 33,91 | 75,629 | 49,279 | 360,000 | 140,000 | 220,000 | 70,506 | 112,000 | 149,494 |
| 2005 | 202,536 | 34,657 | 452 | 458 | 104 | 1,012,679 | 163,587 | 33,26 | 77,898 | 52,453 | 360,000 | 140,000 | 220,000 | 68,391 | 112,000 | 151,609 |
| 2006 | 208,612 | 35,951 | 459 | 479 | 109 | 1,043,059 | 168,494 | 32,51 | 80,235 | 55,688 | 360,000 | 140,000 | 220,000 | 66,339 | 112,000 | 153,661 |
| 2007 | 214,870 | 37,293 | 466 | 501 | 114 | 1,074,351 | 173,549 | 31,99 | 82,642 | 58,987 | 360,000 | 140,000 | 220,000 | 64,349 | 112,000 | 155,651 |
| 2008 | 221,316 | 38,685 | 473 | 523 | 119 | 1,106,581 | 178,755 | 31,21 | 85,122 | 62,353 | 360,000 | 140,000 | 220,000 | 62,419 | 112,000 | 157,581 |
| 2009 | 227,956 | 40,130 | 480 | 547 | 124 | 1,139,779 | 184,118 | 30,65 | 87,675 | 65,787 | 360,000 | 140,000 | 220,000 | 60,546 | 112,000 | 159,454 |
| 2010 | 234,794 | 41,628 | 487 | 572 | 130 | 1,173,972 | 189,642 | 30,02 | 90,306 | 69,294 | 360,000 | 140,000 | 220,000 | 58,730 | 112,000 | 161,270 |
| 2011 | 241,838 | 43,182 | 494 | 597 | 136 | 1,209,191 | 195,331 | 29,42 | 93,015 | 72,875 | 360,000 | 140,000 | 220,000 | 56,968 | 112,000 | 163,032 |
| 2012 | 249,093 | 44,794 | 501 | 625 | 142 | 1,245,467 | 201,191 | 28,89 | 95,806 | 76,533 | 360,000 | 140,000 | 220,000 | 55,259 | 112,000 | 164,741 |
| 2013 | 256,566 | 46,466 | 509 | 653 | 148 | 1,282,831 | 207,227 | 28,25 | 98,679 | 80,272 | 360,000 | 140,000 | 220,000 | 53,601 | 112,000 | 166,399 |
| 2014 | 264,263 | 48,201 | 516 | 682 | 155 | 1,321,316 | 213,443 | 27,71 | 101,640 | 84,094 | 360,000 | 140,000 | 220,000 | 51,993 | 112,000 | 168,007 |
| 2015 | 272,191 | 50,000 | 524 | 713 | 162 | 1,360,956 | 219,847 | 27,16 | 104,689 | 88,002 | 360,000 | 140,000 | 220,000 | 50,433 | 112,000 | 169,567 |
| 2016 | 280,357 | 51,867 | 532 | 745 | 169 | 1,401,784 | 226,442 | 26,63 | 107,830 | 92,000 | 360,000 | 140,000 | 220,000 | 48,920 | 112,000 | 171,080 |
| 2017 | 288,768 | 53,803 | 540 | 779 | 177 | 1,443,838 | 233,235 | 26,08 | 111,064 | 96,090 | 360,000 | 140,000 | 220,000 | 47,453 | 112,000 | 172,547 |
| 2018 | 297,431 | 55,812 | 548 | 814 | 185 | 1,487,153 | 240,232 | 25,58 | 114,396 | 100,277 | 360,000 | 140,000 | 220,000 | 46,029 | 112,000 | 173,971 |
| 2019 | 306,354 | 57,895 | 556 | 851 | 193 | 1,531,768 | 247,439 | 25,[illegible] | 117,828 | 104,563 | 360,000 | 140,000 | 220,000 | 44,648 | 112,000 | 175,352 |
| 2020 | 315,544 | 60,056 | 564 | 890 | 202 | 1,577,721 | 254,863 | 24,57 | 121,363 | 108,953 | 360,000 | 140,000 | 220,000 | 43,309 | 112,000 | 176,691 |

Source: I. Sepharim, 1991 (Annex II)

Table V b (p. 2 out of 3)

"Bad" Scenario

*Scenario:* Bad

| | Water balance: 1000 X cub. m. | | | | | | New water sources: 1000 X cub. m. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Consumption | | | | | | | Sea water osmosis in year | | | | 3X salt water osmosis in year | | Water Import | Zeresh |
| Year | Non Agri. | Agri. | Total | Rain | Deficit | Accumulated deficit | recycle | (1,5) | (5,10) | (10,15) | (15,20) | (1,5) | (10,15) | (5,10) | (5,10) |
| Incre | 5% | -3% | | | | | 60% | A | B | C | D | E | F | G | H |
| 1990 | 40,000 | 80,000 | 120,000 | 60,000 | 60,000 | 60,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 42,000 | 77,600 | 119,600 | 60,000 | 59,600 | 119,600 | 20,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 44,100 | 75,272 | 119,372 | 60,000 | 59,372 | 178,972 | 20,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 46,305 | 73,014 | 119,319 | 60,000 | 59,319 | 238,291 | 20,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 48,620 | 70,823 | 119,444 | 60,000 | 59,444 | 297,735 | 20,000 | 50,000 | 0 | 0 | 0 | 49,500 | 0 | 0 | 0 |
| 1995 | 51,051 | 68,699 | 119,750 | 60,000 | 59,750 | 357,484 | 20,000 | 50,000 | 0 | 0 | 0 | 49,500 | 0 | 0 | 0 |
| 1996 | 53,604 | 66,638 | 120,242 | 60,000 | 60,242 | 417,726 | 20,000 | 50,000 | 0 | 0 | 0 | 49,500 | 0 | 0 | 0 |
| 1997 | 56,284 | 64,639 | 120,923 | 60,000 | 60,923 | 478,649 | 20,000 | 50,000 | 0 | 0 | U | 49,500 | 0 | 0 | 0 |
| 1998 | 59,098 | 62,699 | 121,798 | 60,000 | 61,798 | 540,446 | 20,000 | 50,000 | 0 | 0 | 0 | 49,500 | 0 | 0 | 0 |
| 1999 | 62,053 | 60,818 | 122,872 | 60,000 | 62,872 | 603,318 | 20,000 | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2000 | 65,156 | 58,994 | 124,150 | 60,000 | 64,150 | 667,468 | 20,000 | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2001 | 68,414 | 57,224 | 125,638 | 60,000 | 65,638 | 733,105 | 40,000 | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2002 | 71,834 | 55,507 | 127,342 | 60,000 | 67,342 | 800,447 | 40,000 | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2003 | 75,426 | 53,842 | 129,268 | 60,000 | 69,268 | 869,715 | 40,000 | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2004 | 79,197 | 52,227 | 131,424 | 60,000 | 71,424 | 941,139 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2005 | 83,157 | 50,660 | 133,817 | 60,000 | 73,817 | 1,014,957 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2006 | 87,315 | 49,140 | 136,455 | 60,000 | 76,455 | 1,091,412 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2007 | 91,681 | 47,666 | 139,347 | 60,000 | 79,347 | 1,170,759 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2008 | 96,265 | 46,236 | 142,501 | 60,000 | 82,501 | 1,253,260 | 40,000 | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2009 | 101,078 | 44,849 | 145,927 | 60,000 | 85,927 | 1,339,187 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2010 | 106,132 | 43,504 | 149,635 | 60,000 | 89,635 | 1,428,822 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2011 | 111,439 | 42,198 | 153,637 | 60,000 | 93,637 | 1,522,459 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2012 | 117,010 | 40,932 | 157,943 | 60,000 | 97,943 | 1,620,402 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2013 | 122,861 | 39,705 | 162,565 | 60,000 | 102,565 | 1,722,967 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2014 | 129,004 | 38,513 | 167,517 | 60,000 | 107,517 | 1,830,485 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2015 | 135,454 | 37,358 | 172,812 | 60,000 | 112,812 | 1,943,297 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2016 | 142,227 | 36,237 | 178,464 | 60,000 | 118,464 | 2,061,761 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2017 | 149,338 | 35,150 | 184,488 | 60,000 | 124,488 | 2,186,249 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2018 | 156,805 | 34,096 | 190,901 | 60,000 | 130,901 | 2,317,150 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2019 | 164,645 | 33,073 | 197,718 | 60,000 | 137,718 | 2,454,868 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2020 | 172,878 | 32,081 | 204,958 | 60,000 | 144,958 | 2,599,827 | 60,000 | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |

Source: I. Sepharim, 1991 (Annex II)

Table V b (p. 3 out of 3)

"Bad" Scenario

**"Available for project"**

Scenario: Bad

| Year | #0 | #1 | #2, #2a | #3, #3a, #6 | #4 | #5 | #5a | Local market (1 ton) | Export market ($1,000) | Work force (1 person) | Land (1 dunam) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water production scenarios (1000 X cub. m.) | | | | | | | | | | |
| Incred | A+B | recycle+A | C+E | 2A | 2A | A+G+D | A+B+H | | | | |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130,000 | 20,000 | 10,000 | 112,000 |
| 1991 | 0 | 20,000 | 0 | 0 | 0 | 0 | 0 | 133,900 | 20,747 | 12,550 | 115,240 |
| 1992 | 0 | 20,000 | 0 | 0 | 0 | 0 | 0 | 137,917 | 21,521 | 15,132 | 118,383 |
| 1993 | 0 | 20,000 | 0 | 0 | 0 | 0 | 0 | 142,055 | 22,325 | 17,746 | 121,431 |
| 1994 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 146,316 | 23,158 | 20,396 | 124,388 |
| 1995 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 150,786 | 24,023 | 23,084 | 127,257 |
| 1996 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 155,227 | 24,919 | 25,810 | 130,039 |
| 1997 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 159,884 | 25,850 | 28,577 | 132,738 |
| 1998 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 164,680 | 26,815 | 31,388 | 135,356 |
| 1999 | 100,000 | 70,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 169,621 | 27,816 | 34,244 | 137,895 |
| 2000 | 100,000 | 70,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 174,709 | 28,854 | 37,147 | 140,358 |
| 2001 | 100,000 | 90,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 179,950 | 29,931 | 40,100 | 142,747 |
| 2002 | 100,000 | 90,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 185,349 | 31,049 | 43,105 | 145,065 |
| 2003 | 100,000 | 90,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 190,989 | 32,208 | 46,163 | 147,313 |
| 2004 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 196,637 | 33,410 | 49,279 | 149,494 |
| 2005 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 202,536 | 34,657 | 52,453 | 151,609 |
| 2006 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 208,612 | 35,951 | 55,688 | 153,661 |
| 2007 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 214,870 | 37,293 | 58,987 | 155,651 |
| 2008 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 221,316 | 38,685 | 62,353 | 157,581 |
| 2009 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 227,956 | 40,130 | 65,787 | 159,454 |
| 2010 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 234,794 | 41,628 | 69,294 | 161,270 |
| 2011 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 241,838 | 43,182 | 72,875 | 163,032 |
| 2012 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 249,093 | 44,794 | 76,533 | 164,741 |
| 2013 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 256,566 | 46,466 | 80,272 | 166,399 |
| 2014 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 264,263 | 48,201 | 84,094 | 168,007 |
| 2015 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 272,191 | 50,000 | 88,002 | 169,567 |
| 2016 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 280,357 | 51,867 | 92,000 | 171,080 |
| 2017 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 288,768 | 53,803 | 96,090 | 172,547 |
| 2018 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 297,431 | 55,812 | 100,277 | 173,971 |
| 2019 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 306,354 | 57,895 | 104,563 | 175,352 |
| 2020 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 315,544 | 60,056 | 108,953 | 176,691 |
| | 2,450,000 | 2,590,000 | 2,186,500 | 2,700,000 | 3,300,000 | 3,930,000 | 3,550,000 | << Total production | | | |

Source: I. Sepharim, 1991 (Annex II)

