An overview of water resources in the Mediterranean countries

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AN OVERVIEW OF WATER RESOURCES IN THE MEDITERRANEAN COUNTRIES

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ABSTRACT

The knowledge we have of available water, though inadequate in many ways, has proved useful so far. However, the knowledge about availability, variability, reliability and quality has to become more precise.

In the face of population growth and the increasing demand for water, water quality deterioration, increasing environmental degradation and impeding climate change, more effort is required to assess water resources for rational planning and management to sustain development.

Those efforts should be directed to overcome the present constraints regarding water resources assessment and in particular the institutional weakness, inadequate networks, incompatible technologies for field, laboratory and office work.

Deficiency of staff and their capability and the lack of coordinated, relevant research have constrained efforts further.

Challenges and opportunities for water resources development in the Mediterranean Countries call for institutional reforms, improvements in the knowledge of hydrological processes and increase in funding, capacity building and international cooperation on national, sub-regional, regional and global levels.

INTRODUCTION

Water is a prerequisite for the survival of man and for his development. Current and projected problems with fresh water resources arise from the pressure to meet the food, agricultural, human settlement and industrial needs of a fast-growing population.

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There is no doubt that for developing countries of the Mediterranean region, with erratic rainfall patterns, efficient control and management of water use has to be an essential requirement for this continued development. Without proper water management, self sufficiency in food and energy will continue to be a mirage for most of these countries. Scarcity of water and reliability of its supply are major constraint for agricultural development in those countries. In the majority of these countries, many of all available sources of water which can be economically used have already been developed or are currently in the process of development. In some countries, such as Egypt or Jordan, no new major sources of water that can be further developed.

Water scarcity is taking a terrible toll on people everywhere, especially in developing countries. Globally, at least 1.7 billion people do not have adequate drinking water supplies and at least 3 billions lack access to proper sanitation. In the next 24 hours, while we are meeting, 25.000 people worldwide will die from waterborne diseases.

In the developing countries of the Mediterranean, the major challenge facing water planners and managers in the 1990s is that while physical availability of water is fixed, its demand will continue to increase steadly in the foreseeable future. Accordingly, the problem is how to balance demand and supply of water under those difficult conditions. In addition, the issue of potential climatic change due to global warming and what its impacts could be on natural resources including water, are basically unknown factors at present. This is part of a broader challenge to water planners and managers: to anticipate impacts of climate on the full range of water management and strategies.

MEDITERRANEAN CLIMATE

The mediterranean climate is characterized by a hot and dry season in summer and by mild temperatures associated to annual rainfall in winter. In the Mediterranean basin this climate is the result of interactions between the desert area in the South and the Atlantic Ocean in the North, namely some influences external to the Mediterranean sea.

Average yearly rainfall in the Mediterranean basin (Fig. 1) and the rainfall distribution (Fig. 2), indicate clearly that the rainfall is irregular during the year and over

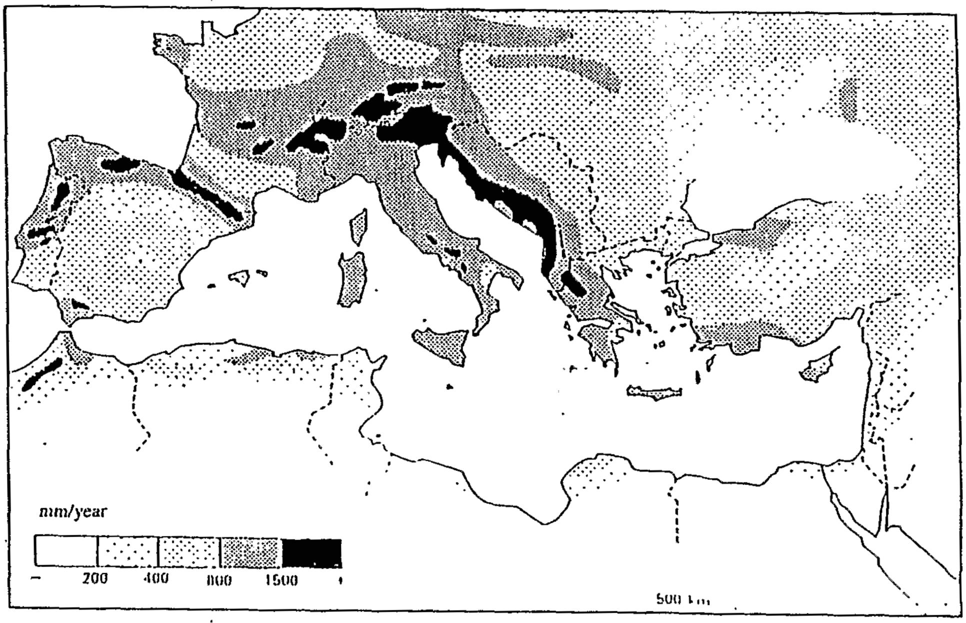


Fig.1 Average yearly rainfall in the Mediterranean Basin

Source: UNESCO-OMM European Climatic Atlas, 1970 & UNESCO World Water Balance

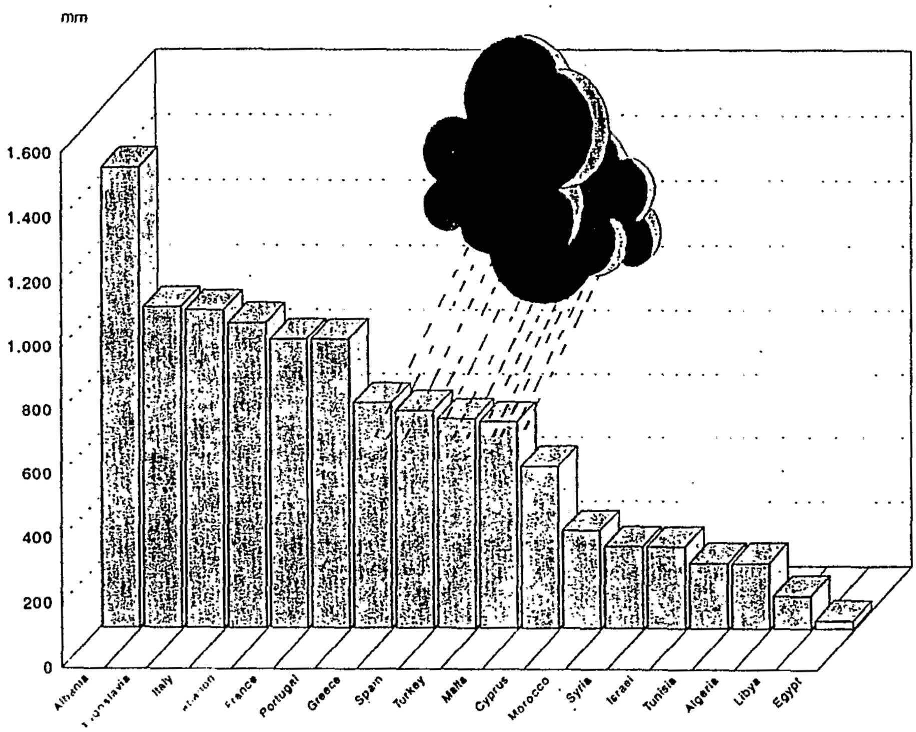


Fig.2 Rainfall Distribution in the Mediterranean Countries

the years above all in the South where the harvest of rainfed crops is never ensured. Furthermore, rain can be heavy and disastrous and it often provoks soil erosion.

Despite the apparent uniformity of Mediterranean climate a more detailed analysis shows great differences. The dry season duration (Fig. 3) clearly illustrates that, while the South is characterized by a long dry season averaging for more than seven months without any precipitation, in the Northern part the dry season is relatively limited and doesn't exceed 2-3 months.

In addition, the rainfall and temperature diagrams (Fig.4) show great differences between the North (autum rainfall) and the South (winter rainfall) of the basin. In summer, the simultaneous occurrence of high temperatures and small precipitation causes high evapotranspiration.

CLIMATIC CHANGES AND WATER RESOURCES

The possible global warming due to the greenhouse effect is now firmly on the world's scientific and political agenda.

The second World Climate Conference (SWCC) in its statement on the specific issues of climatic change impact stated that "among the most important impacts of climate change will be its effect on the hydrologic cycle and water management systems".

There is no question that if the existing rainfall and temperature patterns changes during the forthcoming decades, there could be important implications for agriculture production and water management, at global as well as regional and national levels, depending on the rates, magnitude and spactial distribution of such changes.

The most important implications of climatic fluctuations as they relate to water management are in terms of water availability form both surface and ground water sources; drought and flood management (including efficient operation and safety reservoirs); choice of proper cropping patterns to ensure crop-water requirements are met reliably; maintenance of water quality of rivers lekes canal systems and aquifers; and management of vulnerable, lowlying areas, especially in the deltaic and coastal regions.

