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Meeting of Experts on Fresh  
Water Resources Management  
in the Mediterranean Region

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Convened by UNEP and organized  
in co-operation with CEFIGRE

ELEMENTS OF A REGIONAL CO-OPERATION PROGRAMME  
FOR FRESH WATER RESOURCES MANAGEMENT  
IN THE MEDITERRANEAN REGION

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## SECTION I. INTRODUCTION

1. At the Intergovernmental Meeting of Mediterranean Coastal States held at Split, Yugoslavia, in February 1977, the Governments represented (numbering 16) adopted the draft "Blue Plan" and expressed the wish that a priority actions programme should be launched as soon as possible, the fresh-water resources of the Mediterranean basin being voted a first priority.
2. Accordingly, under the first phase of the Blue Plan, terms of reference entitled "Survey on fresh water in the Mediterranean basin" were drawn up with a view to exploring the present situation and identifying trends determined by the various components of development. These terms of reference were submitted to the Intergovernmental Review Meeting of Mediterranean Coastal States on the Mediterranean Action Plan (MAP) held at Monaco in January 1978.
3. At that meeting, the Governments represented asked that a programme of action relating in particular to fresh water should be formulated at the same time. UNDP, for its part, expressed interest in this request and indicated its preparedness to give favourable consideration, and contribute, to a regional co-operation programme for fresh water. Such a programme should receive support from certain countries in accordance with their technical and financial capabilities. A co-operation programme of this kind is the subject matter of the present document.

## SECTION II. OBJECTIVES

### 1. Long-term objective

In the spirit of the Mediterranean Action Plan, to promote in water matters the solidarity and co-operation which are indispensable for the balanced development of the basin and the preservation of the natural environment.

### 2. Immediate objectives

- (i) In the preliminary stage, to identify and formulate joint and co-operative activities calling for priority action, either bilateral, inter-State (multilateral) or regional at the level of the entire basin;
- (ii) In the main stage of the programme, to implement these priority activities and bring them to completion.

## SECTION III. DESCRIPTION OF THE PROGRAMME

### Geographical coverage

1. For the purposes of MAP, the Mediterranean basin comprises the Mediterranean Sea (excluding the Sea of Marmara and the Black Sea) and its islands and littoral. The countries involved in MAP are the 18 coastal States. 1/

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1/ In geographical order, starting from the south-west: Morocco, Algeria, Tunisia, Malta, Libya, Cyprus, Egypt, Israel, Lebanon, Syria, Turkey, Greece, Albania, Yugoslavia, Italy, Monaco, France, Spain.

2. The basin so defined (see the attached map) represents an area of 4.3 million km<sup>2</sup>. 2.5 million km<sup>2</sup> of which are marine. Depending on the requirements of the programme, the continental area will embrace as many as three overlapping zones:

- A maximum zone, bounded by the natural limit of the catchment areas;
- An intermediate zone, with a conventional boundary determined by States in accordance with a typically Mediterranean natural environment;
- A restricted zone - usually the coastal zone - containing the areas in which constraints are concentrated.

#### Basic data

3. The Mediterranean basin comprises the sea and its littoral. The Mediterranean Sea, excluding the Sea of Marmara and the Black Sea, covers an area of 3.5 million km<sup>2</sup>; its volume is 3.7 million km<sup>3</sup>, <sup>2/</sup> with a renewal period of 80 years, its average depth is 1,500 metres, with maxima at 5,000 metres, and it extends for 3,800 km from east to west. It possesses three major shelves, at the Strait of Gibraltar (365 m deep), the Sicilian Channel (350 m deep) and the Dardanelles (100 m deep) respectively. The first (15 km wide) separates it from the Atlantic Ocean and makes it a virtually closed continental sea; the second divides it into a western and an eastern basin; and the third separates it from the Sea of Marmara and the Black Sea. The mean salinity is 38,000 ppm (by comparison with 35,000 ppm for the Atlantic Ocean and even less for the Black Sea). The Mediterranean contributes to the formulation of continental fresh water by evaporation (an estimated average of 1,440 mm/yr), particularly on the littoral. Conversely, it receives an estimated 470 mm/yr of fresh water by direct precipitation and from watercourses. Evaporation and precipitation at sea are poorly understood, however. Information is also lacking about the contribution of coastal and submarine ground water, which is certainly not insignificant, and of deep-sea hydro-thermal inflows. Nevertheless despite these uncertainties and lacunae, the Mediterranean Sea is currently regarded as a debtor item in the balance of the fresh-water cycle, <sup>3/</sup> with losses of 5,000 km<sup>3</sup>/yr as against gains of 1,700 km<sup>3</sup>/yr. This concept requires serious reappraisal and a different presentation if the existing imbalances are to be properly identified and their future evolution studied.

