Integrated water resources management in the Mediterranean regions. Actions implemented by PAP/MAP-UNEP

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INTEGRATED WATER RESOURCES MANAGEMENT IN THE MEDITERRANEAN REGION - ACTIONS IMPLEMENTED BY PAP/MAP-UNEP

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ABSTRACT

Water supply represents a long lasting problem in the Mediterranean region, and particularly on the islands and in isolated areas. This conclusion was reached after several years experience in solving these problems, within the activities of the UNEP Center for Priority Actions on the Mediterranean. The shortage of water imposes increasing demands upon the water management and on the policy makers, since this problem is not only technical but is becoming a socio economic problem of wide interest. The paper presents the activities of the UNEP-MAP Center, the gained experience and the suggestions for solving the problems related to water resources management as a part of an integrated environmental management system. The paper also presents the main characteristics of two pilot projects.

1. Regional Activity Center for Priority Actions Programme and Priority field Water Resources

1.1. Introduction

United Nations Environmental Programme - UNEP was established by the General Assembly resolution No. 2997 in 1972. UNEP realizes one part of its activities through a special programme for regional seas. Today there are ten regional seas programmes, the Mediterranean region being the first one of the regional seas programme.

This programme of pollution protection and environmental management of the

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Mediterranean has been implemented by the Mediterranean Action Plan - MAP. The Mediterranean Action Plan is a programme for all Mediterranean countries and the European Community in the implementation of Barcelona Convention of the Mediterranean sea against pollution and its related protocols. The Convention has been in force since 1978.

The MAP consists of four components: Integrated Planning; Programme for Research, Monitoring, Assessment of the State of Pollution and Protection Measures (MED POL); Legal Component; Institutional Arrangements; co-ordination by the co-ordinating units for MAP (MEDU), Athens.

The Integrated Planning component of MAP is expected to deal with the problems of development and its impact on the environment. It has been agreed that this particular component should consist of and operate on two planes:

- Long-term development of the Mediterranean and the problems of development in relation to the environment (the Blue Plan - S.Antipolis).

- Current and acute problems of development in the Mediterranean, the use of its resources, and the impact of both factors on the state of environment (the Priority Actions Programme - Split).

The investigation of the current problems and conflicts between the development and the environment, as well as the assessment of the possible use of available resources in conformity with the environmental protection principles is the primary task of the Priority Action Programme - PAP. It is a practical action - oriented programme based on available Mediterranean and international knowledge. The objectives of the programme are to contribute to the exchange of experience among the Mediterranean countries through:

- Network of experts and institutions,

- Substantive documents (national reports, case studies, seminar and workshop reports, guidelines, codes of practice, methodological documents, etc.),

- Training (expert meetings, seminars, workshops, training courses),

- Expert missions to interested Mediterranean countries.

The objective of the programme is also to cooperate with the national and local authorities and institutions in strengthening the national and local capacities for planning and management in the coastal zones through:

- Provision and dissemination of tools and techniques for integrated planning,

- Training of national and local experts,

- Formulation and implementation of multilateral Mediterranean cooperative projects,

- Direct cooperation within site - specific country projects.

PAP realizes this programme through six priority fields: water resources, human settlements, soil protection, tourism, aquaculture, and renewable sources of energy.

1.2. Priority field: Water resources

In the course of PAP development, the priority action relative to water resources management was steered to the water supply problems of smaller Mediterranean islands. As a result, the 1984-1985 PAP programme on water resources issues envisaged the launching and implementation of the action entitled "Water Resources Development of Islands and Isolated Coastal Areas".

At the end of this period PAP in collaboration with WHO/EURO and Gobierno de la comunidad autonoma de las islas Baleares, cosejeria de obras publicas y ordenacion del territorio, organized the seminar on water and sanitation on small Mediterranean islands and isolated coastal areas, which discussed development of the programme. In the period 1986-1987 this action was expanded to water resources development of large

Mediterranean islands and coastal zones. The results of this period were presented and discussed on the seminar "Water and Sanitation Problems in Big Mediterranean Islands and Isolated Coastal Areas with Fluctuating Population due to Tourism", Malta 1987. After this period the major activities of this action were related to wastewater reuse for agriculture and other purposes. One of the activities was also the preparation of the Malta Water Resources Project.