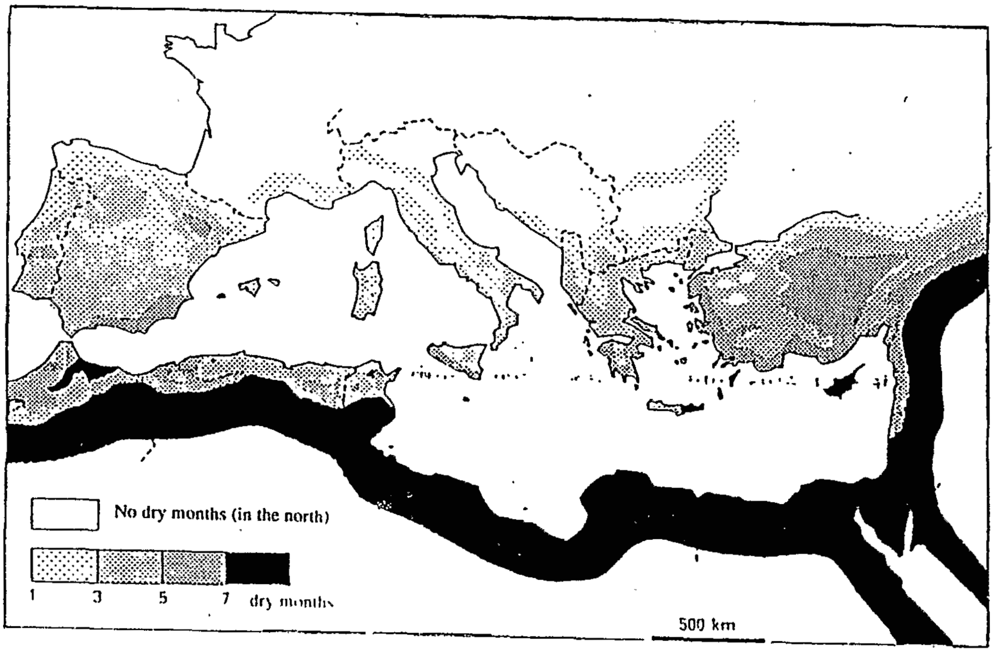


Fig.3 Dry Season Duration in the Mediterranean Basin

Source: P. Birot & J. Dresch, 1953 modified

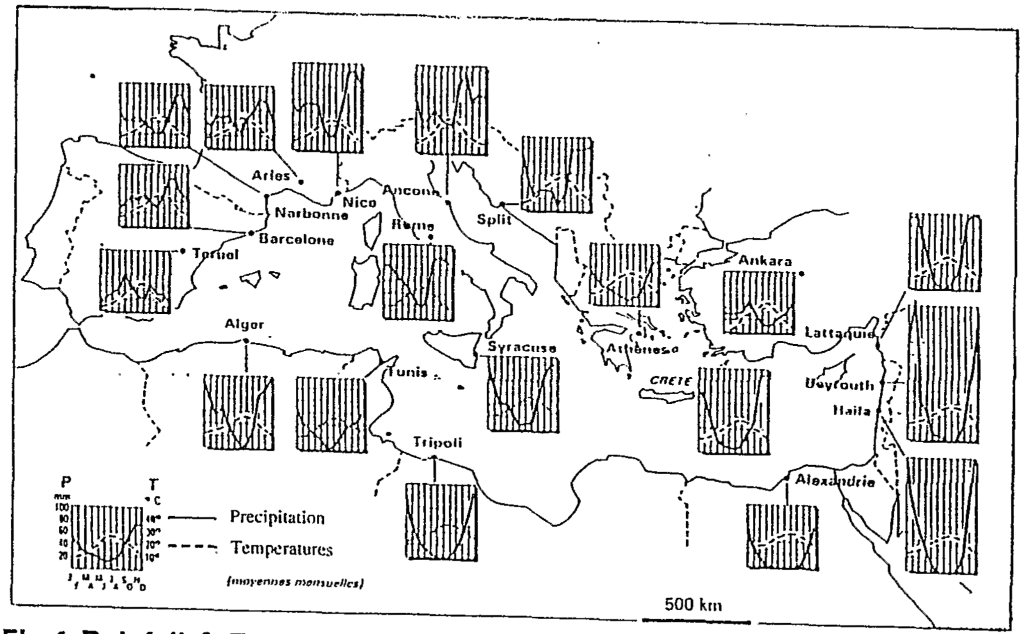


Fig.4 Rainfall & Temperatures diagrams of the Mediterranean Basin

Source: Plan Bleu

It is generally estimated that the global mean temperature might increase by 0.5 °C to 2 °C within the year 2030, reaching 3.5 °C within the year 2050, which is a considerable modification compared to the past. Moreover, it should be underlined that although all emissions of carbon dioxide and CFC would stop today, an increase in the world temperature would result all the same by inertia because of the amounts already in the atmosphere.

This global evolution will certainly have notable repercussions on the mediterranean climate, which might occur quite rapidly over the next decades, although their nature is not exactly known at present. It is estimated that due to a mean rise in the temperature by 1.5°C within the year 2025, the cyclonic systems which affect the central and western parts of the region in winter, will move towards the North. In the centre and West, rainfall will still depend to a large extent on the relief and will increase in the North, whereas the Southern regions where rainfall is uncertain might extend and evapotranspiration would generally increase. Such a change would have serious consequences, especially for agriculture and for the hydrologic regime. The modifications in the thermal structure of water masses resulting from this process could equally cause changes in sea currents which would affect, in return, the aerial currents of the region.

It is, however, estimated that the expected increase in temperature will cause a general raising of the sea level. Historically, the Mediterranean shores have not remained fixed lines due to slow variations of the sea level or to local tectonic movements and it has been possible to redraw the submersions and emersions which have occurred over the last millennia. The general trend since the end of glacial time has been a raising of the sea. The latter has reached about 1.3 mm per year through the last century and it is presently estimated that as a result of the greenhouse effect, which will cause a swelling of the world ocean, a 15 to 40 cm rise in the mean level of the Mediterranean sea is to be expected within the year 2025.

Although these will cause climatic variations, such as droughts or permanent changes, their evolution is still unpredictable for them to be actually integrated within scenarios directly. Nevertheless, they will be considered as "risks".

A UNEP-commissioned report released several months ago suggests that Egypt is one the countries most at risk. Other countries include the Netherlands, Bangladesh and Maldives (Tolba 1992).

In Egypt, the coastal areas of the Nile Delta are most vulnerable, and they account for 15% of Egypt total national product and 60% of its fisheries, and house nearly one- quarter of the nation's population. The lower Delta contains large tracts of land below one metre in elevation. Some areas - including coastal lagoons - are below sea level. A small sea-level rise could have profound impacts. It would overwhelm the brackish lakes of the northern Delta, which comprise one-third of the nation's fish catch. Rising sea levels would salinate lakes and aquifers in the lower Nile Delta, thus affecting as much as 20% of Egypt's 35000 square kilometres of arable land. The lakes of Maryut, Idku, Burrullos and Mawalah would also be engulfed by the sea. Rising sea levels could complicate sewage drainage systems, causing back-up of sewage flows, thereby increasing the risk of infectious diseases in overcrowded cities.

Within another framework, the climatic data might be modified, in limited areas, by the occurrence of microclimates. Urban climates are then modified by gazeous emissions (domestic heating, motor transports, industries) which cause a local warm-up of the climate associated to a modification of raifall distribution in the space and over time.

Preliminary assessments have been made by the IPCC on impacts on water resources in five regions of the world: North America, Western Europe, the Sahel in Africa, India and Australia. These were based on various scenarios of the increase in concentration of CO_2 and other "greenhouse" gases in the atmosphere. The IPCC's findings from these preliminary assessments indicated that "relatively small climate changes can cause large water resource problems in many areas especially arid and semiarid areas where demand or pollution has led to water scarcity. Little is known about regional details of greenhouse induced hydrometeorological change. It appears that many areas will have increased precipitation, soil moisture and water storage thus altering patterns of agriculture, ecosystem and other water uses. Water availability will decrease in other areas, a most important factor for already marginal situations such as the Sahel zone of West Africa".

The IPCC report goes on to state that "change drought risk represents potentially the most serious impact of climate change on agriculture at both regional and global levels". (IPCC 1990)

CLIMATIC CHANGES AND IRRIGATION REQUIREMENTS

The interrelationship between climatic change, water supply, and demand and resource availability are summarized in Fig. (5).

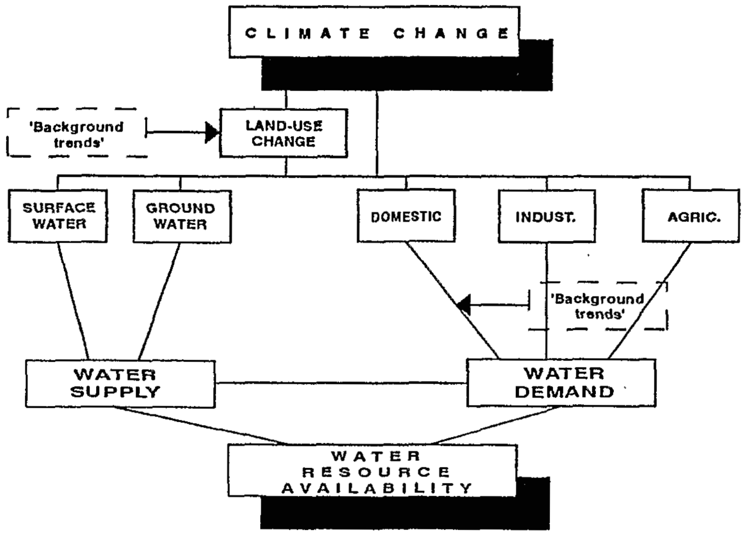


Fig.5 The interrelationships between climatic change, water supply, demand and resource availability. 'Background trends' represent changes due to evolving economic policies (ARNEL. 1992)

Climatic changes have a very significant impact on irrigation requirements. Recently in the Lesotho case study in southern Africa, Klohn and Arnell (1992) declared that the mean annual irrigation demand was found to be most sensitive to changes in evaporation.

A change in precipitation of 10% gave a change of approximately 5% in irrigation demand, while an increase in evaporation of 10% (corresponding to an increase of around 2C) increased irrigation demand by 18%.

Irrigation demands, in arid countries of the Mediterranean, comprise more than 75% of the total water demand, any increase in air temperature or change in other meteorological parameters will affect the irrigation water demands, growth and yield of the cultivated crops, as well as land use-pattern including cropping patterns. Assessing the increase in irrigation water demands resulting from a modification of the weather is important for developing future water supply alternatives and water management schemes.

Here, we outlined some of the challenges facing the water planners and the designers of water management strategies under climatic fluctuations and changes.

For the Mediterranean countries we need comprehensive, credible and cooperative water management policies that anticipate global warming and consequent climatic change. There is an urgent need to establish and/or expand reliable and cost-effective data-collection systems for hydrometeorological data, especially for rainfall, runoff, evapotranspiration and temperature covering all the Mediterranean countries. A reliable long-term data base is essential not only for efficient planning, managment and operation of water resources system but also to determine the future extent of climatic changes (if any) and how to deal with them effectively.

POPULATION IN THE MEDITERRANEAN COUNTRIES

The population evolution (1950-1990) and the expected average population (2000-2025) are given in Table (1) and illustrated in Figs (6 & 7).