4. The northern littoral of the Mediterranean and the islands are fairly well watered by precipitation (400-1,000 mm/yr) and by the hydrographical network, many of whose rivers are perennial and show considerable seasonal variation. Roughly speaking, every inhabitant of this area had potential water resources of 2,000 m<sup>3</sup>/yr available to him in 1975, whereas he used only 400 m<sup>3</sup>/yr under optimum management conditions. The southern littoral of the Mediterranean on the

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<sup>2/</sup> km<sup>3</sup>: one billion cubic metres.

<sup>3/</sup> The deficit is largely offset by water from the Atlantic Ocean which enters through the Strait of Gibraltar.

other hand is mainly arid, with a precipitation of less than 100 mm/yr, except in North Africa (300-600 mm/yr); it has a very poor hydrographic network apart from the Nile Delta and a few North African rivers. Outside these relatively privileged areas, potential water resources rarely exceed 100 m<sup>3</sup>/yr per inhabitant. As regards the littoral as a whole, the hydrometeorological data can be described as average to very good, but the hydrological data in general do not afford scope for valid historical comparisons, except in the case of the major basins.

5. The Mediterranean littoral consists almost entirely of sedimentary rocks, most of which constitute ground-water reservoirs. These reservoirs can play several roles: seasonal regulation of surface water; year-to-year regulation in years of heavy rainfall; water supply and provision of large-scale natural distribution networks; drought reserve; reduction, dilution or transmission of pollution; storage of surplus water by artificial replenishment; and hidden communication with the sea by means of coastal and submarine springs or, conversely, by marine inversion. The reservoirs in question deserve close attention for all the above reasons. Considerable hydrogeological information was to hand on most of them in 1975 and, generally speaking, the available data are of good quality. Special mention should be made of the ground water found in karstic terrain, since calcareous rocks occupy a substantial proportion of the Mediterranean littoral where there is intense circulation. These reservoirs have their outlet in unregulated fresh-water springs of the vauclosian kind, both coastal and submarine; the water is often brackish, especially when discharge is low. Technology for the abstraction, use and management of water from these reservoirs is still backward and, as far as submarine springs are concerned, non-existent. Yet losses are estimated at more than 3 km<sup>3</sup>/yr.

6. During the last 30 years, considerable work has been done on water resource inventories throughout the littoral, with particular emphasis on ground water, whereas resources management and development has concentrated mainly on surface water. In the past decade, water development action has been extended to ground water, largely through the initiative of the private sector. In all coastal States, continental water is "lost to the sea" as soon as it reaches the coast; a loss from their point of view, but a gain for the sea. Basically, therefore, the strategy of States is gradually to reduce these losses, mainly by building surface reservoirs but also by utilizing the water supply and storage role of underground reservoirs. With steadily rising consumption, this ultimately reduces the amount of fresh water reaching the sea; since evaporation remains constant, there is a growing and increasingly noticeable imbalance in the water cycle, which is constantly shrinking.

7. Water shortage is an endemic phenomenon of the Mediterranean littoral. It is seasonal (July to September), for climatic reasons, and can assume dramatic dimensions in certain "dry" years, one or two of which occur every decade. In some countries, because of the deficit in the balance between requirements and resources, drought has become a permanent phenomenon; in others, the crisis is close. Yet water cannot be transported like wheat from countries that are rich in water to those that lack it. Droughts first appear locally, in coastal basins which receive a seasonal population influx in a low-water period. In these cases, the demands of national solidarity have already made themselves felt in some countries in the form of interbasin transfers or use of the costly technique of sea-water desalination. However, in view of the rapid expansion of water needs and the relative poverty of certain coastal States, co-operation is necessary at the level of the entire Mediterranean basin. Inter-State transfers, even of water, should no longer be a utopian concept, but in order to plead the cause of Mediterranean solidarity a well-founded brief is needed in the form of a national water plan.