The experience gained through this period can be summarized like this:

Water resources

Typical elements of islands and isolated coastal areas water resources are perched aquifers, aquifers in contact with sea water, islands mean sea aquifers and karstic aquifers. Rivers are very rare, although the rivers with temporary flow during wet season are common. Lakes are also very rare, but reservoirs are numerous with a wide range of size.

On the majority of islands, the available quantities of water resources have almost completely been exploited; hence, the shortage of water is the main problem and a limiting factor in the development of the islands.

Water utilization

Water is mostly used for domestic purposes, followed by agriculture, with only a small part for industry on the small islands and significant quantities on the large islands. There is a continuously increasing trend in water use for all purposes: population, tourists, industry and agriculture. Today ca. 16,000,000 ha of agricultural land in the Mediterranean region are irrigated and the prediction for 2025 is ca. 40,000,000 ha. The shortage of sufficient water quantities is characteristic for all islands and isolated coastal areas on the temporary basis, while the lack of water for agriculture is permanent during the dry period. However, much worse situations can be expected in the future.

Water resources management

Intensive exploitation and management of water resources has resulted in a great number of structures which should be connected into a unique management system to optimally exploit the available quantities and infrastructure in order to satisfy the increasing

demands. The essential condition for the optimal management of water resources, in addition to good organization, is the availability of necessary basic data, which is still missing on most islands. Thus special attention should be paid to gathering and processing of necessary data.

Non-conventional sources of fresh water (desalination, waste water reuse, tankers, under sea pipelines) are already being used, and in the future, will represent the only additional sources of water supply along with the measures for water conservation. Some islands, like Malta, already use these sources of water significantly, and on some small islands the water supply during the summer depends only on these sources.

Special problem in water exploitation is the unfavorable distribution of precipitation with respect to demand which is much greater during the dry period (summer) due to tourism and climatic conditions. Another big problem is a high fluctuation of demand due to tourism activities which results in water consumption in summer 2 to 30 times bigger than in winter. Smaller settlements in general have bigger fluctuation. This situation makes it difficult to provide sufficient quantities of water especially on small islands, and generally requires the construction of reservoirs for water storage, as well as a more complex organization of management which is still non-existent on most islands. Hence the water resources management in the Mediterranean islands and isolated coastal areas is a very difficult task.

Protection of the water resources

The protection of water resources from pollution is not satisfactory, primary due to insufficient and nonadequate sewer systems and treatment plants. This problem, together with the problem of over-use of aquifers and the problem of sea intrusion, represent the greatest constant dangers and threats to these islands water resources. There is also lack of analysis related to the impact of nonconventionl water sources use on the local water resources. Generally, the major sources of pollution are agriculture and urban wastewater. Frequently local water resources are not used due to their pollution.

Other uses and water-related problems

Protection from floods is not a significant problem although some problems related to this field can be considerable on some large islands. Special problem is the temporary flooding of urban areas caused by the absence of a system for storm water collection and disposal.

The situation presented here is very similar to the situation in the entire coastal area of the Mediterranean. This particularly applies to the southern and eastern part of the Mediterranean.

2. DroughtWater Management

As we said, the shortage of sufficient water quantities is characteristic for all islands and coastal areas on the temporary basis, while the lack of water for agriculture is permanent during the dry period. However, much worse situations can be expected in the future.

Past experience shows that the shortage of the water in the region is mainly the result of:

a) High demand as the result of:

- increasing human population,
- technological advancement,
- increasing standard of living,
- development, especially tourism development,

b) Insufficient capacity of water resources

c) Changing environment

- pollution,
- devastation,
- changing hydrological conditions.

Thus, way this is a complex natural and socio-economic problem which we cannot view as a traditional disaster or natural hazard. Consequently drought management is a difficult task which includes issues of comprehensive water management, ecosystemic interdependencies, and risk-based management approaches.

