Integrated Approach for Efficient Water Use
Case Study: Israel

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EXCUTIVE SUMMARY*

Recent reports claim that more than 40% of the world food and agricultural needs are produced on irrigated lands. As the world and especially the urban populations continue to grow at a rapid rate, the forecasted food and agricultural demand will increase the pressure on the dwindling water resources in many of the world countries especially the developing ones.
As most of the feasible water resources in river basins as well as in the aquifers, have already been connected and used in the various countries, one can not avoid asking the questions from where and how will the demand for more food and water be met?

This paper will try to introduce the concept that the largest and cheapest un- tapped water resource in the world, is hidden in the expression "Water Demand Management"/Water Conservation/Increase of efficient water use. The Israel--water resources strategy will be used as a case study of adequate water management in a highly water scarce conditions. It is not intended to claim that what was followed in Israel has a universal application potential. Rather one should observe it as a pilot project, or see that country as a laboratory. However, this national experiment could serve others, who may learn and possibly implement various elements of that comprehensive water resources management strategy, in semi to arid conditions.

The main lesson may be the one that early realization and planning as well as the need for a courageous politicians and a relevant decision making process could minimize future water supply problems. As approximately 70% of all water resources , globally, are used for irrigation purposes, the experience of Israel could be seen as a proof that the Earth water resources would be able to support the _forecasted populations growth and needs , for a long period of time.

 # The writer's oral, Power Point presentation, should be seen as an integrated part of this paper.

Introduction

Since the early days of human settlements history, food producers and nations have depended on irrigation to produce staple food supplies and meet the growing demand for agricultural products as population growth as well as standard of living have increased in all countries of the world.

By the beginning of the 21st century more than 40% of the global agricultural production and 60% of the world grains supply are grown on irrigated lands. Irrigation accounts to approximately 70 % of the global water use and close to 90% in the developing countries. The needs of the future populations , estimated to exceed 9-10 billions, and the related demand for food and agricultural products will be limited by water shortages unless water resources management policies will be drastically changed.

The past paradigm of expanding water supply as the demand increased can no longer be continued. This paper and the related oral presentation will focus on a country in the Middle East, Israel, which since its establishment followed policies and implementation strategies, which proved that increasing water use efficiencies in all sectors ,and especially in the irrigation sector, are feasible options to sustain socio-economic growth within a water scarce environment.

The option of Water Demand Management is becoming a known phrase in the sector publications around the world, a couple of countries and regions have already followed Israel experience. However, a drastic change in the water resources management is needed soon, in many countries of the world , in order to prevent serious problems and disputes. First signs of inter-boundary water conflicts which could develop into military involvements, in the Middle East as well as other regions.

General Water Economics issues related to Water Demand Management (WDM)

Water is getting scare in many countries or regions, its scarcity raises profound economic issues. Indeed, economics is the science of scarcity. Under regular conditions, air and ocean water are not scarce and do not pose economic issues, as long as they are not polluted. When population grows the water it relies upon becomes scarce: there is not enough water to satisfy the needs and wants of everyone around. In a world of 6+ billion people, water is becoming scarce, almost everywhere

When water is scarce it is costly to develop and to use. Despite being valuable, even vital, fresh air is costless because it is not scarce. When one inhales air and consume its oxygen ,one does not deprive anybody else from using as much air as they need. However, when a farmer or an industry uses water in an area in which it is limited in amount, that quantity is not available to another farmer, neither a city nor an industry. The productive value of the water on the farm or the site where it is missing is the shadow cost of water.

Efficient use of water means that the contribution of water to human welfare is the maximum that may be achieved. Where people are poor and where food supply is not always assured,

contribution to agricultural production is contribution to welfare. To a first approximation, where water is used in agriculture, it should be allocated to users so as to maximize agricultural production. Where water is used for human consumption, in urban or rural areas, it should be allocated to satisfy equally the needs of all.

Failure to realize that scarcity requires careful allocation of water and that such allocation is often not assured in a hands-off policy, is one of the roots of inefficient use of water. The other root is the failure, or the absence of political courage, to realize that over-utilization of water destroys the resources—aquifers, rivers, soils, lakes, and habitats. This last failure is regarded sometimes as the creation of problems for future generations, but these generations are here already. Water resources are tolerant to our actions, despite abuses they have suffered and are suffering they have continued to serve users for decades. But the days of judgment are coming; Aral Lake, lake Chad, the Dead Sea are just three crying examples. It is time we face reality and insist on efficient allocation and use of water. Sustainability is but one aspect of efficiency—efficiency in the distribution of the benefit of water equally over long periods of time is the other aspect.

Efficient utilization means that water contributes equally wherever it is used ,within a defined project ,river or area. Central allocation--(county, state or national)-- can be efficient. But as experience has taught, central allocation, lacking omniscience, is in cases not efficient. Moreover, it breeds political struggle and corruption. Experience has also taught that wherever successfully applied, markets and prices are efficient instrument of allocation.

Water prices function in 2 ways:

The first role of prices, to provide information, is the least understood. The right price will reflect the cost of water to society; that cost materializes only under scarcity. When water is scarce, the quantity used on one farm is missing to others in the same project or basin. The product not produced where the water is missing is its cost. The right or shadow prices will reflect the cost of the resource, this is the basis ,for example, for the abstraction fees imposed in Israel, since 2000.

When prices are right, reflecting its real economic value, farmers, industries and households will utilize water only if its contribution to production and to welfare exceeds its cost. “Right prices”, including prices paid for the extraction of water from common sources, assure efficient allocation of water. The right prices for irrigation are appropriate , when water is scarce, as they maximize production of food and fibers to the satisfaction of human needs. The price system is basically clean; it encourages efficient allocation with no reliance on bureaucratic human interference. Prices are not intended to encourage people to use less water; their aim is to promote people to use the right quantity of water—on the farm, the industry or in the household or urban sector.

However, prices also transfer income. Failing to understand the information and allocation role of the prices, farmers and urban dwellers oppose the adequate price system. They see it only as a means of income transfer. Politicians oppose the price system because they strive to reflect public opinion and because they support the patronizing potentials of central allocation. But prices will encourage efficient use of water, they will increase, not reduce, income in rural and

urban communities alike, and will reduce the reliance of water users on the whims of the political powers-to-be and their servants.