Table 1. Population in the Mediterranean (millions)

	1950	1960	1970	1975	1980	1985	1990	1995	2000	2020	2025
World	2504	3013	3683	4079	4450	4854	5248	5679	6127	7806	8177
Medit.	232	270	318	346	375	407	442	477	514	651	685
North. Medit.	170	189	213	225	235	244	253	263	271	297	305
South. Medit.	62.7	81.1	106	121	141	163	189	215	243	354	381
Medit./ World %	9.3	9	8.6	8.4	8.4	8.4	8.4	8.4	8.4	8.3	8.4

Source: Mode d'acroissement de la population urbaine et rurale, ONU, 1981

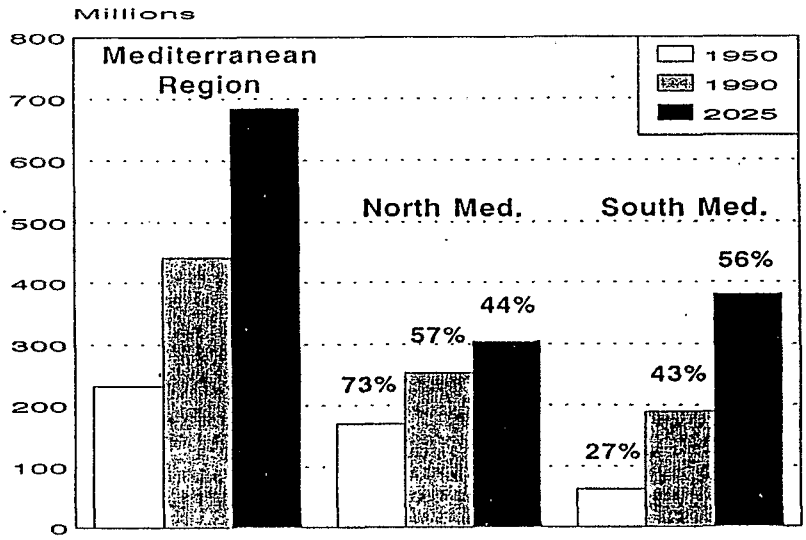


Fig.6 Population in the Mediterranean

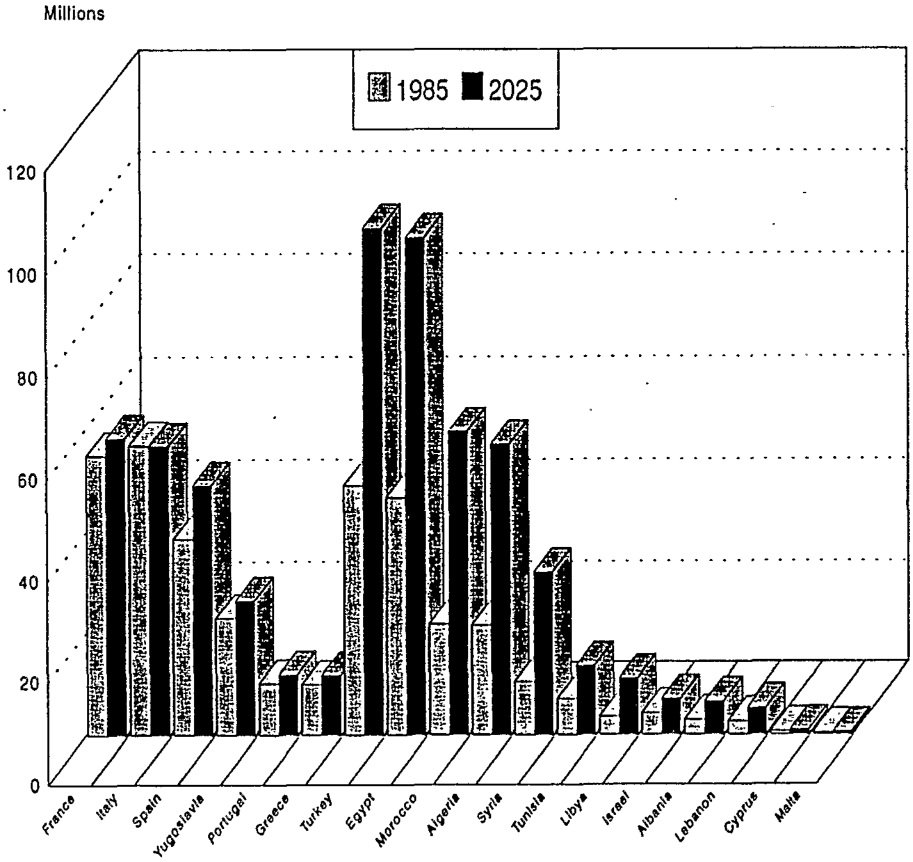


Fig.7 Population in the Mediterranean Countries (1987 - 2025)

The total population of the Mediterranean region has reachead now 443 millions representing 8.4 % of the world's population. Over 40 years (1950-1990), the total population of the southern mediterranean countries has triplicated, whereas, that of the north was only one and half times greater.

Taking the year 1985 as a reference, it is expected that the population of the Northen countries will be increased by only 25% in the year 2025, whereas the one of the South will increase by 133% giving a total increase of 77% for all the the Mediterranean countries. In the southern Mediterranean countries, the population growth rate is very high averaging 3.3% as compared with the northern countries and having an annual increase of only 0.63%. In the year 2025, the southern zone will have more than 55% of the Mediterranean population compared with only 27% in 1950.

From the analysis of the demographic characteristics of the 18 Mediterranean countries, the following three demographic groupings could be identified :

Region A: Spain, France, Greece, Italy, Portugal, Yougoslàvia;

Region B: Algeria, Egypt, Libya, Morocco, Syria, Tunisia, Turkey;

Region C: Albania, Cyprus, Israel, Lebanon, Malta.

The population of these three groupings are provided in Table (2).

As a whole, the Mediterranean population experienced a 67% increase over 35 years from 1950 to 1985, at a mean annual rate of 1.5%, lower than 1.9% observed for the whole world population. The actual rate reached a maximum towards the end of the 60's.

Then, it has slowly decreased but remained still high, in the order of 1.4% between 1986 and 2000 and 1% between 2000 and 2025 (Fig.8).

This evolution is different in the three regions. The countries of region A experience growth rate sharply lower than those of the countries of regions B and C: 0.8% against 2.3% respectively between 1950 and 1985. In 2025 region A only accounts for 38% of the total Mediterranean population against 68% in 1950 and 54% in 1985. Conversely, region B grouped about 60% of the whole Mediterranean population, in absolute terms two times as high as its actual value, and about 5 times higher than in 1950.

Table 2. Evolution of the total population of the Mediterranean countries

Zones		Population (millions) 1950	1970	1985	1990	2000	2025	Multipliers with respect to 1985: 1985	1990	2000	2025
Medit. countries	Total	218.9	295.2	364.7	391.6	444.1	559.1	1.00	1.07	1.22	1.53
	Zone A	148.2	176.4	193.4	197.4	204.5	211.2	1.00	1.02	1.06	1.09
	Zone B	66.2	110.5	161	182.3	225.4	328	1.00	1.13	1.40	2.04
	Zone C	4.5	8.3	10.3	11.9	14.2	19.9	1.00	1.15	1.38	1.93

Source: Mode d'acroissement de la population urbaine et rurale, ONU, 1981

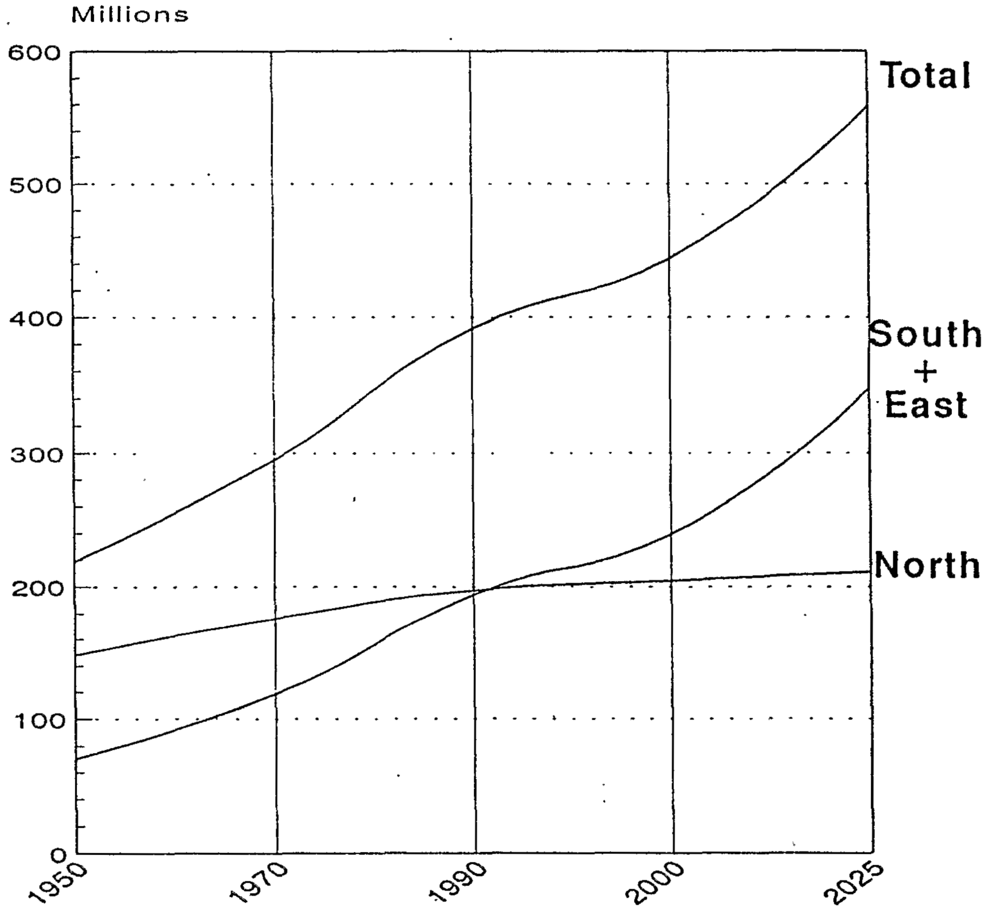


Fig.8 Evolution of the Total Population of the Mediterranean Countries

The growth in population will be accompanied by increasing urbanization. In 1990 the urban population as percentage of the total was of the values 62, 67 and 55% with respect to 52, 57 and 42% for the year 1970 for the whole, North and south of the Mediterranean region respectively (Fig 9).