The shortage of water (drought) is expressed by several different types of drought. The kind of drought which we can have in the region are:

- **Meteorological drought** (period without enough rain) described by location, beginning time , precipitation levels and time variations.

In the Mediterranean region the meteorological drought is a seasonable phenomenon, but it has historically consistent conditions. Such a situation most frequently results also in other types of drought.

- **Hydrologic drought** means the shortage in the streamflow, reservoir storage or aqufirs.

The hydrological situation in the Mediterranean area has been comprehensively and in detail analyzed in the Project Blue Plan (J. Margat). This project analyzes also the possible states in the future in accordance with several development scenarios. Some Results of this project are presented in Figures 1,2, and 3.

- **Agricultural drought** depends on soil moisture level determined by precipitation and plant use.

As we have already mentioned this shortage of water on the islands and in the coastal area is constantly expressed, particularly in the summer period.

- **Socio-economic drought**, resulting in shortages, often results from poor preparation and excessive demand rather than lack of rain.

Inadequate planning, lack of financial means, insufficient personnel and improper organization result in an inadequate state of water supply, particularly in the summer period.

Many water managers are dealing with this problem trying to find solutions for on-going droughts and approaches to drought on long-term basis.

Water managers must overcome the complexity and conflict in order to have a chance to successfully apply management methods. Preparation for water management requires planning, design and implementation of water control system, including operations and maintenance, regulatory oversight and coordination. The management of water shortages integrates all facets of water resources management, including water supply, water quality management, irrigation and farm drainage, energy generation, fisheries enhancement, recreation and general aesthetics, as well as flood control.

In such a complex task, there is confusion about who should do what in order to be ready to handle the problem. It is especially true for islands and isolated areas, located generally far from governmental centers.

Responsibilities of water management organizations are direct as:

- Water supply
- Wastewater management
- Environmental water quality
- Irrigation supply
- Energy

and indirect as:

- Water use and discharge regulation
- Information activities

- Policy development
- Financial assistance
- Emergency response.

The general situation is such that water management is a direct and indirect responsibility of more than one organization which makes the problem more complicated.

What should be done to improve the situation and be ready to overcome future shortages of water? It is very difficult to speak generally, but some improvement can be done using past experience and accumulated knowledge through past PAP activities.

According to our experience the topics to be taken into account in order to alleviate the problem of water shortage during a short term and long term periods are, as follows:

We need to improve information activities because they are very important, but generally the most neglected ones. They include:

- Data collection and management
- Analysis and planning
- Coordination
- Research
- Technical assistance
- Training
- Public information/education.

Data management is a critical information activity in the situation of shortage of water. To be sucessfull, data management must be integrated with regulation, water supply assurance, water allocation, planning for development, and comprehensive water management.

In order to overcome the problems of water shortages, the management of water resources should be a continuous process and not a project which starts when we have a drought and finishes when water supplies are back to normal.

The education of the public and officials needs constant attention. To be able to do it we need to improve our knowledge of the problem and local situation and especially interrelationships of natural and man made phenomena.

The administrative structure and communication between water managers in different organizations ,must be very efficient vertically and horizontally, to be able to improve integration of regional water management.

Also, we must improve the general planning and contingency planning and introduce new and adequate techniques for risk assessment and decision making.

However the most important task is to respect nature by using strategies that increase resilience and sustain our resources base. Such strategies include improved agricultural practices , wise water management, strong conservation measures, and institutional changes.

We should try to achieve all this within the existing administrative and governmental system. It means that effective planning and management require imaginative problem-solving and implementable decision-making.

Technical measures which can be used to improve water supply in the future can be summarized in three groups:

- improvement of the use of existing resources,
- water import, and
- use of non-conventional sources.

The improvement of the existing water resources can be generally achieved through: efficiency uses, construction surface retentions, conjunctive use of surface and ground water, conservation and protection of water resources, rain harvesting, and others.

Water import can be realized by import of bottle water, by development of regional water supply systems (inland and off shore systems) and by tankers.

Typical non-conventional water sources are: desalination of sea water, waste water reuse, rain harvesting, widely used in the Mediterranean region.