However water is intended to satisfy the needs of all members of society and thus must be under public control, especially in periods, like droughts, when prices by themselves can not maintain needed distribution.

Water is already scarce around the world; we have already over-utilized and damaged our resources. We must promote the sustainable and efficient utilization of the gift of nature. We have to turn to The management instruments like simple maxims of economics and start "THE WATER REVOLUTION" from the introduction of adequate prices into the water sectors.

Israel –A case study in irrigation water demand management

General Comments:

** This paper is not intended to advocate that the level of Water resources management (WRM) achieved in Israel can neither OR should be implemented universally. Water mgmt. experts should look at the experience and the strategy model of Israel as a laboratory for others, or as a long range objective of Water resources mgmt. A number of countries had already followed and inserted into their regulations and codes, pioneering elements which started in Israel more than 50 years ago.*

** Israel is a water scarce, semi arid country, small (20000+ sq.km/approx. 8000 sq.miles.)--with a present population of 6.5 millions, and a total availability of average natural fresh water resources of approx. 1600--1650 Millions of Cubic Meters(C.M.) per average year--less than 260 CM/cap/year--in a country that irrigation is essential to maintain economic agricultural production, as rain falls along the 5 months of winter ,only, mainly in the northern and central regions of the country.*

** Since its establishment in 1948 as an independent state, water resources research, planning, development, control and management, have become national priority. It was supported by the legislative basis ,the institutional set up, the needed budgetary investments, R&D in water related technology and Agronomy, and the creation of monitoring data and tools, as a feed back to the continued research and development efforts.*

**As it was clear from the start that ground water will be the major resource of the country, The Water Drilling law and Water Metering Law preceded the General Water Code which declared all water resources of the country to be public property. It was followed by the Water pollution prevention law and a whole set of relevant regulations in order to enable the authorities to implement all the legal and institutional demands. Ground water development started back in the history of Israel, with archeological findings of Hydro-Geological research and understandings since 1000-2000 B.C.E ,urban and irrigation projects by the occupants of the country.*

In the 20th century, ground water resources became the major initial tool of development , the total aquifers knowledge have been developed,(over 65% of the total water supply of the country is pumped from the aquifers) all wells are metered, as well as all other resources used. The total supply is metered to each farmer ,apartment in the cities ,houses in villages, industry etc--water is allocated to all consumers and progressive water pricing have been imposed on all consumers, as well as Pumping levies per C.M. pumped.

* Constant monitoring of water tables in all aquifers lakes , springs etc. is followed, water quality sampling and analysis, as well as control over consumption, the operation of the water meters and any changes in patterns are recorded and investigated.
Water pollution trends analysis and actions are enforced, artificial recharge with fresh water as well as Sewage treated effluents, are integrated parts of the national water development and mgmt. policies.

*The presentation in this symposium is therefore a retrospective look at the results of the strategy after 50 years of the national operation and comprehensive use of its surface and Ground Water Resource

Development and water experts, who have an interest in the Middle East and in the economic development process of semi-arid countries, often pose the following question: how does Israel, a semi-arid country, prosper with less than 300 cubic meters of water (per capita per year) for all its uses, while international organizations define arid countries with less than 1000 C.M./cap/year as highly stress countries, where water becomes a severe constraint to socio-economic growth. While semi arid countries with less than 500 C.M./Cap/Year , are considered under acute water conditions.

This section will try to clarify some of the policies, legislative basis and selected economic issues that enabled Israel, former developing country to reach a GDP of $16000 per capita per year, supply much of its agricultural needs (except grains), export agricultural products, supply its population and industry and maintain a high standard of living, all with very limited fresh water resources.

The basis of the past strategy as well as the future one lies with a balanced combination of measures: legislative, institutional, economic, and technological focusing on water demand management, increased efficiency of water use in agriculture, as well as the industrial and urban water use (see graphs enclosed), re-use of most of its treated sewage effluents, based on the economic and integrated use of all its total surface and ground water resources.
Potential future water markets (internal and possibly regional), continuous updating of its water pricing policies and future large scale sea and brackish water Desalination (as of 2005)will enable the country and its immediate neighbors (as part of the peace process) to continue their social and economic growth despite the water scarce conditions that all entities of the middle-east are facing.

The policy of Israel to meet the growing demand for water focuses on combined supply and demand activities and investments, while the long range solution lies with the total re-use of its wastewater as well as brackish and sea-water desalination. Past and present activities are aimed at delaying the high investments and the associated costs involved with the integration of large-scale sea-water desalination, an expensive unlimited source of water, which will be a major supplementary source of fresh water as of 2oo5 and on.

Summary of the main instruments of the national water resources development and water demand mgmt. they are:

1. **Pricing and economic policies** – Progressive block rates coupled with total metering system (for every farmer, house, apartment and industry), prices are updated automatically with a cost of living formula, minimization of subsidies, and recently water abstraction fee/levee ,have been approved by parliament.

2. **Re-use of sewage effluents.**

Regulations have been legislated in order to increase the quality levels of sewage treatment plants and its effluents to maximize its re-use potential and minimize the health and environmental risks as well as enhancing the trading instruments for the exchange of fresh water allocations, with treated effluents mainly for irrigation purposes. The allocation policy concentrates on reduction of fresh water allocations to the farming community and replacing it with treated wastewater effluents. (Total sewerage costs borne by the city, while the re use component costs are borne by the water sector.).

3. **Water conservation/improved efficiency of water use.**

Continued policies concentrate on mixed tools including: (a) allocations, norms and progressive block rates for each sector, and (b) research, development and implementation of agronomic techniques(the most famous of which were the large scale implementation of Drip Irrigation techniques and automation of irrigation) as well as wide scale implementation of technological means to improve water use efficiency and reduce water consumption in the domestic sector, commercial, industrial and the irrigation of urban parks and gardens.

4. **Agricultural Sector Water Allocations System**

The irrigation water allocations are based on norms developed by the agriculture
Research community together with the farmers community, reflecting the potential economic gains by introduction of new irrigation technologies, changes of cropping patterns ,and move away from crops where the product value per unit of water is relatively low, like Grains for example.