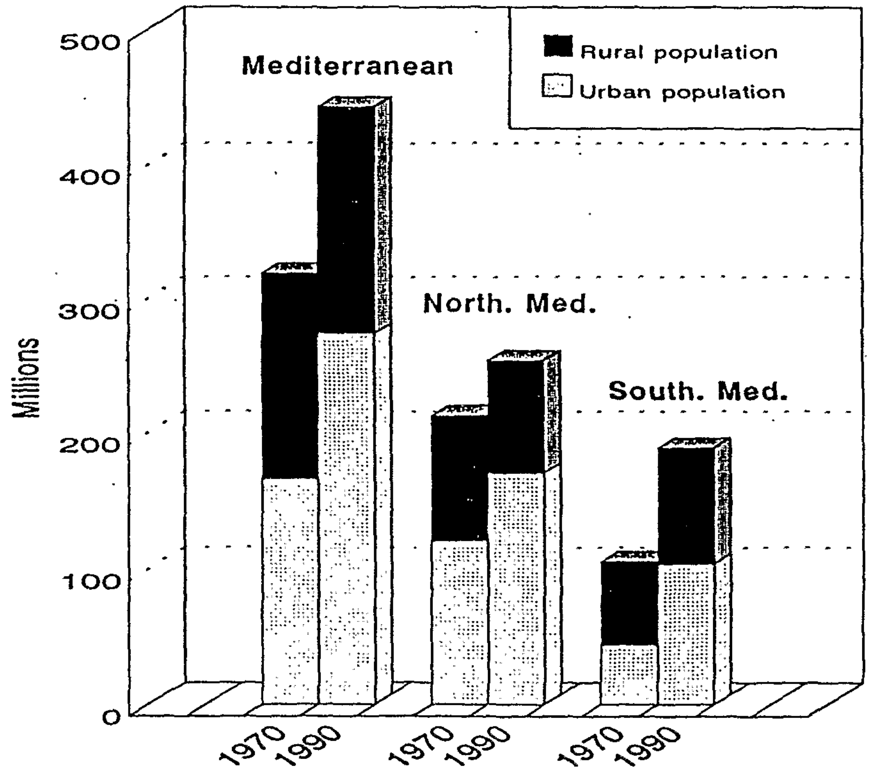


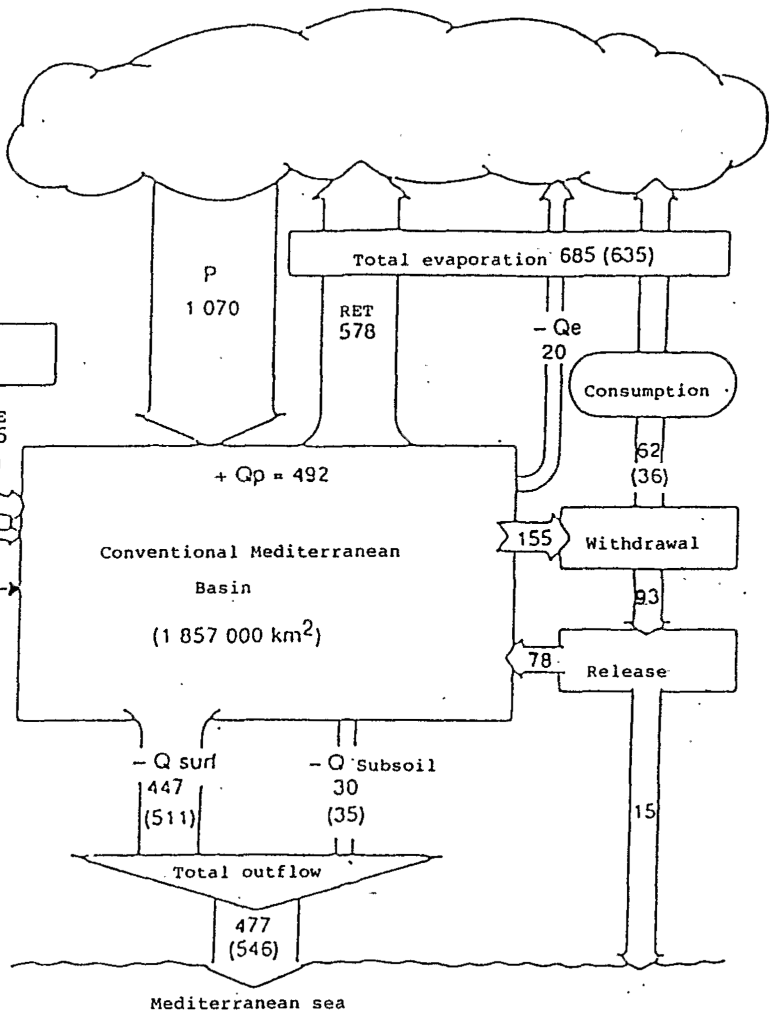
Fig.9 Urban e Rural Population in the Mediterranean.

Generally, the annual growth rate of urbanization is high in the Mediterranean region, but it is much higher in the South, 4.5% with respect to the North 2.8%.

This population increase will impose serious stress on the fresh water resources particularly with consumptive uses in the developing countries of the Mediterranean region.

WATER RESOURCES IN THE MEDITERRANEAN REGION

Figure 10 summarizes the global water balance of the Mediterranean region. On a regional scale, water is a poor and irregularly distributed resource.



Units: billion m³ / year (Gm³ / year)
P= Precipitation
RET= Effective evotranspiration
+ Qp= Potential flow (=effective rainfall)
- Qe= Water losses by evaporation
+ Q subsoil= Subsoil inflow
- Q surface= Surface outflow --> sea
- Q subsoil= Subsoil outflow --> sea

Fig.10 Present global water balance of the Mediterranean Basin

Source: Plan Bleu (J. Margat, 1988).

The multiple uses and functions suggest conflicts, both among different human uses (including those between farms and in-situ uses) and between them and the natural functions.

Table 3 summarizes the balance in the mid-80s in terms of water supply and demand related to uses in the Mediterranean area.

Table 3. Water supply and demand in the Mediterranean catchment area

Catchement area		Resources		Demand		Ratio	
						Supply	Demand
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
	Estimated population in millions	Total water resources bill. m^3/year	Stable or stabilized water resources bill. m^3/year	Water withdrawals bill. m^3/year	Net consumption bill. m^3/year	Exploitation ratio referred to (b): d/b	Exploitation ratio referred to (c): d/c
Spain	≈16	31.1	7.5	13.8	11.7	38	184
France	12.4	74	35.2	15.75	≈2.37	21	45
Italy	57.2	187	30.5	46.35	≈15	25	152
Malta	0.33	≈0.03	0.023	0.023	0.02	≈77	100
Yugosl.	≈2.4	77.5	11.5	1.5	0.28	2	13
Albania	2.2	21.3	6.5	≈0.2	0.036	1	3
Greece	9.44	58.6	7.7	7	3.65	12	91
Turkey	11.9	≈67	15.6	6.7	≈3.27	10	43
Cyprus	0.66	0.9	0.27	0.54	0.40	60	200
Syria	≈1.7	4	2.3	0.88	0.51	22	38
Lebanon	3.16	≈4	≈2.8	0.6	0.38	15	21
Israel	4.34	≈1.3	0.28	≈1.5	0.95	115	536
Egypt	46.7	57.3	55.8	55.9	≈39	98	100
Libya	≈2.3	≈0.7	≈0.2	1.6	1.25	229	800
Tunisia	5.5	3.1	≈1.5	≈2	1.45	65	133
Algeria	15	10.9	2.5	1.7	≈1	16	68
Morocco	2.2	3.8	0.9	1.1	0.57	29	122
Total	193	602	...	157	82	...	...

Source: Plan Bleu (after J. Margat, 1988)

The water physical resources are included in columns *b* & *c*. These physical resources are the available ones, i.e they do not include rainfall resources but include spontaneous runoff from nearby countries. These resources are renewable: they do not include the resources provided by the exploitation of reserves, such as fossile water, which are significant for most North African countries, nor other unconventional resources such as the production of fresh water by sea water desalination, etc.. (the amount excludes the double counts due to the spontaneous exchanges between neighbouring countries in the region, in the order of 28 billion m^3/year). All these resources are not necessarily accessible. The most accessible fraction is the natural runoff of waterstreams and ground water, or the flood runoff trained by existing infrastructres (reservoirs) (column *c*, for which some uncertainties about infrastructures make a summation impossible). Gross withdrawals, for all grouped uses, making use of both regular or regularized water and irregular water, equal the allocated amounts (column *d*). A fraction of this withdrawn water is not returned to continental water of the natural medium. Calculated by general coefficients, such a fraction represents the net amounts of consumed water (column *e*).

Two ratios allow demands to be compared to supplies:

- the ratio of withdrawals to total resources (*d* over *b*, column *f*);

- the ratio of withdrawals to the regular fraction (*d* over *c*, column *g*).

It is worthwhile noticing that for the Mediterranean region:

- storage reservoir infrastructures increased by at least 55% natural regular resources (20% of which due to the Nile infrastructures only);

- out of the 154 billion m^3/year withdrawn, about 72% (110 billion m^3) are used for irrigated farming, 10% for the production of drinking water supplied to built-up areas (mostly domestic uses) and 16% for unjoined industries, including thermal power stations;

- a large portion of the waters flowing into the Mediterranean Sea (theoretical resources minus the net amounts consumed, column *b* minus column *e*, say about 486 billion m^3/year) carries some residues of wastewater, resulting in a considerable depreciation of its value, in terms of quality.

The high rates of utilization in most countries lead us to expect low rates of future supply (20% for Egypt for example), or no supply in extreme cases (Israel, Libya, Malta, for instance where the rate is already above 100%).

The volume of polluted water discharged into the sea, on the one hand, and the risks of conflicts related to the rise in demand to meet the needs of agriculture and urbanization (drinking water) intensification, on the other, led to choose water as the second "environmental component".

AVAILABLE TOTAL WATER AND WATER WITHDRAWAL

Clearly, water availability alone is just a first indicator as to whether abundance or scarcity is more likely. Not all water made available by nature can be used and the actual withdrawals depend upon upstream - downstream relations as well as upon water needs emerging from the socio-economic development.

Total available water, withdrawal and the withdrawal per capita are shown in Table (4). Concerning the total available water, it is quite clear that they greatly vary from one country to the other of the Mediterranean region. Generally, the northern countries are relatively rich in their available water resources with maximum values of 244 billion m^3 in Yugoslavia and minimum 62 billion m^3 in Greece. The other northern countries are of values in between with an average of around 144 billion m^3. Contrasts exist in the southern and eastern part of the Mediterranean region, where total available waters are of values much lower than in the north. The poorest among those countries is Malta with only 0.03 billion m^3, followed by Libya 0.60 billion m^3, then Cyprus 1 billion m^3 and Israel 1.65 billion m^3.

Regarding the water withdrawal as percentage of total water available (Fig 11), it is quite clear that in the countries of very poor water resources; the withdrawal water had exceeded the total available one (Libya 245% and Israel 104%). With the rich countries (Yugoslavia and Albania) their water withdrawal did not exceed 4% of the total.

On the other hand, the southern countries with high population intensity, water withdrawal is relatively intensive, around 30% of the total which is nearly two times superior to that withdrawn by the northern countries.