<u>Table V c (p. 1 out of 3)</u>

"Very Bad" Scenario

| | Market for fruit & vegetable | | Electricity: | | | | | | | | Scenario: Very bad | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Local: 1 Ton | Export: $1000 | KWH | Mill. KWH | MegaW | | | | | Work force: 1 person | | | | | | Land: 1 dunam |
| ear | Local market | export market | consumption per person | Total consumption | peak consumo. | Total Population | Total work force | Employed in Israel | Employed in gaza | Available for project | Total land | Not farmed | Farmed | Traditionaly Irrigated | Not irrigated | Available for project |
| cred | 3% | 4% | 1% | 5% | 5% | 3% | 3% | -2% | 3% | 10% | 0% | 0% | 0% | 0% | 0% | |
| 990 | 130,000 | 20,000 | 363 | 236 | 54 | 650,000 | 105,000 | 45,000 | 50,000 | 10,000 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 991 | 133,900 | 20,747 | 368 | 247 | 56 | 669,500 | 108,150 | 44,100 | 51,500 | 12,550 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 992 | 137,917 | 21,521 | 374 | 258 | 59 | 689,585 | 111,395 | 43,218 | 53,045 | 15,132 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 993 | 142,055 | 22,325 | 379 | 269 | 61 | 710,273 | 114,736 | 42,354 | 54,636 | 17,746 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 994 | 146,316 | 23,158 | 385 | 282 | 64 | 731,581 | 118,178 | 41,507 | 56,275 | 20,396 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 995 | 150,706 | 24,023 | 391 | 294 | 67 | 753,528 | 121,724 | 40,676 | 57,964 | 23,084 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 996 | 155,227 | 24,919 | 396 | 308 | 70 | 776,134 | 125,375 | 39,863 | 59,703 | 25,810 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 997 | 159,884 | 25,850 | 402 | 322 | 73 | 799,418 | 129,137 | 39,066 | 61,494 | 28,577 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 998 | 164,680 | 26,815 | 408 | 336 | 76 | 823,401 | 133,011 | 38,284 | 63,339 | 31,388 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 999 | 169,621 | 27,816 | 414 | 351 | 80 | 848,103 | 137,001 | 37,519 | 65,239 | 34,244 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 000 | 174,709 | 28,854 | 420 | 367 | 83 | 873,546 | 141,111 | 36,768 | 67,196 | 37,147 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 001 | 179,950 | 29,931 | 427 | 384 | 87 | 899,752 | 145,345 | 36,033 | 68,212 | 41,100 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 002 | 185,349 | 31,049 | 433 | 401 | 91 | 926,745 | 149,705 | 35,312 | 71,288 | 43,105 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 003 | 190,909 | 32,208 | 439 | 419 | 95 | 954,547 | 154,196 | 34,606 | 73,427 | 46,163 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 004 | 196,637 | 33,410 | 446 | 438 | 100 | 983,183 | 158,822 | 33,914 | 75,629 | 49,279 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 005 | 202,536 | 34,657 | 452 | 458 | 104 | 1,012,679 | 163,587 | 33,236 | 77,898 | 52,453 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 006 | 208,612 | 35,951 | 459 | 479 | 109 | 1,043,059 | 168,494 | 32,571 | 80,235 | 55,688 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 007 | 214,870 | 37,293 | 466 | 501 | 114 | 1,074,351 | 173,549 | 31,919 | 82,642 | 58,987 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 008 | 221,316 | 38,686 | 473 | 523 | 119 | 1,106,581 | 178,755 | 31,281 | 85,122 | 62,353 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 009 | 227,956 | 40,130 | 480 | 547 | 124 | 1,139,779 | 184,118 | 30,655 | 87,675 | 65,787 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 010 | 234,794 | 41,628 | 487 | 572 | 130 | 1,173,972 | 189,642 | 30,042 | 90,306 | 69,294 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 011 | 241,838 | 43,182 | 494 | 597 | 136 | 1,209,191 | 195,331 | 29,442 | 93,015 | 72,875 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 012 | 249,093 | 44,794 | 501 | 625 | 142 | 1,245,467 | 201,191 | 28,853 | 95,805 | 76,533 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 013 | 256,566 | 46,466 | 509 | 653 | 148 | 1,282,831 | 207,227 | 28,276 | 98,679 | 80,272 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 014 | 264,263 | 48,201 | 516 | 682 | 155 | 1,321,316 | 213,443 | 27,710 | 101,640 | 84,094 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 015 | 272,191 | 50,000 | 524 | 713 | 162 | 1,360,956 | 219,847 | 27,156 | 104,689 | 88,002 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 016 | 280,357 | 51,867 | 532 | 745 | 169 | 1,401,784 | 226,442 | 26,613 | 107,830 | 92,000 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 017 | 288,768 | 53,803 | 540 | 779 | 177 | 1,443,838 | 233,235 | 26,081 | 111,064 | 96,090 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 018 | 297,431 | 55,812 | 548 | 814 | 185 | 1,487,153 | 240,232 | 25,559 | 114,396 | 100,277 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 019 | 306,354 | 57,895 | 556 | 851 | 193 | 1,531,768 | 247,439 | 25,048 | 117,828 | 104,563 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |
| 020 | 315,544 | 60,056 | 564 | 890 | 202 | 1,577,721 | 254,863 | 24,547 | 121,363 | 108,953 | 360,000 | 140,000 | 220,000 | 108,000 | 112,000 | 112,000 |

Source: I. Sepharim, 1991 (Annex II)

Table V c (p. 2 out of 3)

"Very Bad" Scenario

*Scenario:* Very bad

Water balance: 1000 X cub. m. — New water sources: 1000 X cub. m.

| | Consumption | | | | | | | | Sea water osmosis in year | | | | 3 X salt water osmosis in year | | Water Import | Zereshi |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Non Agri | Agri | Total | Rain | Deficit | Accumulated deficit | recycle | | (1.5) | (5.10) | (10.15) | (15.20) | (1.5) | (10.15) | (5.11) | (5.10) |
| Increa | 5% | 0% | | | | | 60% | | A | B | C | D | E | F | G | H |
| 1990 | 40,000 | 30,000 | 120,000 | 60,000 | 60,000 | 60,000 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 42,000 | 30,000 | 122,000 | 60,000 | 62,000 | 122,000 | 20,000 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 44,100 | 30,000 | 124,100 | 60,000 | 64,100 | 186,100 | 20,000 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 46,305 | 30,000 | 126,305 | 60,000 | 66,305 | 252,405 | 20,000 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 48,620 | 30,000 | 128,620 | 60,000 | 68,620 | 321,025 | 20,000 | | 50,000 | 0 | 0 | 0 | 49,500 | 0 | 0 | 0 |
| 1995 | 51,051 | 30,000 | 131,051 | 60,000 | 71,051 | 392,077 | 20,000 | | 50,000 | 0 | 0 | 0 | 49,500 | 0 | 0 | 0 |
| 1996 | 53,604 | 30,000 | 133,604 | 60,000 | 73,604 | 465,680 | 20,000 | | 50,000 | 0 | 0 | 0 | 49,500 | 0 | 0 | 0 |
| 1997 | 56,284 | 30,000 | 136,284 | 60,000 | 76,284 | 541,964 | 20,000 | | 50,000 | 0 | 0 | 0 | 49,500 | 0 | 0 | 0 |
| 1998 | 59,098 | 30,000 | 139,098 | 60,000 | 79,098 | 621,063 | 20,000 | | 50,000 | 0 | 0 | 0 | 49,500 | 0 | 0 | 0 |
| 1999 | 62,053 | 30,000 | 142,053 | 60,000 | 82,053 | 703,116 | 20,000 | | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2000 | 65,156 | 30,000 | 145,156 | 60,000 | 85,156 | 788,271 | 20,000 | | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2001 | 68,414 | 30,000 | 148,414 | 60,000 | 88,414 | 876,685 | 40,000 | | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2002 | 71,834 | 30,000 | 151,834 | 60,000 | 91,834 | 968,519 | 40,000 | | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2003 | 75,426 | 30,000 | 155,426 | 60,000 | 95,426 | 1,063,945 | 40,000 | | 50,000 | 50,000 | 0 | 0 | 49,500 | 0 | 90,000 | 50,000 |
| 2004 | 79,197 | 30,000 | 159,197 | 60,000 | 99,197 | 1,163,143 | 40,000 | | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2005 | 83,157 | 30,000 | 163,157 | 60,000 | 103,157 | 1,266,300 | 40,000 | | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2006 | 87,315 | 30,000 | 167,315 | 60,000 | 107,315 | 1,373,615 | 40,000 | | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2007 | 91,681 | 30,000 | 171,681 | 60,000 | 111,681 | 1,485,295 | 40,000 | | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2008 | 96,265 | 30,000 | 176,265 | 60,000 | 116,265 | 1,601,560 | 40,000 | | 50,000 | 50,000 | 50,000 | 0 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2009 | 101,078 | 30,000 | 181,078 | 60,000 | 121,078 | 1,722,638 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2010 | 106,132 | 30,000 | 186,132 | 60,000 | 126,132 | 1,848,770 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2011 | 111,439 | 30,000 | 191,439 | 60,000 | 131,439 | 1,980,209 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2012 | 117,010 | 30,000 | 197,010 | 60,000 | 137,010 | 2,117,219 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2013 | 122,861 | 30,000 | 202,861 | 60,000 | 142,861 | 2,260,080 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2014 | 129,004 | 30,000 | 209,004 | 60,000 | 149,004 | 2,409,084 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2015 | 135,454 | 30,000 | 215,454 | 60,000 | 155,454 | 2,564,538 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2016 | 142,227 | 30,000 | 222,227 | 60,000 | 162,227 | 2,726,765 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2017 | 149,338 | 30,000 | 229,338 | 60,000 | 169,338 | 2,896,103 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2018 | 156,805 | 30,000 | 236,805 | 60,000 | 176,805 | 3,072,908 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2019 | 164,645 | 30,000 | 244,645 | 60,000 | 184,645 | 3,257,554 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |
| 2020 | 172,878 | 30,000 | 252,878 | 60,000 | 192,878 | 3,450,432 | 60,000 | | 50,000 | 50,000 | 50,000 | 50,000 | 49,500 | 49,500 | 90,000 | 50,000 |

Source: I. Sepharim, 1991 (Annex II)

Table V c (p. 3 out of 3)

"Very Bad" Scenario

"Available for project" — Scenario: Very bad

| Year | #0 | #1 | #2, #2a | #3, #3a, #6 | #4 | #5 | #5a | Local market | Export market | Work force | Land |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water production scenarios (1000 X cub. m.) | | | | | | | (1 ton) | ($1,000) | (1 person) | (1 dunam) |
| increment | A+B | recycle+A | C+E | 2A | 2A | A+G+D | A+B+H | | | | |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130,000 | 20,000 | 10,080 | 112,000 |
| 1991 | 0 | 20,000 | 0 | 0 | 0 | 0 | 0 | 133,901 | 20,747 | 12,550 | 112,000 |
| 1992 | 0 | 20,000 | 0 | 0 | 0 | 0 | 0 | 137,917 | 21,521 | 15,132 | 112,000 |
| 1993 | 0 | 20,000 | 0 | 0 | 0 | 0 | 0 | 142,055 | 22,325 | 17,746 | 112,000 |
| 1994 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 146,316 | 23,158 | 20,396 | 112,000 |
| 1995 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 150,706 | 24,023 | 23,084 | 112,000 |
| 1996 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 155,227 | 24,919 | 25,810 | 112,000 |
| 1997 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 159,884 | 25,850 | 28,577 | 112,000 |
| 1998 | 50,000 | 70,000 | 49,500 | 100,000 | 100,000 | 50,000 | 50,000 | 164,680 | 26,815 | 31,388 | 112,000 |
| 1999 | 100,000 | 70,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 169,621 | 27,816 | 34,244 | 112,000 |
| 2000 | 100,000 | 70,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 174,709 | 28,854 | 37,147 | 112,000 |
| 2001 | 100,000 | 90,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 179,950 | 29,931 | 40,100 | 112,000 |
| 2002 | 100,000 | 90,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 185,349 | 31,049 | 43,105 | 112,000 |
| 2003 | 100,000 | 90,000 | 49,500 | 100,000 | 100,000 | 140,000 | 150,000 | 190,909 | 32,208 | 46,163 | 112,000 |
| 2004 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 196,637 | 33,410 | 49,279 | 112,000 |
| 2005 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 202,536 | 34,657 | 52,453 | 112,000 |
| 2006 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 208,612 | 35,951 | 55,688 | 112,000 |
| 2007 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 214,870 | 37,293 | 58,987 | 112,000 |
| 2008 | 100,000 | 90,000 | 99,500 | 100,000 | 100,000 | 140,000 | 150,000 | 221,316 | 38,685 | 62,353 | 112,000 |
| 2009 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 227,956 | 40,130 | 65,787 | 112,000 |
| 2010 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 234,794 | 41,628 | 69,294 | 112,000 |
| 2011 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 241,838 | 43,182 | 72,875 | 112,000 |
| 2012 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 249,093 | 44,794 | 76,533 | 112,000 |
| 2013 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 256,566 | 46,466 | 80,272 | 112,000 |
| 2014 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 264,263 | 48,201 | 84,094 | 112,000 |
| 2015 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 272,191 | 50,000 | 88,002 | 112,000 |
| 2016 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 280,357 | 51,867 | 92,000 | 112,000 |
| 2017 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 288,768 | 53,803 | 96,090 | 112,000 |
| 2018 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 297,431 | 55,812 | 100,277 | 112,000 |
| 2019 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 306,354 | 57,895 | 104,563 | 112,000 |
| 2020 | 100,000 | 110,000 | 99,500 | 100,000 | 150,000 | 190,000 | 150,000 | 315,544 | 60,056 | 108,953 | 112,000 |
| | 2,450,000 | 2,590,000 | 2,186,500 | 2,700,000 | 3,300,000 | 3,930,000 | 3,550,000 | << Total production | | | |

Source: I. Sepharim, 1991 (Annex II)

## D. ECONOMIC AND SOCIO-ECONOMIC ASPECTS

### 1. Transfer of Technologies and Complementarity of Markets

Water desalination could be the solution to water shortages in the Gaza Strip, but unless the supply of water is accompanied by a fundamental structural change, such a solution will be incomplete. Urban population could more readily adapt itself to the use of desalinated water, but the cost of such water would probably seem prohibitive to the rural population. They would tend to use, legally or illegally, poor quality but readily available and inexpensive ground water rather than pay the high price for desalinated water. By so doing they would exacerbate the deterioration of ground water quality.

#### a. Transfer of Agricultural Technologies

The portfolio of produce in the Gaza Strip at present includes mostly water-intensive citrus groves (partially for export), and other fruits and vegetables (mostly for local consumption). The modification of this portfolio and the introduction of more sophisticated technologies could result in growing less water-intensive produce and creating a higher value-added economy. Part of the produce in the new structure will probably be exported to Israel and abroad. This may put the Gaza Strip agriculture in direct competition with Israeli agriculture.

A number of elelments indicate, nevetheless, that such a threat may be less serious than expected:

(1) The rapid growth of the Gaza Strip's population and the a parallel rise in Judea and Samaria will create rapidly expanding local markets there.

(2) Exporting to Europe is costly, relates only to top quality products and requires exact delivery timing. The Gaza Strip agriculture will not be ready for this in the short run. In the longer run, however, due to the political and economic importance of exporting to Europe, local produce will come up to European standarts.