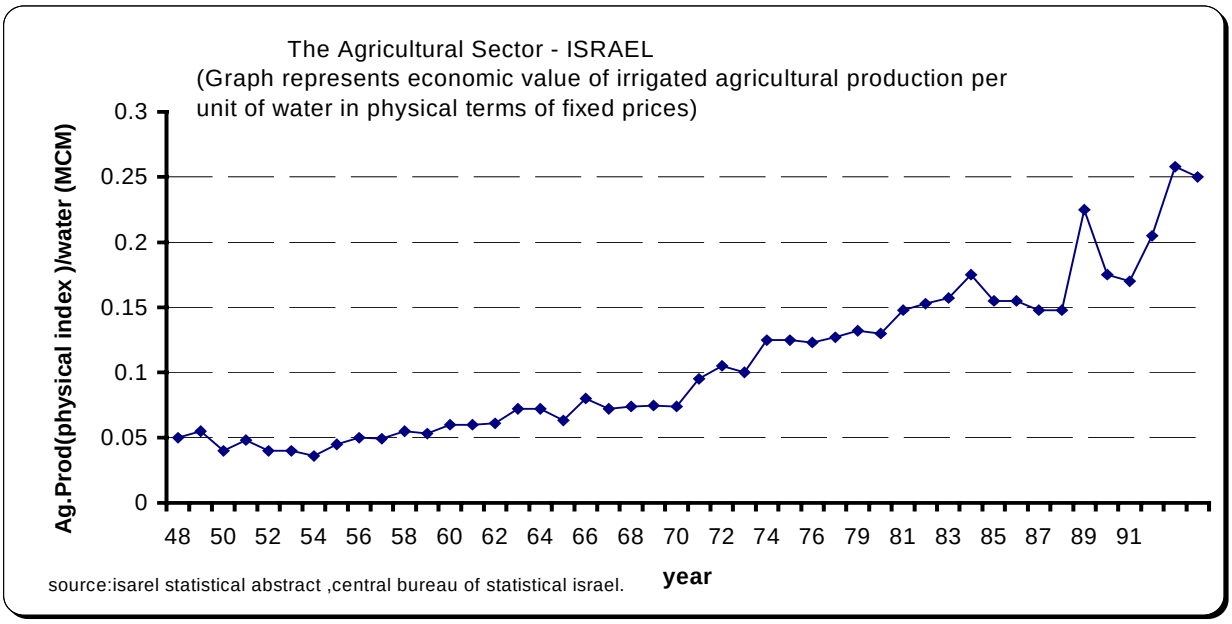
5. **"Virtual water policy"**

When realizing that water resources will not meet the demand the authorities have taken a most difficult decision, in the 1960s, to import the great majority of its grains needs instead of growing it in Israel. In today's figures it means the "Virtual Import" of almost 3 Billion cubic meters of water annually, almost, twice the total availability of fresh water resources in Israel. One should stress the meaning of that decision ,40 years ago, thus creating a situation where the most strategic products like bread, beef, poultry ,eggs, dairy products etc, are all at a risk of world grains markets and the risk of potential political impacts.

6. **Water markets (internal and possible external)**

The authorities as well as Parliament have recently approved a change in the water code enabling holders of water allocations to sell their permanent or temporary allocations to others transferring the actual transaction via the national water carrier, thus opening the sector for a market like operation. The water commissioner has been doing it for years already by trading fresh water with treated sewage effluents.
The market concept could well serve or even promote peaceful exchanges of water between the countries of the Middle East.

Graph No' 1



Real Agricultural production per unit of water

The integrated water resources network (the water supply strategy)

See graph No' 2

As was mentioned earlier, ground water development associated with Hydro-Geological studies started in the Holy Lands more than 3500 years ago. Archeological findings unveiled rather sophisticated knowledge during the early Biblical times. However, this subject deserves a separate paper.

Modern Hydro-Geological studies started in the 1930s, while the Hydrological department was created, and intensive research was initiated. Preliminary master planning of water resources and works to support forecasting of water supply and demand, mainly started after the formation of Israel ,in its new boundaries and populations.

Israel was established as an independent state in May 1948, and had to struggle with waves of post world war II immigrants, these waves tripled its population within few years. The only feasible way, for the country was to resettle the immigrants in the rural areas, in villages, followed by urgent water resources development and distribution, in order to provide income as well as irrigated crops as agricultural products, for a developing nation with limited financial resources.

The situation forced the authorities to initiate the basic legislative tools, the institutional set up and a rapid ground water development, as most of the surface water resources were in the northern part of the country,--(and it would take 10 or more years to complete the transfer project)-- while the population growth was mainly in the central and southern regions.

Wide-scale drilling and pumping water from the various aquifers, enabled the authorities to meet the water demand throughout the country, and allowed for "over pumping" as the National Water Carrier (NWC) was already being planned and its construction has already started.

That planning concept has enabled the country to move surplus water from the north to the centers of population and development in the south. In 1964 the National Water Network was completed, thus creating a national integrated network of all Ground water and surface sources. The Sea of Galilee, in the middle of the Jordan basin was linked with a closed piping (108" + a couple of 66",70"and 84" lines) all the way to the extreme southern end of the country ,interconnecting along its way all regional projects, which are based on the various aquifers.