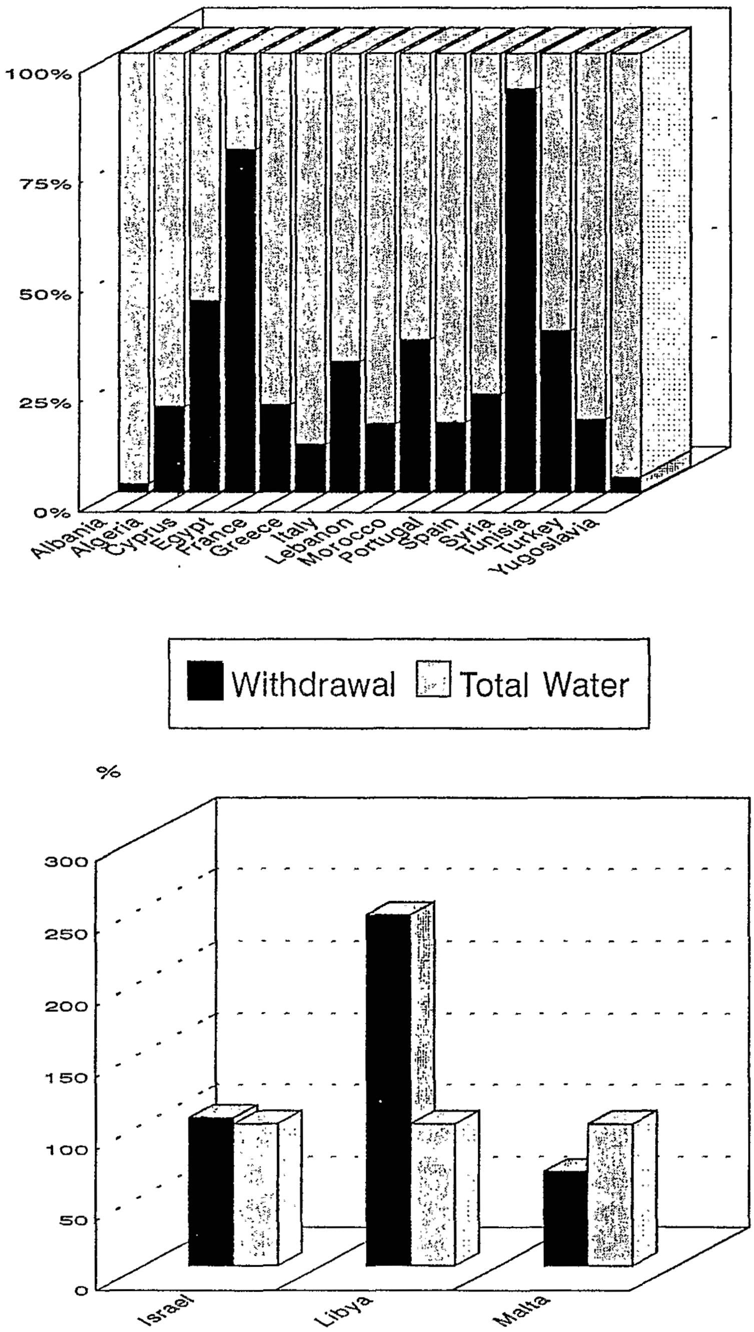


Fig.11 Water Withdrawal in the Mediterranean Countries 1987

In some countries (Egypt and Syria), the already withdrawn water is very excessive, amounting to nearly 90% of the total available water resource.

The water withdrawal per capita (Fig. 12) greatly varies not only between the regions of the Mediterranean area but also among the countries. Among the Mediterranean countries, the highest withdrawal per capita is found to be in Portugal with over 1000 m^3/year, whereas the lowest refers to Malta with only 51.5 m^3/year. The withdrawal per capita in Egypt is nearly equal to that of Italy but is twice greater than that in Morocco, and nearly six times greater than Tunisia and Algeria.

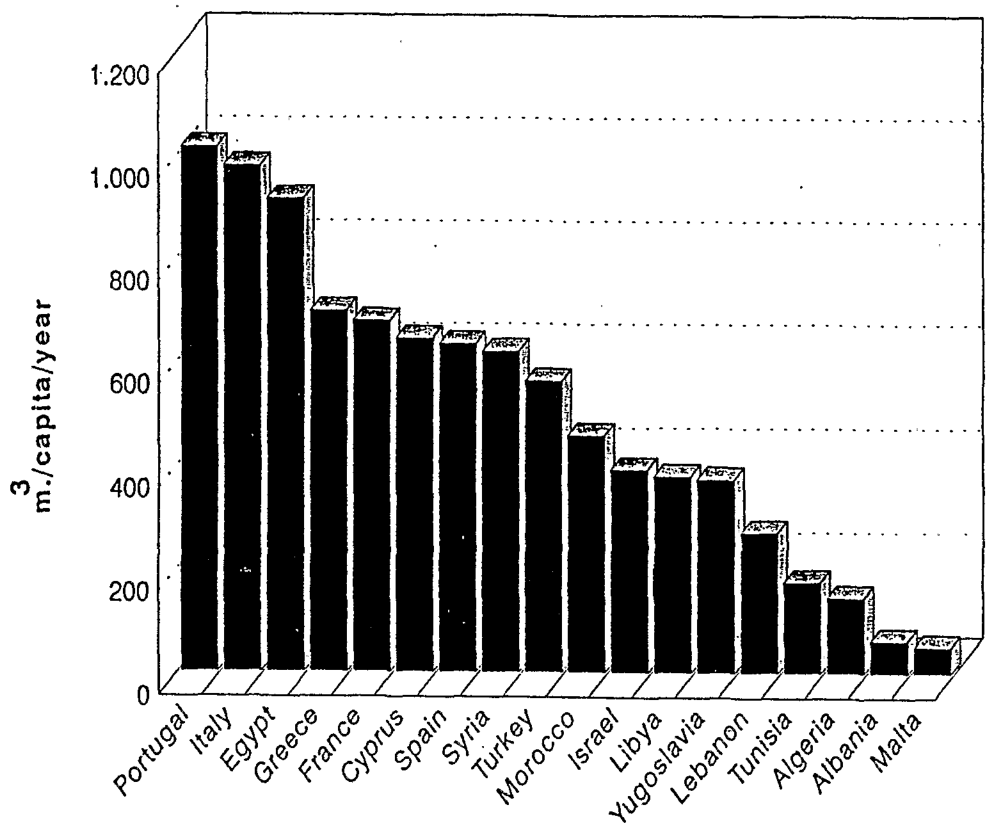


Fig.12 Withdrawal per Capita in the Mediterranean Countries (1987)

The previous data characterize the situation in the year 1987. Assuming that we need to keep the water withdrawal per capita, by the year 2025, at a value around that of 1987, the prospects for the year 2025 are really complicated and announces difficulties and severe problems, particularly for the countries with shortage in water resources and a relevant population growth rate. In Egypt, the water to be withdrawan will be doubled and nearly twice the actual total available resources.

Table 5. Water resources: total, withdrawal and withdrawal per capita

Country	Total water available	Total water per capita		* Category	
		1987	2025	1987	2025
Albania	10.00	3.144	1.530	Medium	Low
Algeria	17.20	0.743	0.300	Very Low	Very Low
Cyprus	1.00	1.462	1.117	Low	Low
Egypt	57.50	1.170	0.590	Low	Very Low
France	185.00	3.366	3.161	Low	Low
Greece	62.90	6.316	5.351	Medium	Medium
Israel	1.65	0.375	0.235	Very Low	Very Low
Italy	187.00	3.259	3.284	Low	Low
Lebanon	4.80	1.738	0.919	Low	Low
Libya	0.60	0.155	0.054	Very Low	Very Low
Malta	0.03	0.077	0.065	Very Low	Very Low
Morocco	30.00	1.304	0.501	Low	Very Low
Portugal	65.60	6.344	5.505	Low	Low
Spain	109.80	2.815	2.230	Low	Low
Syria	7.60	0.672	0.236	Low	Low
Tunisia	3.50	0.473	0.257	Very Low	Very Low
Turkey	172.90	3.364	1.741	Low	Low
Yugoslavia	244.00	10.400	9.164	High	Medium

Water availability per capita (World resources Institute, 1986):

* Category	Per capita availability m^3/year
Very Low	1000 or less
Low	1000 - 5000
Medium	5000 - 10000
High	10000 and more

Units:

Total water available in billions m^3

Total water available per capita in 1000 m^3

This will be also the case with the majority of the southern mediterrnean countries (Tunisia, Morocco, Algeria), hence for the realization of this assumption more than 90% of