8. Such a plan necessitates above all a forecasting analysis of water supply problems at the national level. An analysis of this kind must answer the questions of both planners and decision-makers. These are as follows: if demographic, economic, environmental protection and technological trends take this or that direction, what problems will arise, and when and why? In these circumstances, what are the various co-ordinated measures and activities that could overcome the difficulties? In other words, the results of the forecasting analysis or "water strategy" serve to facilitate the choice of a plan for water resources management and water quality protection. To judge from the evidence, very few Mediterranean coastal States have embarked on this course.

#### Criteria employed in formulating the programme

9. For the purposes of this discussion paper, the following criteria have been taken into account:

- Mediterranean experience acquired by UNDP in its operations since 1958;
- Wishes and recommendations of States as put to the United Nations Water Conference at Mar del Plata (March 1977);
- The author's knowledge of the Mediterranean basin.

10. The major demands and concerns of the coastal States have obviously not been taken into consideration yet, at this preliminary stage in the formulation process, but that essential need will nevertheless be met by:

- (i) The Meeting of Experts from coastal States scheduled for 25-29 April 1978;
- (ii) Visits to national water officials.

#### The need for a Mediterranean water policy

11. Despite the striking disparities in water resources among the coastal States, water-related development has progressed normally throughout the basin in recent decades and water has not been a constraint, either quantitatively or qualitatively. Development action has obviously been keener in countries with chronic shortages.

12. Surface water management has been the predominant feature hitherto, following closely on the collection of satisfactory hydrological data. There are now few coastal States without an acceptable observation network for main surface drainage. Surface water development has benefited everywhere from widespread action in the public sector, to the point that action to develop ground water, although the latter is abundant in the Mediterranean basin, has been neglected.

13. It must be said in defence of States that, until the 1960s, information on ground water was virtually non-existent throughout the basin. International action, above all in UNDP, has substantially altered the state of knowledge. Today, with few exceptions, coastal States possess fairly accurate information about their potential fresh-water resources, which is a sine qua non for long-term water policy and satisfactory water management.

14. However, the water knowledge now available points to crucial eventualities which for several coastal States will represent a slowing-down, and then a complete halt, in development in the next 20 years unless water policy is reconsidered. In the present climate of opinion, the policy is one of expansion at all costs, especially through increases in the area under irrigation. Moreover, priority continues to be given to urban domestic supplies and industrial uses in which the proportion of water wasted increases step-by-step with excessive demand, while waste water is almost totally neglected.

15. A change of policy is clearly needed in order to stave off the crucial situation predicted above. The idea of extending irrigated areas must give way to a policy of using the areas at present under irrigation more intensively and of selecting crops that require the least amount of water. Water saving based on new technology must replace the continuous development of new resources. Henceforth, the water policy of the Mediterranean basin should lay stress on water management rather than water development.

16. Most coastal States will have to give greater attention to teaching, and particularly to the training of high-level specialists and even research, which should focus primarily on chronic and cyclic shortages. More effective use must be made of the specialized institutions existing in the Mediterranean, since they are best equipped to deal with local conditions. In the same context, professional staff must be trained as far as possible in and by the countries concerned, either with or without guidance from the leading specialists of the Mediterranean basin.

17. Water co-operation in the Mediterranean basin should grow through the facilitation and provision of free access to advanced technology and through exchange of experience, even where such experience results from mistakes and technical errors. In particular, the efficiency achieved in irrigated plant farming is of fundamental importance. A policy of co-operation calls for the adoption throughout the basin of joint methods of collecting, storing and retrieving data and information on surface and ground water, both qualitative and quantitative, and on its present and proposed uses. With this in mind, some countries have recommended the creation of a special fund to finance a world information bank, which would be the starting-point for a programme of technical assistance. Why not begin at the more rational level of the Mediterranean basin?

Outline for a priority actions programme

18. Principles

A number of activities deserve preferential treatment but no order of priority can be established. They will nevertheless be listed according to an order of preference which is fairly subjective and open to modification. Some of these activities concern the entire basin and will be described as "regional"; others concern a number of coastal States and will be called "multilateral"; finally, some are limited to two States and will be described as "bilateral". In addition, some activities conducted at the national level may be of great interest regionally. The programme will therefore be presented in that order and in accordance with these criteria. Each activity will be prefixed by the indication "MED/WATER" (Mediterranean Fresh Water) followed by a serial number.

(i) Proposals for regional projects

19. MED/WATER 1. Training of professional staff: management, development, data collection

Professional staff of various grades might be trained by the competent water management bodies, whose international or Mediterranean function is a guarantee of the best training. Also, as indicated in paragraph 16, professional staff should be trained in and by the countries concerned whenever possible.