The National Water strategy Model

A number of corner stones of the national water strategy have been established :

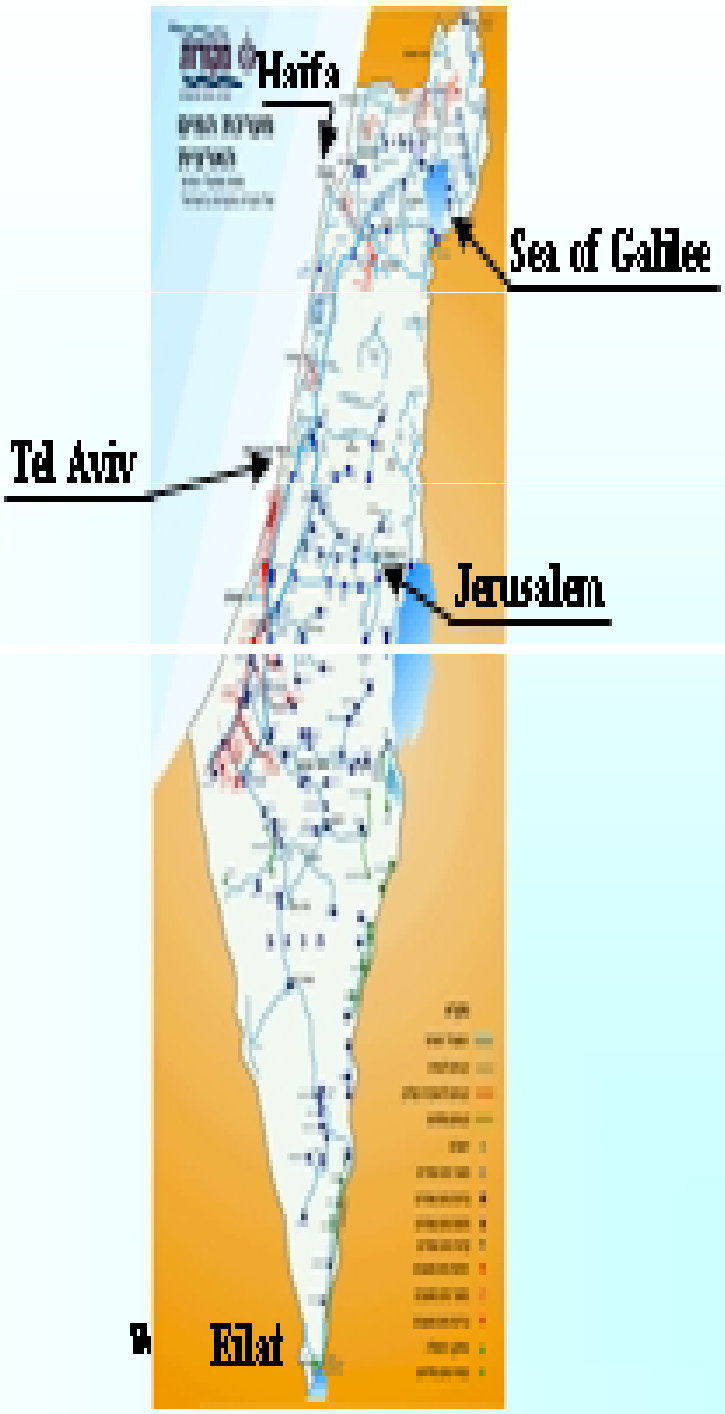
1) Water code based on the declaration of all water resources as public property, and the promotion of water conservation and promotion of water use efficiency, in order to meet future demands, following gradual and economic development of the water resources. The Code includes all the relevant and specific laws like "The Water Drilling law" ,the water metering law, the water pollution prevention laws and others.

2) Establishment of a Water commissioner's office having complete responsibility for all water affairs and its management.

3) Integration of the great majority of the water resources

In the country ,ground and surface ,in one net work, the NWC--- the National Water Carrier, enabling the country maximum flexibility in the operation of the various water resources in the country. The aquifers and the ground water reserves acted and still do as the most effective storage of water between seasons, dry and wet years and weather fluctuations.

Main Water Supply System



Graph No' 2

4) Total water metering was started and completed within 10 years. Each well and water producer and consumer in the rural , urban and Industrial sectors are legally obligated to install standard water meters, calibrated regularly, by certified laboratories—these meters form the basis for the Water demand mgmt. strategy, as well as the basis for the Ground and surface water resources mgmt.

Each well, each farmer, each industry each apartment in the urban sector, and any other producer or water user are all metered, read routinely and reported to the water authorities.

5)The water annual licensing and allocation system was initiated in 1959, based on water Production and Consumption Norms mainly used in the Agriculture and industrial sectors. The NORMS were developed, and are being changed along time, through an intensive research and development program , in order to establish the optimum water use by crops ,regions ,industrial products and others.

6) Water Pricing: Prices are based on the Progressive Block Rates principles, set by Parliament commission for over 70 % of the total water in the country, mainly for water produced and distributed by the National Water corp. operating the NWC and the Integrated national net work . The water rates for the rest of the producers and consumers are based on costs in addition to Abstraction Levees /fees which reflect the average economic shadow values of water.

7) A number of other important issues like the prevention of water pollution, water quality control, water drainage regulations, and others supplement the main features of the strategy as described above, but will not be detailed here.

However, it is worthwhile to stress , that as a result of the recent dry spells and water demand beyond natural recharges the Government has decided to initiate and accelerate the construction of Reverse Osmosis Sea Water Desalination Plants (ROSWDP), adding in 2005/6

,about 25% to the total fresh water availability of the country, following significant costs reductions of ROSWDP, during the international tenders of Israel in 2001/2.

The decision includes as well, the completion of a nationwide treatment and re-use of all its treated waste water, Tertiary or Secondary treated, and allocating these new sources of water to the farmers in exchange for their fresh water allocations. THIS POLICY AND INVESTMENTS WILL ALLOW THE COUNTRY TO CONTINUE, INDEFINITLY ITS SOCIO-ECONOMIC GROWTH DESPITE THE INCREASE IN POPULATION AND STANDARD OF LIVING,AS WELL AS OPENING THE DOOR FOR THE POTENTIAL SOLUTIONS OF WATER CONFLICTS BETWEEN ISRAEL AND ITS NEIGHBORS**.**

National Water Demand Management Program

The present population of Israel is approximately 6.5 million- (it was 700000 in 1948) -and is increasing at an approximate rate of 2.2-2.5 per cent per year. Best estimates for the year 2020 indicate a potential population of 10-12 million Israeli citizens. (The variation is mainly due to unpredictable future immigration levels).

Present average of urban water consumption (domestic, commercial, and industrial) is approximately 108 C.M./ per capita /per year. It would have been today approximately 150 C.M./cap. if not for past efforts that have resulted in over 30 per cent savings(see graph no. Present industrial forecasts coupled with projections for urban water consumption per capita, converge at an estimate of 110-120 m/3 per capita per year by the year 2020.