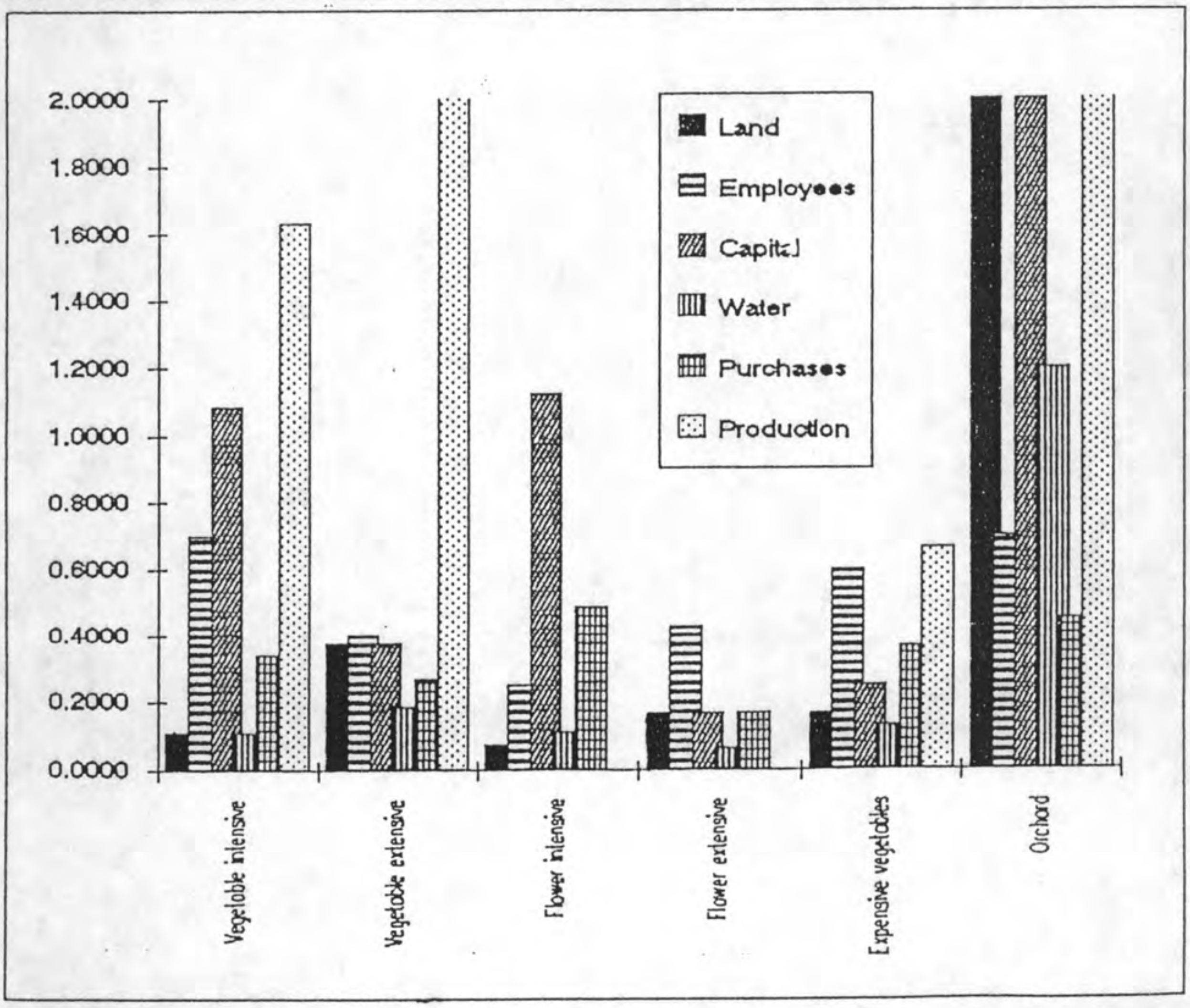
(3) Good (but not top) quality products could be exported, even in the near future, to the Persian Gulf area, where they would open new markets, not in direct competition with Israel's markets.

Modern technology will be introduced into the Gaza Strip sooner or later. Its early introduction could contribute directly to the solution of the water shortage problem. The introduction of modern agricultural technology requires intensive research as well as the lifting of political and administrative restrictions. Since all these elements are now under Israeli control, Israel could, with some local cooperation, use them as part of a strategy which would benefit all parties concerned. It could thereby contribute to an improvement of the regional political atmosphere. The choice of technologies for the Gaza Strip must take into account the intensitivities of each technology in elements that are either abundant or insufficient in the Gaza Strip. Five technologies were compared to that of traditional citrus orchard growing in terms of the following intensivities: land, labour, capital, water and purchases (see graph on next page). The intensivities are calculated by units of revenue rather than by production units, in order to provide an equitable measure for all teachnologies. The volume of production per unit of revenue is also given. The table is based on Israeli data.

Figure 2

# Intensivities per $1000 production

| Agriculture | Land dunam | Employees (per $10.000) | Capital $1.000 | Water 1000 cub. | Purchases $1.000 | Production ton |
|---|---|---|---|---|---|---|
| Vegetable intensive | 0.1087 | 0.7000 | 1.0870 | 0.1087 | 0.3400 | 1.6304 |
| Vegetable extensive | 0.3750 | 0.4000 | 0.3750 | 0.1875 | 0.2700 | 3.7500 |
| Flower intensive | 0.0750 | 0.2500 | 1.1250 | 0.1125 | 0.4910 | 0.0000 |
| Flower extensive | 0.1667 | 0.4300 | 0.1667 | 0.0667 | 0.1700 | 0.0000 |
| Expensive vegetables | 0.1667 | 0.6000 | 0.2500 | 0.1333 | 0.3700 | 0.6667 |
| Orchard | 2.0000 | 0.7000 | 2.0000 | 1.2000 | 0.4500 | 6.0000 |




Source: I. Sepharim, 1991 (Annex II)

It is clear from the graph that, for an equal revenue from production, citrus orchards are very costly in terms of land, capital and water, and moderately costly in terms of labour and purchased inputs. Although land is plentiful in the Gaza Strip, the other inputs, and water above all, are scarce commodities. Supplying expensive water to the region would make citrus growing uneconomical, and require a technological shift to other agricultural products, (i.e. transfer of agricultural technologies).

The transfer of agricultural technologies to the Gaza Strip may include the following items:

(1) Producing vegetables and fruit for local consumption and for export (to the Persian Gulf), using conventional extensive technology.

(2) Producing vegetables for export, using intensive technology.

(3) Producing flowers for export, using extensive technology.

(4) Producing expensive agricultural products (e.g., strawberries, etc.) for export, using extensive technology.

"Intensive Technology" in the above terminology refers to a technology which, for an equal measure of output, uses a higher measure of inputs than an extensive technology for the same kind of product. Since the use of weight as output measure is not equitable for some products (such as flowers) and doesn't reflect the real porduction value, the measure used here is sales value.

It is clear that the chosen technologies are much more adapted to local resources and constraints than citrus growing. Most of all, they need very little water and are relatively labour intensive. They vary in capital intensivity and in external purchases.

The transfer of such technologies to the Gaza Strip was planned in our projects to follow a constant pace from their very beginning, even though new water sources will only be operational several years later. Under such circumstances the likelihood that the "Good" scenario will materialize is higher, thanks to an immediate replacement of water-intensive cultures by non water-intensive ones.

The rate of introduction of each technology has been determined by us as users of the MB model, taking into account environmental and economic factors. The purpose was not to maximize any specific element, but to enable us to evaluate the effect of a particular mix on employment and overall value added. The technologies are packaged in modules, with a time horizon of 25 years.

While the Israeli agriculture is gradually shifting towards a less labour-intensive mode, the transfer of modern but labour-intensive technologies into the Gaza Strip would create a complementarity between the two economies: labour intensive products produced in the Gaza Strip would have Israel as one of their major markets, and Israeli agriculture could shift to more capital-intensive and sophisticated areas and still have a supply of the less sophisticated products.

b. Transfer of Industrial Technologies

In addition to the introduction of water non-intensive agriculture, another process of economic development, that would reduce the water consumption and use the electricity provided by the planned power stations, is the industrialization of the Gaza Strip. Much like the issue of agricultural technologies, industrialization will eventually happen in the Gaza Strip. Its development so far has been slow and unbalanced. If undertaken early enough and within a well defined strategy, it could follow the same pattern as we predicted for agriculture: Gaza taking over mainstream technologies which will be phased-out in Israel, and creating a complementary, non-competing economy. This process is within reach of the Gaza Strip in its current economic and technological capacity.

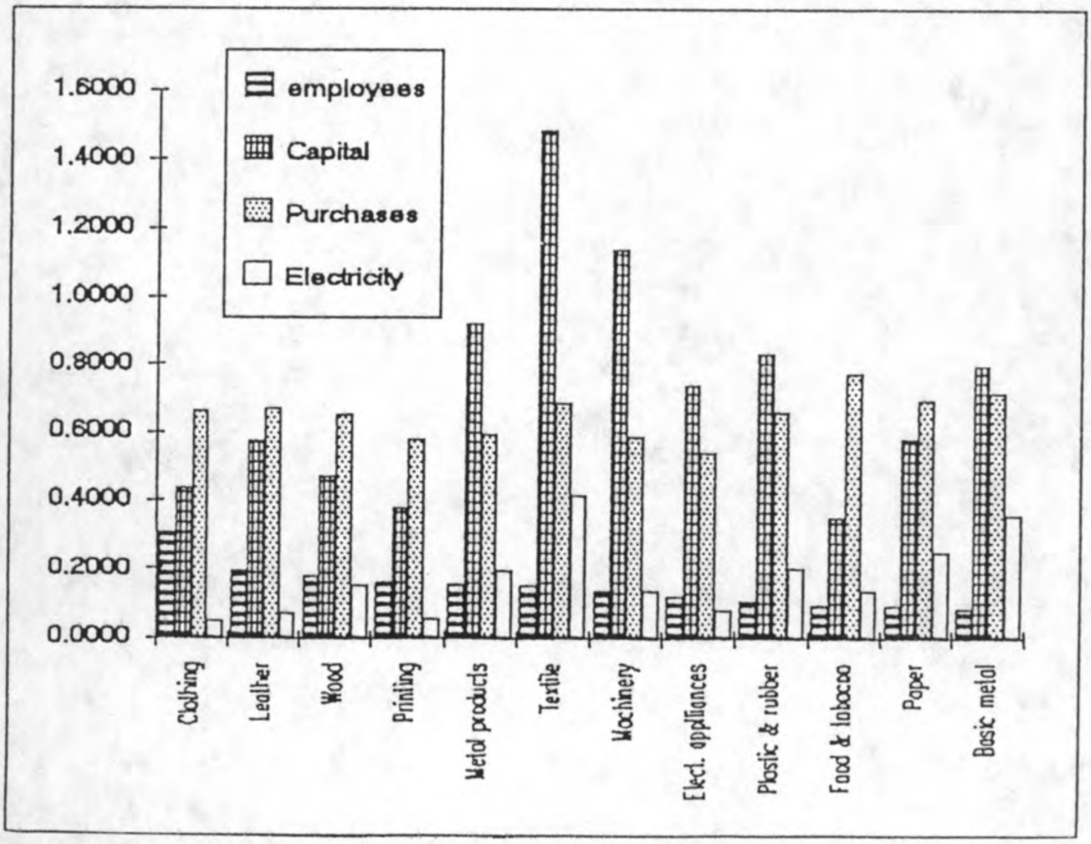
In order to identify the appropriate industries for the first phase of development in the Gaza Strip, we analysed key industrial branches focusing on the principal factors: labour, capital, energy and external purchases. Most industries are water non-intensive compared to agriculture. Several industries have been surveyed and the intensivities for each of the above elements compared. As a result of this comparison, four major industries were singled out as targets for technology transfer into and development in the Gaza Strip: clothing, wood, leather and electric home appliances. Their choice indicates high labour intensivity, low capital reauirements and high value added.

Here again, the maximum scope of each technology has been estimated, as was their rate of introduction, and they are represented in "modules", reflecting the establishment in a time horizon of 25 years of a number of production units in a specific economic branch.

Figure 3

# Intensivities per $1000 production

| Industry | Employees (per $10,000) | Capital $1,000 | Purchases $1,000 | Electricity KWH1000 |
|---|---|---|---|---|
| Clothing | 0.3065 | 0.4342 | 0.6610 | 0.0513 |
| Leather | 0.1955 | 0.5739 | 0.6688 | 0.0719 |
| Wood | 0.1796 | 0.4683 | 0.6527 | 0.1518 |
| Printing | 0.1595 | 0.3759 | 0.5775 | 0.0551 |
| Metal products | 0.1534 | 0.9183 | 0.5934 | 0.1947 |
| Textile | 0.1509 | 1.4858 | 0.6855 | 0.4139 |
| Machinery | 0.1360 | 1.1370 | 0.5848 | 0.1360 |
| Elect. appliances | 0.1228 | 0.7340 | 0.5379 | 0.0807 |
| Plastic & rubber | 0.1081 | 0.8310 | 0.6600 | 0.2016 |
| Food & tabacoo | 0.0955 | 0.3521 | 0.7744 | 0.1340 |
| Paper | 0.0925 | 0.5776 | 0.6949 | 0.2486 |
| Basic metal | 0.0830 | 0.7971 | 0.7141 | 0.3538 |




Source: I. Sepharim, 1991 (Annex II)

In all these branches the tendency in Israel is that of differentiation, that is: shifting from mass production for local consumption to specialized, top-quality production for export. Moving the mass production to a labour intensive area such as the Gaza Strip could make it competitive with East and South-East Asian production centers, while enjoying easier access to Europe and the US, directly or via Israel. The proximity of research and development centers in Israel and the availability in Gaza of an inexpensive work force with good technological capabilities could give it an additional advantage in areas such as electric home appliances, especially if foreign partners would participate in financing and international marketing.

## 2. Reaction Scenarios

### a. Underlying Guidelines for Integrated Development Projects

The integrated development project must include three elements: water supply technologies, agricultural technology transfer and industrial technology transfer. An integrated project must respond to the political, economic and social environment expected at the end of the planning horizon. Such horizon is described in the environmental scenarios as 25 years.

"Reaction Scenarios", or projects, were planned here by arranging water supply units, agricultural and industrial modules over time and evaluating their impact on relevant elements in the development of the Gaza Strip. The elements considered were capital investment, water, electricity and the project's contribution to employment and export from the Gaza Strip.

The scenarios were put together by the authors of the MB model in order to evaluate the impact of each scenario on the economy and society of the Gaza Strip. Water supply in each scenario was adapted to the development program in such a way as not to create too large a deficit. The amount of water generated is an outcome of the scenario, not its target.

In this study we use the term "net income" in the sense of value added, in other words sales minus outside purchases. This is not exactly the business definition of the term, but it is suitable for evaluating the public benefits of the projects. Other criteria for the usefulness of the projects to the Gaza Strip are production value, agricultural exports, employment and inputs in terms of covering the accumulated water deficit and the current consumption of water and electricity.

b. Technological Reaction Scenarios

Parallel to the water production scenarios described in the previous chapter, here is a set of scenarios including the transfer of technologies and their respective descriptions. The scenarios were used for the calculation of the water needs to be provided by the project as described in the presentation of the Morphologic Box above. The summarized results are presented in tables VI a and VI b.

(1) Transfer of mainstream industrial technologies (scenario #0): Since agriculture alone, even under the best circumstances, cannot provide sufficient value added to the Gaza Strip's economy, industries can be transferred to this area which are phasing out in Israel including the know-how (extension by experts from the former producing firms) and markets. This scenario does not assume any other proactive change than the transfer of

such technologies as soon as possible, without waiting for conditions to dictate such a step.