All of these possibilities have already been implemented in the Mediterranean region so that there is some experience which can be beneficial to those who plan to carry out similar activities.

3. Integrated approach and actions implemented by PAP/MAP-UNEP

All the previously mentioned facts should be taken into account in solving the problem of water resources management, in an organized manner which integrates, on one hand, the developemtn and its water demand, and on the other hand, the natural characteristics and the capacity of the area, including the water resources.

The problem can be solved in the long term period only if it is considered and solved by an integrated approach. This is particularly true for the Mediterranean islands and the coastal zones, where the environment is specially vulnerable, and it presents a natural basis for the development.

Understanding that the protection and enhancement of coastal areas and their ecosystem can be achieved only through a rational development which uses integrated planning as its major tool, PAP placed a special emphasis on its priority action "Integrated Planning and Management of the Mediterranean Coastal Areas".

In order to verify in practice the knowledge and experience gained in all priority actions, and based on the principle of integrated planning and management of resources, PAP started in 1988 the implementation of 4 country pilot projects as a new form of advanced collaboration of PAP and other MAP programmes with national and local institutions and experts aimed at creating conditions for introducing or developing the process of integrated planning and management of coastal resources.

The objective is to achieve an optimal Management Policy which ensures the social goals : equity, efficiency and environmental quality starting from: physical environment, economic criteria , and social and legal decision-making processes.

In the text we will present primary characteristic of two Projects which are in an advance stage.

3.1. Country pilot Project - Malta

Background

At the seminars (Palma de Mallorca, October 1986, and Malta Malta, December 1986) it was recommended that, in the course of the future activities within the priority actions, several pilot projects should be organized in order to analyze the methodology and gather the necessary knowledge and experience of interest for the Mediterranean area and wider areas.

Starting from these recommendations the Government of Malta suggests that the island of Malta should be considered a pilot area.

Consequently a project was suggested; within this project methodologies for an integrated water management system should be developed, both for the watershed and water supply system.

The proposal of the Project was submitted for international competition, and preliminary proposals for the study were received from four firms. After the review of the preliminary proposals the firm Bureau de Recherches Geologiques et Minieres was selected as the most appropriate one.

The agreement for a Study of the Fresh Water Resources of Malta was signed at the Secretariat for Water and Energy in Valetta on June 17, 1989.

UNEP-PAP would be using the Study of the Fresh Water Resources of Malta as a pilot for similar studies on aquifers in other countries. Malta would in the future become the center for seminars on groundwater organized by UNEP-PAP/RAC.

General Project objective

The general Project objectives can be summarized like this:

- To safeguard human health by the protection of the natural resources of the Malta Island.

- To protect the quality of the environment, particularly the fresh water resources, by introducing the necessary administration and infrastructure to ensure the continuing operational control of fresh water utilization.

- To promote the introduction of system engineering practice made suitable for the optimal control of fresh water utilization.

- To develop mathematical models which will permit effective management of aquifers, particularly with regard to: minimization of salt water intrusion; maximization of nett recharge of the aquifer; identification of a well field configuration which will maximize groundwater extraction for the supply; development of a management strategy for the protection of water quality from the surface sources of pollution.

- To provide expertise capable of monitoring previously mentioned items.

- To secure protection of water supply sources against pollution by unidentified factors to be taken into account in the national land-use policy.

- To propose a suitable organization, and advise appropriate legislative and other measures to meet the objectives of the project.

Results and follow up

The Project is in the final phase and the achieved results satisfy the proposed objectives.

One of the results of this Project is a completely new legislation with a new organization of water management resulting from the knowledge that the fresh water on the Island is a finite and vulnerable environment, and that water has an economic value in all its competing uses.

The second result of the Project is the Water Conservation Project for the Island Malta. Namely, in the case of Malta the Water Conservation is the only long term measure which can ensure sustain life, development and protection of environment on the Island.

3.2. Rhodos project

Background

Within the activities carried out for the realization of the MAP Coastal Area Management Programme is the Rhodos Project.