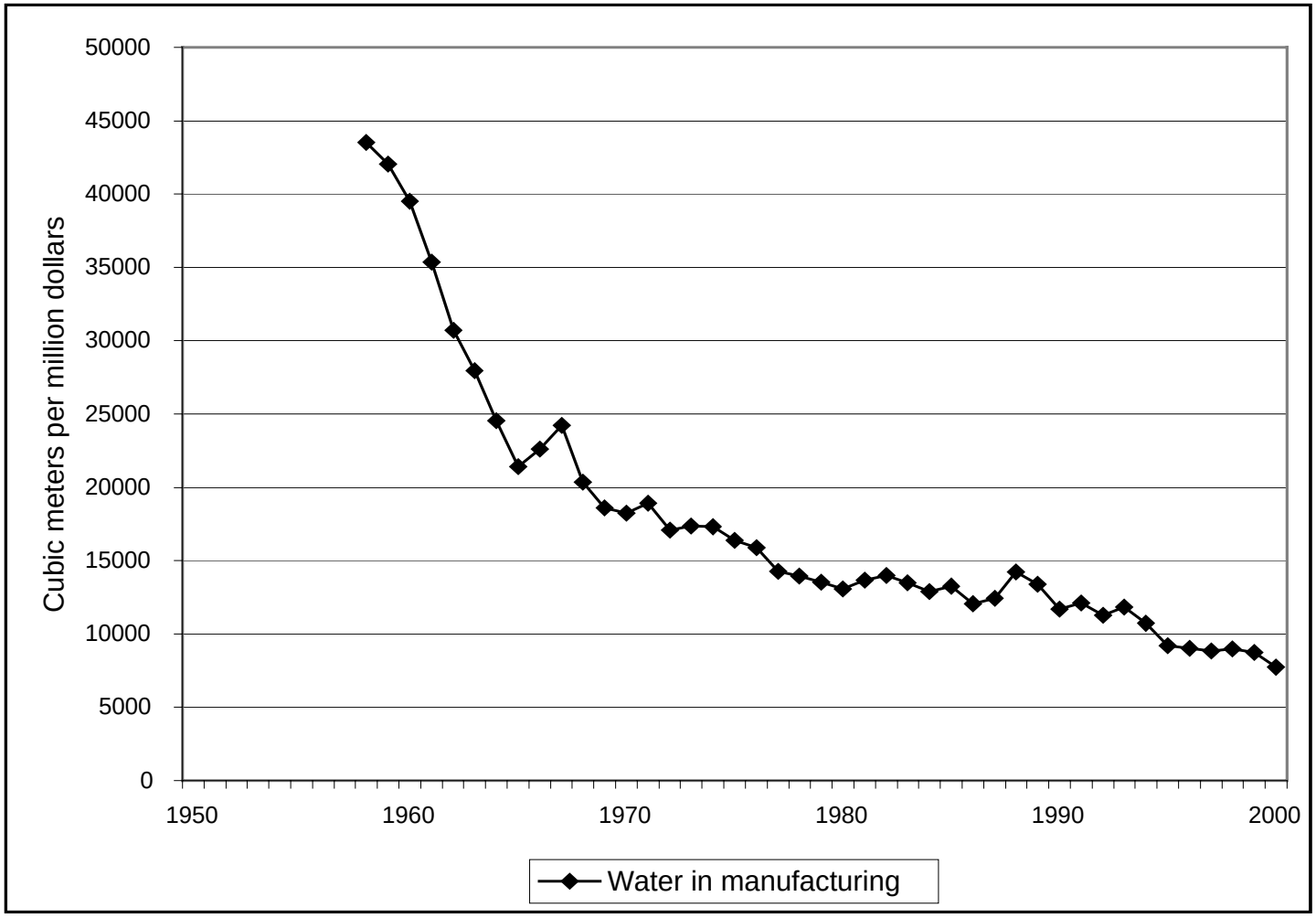
These figures assume a much higher standard of living coupled with the continued of rigid and wide-scale implementation of demand management policies.

Inelastic agricultural demand for water to supply basic fresh food (dairy products, eggs, and vegetables) are estimated at 25-30 m/3 per capita; this adds an additional 220-330 M.C.M./y.

Re-use by the farmers of treated effluents in Israel will reach 70-75 per cent of the total DCI use (domestic, commercial, industrial). which amounts to almost 100 per cent of the total sewerage flows (the entire population will be connected to the sewerage by 2010). The estimated treated effluent flow by 2020 will be approximately 700-1000 M.C.M./y.(see graph no.6)

DEMAND MANAGEMENT IN THE AGRICULTURE AND INDUSTRIAL SUB SECTORS: (See Graphs 1 and 3)

This endeavor includes continued efforts, both technological as well as economic, and agronomic to further reduce water demand and improve the efficiency of water use, for the 2 production sectors, Incremental costs of water saved in these two range from US $0.05 – 0.40 per C.M.. The figures for irrigation assume increased production per unit of water in real terms; they do



reflect changes in the basic production cycle that is adapting to more economical cropping patterns. It assumes benefits of genetic engineering as well as modifying industrial processes.

The levels of "indirect" additional water production through savings and improved efficiency of water use, are very important as they represent permanent reduction in demand. Israel has already gone a long way in its efforts in these two sectors. The term 'effort' is much more complicated than it sounds. It means the large-scale application of appropriate irrigation technology (drip, sprinkler, automation of irrigation projects and at the farmer's plot), changes in industrial water use and water processes (like 'cascading' water uses and cooling methods).