(2) Transfer of mainstream technologies as a result of an ecological catastrophe (scenario #1): Assuming no change in the Gaza Strip's water consumption, overdrawing water for water-intensive cultures (citrus, fruit and vegetables) will eventually lead to complete salination of ground water by sea water. The reaction to that would be an immediate introduction of sea water desalination for non-agricultural use and conversion of agriculture to the use of treated sewage water. Ground water, in this case, are assumed to have reached a level of salinity that makes them non-potable. Here too, employment will depend on industrialization, after transferring mainstream technologies from Israel.

(3) Gradual shift from agriculture to mainstream industry (scenarios #2 and #2a): The Gaza Strip inhabitants will go on drawing ground water until it becomes non-potable. As a reaction, the Strip's brackish water will have to be desalinated in a volume that would cover all non-agricultural water consumption. Using the RO technology for close-to-surface brackish water from nearby existing wells will keep water prices down. Increased salinity of the water will lead to the phasing out of agriculture in favor of mainstream industry. This is the only scenario where agriculture is not part of the future plan, thereby saving the high cost of installing a new water distribution system.

(4) Export-agriculture (to Europe) and mainstream industry (scenarios #3 and #3a): Sea water desalination plants will have a capacity just enough to cover the current deficit but not the accumulated deficit. Desalinated water will also be used for agriculture, which will have to be converted from

water-intensive to water non-intensive technologies. The political reality will not allow export to the Gulf. The Gaza Strip will specialize in products which are labour-intensive but need little capital. New products will be developed, dedicated to the needs and capacities of the Gaza Strip and relying on the local professional workforce. Some of the inputs will be purchased in Israel, which will also call for marketing logistics.

(5) Elimination of the cumulative water deficit (scenario #4): Similar to the previous one, but with twice as much water desalination, creating a surplus which will be allowed to penetrate the aquifer and eliminate the cumulative water deficit. This scenario is intended to illustrate the actual cost of decreasing or eliminating the water deficit.

(6) Export agriculture to Europe and the Persian Gulf (scenarios #5 and #5a): Scenario #5 is expected to provide a high return on investment and a high level of employment. It is based, though, on the optimistic assumptions that:

(a) Water could be imported from Egypt;

(b) The Gaza Strip could export to the Gulf. Under these circumstances there will also be a gradual reduction of the accumulated deficit in ground water.

Without the possibility of using water from Egypt, scenario #5a assumes desalinating all the required water, implying a higher investment or international aid, lower value added and no contribution to the accumulated water deficit. If the Gulf markets do not open up for agricultural products from the Gaza Strip, markets would have to be found in the West, such as Europe. Exporting to Europe assumes overcoming a steep logistical hurdle which will be directly reflected in the unit price. Such export could only be profitable in market segments providing high returns for high quality products, and would rely heavily on product quality and on the right marketing timing.

(7) Transfer of more sophisticataed technologies for the production of mass-market products as well as mainstream technologies (scenario #6): The combination of the relative advantages of the Gaza Strip (low-cost, relatively well trained work-force) and the availability of Israeli engineers and know-how could create a joint competitive force in regular and mass-marketed products. This scenario follows the logic of economies such as Singapore and Hong Kong. The main markets in such a scenario should be in Europe and the United States. The main drawback in this scenario is doubt as to the ability of the Gaza Strip to realize this.

(8) Evaluation and choice of projects

In the following Tables VI a and VI b, a selection of projects are evaluated for the solution of the Gaza Strip water problem, including their respective contribution to key goals in the development of the Gaza Strip. It should be noticed that the arrangement of projects is not the only one possible, since not all possible environmental scenarios could be taken into account. The choice of the "ideal" project is not absolute, and there is always a quid pro quo. Preferring one project to another should reflect decision makers' criteria and resources, and the model should help them in evaluating the different options' contribution to each goal.

## Table VIa
## Reaction Scenarios: Results

| | UNITS | #0 | #1 | #2 | #2a | #3 | #3a | #4 | #5 | #5a | #6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Production | | | | | | | | | | | |
| 1st year plant | | ROSW | ROSW | ROBW | ROBW | 2xROSW | 2xROSW | 2xROSW | ROSW | ROSW | 2xROSW |
| 5th year plant | | ROSW | | | | | | | Nile | MED+ | |
| 10th year plant | | | | ROSW | ROSW | ROSW | | | | ROSW | |
| 15th year plant | | | | | | | | ROSW | ROSW | - | |
| Sewage water treatment | | no | yes | no | no | no | no | | no | no | no |
| Water Distribution system | | yes | yes | no | no | yes | yes | | yes | yes | yes |
| Financial indicators | | | | | | | | | | | |
| NPV of value added | $US m. | (77.0) | 298.7 | 286.0 | 771.9 | 88.3 | (397.5) | (20.9) | 1002.1 | 770.8 | 599.5 |
| CIR | | 0.856 | 1.662 | 2.263 | 3.422 | 0.227 | 1.146 | 0.968 | 2.536 | 2.066 | 1.830 |
| PVI | $US m. | 536.9 | 451.0 | 226.4 | 318.7 | 514.4 | 606.7 | 664.6 | 652.3 | 730.4 | 722.1 |
| Input requirements, year 25 | | | | | | | | | | | |
| Energy | m. KWH | 574.0 | 299.0 | 370.3 | 394.3 | 550.0 | 574.0 | 849.0 | 574.0 | *134.0 | 595.8 |
| Land | Mill-$m^2$ | 23.9 | 29.3 | 5.3 | 5.3 | 36.7 | 36.7 | 36.7 | 114.8 | 114.8 | 36.7 |
| Employment | employee | 12,089 | 13,457 | 10.897 | 20.424 | 6,959 | 16,488 | 16,488 | 26,394 | 26,394 | 19,800 |
| Agr. Prod. for Europe | US$m | 0.0 | 31.8 | 31.8 | 31.8 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 | 76.5 |
| Agr. Prod. for Gulf | US$m | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 229.1 | 229.1 | 0.0 |
| Agr. Prod. for Lccal MKT | Mill.Ton | 0.0 | 237.0 | 237.0 | 0.0 | 246.4 | 246.4 | 246.4 | 246.4 | 246.4 | 246.4 |
| Total output, year 25 | $US m | 414.0 | 452.8 | 388.8 | 738.8 | 144.4 | 494.4 | 494.4 | 723.5 | 723.5 | 764.0 |
| Water balance | $Mm^3/y$ | (44.9) | 53.4 | (99.4) | (99.4) | 34.5 | 34.5 | 634.5 | 421.9 | 41.9 | 34.5 |

* After generating 550 m.KWh using MED.

#0 Conventional industry and agriculture for local market.
#1 Ecological catastrophe and conventional industry.
#2 Conventional industry and gradual reduction of agriculture.
#2a Conventional industry and gradual reduction of agriculture.
#3 Agriculture for export to Europe and for local market.
#3a Agriculture for export to Europe and conventional industry.
#4 Covering the accumulated water deficit.
#5 Agriculture for export to Europe and the Persian Gulf and Conventional industry.
#5a Agriculture for export to Europe and the Persian Gulf, and conventional industry.
#6 Agriculture for export and mass-produced sophisticated industry.

ROSW = Reverse Osmosis Sea Water    ROBW = Reverse Osmosis Brackish Water

Sour ce: Ishai Sepharim, 1991 (Annex II).

## Table VIb
## Reaction Scenarios: Module distribution

| | UNITS | #0 | #1 | #2 | #2a | #3 | #3a | #4 | #5 | #5a | #6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Industry (*) | | | | | | | | | | | |
| Conventional industry | module | 1 | 1 | 1 | 2 | | 1 | 1 | 1 | 1 | 1 |
| Sophisticated industry | module | | | | | | | | | | 3 |
| Agriculture (**) | | | | | | | | | | | |
| Vegetables-intensive | module | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| Vegetables-extensive (export to Gulf) | module | | | | | | | | 3 | 3 | |
| Vegetables-extensive (Local market) | module | 1 | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 |
| Flowers-Extensive | module | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Ecpensive Vegetables (export to Europe) | module | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| Expensive Vegetables (export to Gulf) | module | | | | | | | | 1 | 1 | |

* Industrial Modules:

| Industry | Production Units in 25 years | proudction value per unit ($1000) |
|---|---|---|
| Clothing | 50 | 5,000 |
| Wood | 100 | 500 |
| Leather | 50 | 1,000 |
| Home appliances | 9 | 10,000 |

(**) Agricultural Modules:

| Branch | Production Units in 25 years | proudction balue per unit ($4000) |
|---|---|---|
| Vegetables - intensive | 250 | 46 |
| Vegetables - extensive | 1,600 | 40 |
| Flowers - extensive | 1,060 | 30 |
| Expensive products | 1,060 | 35 |

The full picture can be deduced from tables VI a and b above where the results of calculating the values of modules, the use of inputs and economic indicators are given for each individual project scenario. Here are some comments about the more meaningful reaction scenarios (referred to in the graphs as "projects"):

(1) Reaction scenarios #2 and #2a assume a gradual decrease in agriculture and require water desalination only for non-agricultural consumption. Scenario #2 is less expensive, since it can use brackish water. Scenario #2a is similar, but could provide more employment by accelerating the transfer of current technologies into the Gaza Strip. Both versions of the project are relatively inexpensive, provide a high return on investment but involve a continued deterioration of water quality in the aquifer and run the risk of an ecologic disaster.

(2) The reaction to an ecologic disaster is considered in reaction scenario #1, assuming an instant deterioration of the aquifer by penetration of sea water. The scenario itself is intended to minimize the socio-economic reprecussions of such a scenario, but it is incapable of reversing the ecologic damage. In this case industry will replace export agriculture as the main source of income and employment, and agriculture for local consumption will rely on recycled sewage water.

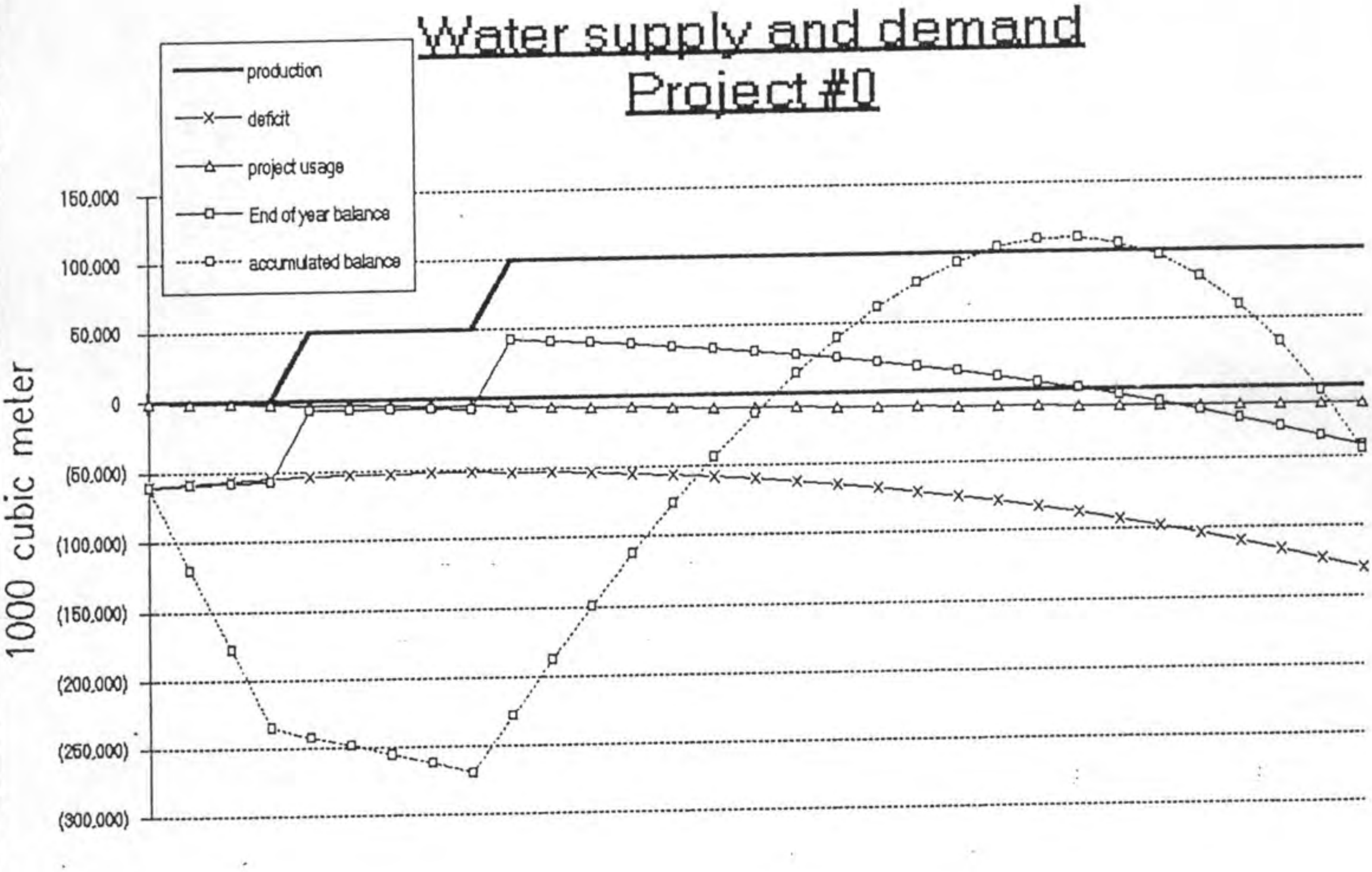
(3) Reaction scenario #3 is intended as a way to counter the current water deficit, by introducing sea water desalination plants and non water-intensive agricultural technologies. As such, this project is too small in terms of the output and employment it can provide, and the value added it can generate could not cover the investment involved. Output

here is a function of the market-niche for expensive, top-quality agricultural products. Reaction scenario #3a is the same as #3, but also includes the transfer of industrial technologies. This addition could bring the project to a size in which the value added of the overall project would cover the investment involved.

(4) In reaction scenario #4, water production and its timing will make it possible to minimize the accumulated water deficit. From all other points of view it is identical to scenario #4a. It requires ideal political conditions, permitting the import of water from Egypt and the export of agricultural products to the Gulf. It will yield a high return on investment and a high level by employment. If import of water from Egypt is not feasible, scenario #5a will be used relying completely on the desalination of sea water. Investment rises slightly compared to scenario #5, the ratio between value added and investment is not encouraging and there is no contribution to the elimination of accumulated water deficit.