The priority activity is the development of the Water Resources Master Plan for the island of Rhodos. This plan should present an integrated presentation of all the water resources characteristics and would be used to define the optimal exploitation and protection of the resources in accordance with the present and subsequent long-lasting demands on the island. Thus, it would be possible to carry out a sound and efficient management of the both water resources and other natural resources on the island.

Objectives

The long term objective of this study is the protection of the water resources of the island and their optimal utilization.

The immediate objective is development of the Water Resources Master Plan and solution of the current problems in protection end exploitation of fresh water resources.

The expected benefits are a harmonized development and protection of the natural resources of the island of Rhodos.

Results

The project is in the preparatory phase and it is expected that it will be completed by the end of 1993.

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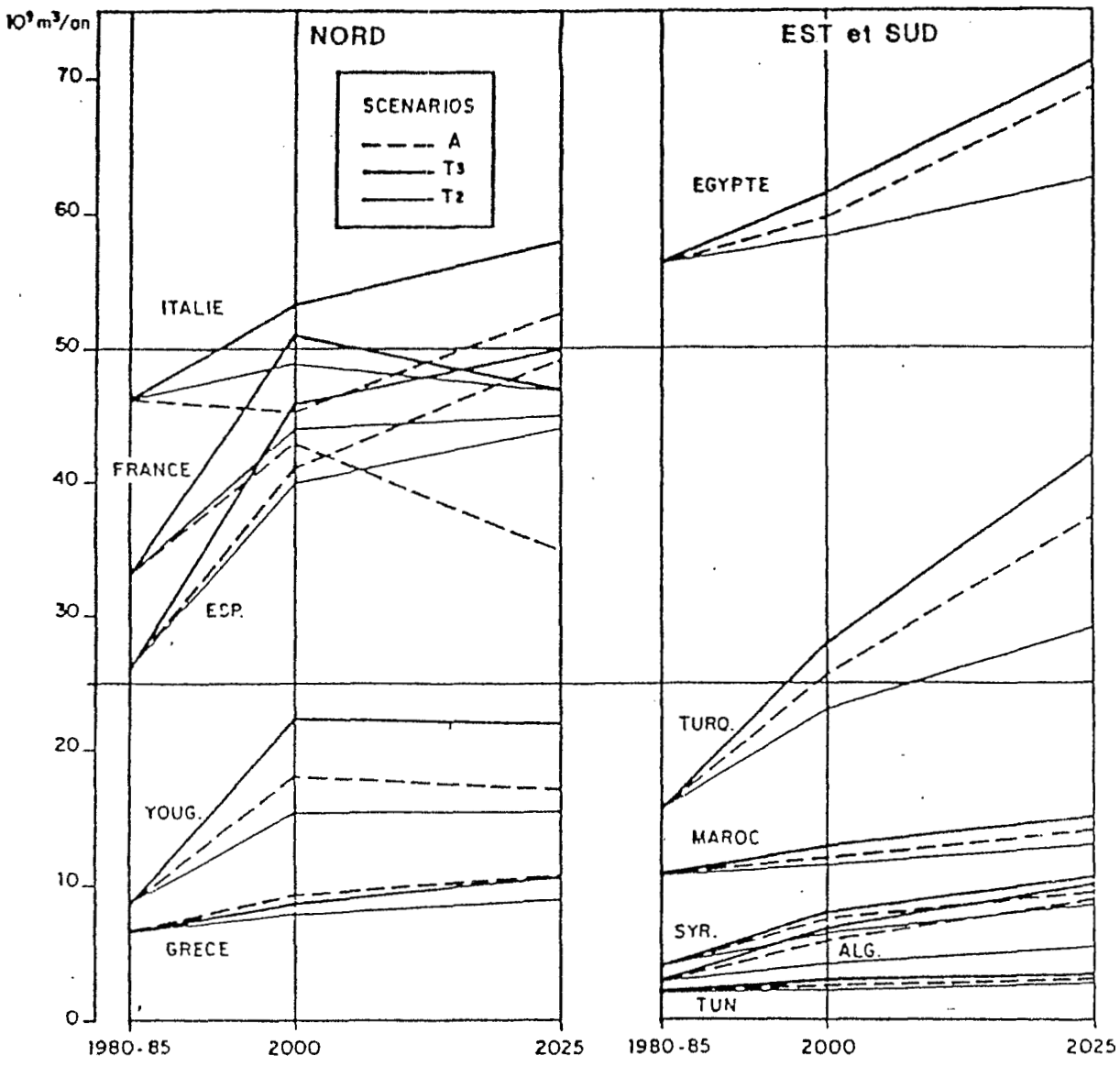

Figure 1. Prospective changes in total water withdrawals generated by needs calculated for the major user countries in 2000 and 2025, for each scenario.