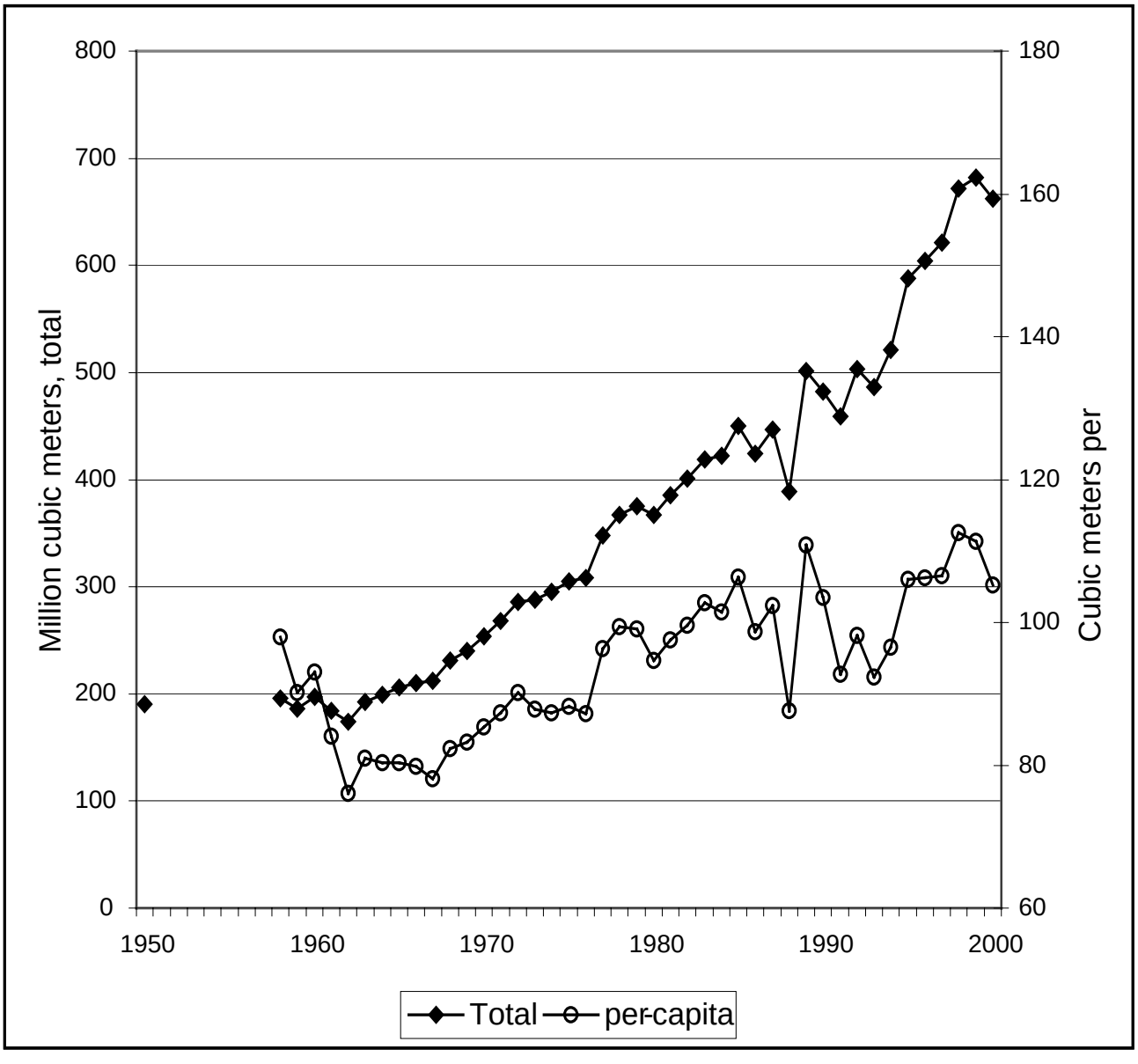
Graph No' 3

The graph represents the National Industrial Water use per real term value of the Industrial production.

(Source: Prof. Yoav Kislev, Faculty of Agriculture, Department of Economics, Hebrew University)

Special funds, training, public education, and effective extension services has been active in the past and must continue and supplement the promotion and implementation instruments. Finally, the further impact of improved pricing mechanism and the application of a market or trading system can play a dominant role in the whole operation.
The significant achievements of Israel's agricultural sector have lead to 300% real term increase (see graph no.1) which clearly identify the significant results over 50 years in economic as well as physical terms. A comparison of prevailing prices for irrigation water between most irrigating countries and Israel illustrates and partially explains the gap in the countries agricultural yield/ unit of water, and the potential for reducing agricultural water demand in other countries when following comprehensive and rigid water demand policies.

Irrigation water prices in Israel are one of the highest in the world, when farmers pay an average of 20-25 USC/C.M. (approximately 260-290 $ per Acre.Foot, and still manage to compete in the



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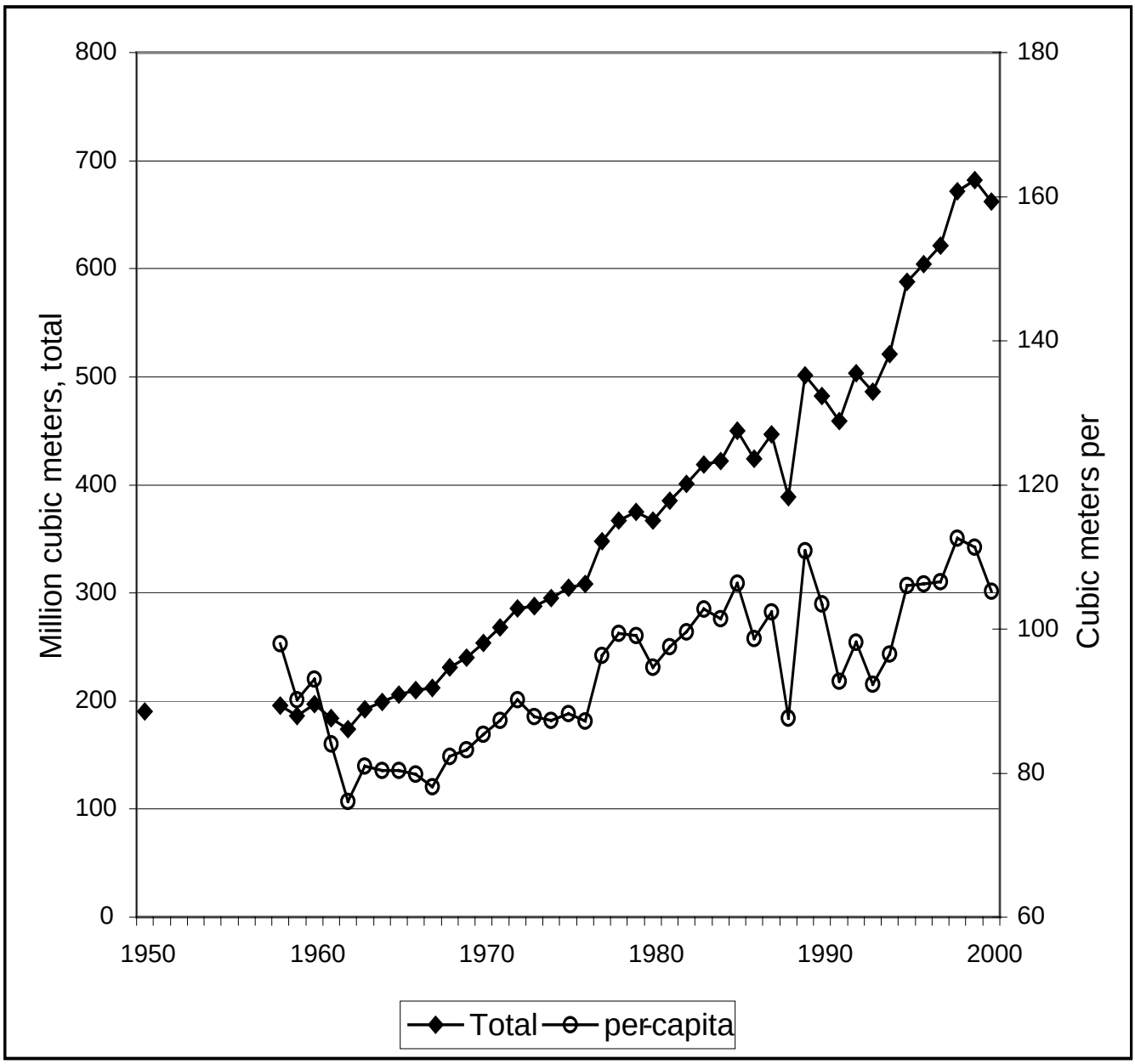
URBAN WATER CONSERVATION (see graphs No'. 4,5,6)