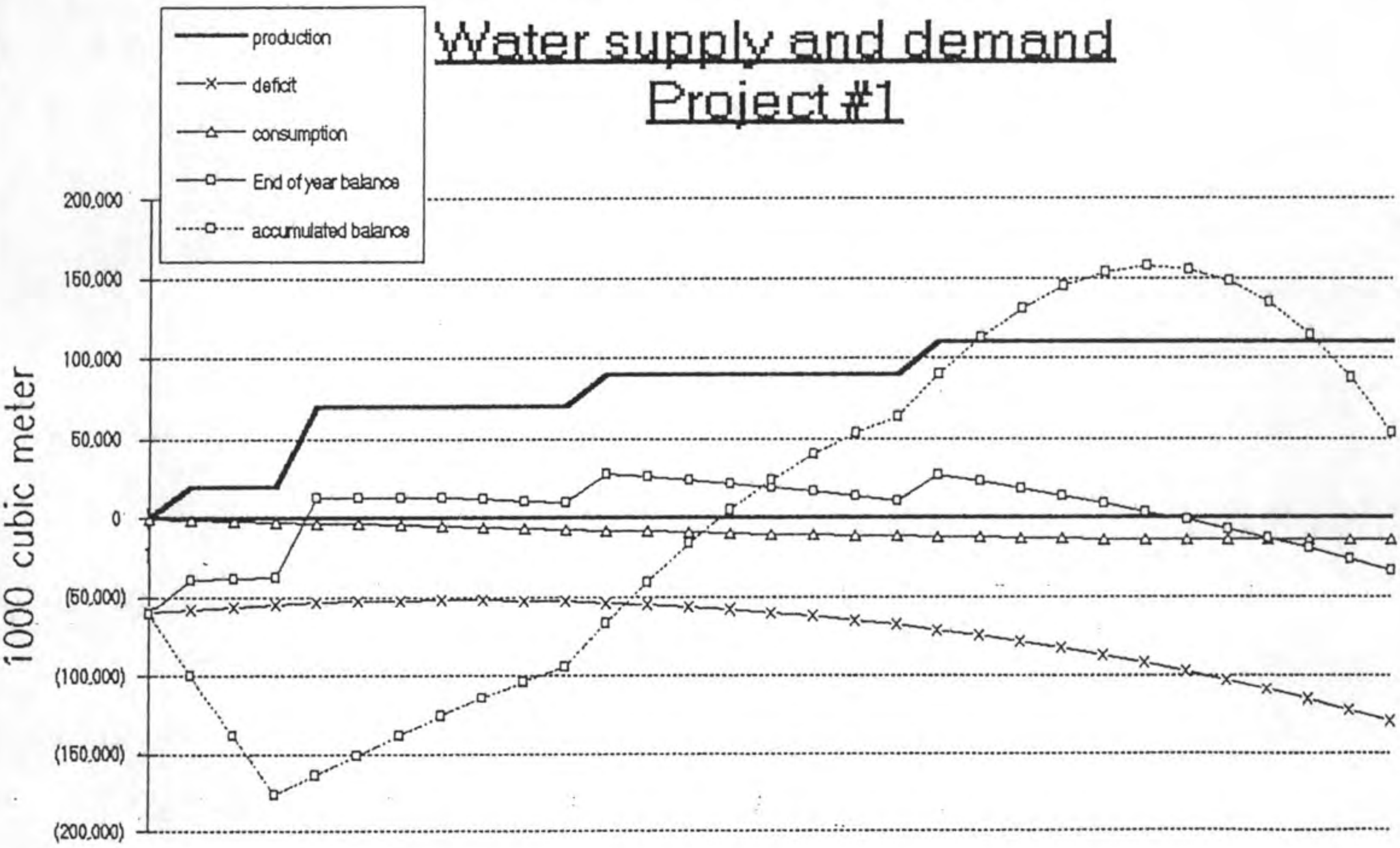
(5) In reaction scenario #6 the intention is to include high quality agriculture for export, like in scenario #3, conventional industry for export to Israel, like in scenario #3a, and in addition to that a more sophisticated industry producing electronic and electric appliances, for export to Europe and the United States.

Figure 4a



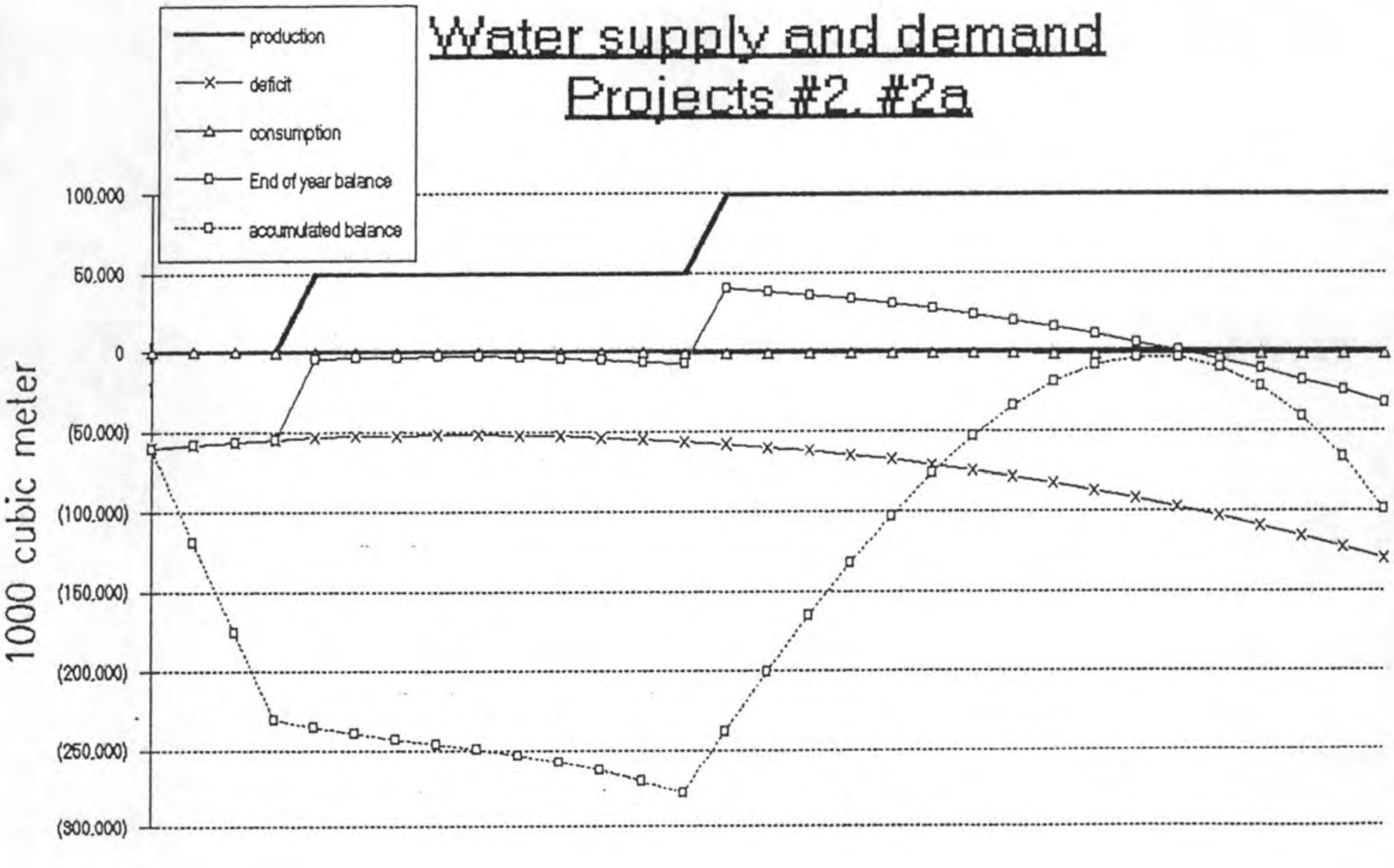

Source: I. Sepharim, 1991 (Annex II)

Figure 4b



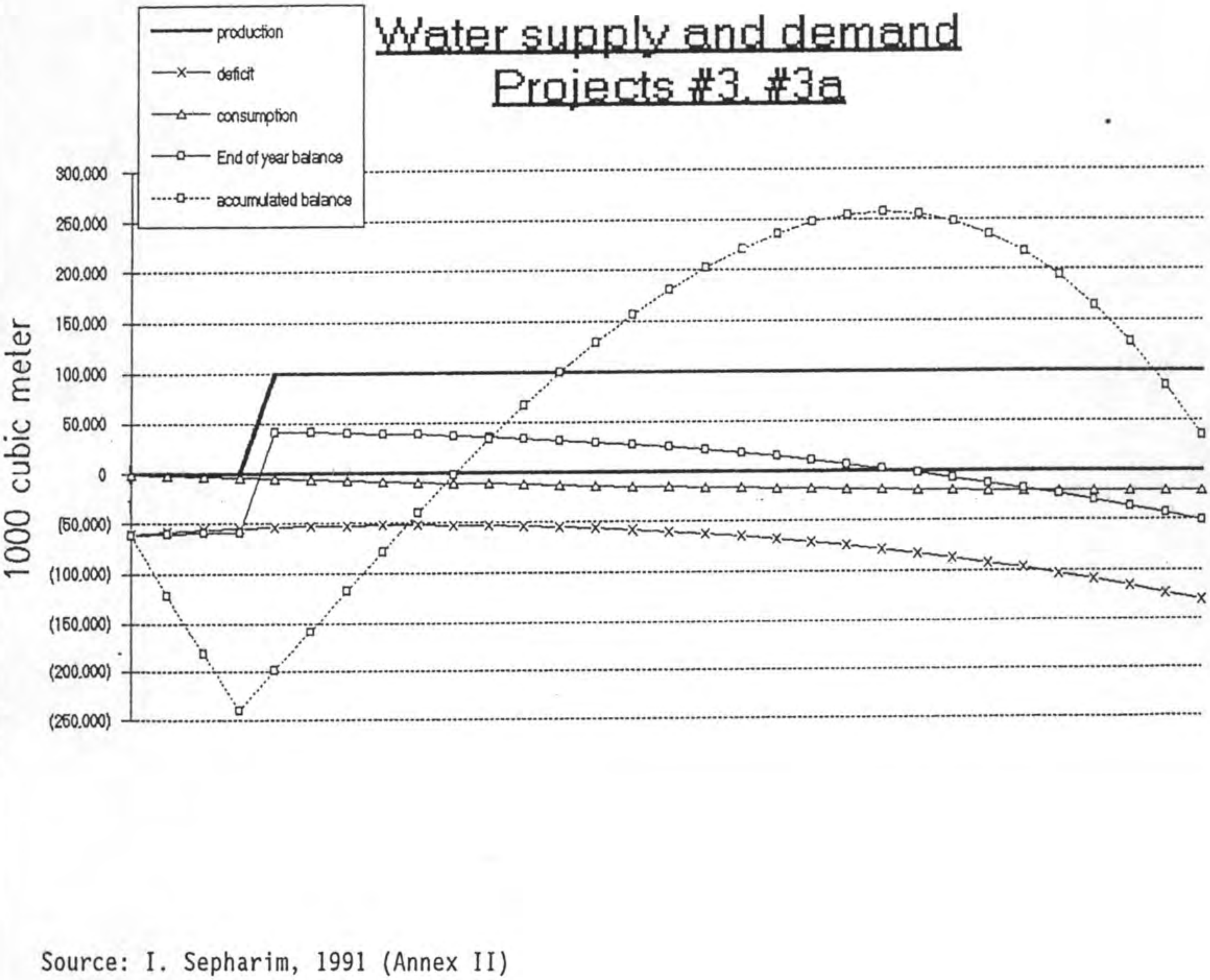

Source: I. Sepharim, 1991 (Annex II)

Figure 4c



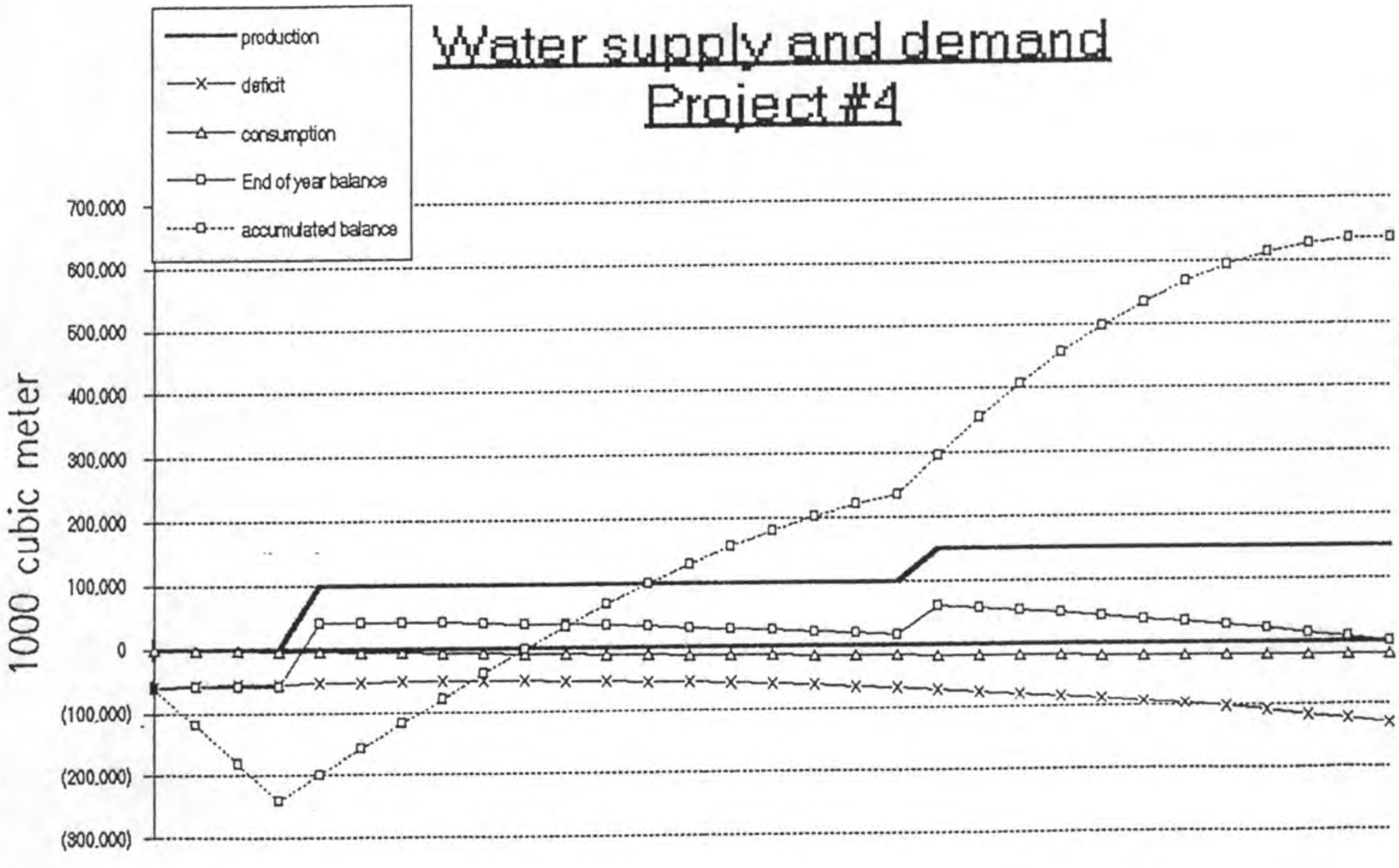

Source: I. Sepharim, 1991 (Annex II)