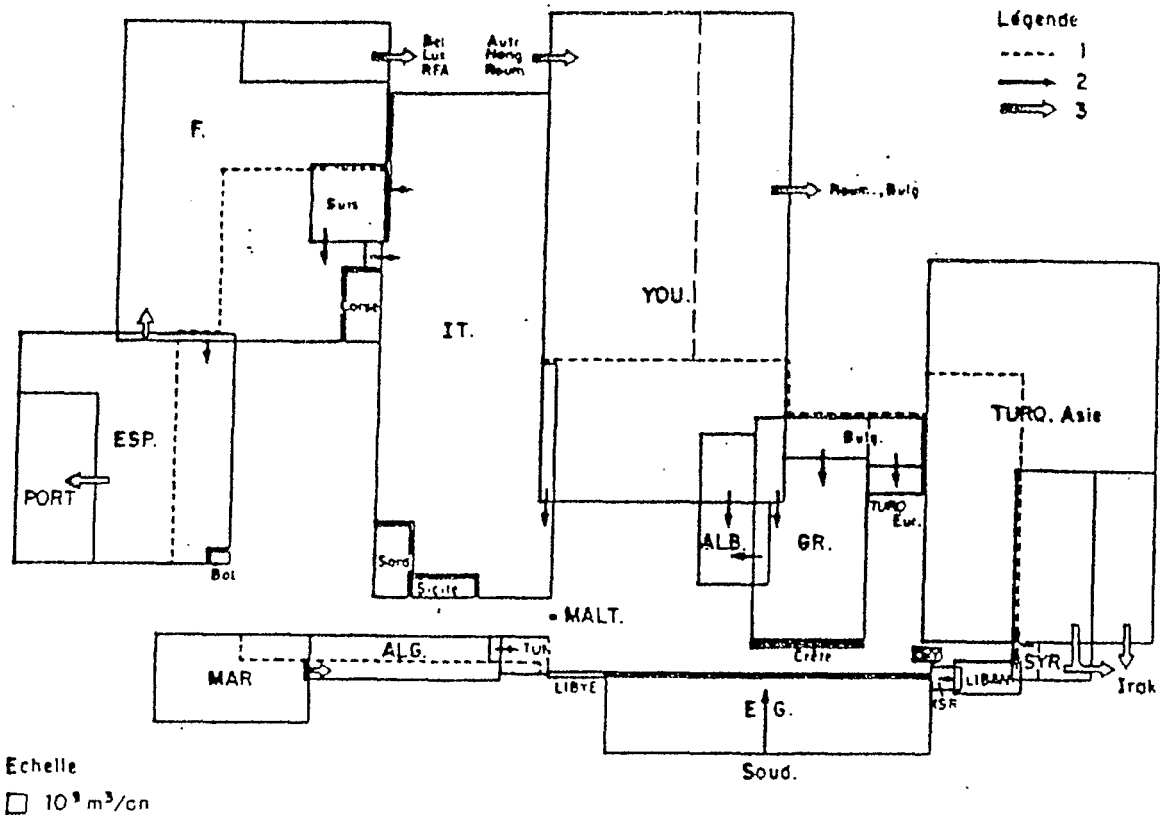

Figure 2 . Comparative "natural water resources in the countries along the Mediterranean (global mean annual volumes of water flow). Cartographic anamorphosis. The intersections correspond to common resources;
1. Boundary of the Mediterranean Basin
2. Natural internal transfers in the Mediterranean Basin
3. Natural transfers to or from outsde the Basin