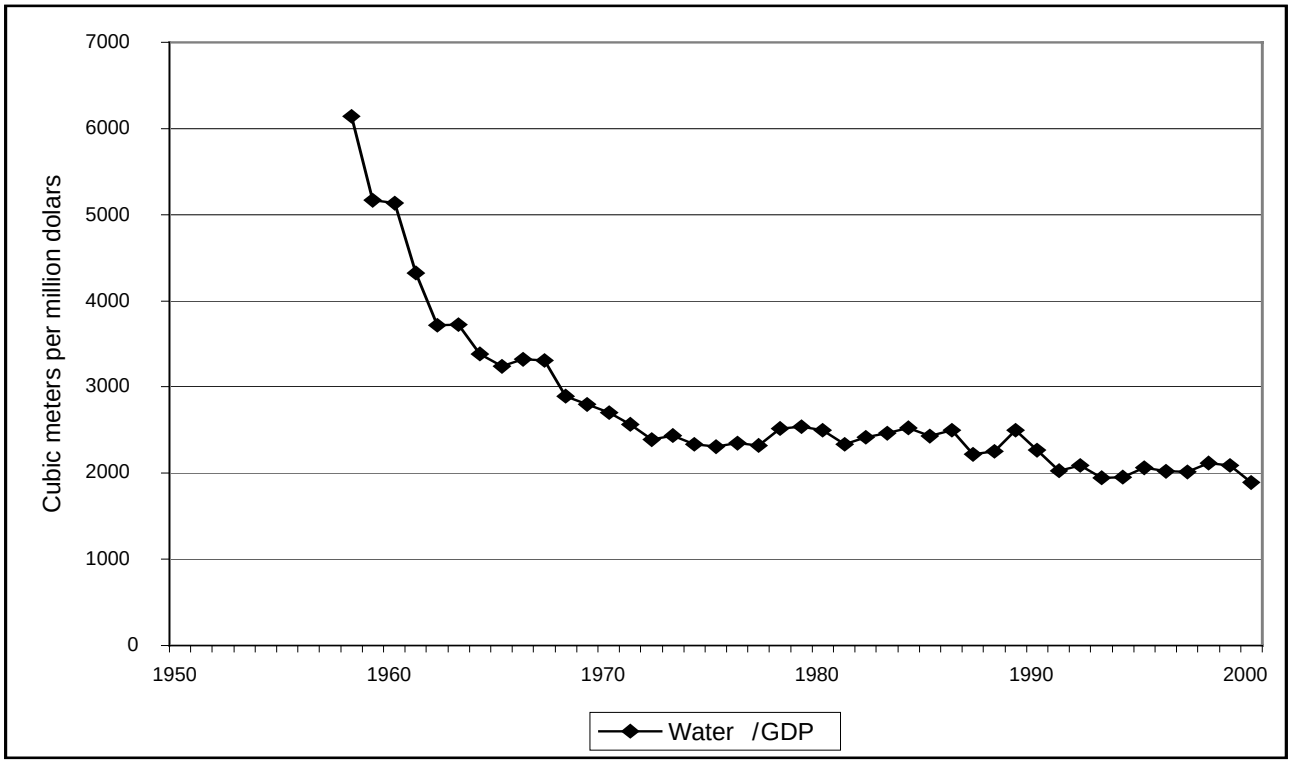
"Unaccounted for water" (UFW) causes significant water and financial losses to urban utilities and municipalities. Unaccounted for water has been substantially reduced in Israel (down to 11-12% on average from 25%, 15 years ago), but remains a serious problem in other Middle Eastern countries, where for example, UFW rates in some cities are over 50 per cent and represent critical water and financial losses.