Figure 4d



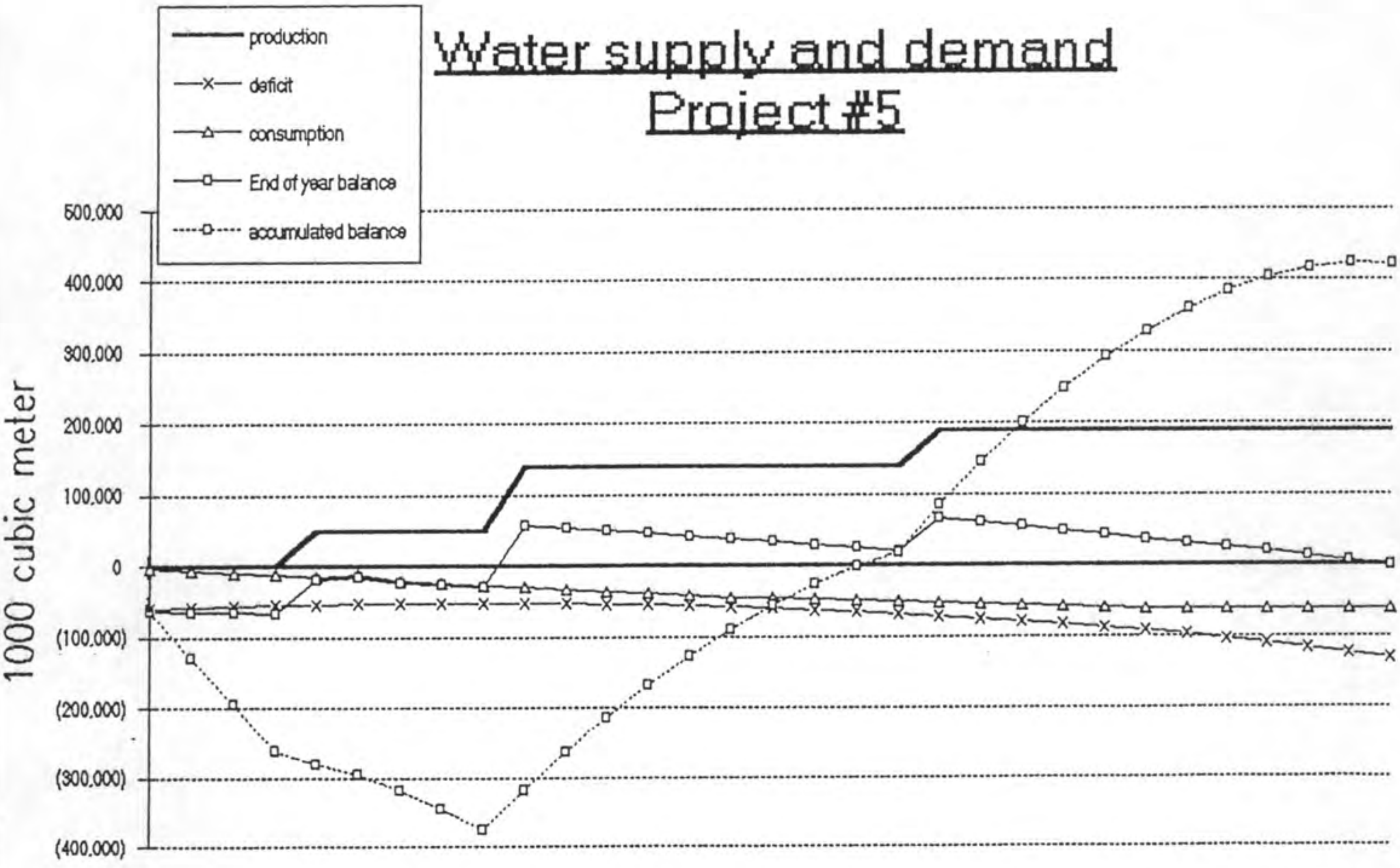

Source: I. Sepharim, 1991 (Annex II)

Figure 4e



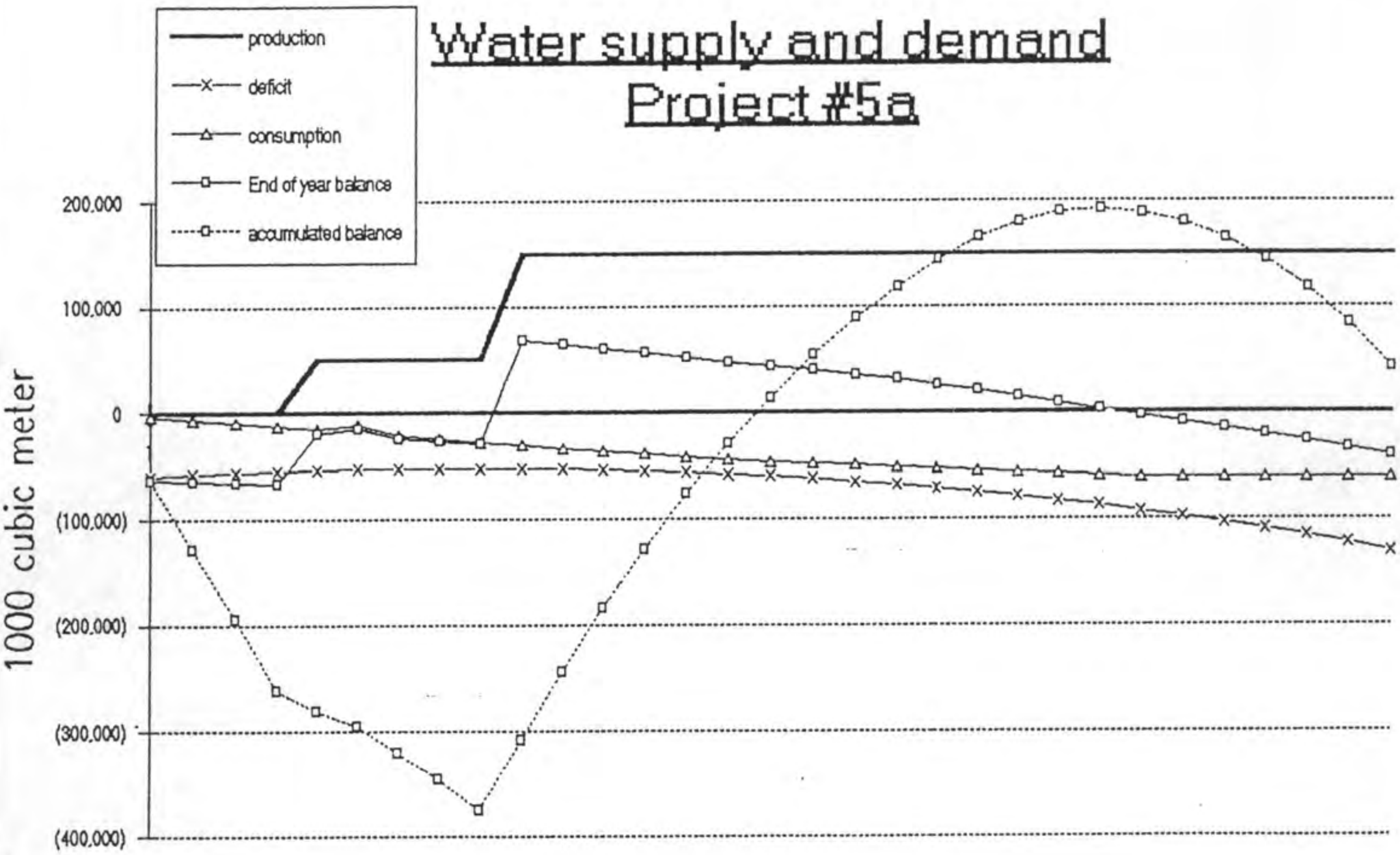

Source: I. Sepharim, 1991 (Annex II)

Figure 4f



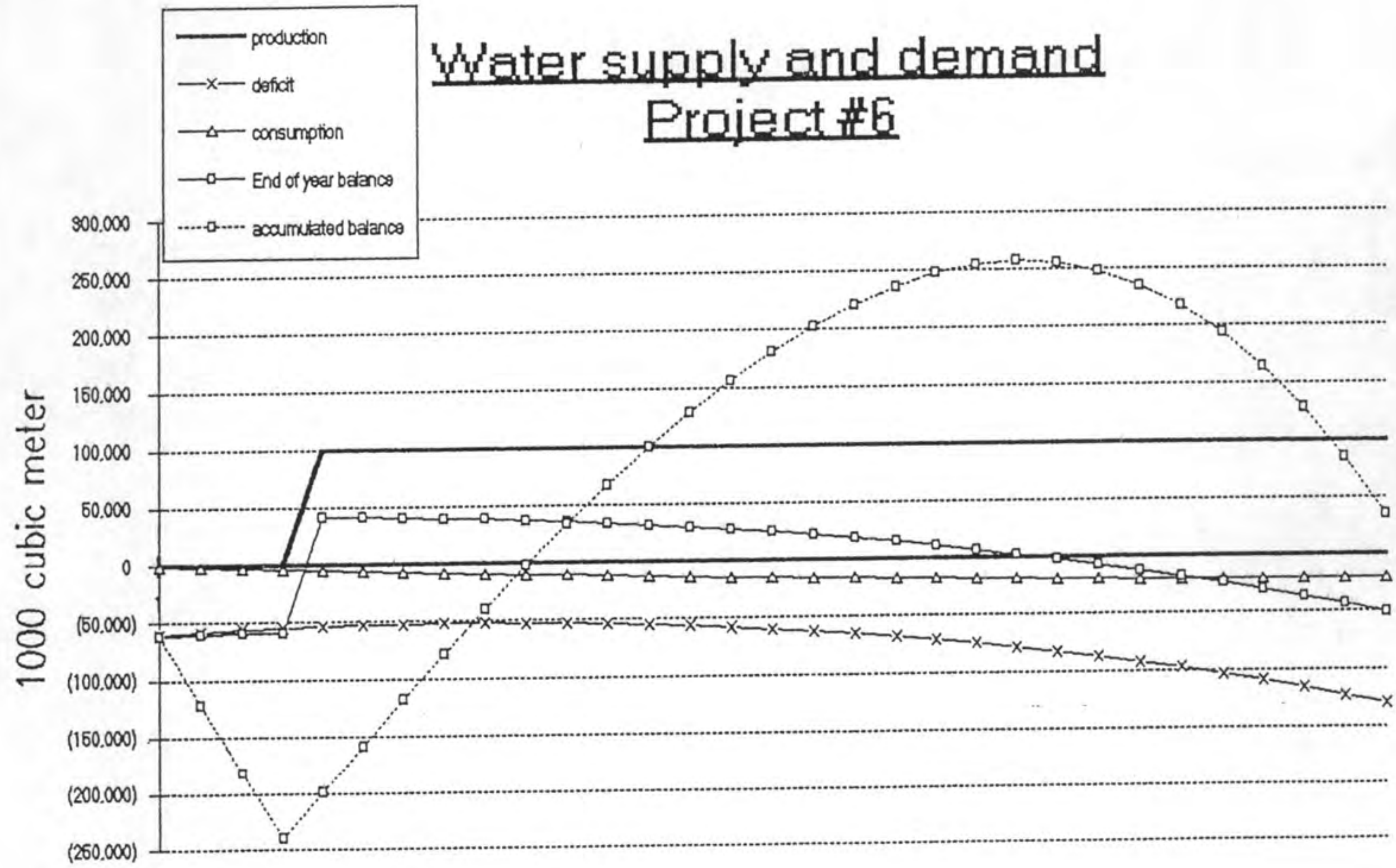

Source: I. Sepharim, 1991 (Annex II)