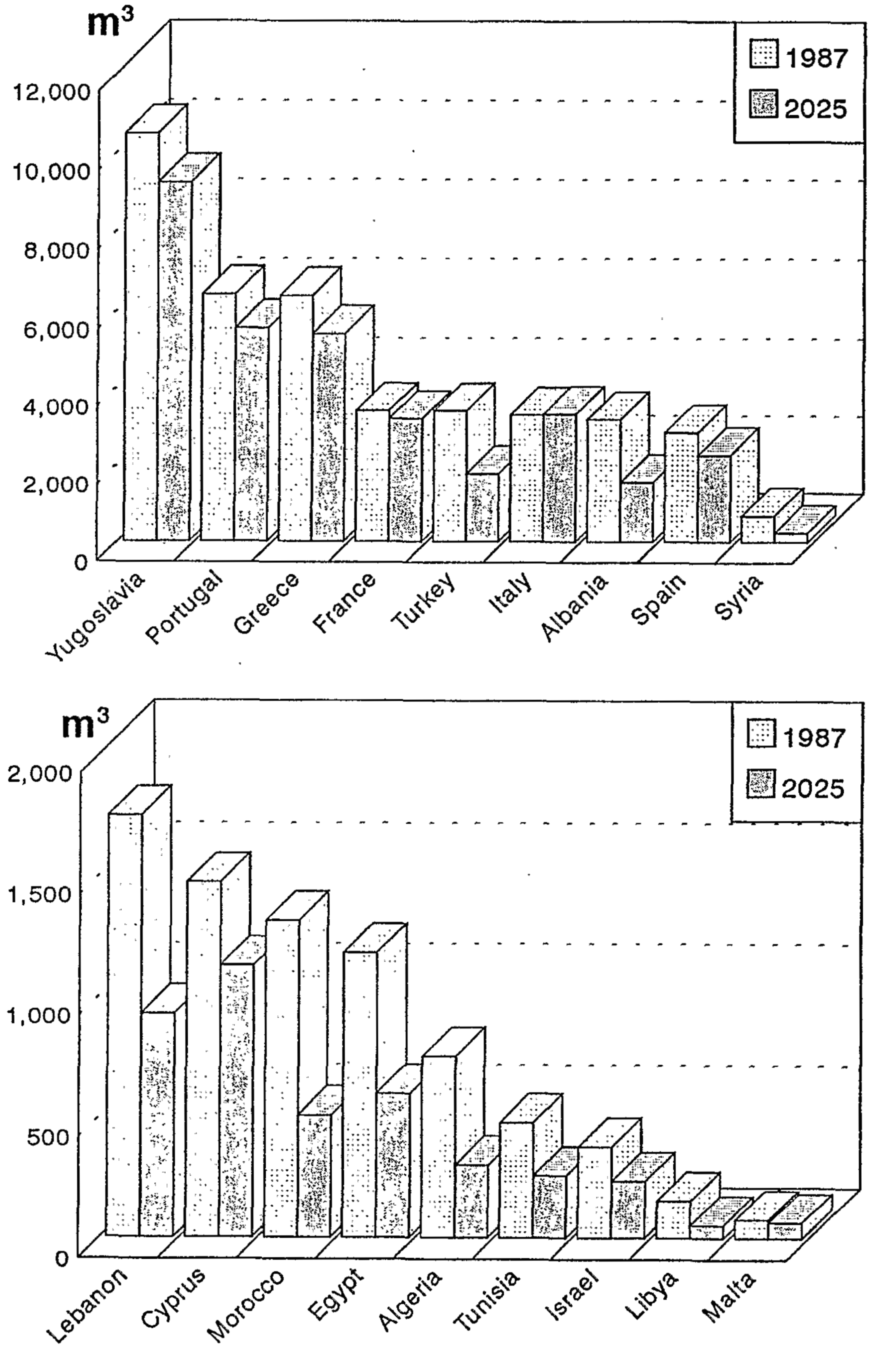


Fig.13 Water Availability per Capita in the Mediterranean Countries (1987 - 2025)

the total available water resources have to be withdrawn, this being practically impossible. In other countries (Libya, and Syria) to satisfy the water needs for the year 2025 the situation will be much worse.

This is clearer by considering the water availability per capita (Fig. 13 and Table 5). In terms of per capita water availability there are wide variations between countries. For example, France and Italy provides about three times more water per person than Egypt and Morocco, seven times more than Tunisia and nearly ten times more than Algeria.

The picture for the year 2025 shows that much less water will be available per capita in the Southern and Eastern part of the Mediterranean than the Northern one.

In the year 2025, it is expected that water availability per capita in the Southern countries will drastically drop (50 to 70%) with respect to the year 1987, with an average around 60%, but availability will be reasonably stable in the northern countries with very slight differences not exceeding 10%.

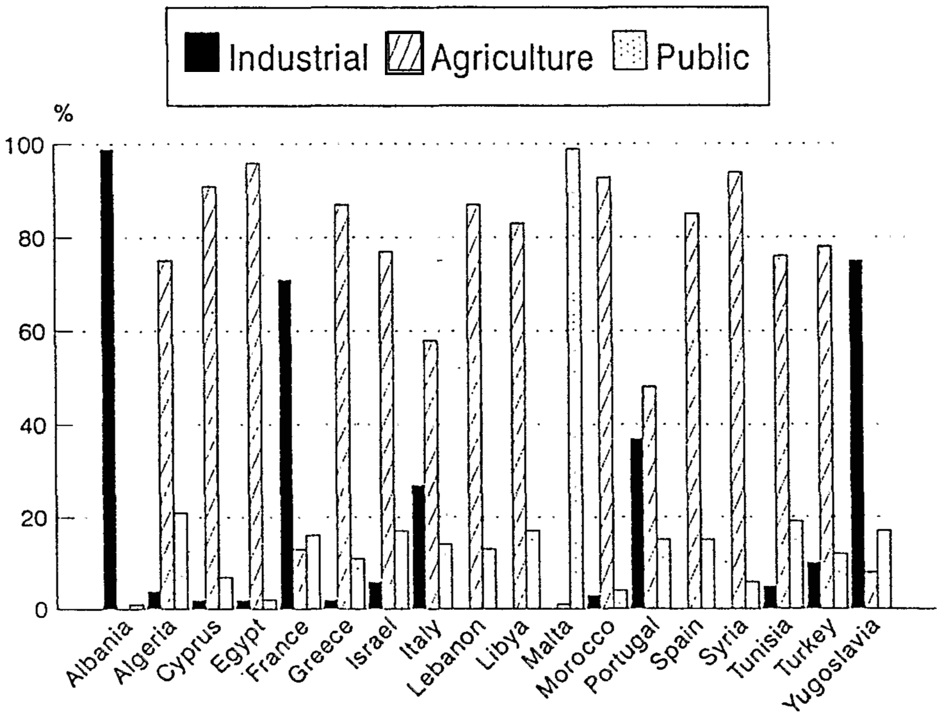


Fig.14 Sectorial Water Use in the Mediterranean Countries

This will normally be reflected on the sectorial water distribution and its use (Fig 14). Under such conditions, countries will experience difficulties in ensuring self sufficiency in meeting agricultural, domestic and industrial water needs. In the developing Mediterranean countries, because of the critical priority for drinking water, it is expected that the balance of water distribution between domestic, municipial, industrial and agricultural sectors will change in the favour of the first of these sectors.

LAND AND WATER RESOURCES

Land use and repartition of agricultural surfaces are illustrated in Figs (15 & 16).