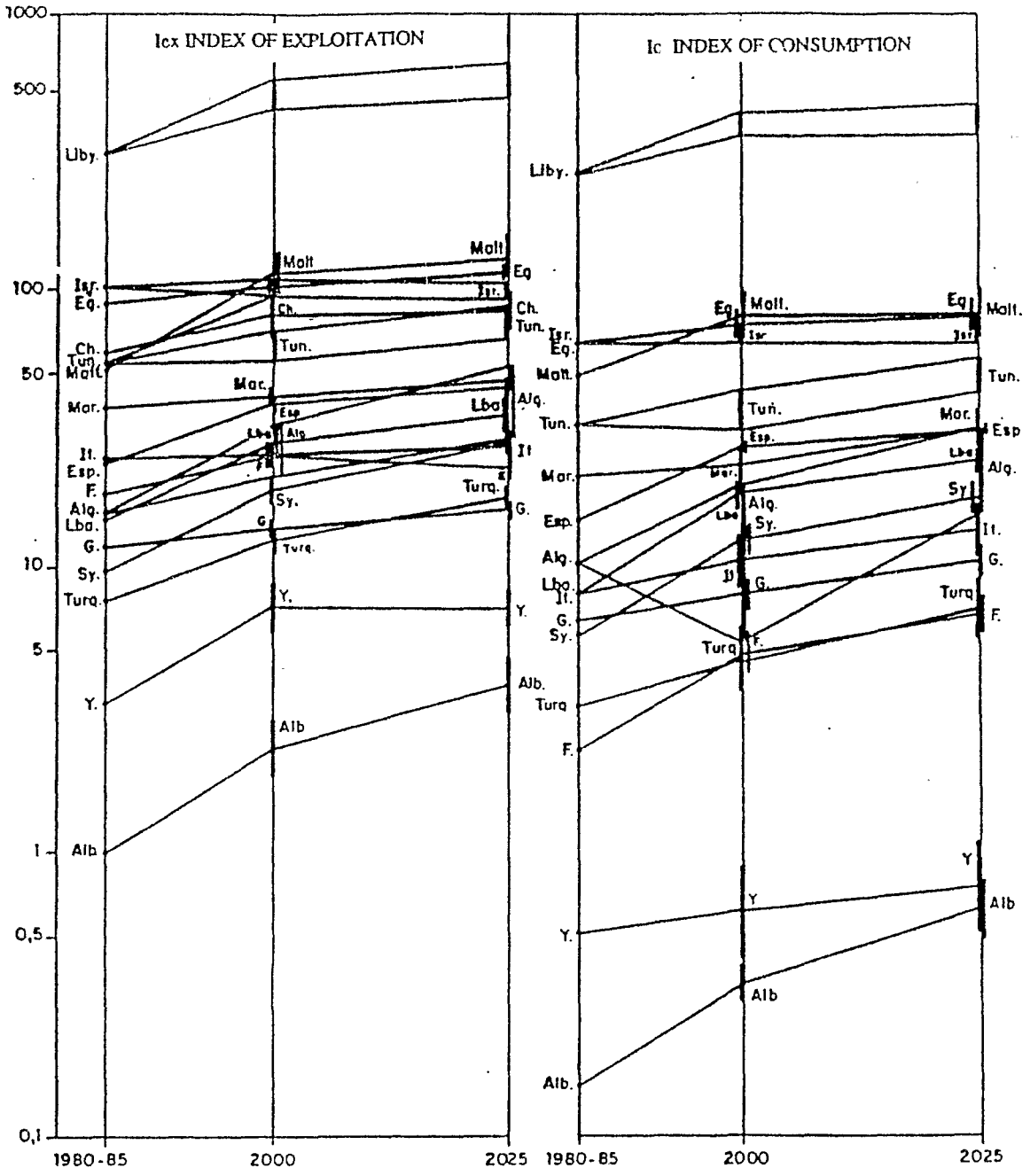

Figure 3. Prospects for indices of exploitation and irretrievable consumption of renewable natural resources in the Mediterranean countries in 2000 and 2025 (averages for each scenarios).