Figure 4q



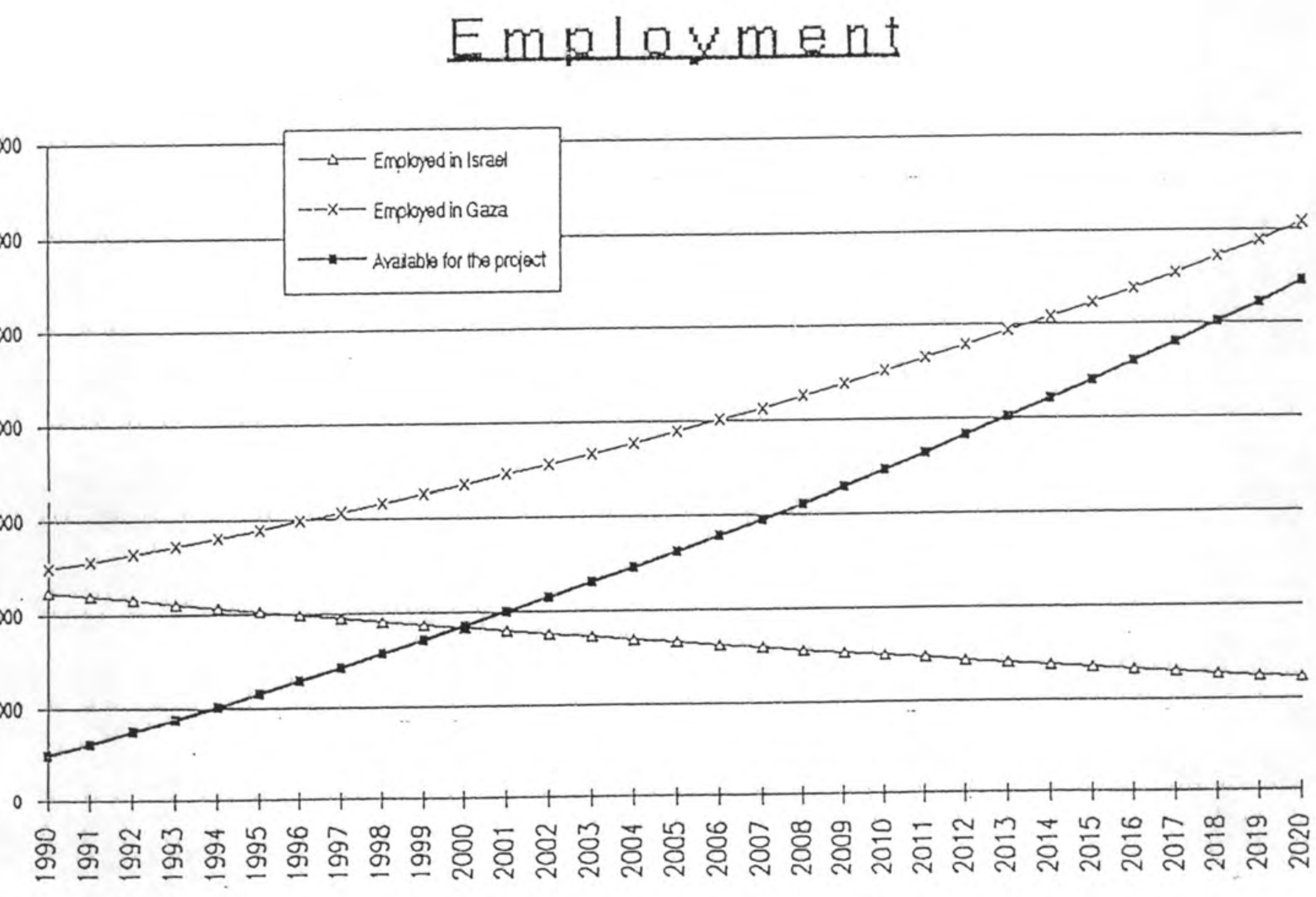

Source: I. Sepharim, 1991 (Annex II)

Figure 4h




Source: I. Sepharim, 1991 (Annex II)

Figure 5




Source: I. Sepharim, 1991 (Annex II)

## E. POLITICAL AND SOCIO-POLITICAL ASPECTS

### 1. Political and Socio-Political Aspects Within the Gaza Strip

The establishment of a water desalination plant, with or without an adjacent power station, in or near the Gaza Strip cannot be devoid of political implications. The very decision to begin such a venture is of political significance for the initiating party, for local and foreign collaborators in the field and for eventual trade partners. The immediate social and political significance involves the the Gaza Strip itself. A more extensive study must be undertaken to provide a deeper analysis of social and political trends in the Gaza Strip. Here we would like to point out some of the influences that such a project could have.

#### a. Impacts of the Project on the Gaza Strip Society

Whatever scenario is adopted for the implementation of the project, it is expected to influence the society in the Gaza Strip from its initiation. The main influences will probably be in the following areas:

(1) Employment

Assuming no external intervention (such as closing the borders to Israel after regional arrangements are achieved), structural changes and the project itself will gradually increase the volume and availability of job opportunities, career paths and entrepreneurial business opportunities. This will be the case both within the project itself and in business and service units that will interacat with it from outside. As a result, the dependence of the society on income from work in Israel and from relatives abroad will decrease. In the short run, the project under construction could provide jobs in the construction itself and in the preparation for its implementation. This will also begin a process of in-situ training of professionals.

(2) Standard of living

The immediate effect of offering individuals more jobs, even under an unlikely assumptions of no rise in salaries, will improve the income of family units by increasing the number of family members employed. In the longer run, the market will create an increased demand for skilled and unskilled labour. This, in turn, will push wages upwards and begin a spiral of rising purchasing power, developing the local market, higher standard of living expectation and its actual improvement. The wider choice of employment will support the upward movement of wages by creating a competition among employers for quality employees.

(3) Social structure

Economic changes resulting from the project will influence the social roles of individuals and families. In the short run, individuals will be less dependent on families for their livelihhood and protection, and family units will be less dependent on their adult sons for their subsistance. In the longer run, this may lead to a gradual lessening of the family-orientation of the society. It may follow similar trends to those of other societies in the region in periods of accelerated urbanization and a steep rise in the standard of living. The introduction of more professional options will increase the complexity of the social structure of the Gaza Strip and reduce the role and importance of traditional institutions. Such institutions (religious or political) can be expected to resist such changes, which may result in a difficult transition period.

b. Political Implications of Socio-Economic Changes

As mentioned before, the very decision to introduce new water and electricity resources in to the Gaza Strip is a political one. In earlier periods one could expect political resistance even to such initiatives intended principally for the welfare of the local population. Such resistance occured in the 1970's when Gaza Strip Palestinians objected to Israeli projects for improving housing conditions in and near refugeee camps there. It reflected their suspicion as to the deeper motives behind these initiatives. Hopefully, local political leadership will now be more receptive to such ventures, and could enjoy the benefits of the project without feeling that they have to pay a political price for it. Such attitudes will be encouraged if foreign governements, international organizations and foreign business entities are involved in the project. Having said that, it should be kept in mind that no such venture can be realized without an explicit or implicit political acceptance by representatives of the Gaza Strip population. We believe that a full-fledged analysis of such impacts is called for, including a systematic field study, interviews with key figures in the area and abroad in order to devise a specific and detailed plan of action. This level of detail is beyond the scope of the present study, but on the basis of the knowledge accumulated for it, we reckon that the political impact of the project will include:

(1) A lower level of frustration and dissatisfaction in the Gaza Strip;
(2) Decrease in the influence of radical groups in the Gaza Strip and of organizations located abroad;
(3) Increase in the influence of local political leadership in the Gaza Strip;
(4) Stabilisation of an internal and regional political process centered around common economic and political interests.

## 2. Aspects of Israel-Gaza-Strip Relations

The only political scenario within which no economic interaction will exist between Israel and the Gaza Strip is a return to the pre-1967 situation of total separation and outright belligerency. Even though such an eventuality should not be ruled out, its probability is negligable. Under all other circumstances, between full independence and annexation, the two entities will continue to have some kind of economic ties.

Political ties cannot be dissociated from economic ones. The range of political ties between Israel and the Gaza Strip can go, under the present circumstances, from a tight Israeli control of Gaza as an occupied territory, to a high level of autonomy in managing its internal affairs. As a result of implementing the Sadan Commission's recommendations, a shift from tight control to more autonomy has begun. The peace process may enhance the role of the local leadership as a partner in decision making on matters that concern both sides.

a. Israeli Involvement in Implementing the Project

At present, the Gaza Strip is, for all practical purposes, an integral part of the Israeli economic structure. It is also part of the Israeli electricity and water supply networks. This implies a high level of Israeli involvement in the project, if implemented immediately. The interest of Israeli business entities to be involved in it will depend on several criteria, such as:

(1) The level of autonomy given to local authorities, including:
   (a) The willingness of local leadership to involve Israeli partners.
   (b) The availability of alternative (Arab or other) partners.
(2) The level of priority that Israeli authorities want to give, and can give, to Israeli contractors and suppliers.
(3) The level of commitment to employ foreign companies as part of the conditions attached to the financing coming from abroad.

We believe that ultimately, mainly due to the advantage of proximity, the Israeli component in the business part of the project will be relatively high. Nonetheless, such involvement will depend on the overall competitive position of Israeli versus foreign suppliers.

b. Impacts of the Project on Israeli-Palestinian Relations

The social and economic changes expected in the Gaza Strip as a result of the project will undoubtedly influence the political relationship between the Gaza Strip and Israel. Assuming no change in the political status of the Gaza Strip (as long as the results of bi- and multilateral negotiations are not known), the following are possible impacts on this relationship:

(1) Dialogue between Israeli political leadership and an accepted leadership in the Gaza Strip on issues of common concern, on the basis of near equality.

(2) Development of communication and cooperation routines for future projects.

(3) Reduction of the motivation for hostile activities by Gaza inhabitants against Israeli targets, as a result of an improved standard of living, employment and future prospects.

(4) Higher incentives for local authorities to discipline their population and prevent political violence, as part of their aspiration for autonomy and long-term political leadership.

3. International Aspects

a. International Involvement in Implementing the Project

The scope of the proposed project is too wide for it to be tackled solely by local partners and using local resources. International involvement in it is also in the interest of potential foreign partners, from both economic and political standpoints.

(1) Politically, such involvement would be perceived as a commitment to the peace process and to the peaceful and prosperous future of the region. It could be described as "putting your money where your mouth is".

(2) Economically, it would give the foreign partners a foothold in the region, in anticipation of its future prosperity under peace. It would also enable the local economies to benefit from technologies, suppliers, markets and financial benefits to which they previously had no access.

Foreign involvement in the project is a prerequisite to its realization. From that point of view, foreign partners to the peace process are expected to make a commitment and use their influence on other potential business partners to commit themselves to the project. This can be a test of their sincerity in wanting to contribute to solving the problem. Foreign involvement will be most needed in the aspects of financing and marketing.

b. International Financial Support and Credit

An economic feasibility study and a business plan is needed to establish the exact financial requirements of the project. Whatever the exact figure, whatever can be raised for it from local sources is finite and insufficient. There are two kinds of financial requirements for the project: capital investment and operating costs. Funding can be done by making direct contribution or by extending soft loans.

Capital investment in the project could be made through a consortium including the Israeli government, the Gaza Strip leadership, Israeli and foreign companies supporting foreign governments, international organizations and international development agencies:

(1) Part of the budget will come from funds already commited for such purposes (e.g., Israel's energy development plans and water resource development plans).

(2) Another part should come from funds allocated for such purposes by foreign entitities (e.g., the EEC funds for the improvement of living conditions in the territories occupied by Israel).

(3) The rest of the money will have to be covered by loans extended to the project by international financing agencies such as the World Bank, UNDP, etc.

c. Foreign Markets and their Role in the Project

One of the most crucial issues for the success of the project and the economic survival of the Gaza Strip, is access to foreign markets. In applying the MB model we limited ourselves to industries and agricultural branches which can be competitive in foreign markets. Nonetheless, there are no guarantees as to the access to such markets by a "new" supplier. As part of their goodwill, foreign governments and regional organizations (such as the EEC) are expected to allow easy and unobstructed access of the Gaza Strip products to their markets, under equitable competitive conditions. Such expectation is not easy to fulfill, given the sensitivity of the markets and internal political pressures. Potential markets, including the EEC, the US, Japan and the Gulf States would have to negotiate with the Gaza Strip and Israel the conditions for allowing produce into their markets.

## CONCLUSION

Water is vital to man, and its scarcity in the Gaza Strip makes the supply of water from new sources there imperative. So much so, that the cost of producing water for Gaza need become a secondary consideration. Supplying expensive water to the Gaza Strip will not allow the continuation of water-intensive agricultue as its main source of livelihood. A major change will be required in the economic structure of the region. Such change must be gradual, even though the needs are pressing. As part of the structural change, industry will gain momentum and the standard of living will rise, creating an increasing demand for electric power there.

In the present study we propose to bring about such change through an economic project based upon a dual-purpose plant for the production of water and electric power. The original idea was to set up a large scale unit supplying water and electricity to Egypt, Gaza Strip, Israel and the West Bank. Although there is much to be said in favor of such a project, especially from the political standpoint, we preferred, for the present study, to begin on a smaller scale, using a modular approach, in the Gaza Strip only. Around the areas currently not cultivated, an alternative economic structure will evolve using agricultural and industrial technologies from Israel. The project is so conceived as to rely on complementarity rather than competition between the Gaza Strip and Israel. The application of Ishai Sepharim's Morphologic Box model helped us forecast several scenarios based on different assumptions, covering positive, negative and neutral conditions, domestic and export market, mixes of industry and agriculture and other vital components. The application of the model in conjunction with existing technical solutions such as analysed by the IEC team, led to the following conclusion:

The project itself seems feasible and within the existing technological capabilities in Israel and the Gaza Strip. It has the advantage of introducing change into a very volatile area gradually and while allowing the local population and leadership to join the project itself, to apply its outcomes indirectly or even to ignore it. It does not require land expropriation, and the investment in it is gradual. Therefore, even if the project is unsuccessful or halted for external reasons (political, military, etc.), the sunk-cost will be minimal, and so is the case of irreversible damage to the inhabitants. If, as we hope, the project is successful, its implications on the Gaza Strip will be tremendous and indirectly also on the Middle East as a whole. In addition to the rise in standard of living and the industrialization of the Gaza Strip, unemployment will be reduced, as will dependency on Israel and money transfers from overseas for the livelihood of local households. Capital stock in the region will grow and the wheels of economic machine will begin to turn. The effects on society and on politics in the Gaza Strip can only be guessed, but in all likelihhod they seems to be positive and stabilizing.

In the longer run, the project could be expanded to supply water and electricity also to Egypt's Northern Sinai, Israel's Negev and Judea in the West Bank. Such a prospect will undoubtedly be a giant leap towards the integration of the Middle-East, economically and politically. However, technical problems as well as strategic ones seem to rule this solution out for the time being. The gradual modular approach could, we believe, lead us towards the same goal in stages which allow for immediate implementation.

Last but not least, the proposed project will require substantial investments, more than any local party can provide. We are fortunate to witness times when the prospect of peace and its economic sequels are being debated openly between the interested parties and the great economic powers in the world. These powers have, time and again, declared their readiness to be involved in regional projects that would enhance peace and contribute to the well-being of the region's inhabitants. We believe that the present project is an excellent vehicle for the realization of such intentions, and would welcome their involvement in its implementation.