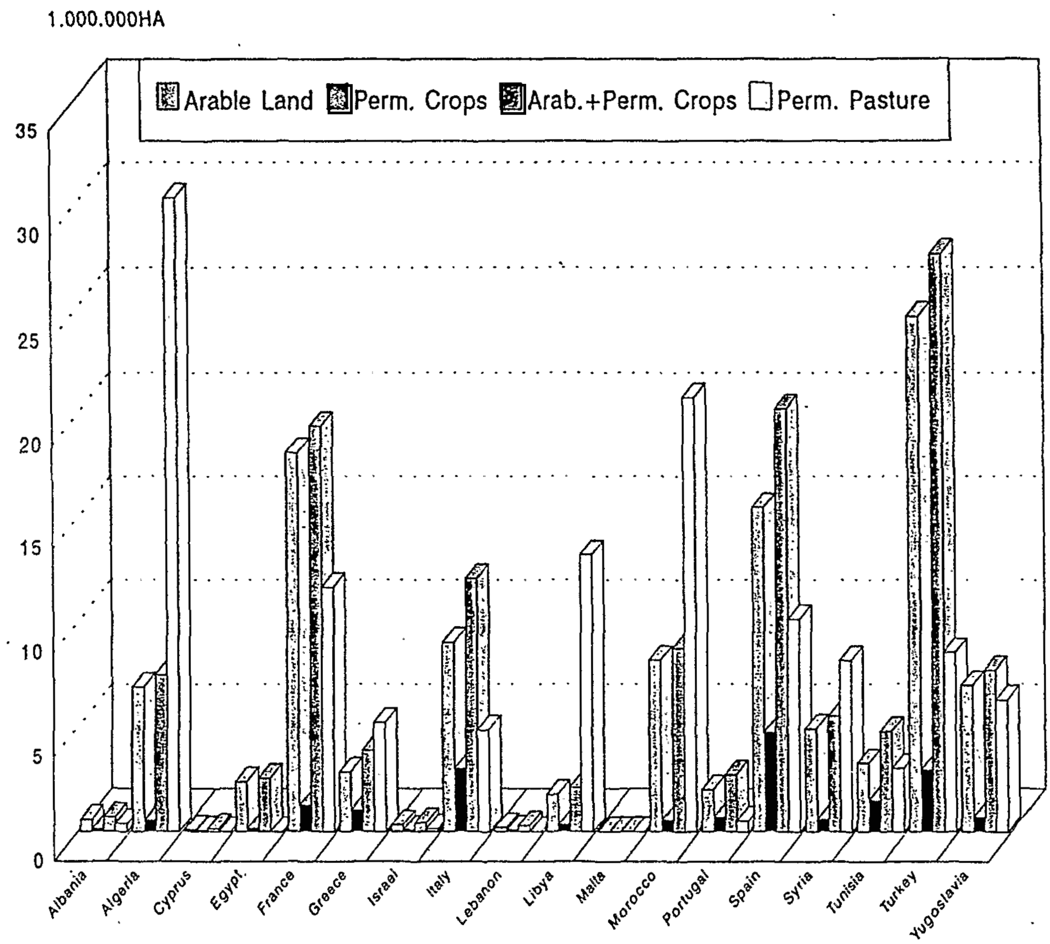


Fig.15 Land Distribution in Mediterranean Countries

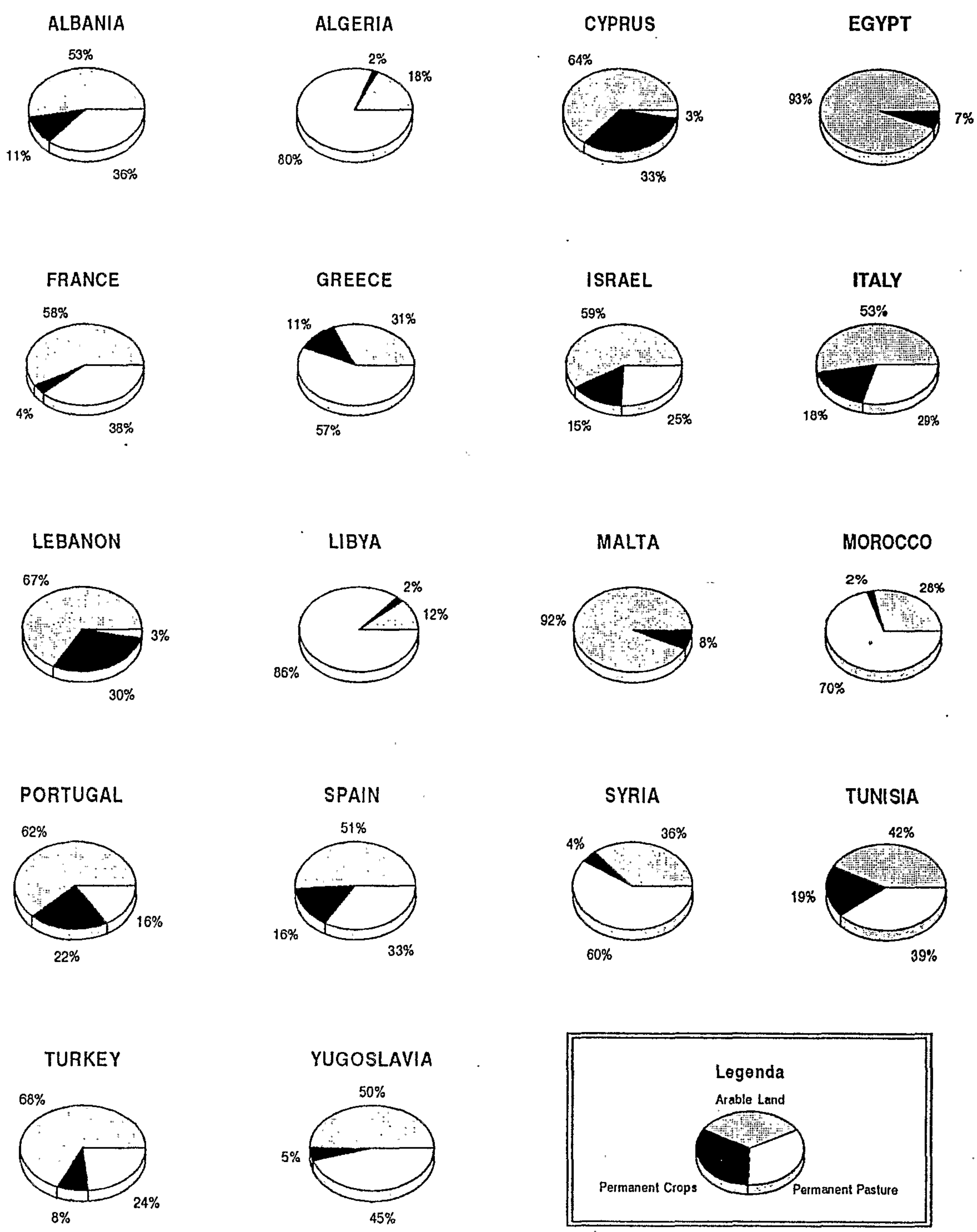


Fig.16 Repartition of Agricultural Surfaces

The figures show that the extent of soils grown with respect to the total area of countries is always below 50% in the Mediterranean countries and even below 10% in few cases (Algeria, Libya, Egypt) where the total land area mostly consists of deserts.

For a total area of about 850 million hectares, 125 millions are arable land and land under permanent crops. Pastures represent several hundred million hectares, suitable for extensive animal breeding with great possibility of a relatively high animal production through a proper and better management.

Arable land refers to land under temporary crops, meadows for mowing or pasture, land under market and kitchen gardens (including cultivation under glass), and land temporarily fallow or lying idle.

The land under permanent crops refers to land cultivated with crops that occupy the soil for long periods and need not to be replanted after each harvest; it includes land under shrubs, fruit trees, nut trees and vines, but excludes land under trees grown for wood or timber.

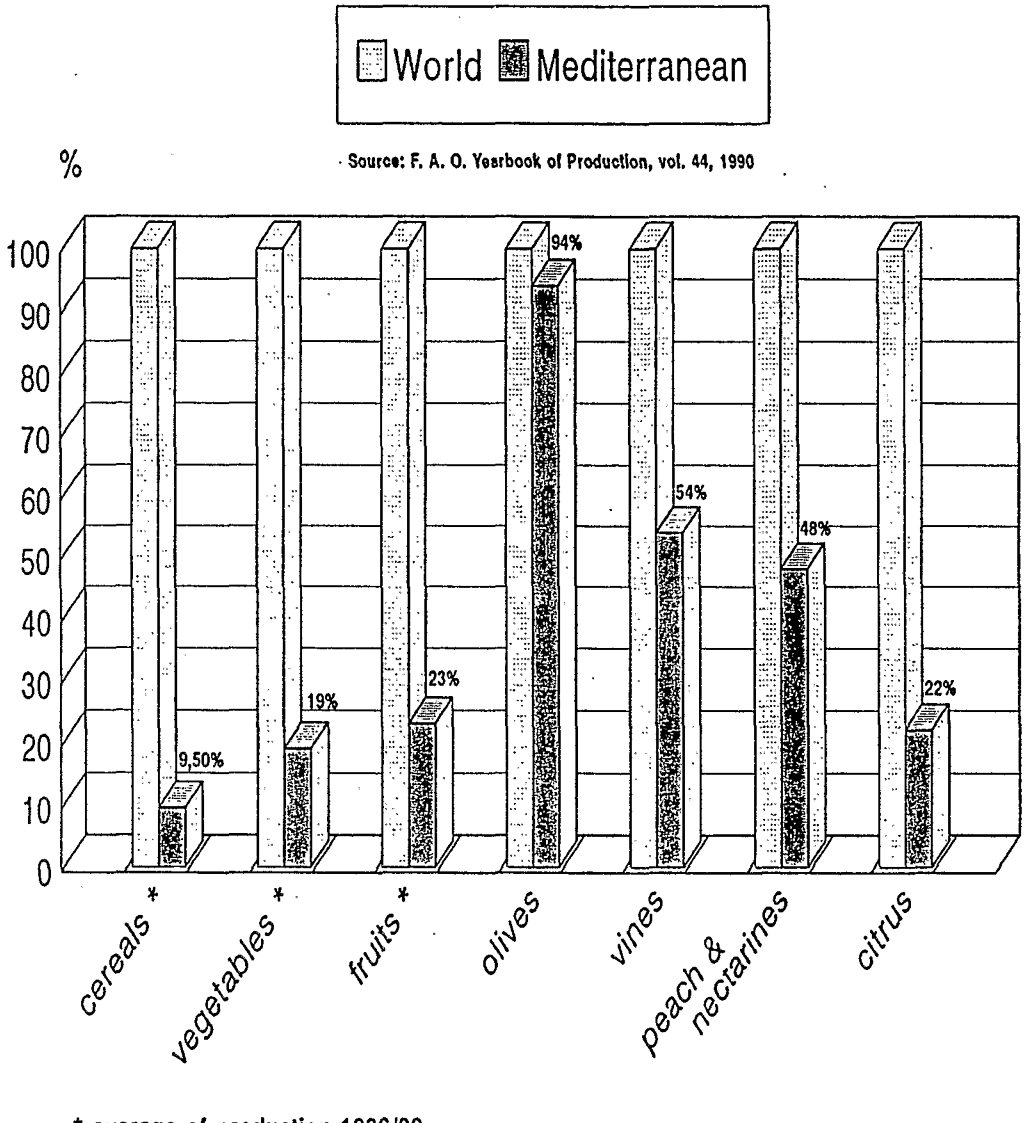
The permanent meadows and pastures refer to land used permanently (five years or more) for herbaceous forage crops, either cultivated or growing wild (wild prairie or grazing land).

There are great differences in the land use between one country and an other in the Mediterranean region Fig. (16), and this also holds true among the Southern, Northern and Eastern Mediterranean regions Table (6).

Table 6. Land use as percentage of cultivated area

Regions	Cultivated area		
	Annual crops %	Permanent crops %	Permanent pastures %
North	57.55	10.90	30.89
South	38.60	6.40	55.00
East	56.50	2.50	22.75
Average	50.88	12.60	36.21

The production of some of the main crops in the Mediterranean region versus the world production is given in Fig (17).



* average of production 1986/89

Fig.17 Main Crops in the Mediterranean

The data evidently declare that, the production of certain Mediterranean crops is very high and amounts to a relatively high portion of the world out put [olives 94%, vines 45%, peach and nectarines 48%, citrus and fruits 24%].

IRRIGATION AND WATER RESOURCES

The irrigated land in the Mediterranean countries, the evolution pattern and the percentage of surface irrigated to the total cultived is given in Figs. (18, 19 & 20) respectively.

Only four countries do irrigate more than one quarter of their cultivated land (Albania, Cyprus, Israel, Lebanon). The case of Egypt, where agriculture is completely irrigated, is a particular one.

In the northern Mediterranean countries (Italy, Greece, Portugal, Spain), the irrigated surface ranges between 10 to 20% of the total cultivated one with the exception of France with only 4%. In the rest of the Mediterranean countries, the irrigated land corresponds to less than 10% of the cultivated one (Algeria, Libya, Malta, Morocco, Syria, Tunisia, Turkey, Yugoslavia).

At present, the irrigated areas account for more than 16 million hectares; in 15 years, these areas has increased by 3 million hectares and the growth rate seems to stabilize around 200,000 hectares per year. This implies the use of a supplementary capacity in the order of 2 billion m^3 of water per year only for agriculture. This will certainly cause some difficulties for the partioning of water resources between agriculture and urbanization. It is likely that the use and recycling of both urban and irrigation wastewater will become necessary in a given number of countries, particularly those of the arid region of the Mediterranean area.

Irrigation is extremely water intensive. It takes about 1000 tons of water to grow one ton of grain and 2000 tons to grow one ton of rice. In the Mediterranean area irrigation represents 72% of the total water withdrawals.