Urban water use total and per-capita: Graph No' 4



(Source: Prof. Yoav Kislev, Faculty of Agriculture, Department of Economics, Hebrew University)

Graph No' 5



Total urban water consumption per GDP in real terms

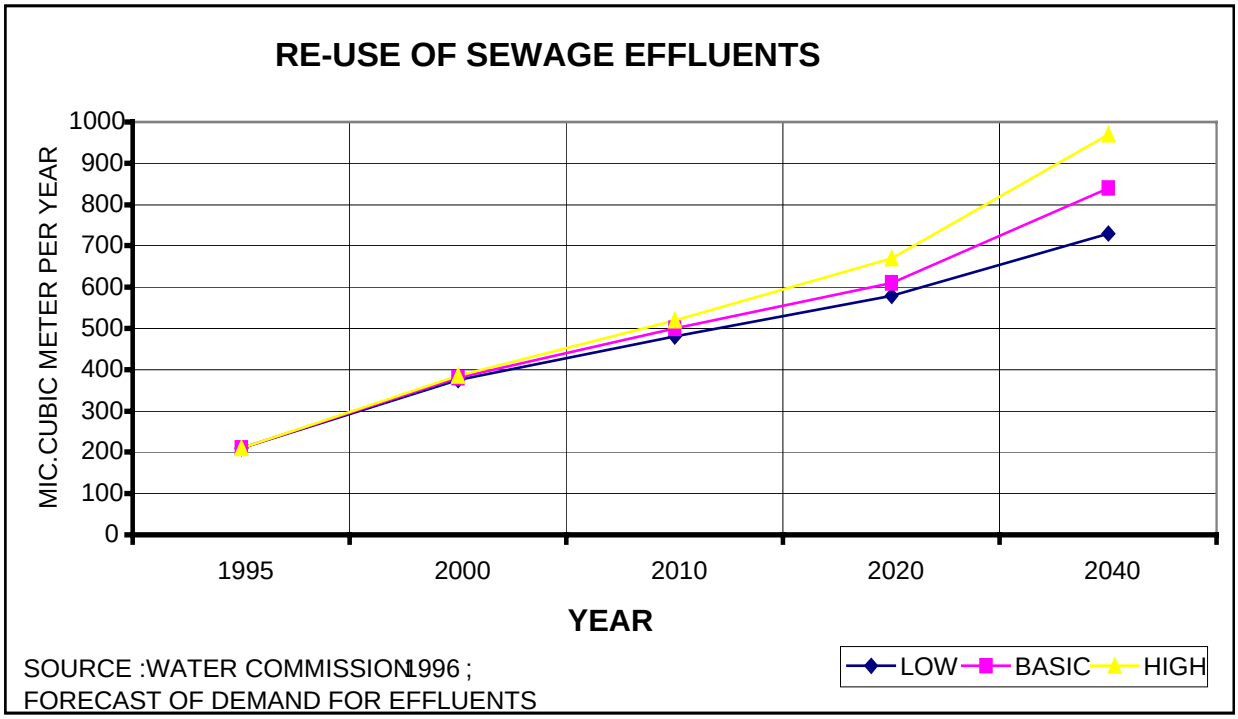
(Source: Prof. Yoav Kislev, Faculty of Agriculture, Department of Economics, Hebrew University)

RE USE OF HUMAN AND INDUSTRIAL treated WASTE WATER EFFLUENTS:

As stated before, water effluents become an integrated water resource and are traded for fresh water. . The price mechanism as well as effluent charges are gradually being enforced and are contributing their share to urban and industrial water demand management. Many of the industries are located in the urban sector and are subject to the additional utility prices. The industrial sub-sector has observed an increase of 250% of industrial production per unit of water (in real terms) following 20 years of demand management campaign.(see graph no. 5)

Re-use of secondary effluents in Israel is restricted to industrial field crops (cotton, maize etc) and the Tertiary treated effluents used for unlimited irrigation with sub surface drip irrigation in horticulture.

Graph No' 6



National Planning for comprehensive use of treated effluents

WATER MARKET—A TEMPORARY OR PERMAMENT?

(Internal a/or regional solutions??)

Water in Israel is used within a system of allocations (annual or multi-annual) while in most other countries in the region it is user rights that determine the demand. In many regions, a person who owns land (or cultivates it) has the right to the water flowing beside or under the plot. In other regions various quota systems allocate the amounts of water on an annual, monthly, weekly, daily, or even hourly basis. Veteran users usually have the rights to continue to use the resource, when shortages prevail.

In Israel it has been shown that the efficiency of water resource allocation and use can be substantially improved through the increased use of price and trading mechanisms. Trading water on the margin or using a system in which urban/industrial demand is met by supply from farmers selling quotas reduces inefficiency of administrative allocations. Irrigation water in Israel was, and is today, partially subsidized when supplied by the National Water Corp., and administrative allocation system which create a 'rent seeking' operation for the development of new resources and higher demand both lead to built in inefficiency which could be improved when water trading will be active between consumers using the national water system, as

conduit and or using the aquifers as common – pools allowing one to pump more and others less to be compensated ,according to the regulations.

THE MIDDLE EAST REGION: (excluding Israel)

Many of the Middle East and North Africa countries face an environmental crisis, much of it as a result of water scarcity and the existing and potential pollution of their water resources. It is estimated that the investment needed to deal with and solve the problem could reach US $70-80,000 million in the period of 1995-2005 (World Bank).

The hydro-geological conditions are in constant deterioration. As extraction from ground and surface water resources increases, so do the problems associated with low water levels and decreased quality. Inadequate human and industrial waste discharges as well as inappropriate waste water re-use programs lead to higher concentrations of chemicals and organic contaminants.
The concentrations of heavy metals and toxic compounds have already reached alarming levels in various countries in the region and the projected future cleaning costs could reach prohibitive levels unless urgent and strict measures are introduced.
The expected population growth in the region is likely to exacerbate the problems. World Bank forecasts indicate growth of approx. 40 per cent in population (from 250 million in 1990 to 350 million by the end of the century). Some regional governments may be unable to generate the financial and human resources needed to provide adequate water and sanitation facilities to meet the future demand.
Already, almost 20 per cent of the total population in the region lack an adequate potable water supply and almost 35 per cent lack appropriate sanitation. Less than 20 per cent of the urban water supplied in 1990 has been properly treated, while in the industrial world this figure is above 70 per cent.

Most of the countries in the Middle East therefore face serious water scarcity and pollution problems already, while water shortages are reaching acute levels. During the last 20 years the average water availability per capita has dropped from 3500 C.M./capita and will fall to approximately 1500 m/3 per capita by the year 2020 for the whole region. Israel, the kingdom of Jordan and the Palestinian Autonomy are in the most acute level. All fall below 300 C.M./capita. (Cubic meter per capita).

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