## TABLE VII

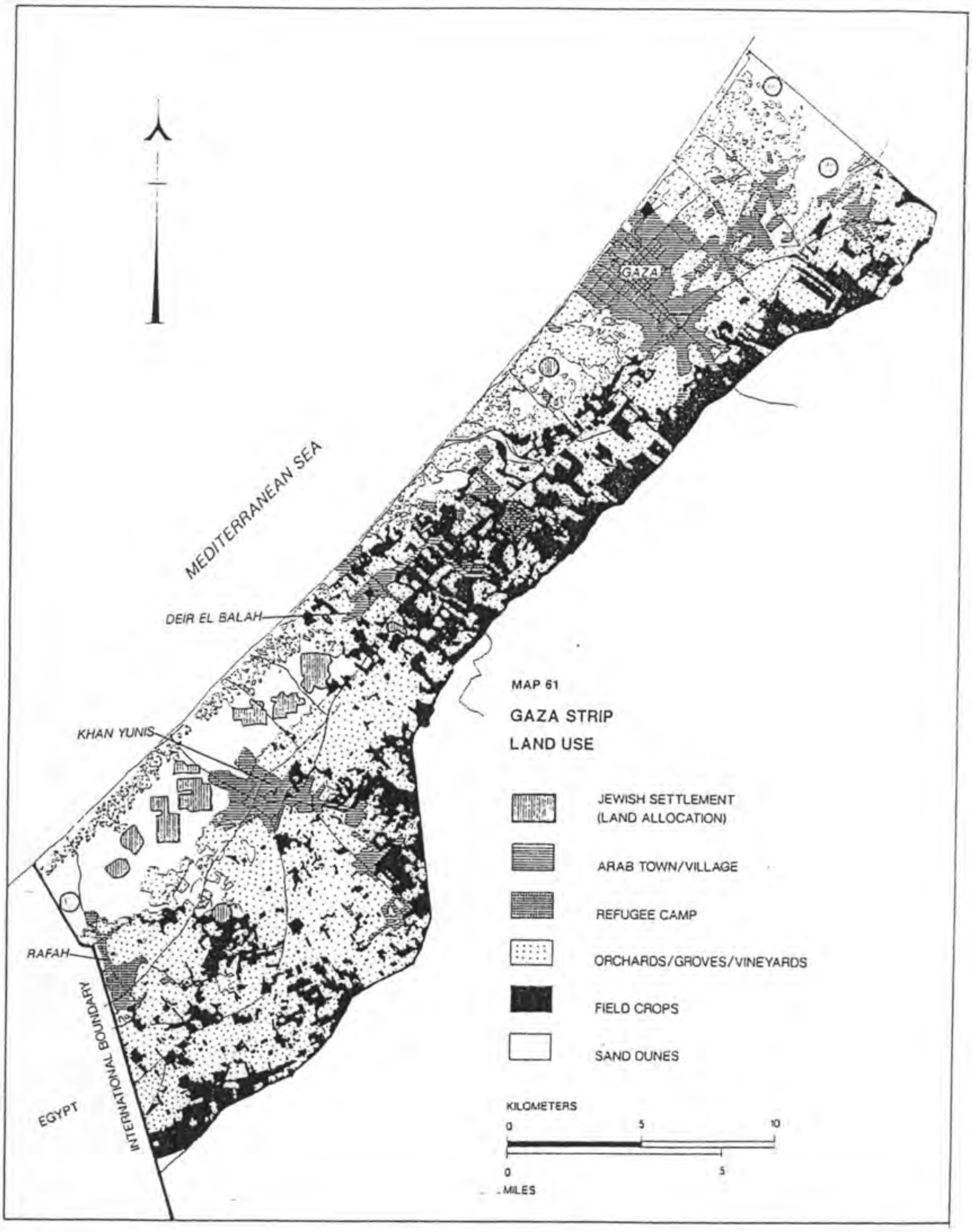
### Gaza Strip General Indicators

| | |
|---|---|
| 1. Total population (1987) | 633,000 |
| Total population (1967) | 390,000 |
| 2. Refugees | 367,000 |
| Refugees in camps | 182,000 |
| 3. Natural increase 3.2% (annual) | |
| 4. 59.0% of the population is under 19 years | |
| 5. 77.0% of the population is under 29 years | |
| 6. Work force | 92,000 |
| 7. Employed in Israel | 41,700 |
| 8. Density per sq. km. 1,730 (compared with 198 in Israel and 193 in the West Bank) | |
| 9. Number of government schools (all levels) | 98 |
| Number of students | 76,500 |
| 10. Number of UNWRA schools | 145 |
| Number of students | 90,000 |
| 11. Number of hospital beds | 935 |
| Occupancy rate | 70% |
| 12. Beds per 1,000 population (1974) | 2.4 |
| Beds per 1,000 population (1985) | 1.6 |
| 13. Cars per 1,000 population (1976) | 20.4 |
| Cars per 1,000 population (1986) | 46.1 |
| 14. Per capita water consumption | 35.0 cu.m./A |
| 15. Household electricity consumption | 0.56 kwh |
| 16. Telephone lines | 14,200 |
| 17. Telephone exchanges | 5 manual, 1 automatic |
| 18. Central sewerage systems | 3 localities |
| Cesspits | 13 localities |
| 19. Total construction in government housing projects (by 1985) | 1,440 rooms |
| 20. Plots allocated for build-your-own projects | 6,382 |
| 21. Total MG development budgets (1983-87) | US$ 68.7 million |
| 22. Per annual capita public consumption (including UNWRA) | US$ 186 |
| 23. Net transfer to Israeli Treasury (surplus emanating from government transfers less government revenues, 1985) | US$ 9.7 million |

Source: BENVENISTI & KAHYAT, THE WEST BANK AND GAZA ATLAS, 1988.

Figure 6

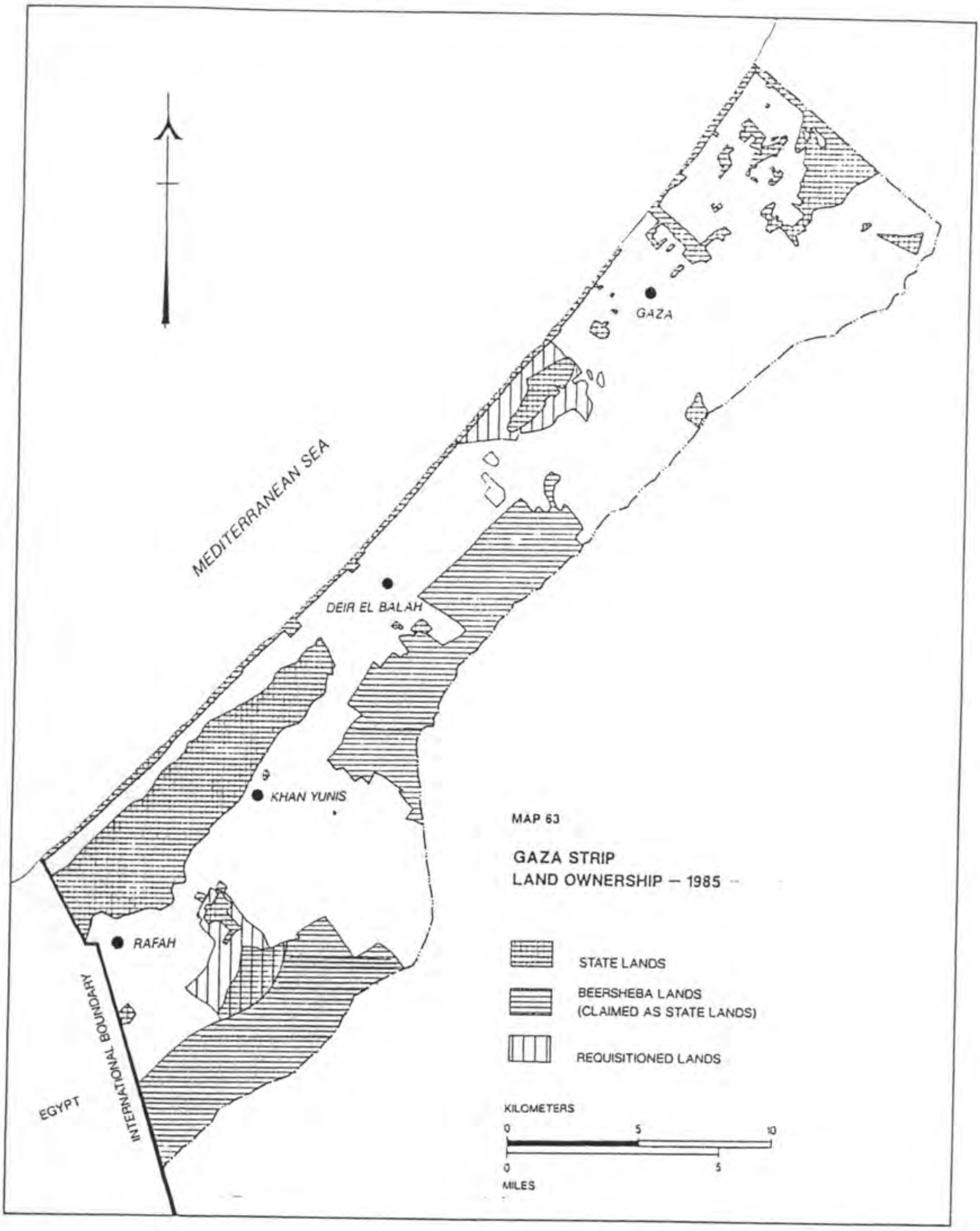
Gaza Strip Land Use




Source: BENVENISTI & KAHYAT, THE WEST BANK AND GAZA ATLAS, 1988.

Figure 7

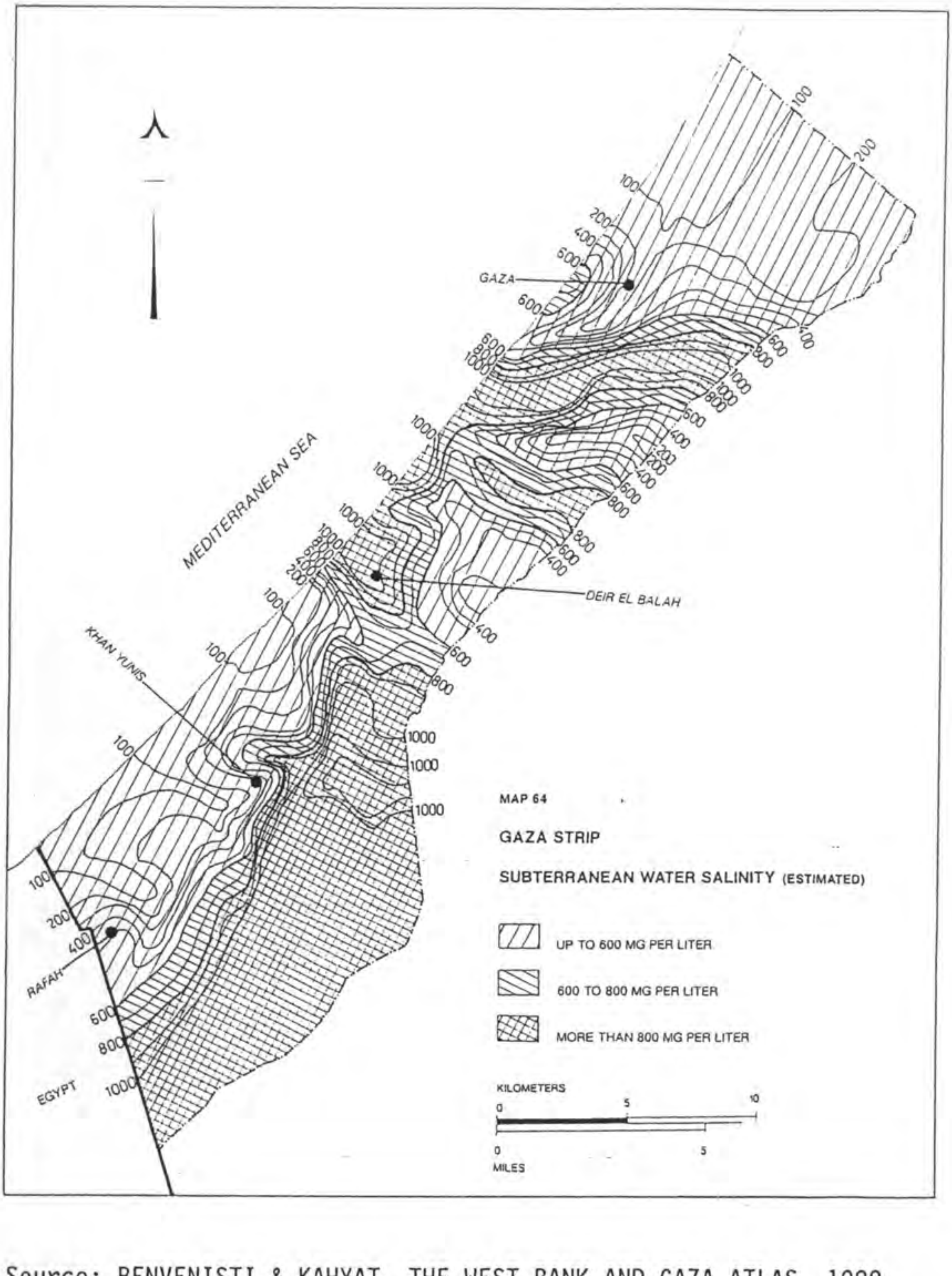
Gaza Strip Land Ownership 1985




Source: BENVENISTI & KAHYAT, THE WEST BANK AND GAZA ATLAS, 1988.

Figure 8

Gaza Strip Subterranean Water Salinity




Source: BENVENISTI & KAHYAT, THE WEST BANK AND GAZA ATLAS, 1988.

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VOLUME II * (in Hebrew)

ANNEX I — נספח I

חברת החשמל לישראל בע"מ, אגף מחקר ופיתוח

בחינה טכנו-כלכלית של חלופות למיתקן דו-תכליתי לייצור חשמל ולהתפלת מי-ים

באיזור עזה, נובמבר 1991

The Israel Electric Corporation Ltd.

A Techno-Economic Examination of Alternatives for a Dual Purpose Power Generation Sea-Water Desalination in the Gaza Strip Region

November 1991

ANNEX II — נספח II

ישי ושי ספרים

בדיקת יתכנות ראשונית של פרויקט הפקת מים לרצועה, נובמבר 1991

Ishai and Shai Sepharim

Pre-feasibility Study of a Water Generation Project for the Gaza Strip

November 1991.

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