Despite the high periority and massive resources invested in the water resources development, the performance of large public irrigation systems has fallen short of expectation in developing and developed countries of the Mediterranean area. Crop yield and efficency in water use are typically less than originally projected and less than reasonably achieved. In addition, the mismanaged irrigation project schemes lead to the "sterilization" of some of the best and most productive soils. Salinity now seriously

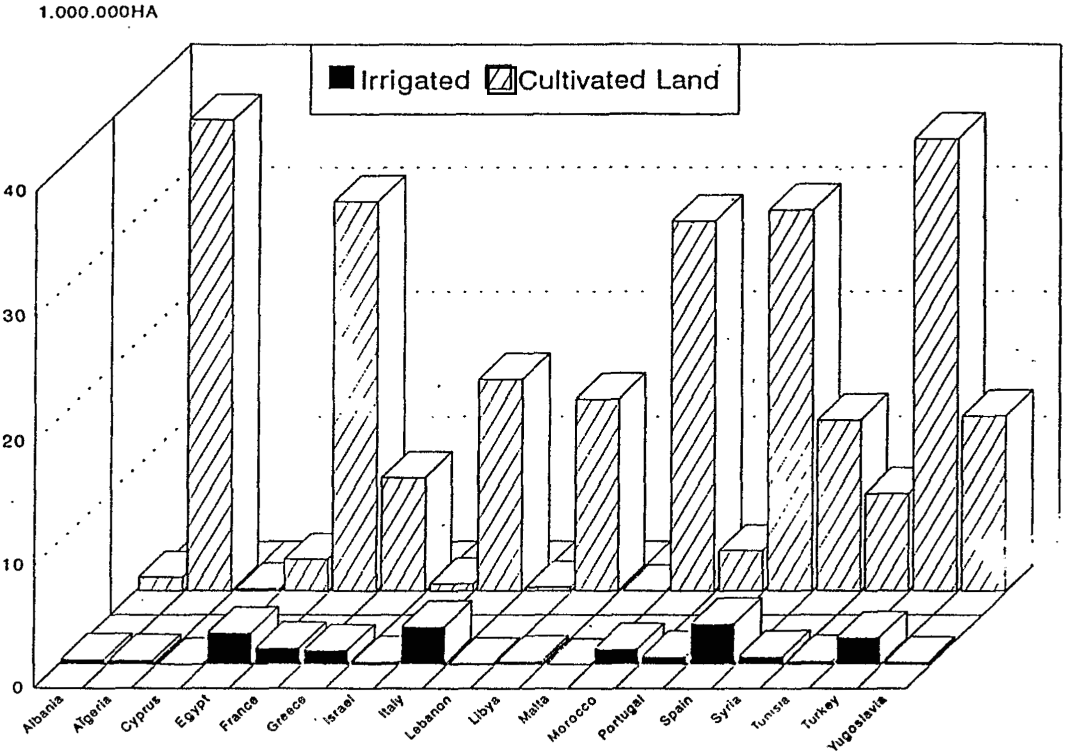


Fig.18 Irrigated Lands in Mediterranean Countries

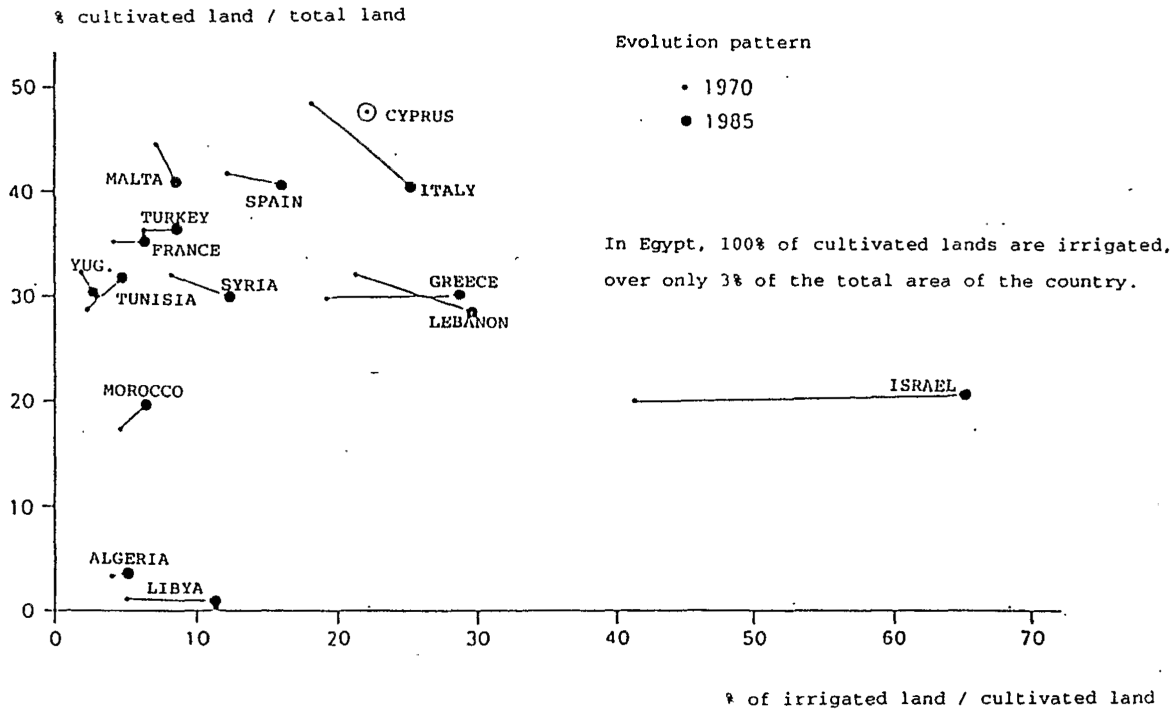


Fig.19 Total Cultivated and Irrigated Areas

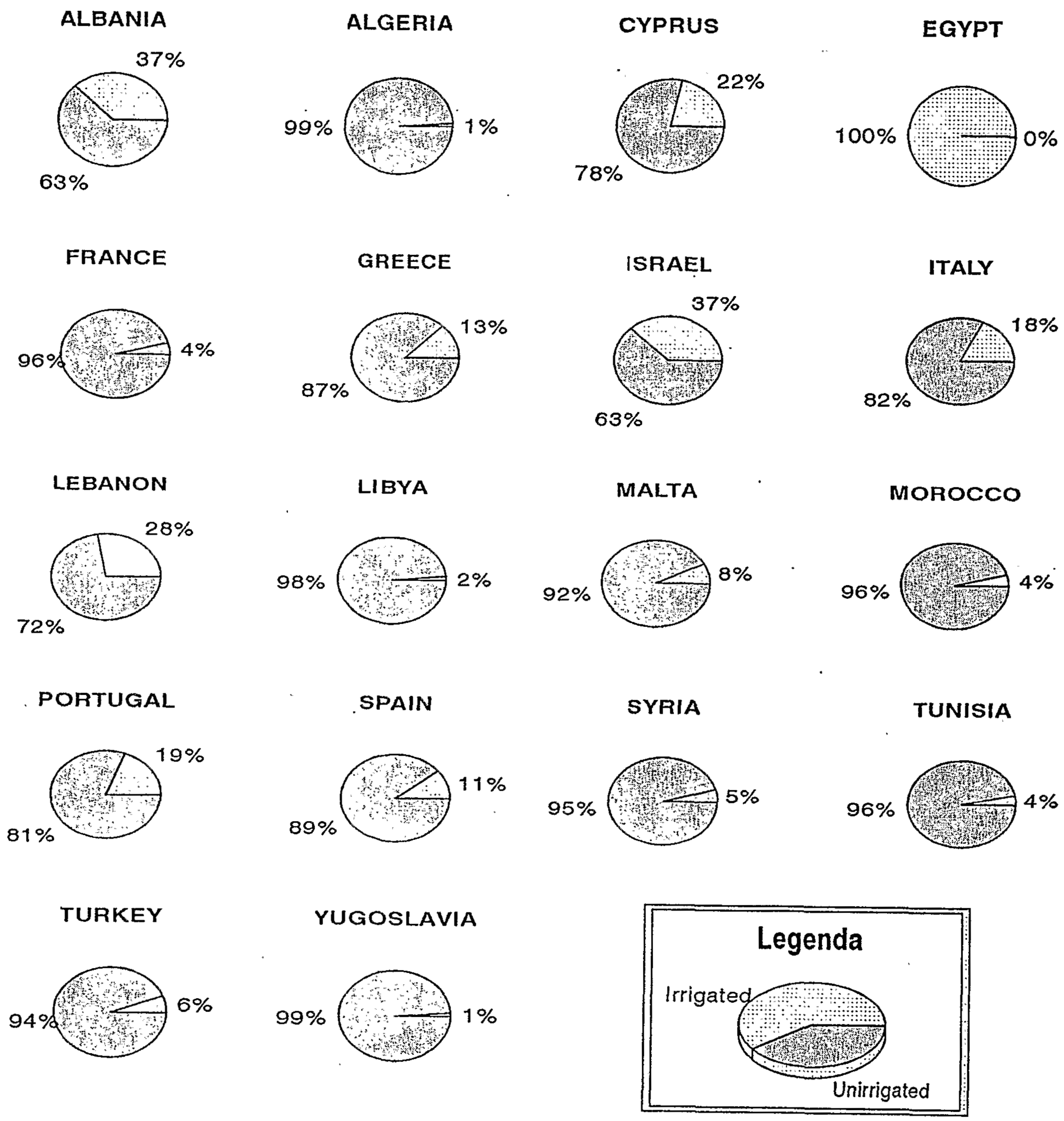


Fig.20 Irrigated Land in the Mediterranean Countries (%)

affects productivity in the majority of the southern Mediterranean countries as well as in the costal zone.

Despite the many social, political, cultural and economical differences between the Mediterranean countries in arid and semi arid environments, many similarities actually exist. The following rank first:

(1) Poor management practices, inefficient water use, and failure to place a high economic value on water result in resource degradation by water logging, soil and water salinization and pollution of acquifers.

(2) Incentives for water conservation in agriculture are few and disincentives are numerous.

(3) Irrigation is developing faster than the water source mobilization. The rapid population growth and the increasing demand for water for other uses are leading to rapid mining of acquifers, water shortages, and to competitions and conflicts.

(4) The outlook for developing new water supplies to meet increasing demands is questionable, given limited financial resources, escalating construction costs, and rising environemental oppositions.

POSSIBLE WATER SAVINGS

Significant water savings are possible in the Mediterranean regions through :

- Better management of water conveyance

The modernization of conveyance works and networks could result in saving 20 to 30%, and in a better irrigation management.

The investments and running costs for these improvements, indeed high, should be compared to the ones resulting from the mobilization of new resources. Concrete cases in South-Eastern France show that they can be far lower.

- Increasing irrigation efficiency

Many opportunities exist for improving irrigation efficiency, which would release water for other sectors, reduce conflicts, and improve agricultural productivity.

In the southern part of the Mediterranean region, for example, improving irrigation efficiency by just 10% would double the amount of water for urban residences and business.

The case of Egypt, with the very critical available water resources to cope with the future development, a 10 percent increase in water efficency (which average less than 40%) would release enough water to increase the irrigated area by nearly 10% or to be used for other purposes, thus reducing the pressure for future development of water supplies.

- Water demand regulation by water price

The general thesis behind water pricing is that if right water prices could be charged on the users, they would then become rational optimizers. If the farmers had to pay an economic price for this resource, great water saving could be achieved through the significant reduction in the excessive water use . In addition, the revenues thus generated through water pricing will enable the irrigation institutions to operate and maintain their irrigation systems more efficiently.

Despite the fact that during the eigthies water pricing was seriously considered as a tool for water saving and a better water use efficency, unfortunately so far in the mojority of the developing Mediterranean countries, it has not been applied.

Water pricing is a very effective way of reaching water management objectives in the region. A pricing policy must be found which assures balanced economic development.

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