20. MED/WATER 2. Data bank on Mediterranean fresh water

The information acquired and collected on fresh water in the Mediterranean is among the richest in the world, but its exchange has remained haphazard. A proper data bank should be established for use by all coastal States. Such a system by itself could generate a programme of mutual assistance, but the process requires care. It should therefore comprise:

(a) A preliminary stage:

- (i) Critical analysis of final reports on UNDP projects executed in the past 20 years, in order to identify and extract information with a view to its practical application;
- (ii) Study of possible information systems and choice of a suitable system.

(b) The main stage:

Introduction of the system selected, which might be one of the following: a data bank consisting of a data-processing centre and consoles, a Mediterranean information service, an information centre, etc.

21. MED/WATER 3. Methods and techniques for efficient water use

This involves not only compiling and making available proved methods and techniques but also research or development in advanced technology, as well as regional and national manufacture. The project is a sophisticated one calling for a preparatory stage and pilot experiments before it is set up permanently.

- (a) Preparatory stage
- (b) Pilot experiments: approximately three in different countries and with different systems 4/
- (c) Permanent installation: after (a) and (b) and within the national framework.

22. MED/WATER 4. Transfer of technology and of methodology

This is a varied project involving an unlimited number of techniques and different coastal States according to the technique in question, and concerning various methods, such as technical inspections, study tours, courses lasting from one to several weeks, comparison and research seminars and surveys of the state of the art.

Such a project would be based on ongoing or completed projects in the Mediterranean basin. Among the most interesting techniques, processes and methods, special attention should be paid to:

- (a) Water demand and disposal demand in major urban centres, as exemplified by the Athens-Piraeus complex, assisted under an ongoing UNDP/WHO project, and by the former UNDP/WHO Istanbul project.
- (b) Formulation of a national or regional water plan (by basin), as exemplified by Egypt, assisted under an ongoing UNDP/WHO project, and the Rhone basin (France).
- (c) Artificial replenishment of underground reservoirs, as exemplified by the former UNDP projects in Tunisia and Israel, the publicly executed and financed projects for Tangiers (Morocco) and the Durance project in Lower Provence (France).
- (d) Coastal collectors for ground water lost to the sea, e.g. the former UNDP project in Israel.
- (e) Irrigation with brackish water (for example, the former UNDP/UNESCO project in Tunisia and the Negev in Israel) and with waste water (e.g. Libya and Israel).
- (f) Salt-water and brackish-water desalination on a large or small scale in various Mediterranean coastal States and islands.
- (g) Transfer of manufacture of low-capacity pumps and other small-scale hydraulic equipment and appliances in various coastal States; the question of patents. This topic should give rise to a fairly large-scale project.

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4/ Drip irrigation; sprinklers for hilly and steeply sloping terrain irrigation regulators; devices and appliances to reduce domestic water consumption; manufacture of water-saving equipment and appliances, etc.



3. MED/WATER 5. Priority feasibility studies

Events and circumstances in recent decades have shown that crises due to water shortage are imminent in the Mediterranean basin. The means of overcoming them are economic rather than technical. The feasibility of these means should therefore be examined without delay. Initially, the activity would be confined to a critical analysis of the components of the problem and a preliminary estimate of financial resources. Depending on the results, certain feasibility studies might lead to priority activities and projects. The most important of these feasibility studies would concern:

(a) A socio-economic survey of water cost and value for the different socio-cultural environments of the basin, taking into account the future of agricultural water use (the case of the Balearic Islands, for example);

(b) Management of chronic and cyclic shortages;

(c) Hydrological forecasting of cyclic shortages;

(d) Tapping of submarine fresh-water sources;

(e) Inter-State transport of water and, possibly, transfers.

In the preliminary stage, each of these feasibility studies would be confined to consultation.

24. MED/WATER 6. Remote sensing

Observation by satellite and other means (aerial and infra-red photography) concerns not only fresh water but also other elements of the environment and various components of development. This would therefore be a project of the greatest importance for the Mediterranean and the interpretation of its water aspects would represent a partial step forward.

(ii) Proposals for multilateral projects

25. MED/WATER 7. Island water supplies

Such a project might interest Malta, Cyprus, Greece, Yugoslavia, Italy, France and Spain. The question is a difficult one and a matter for concern in each country; often taken up, sometimes from a makeshift point of view, it is not usually solved satisfactorily. On the Mediterranean scale it must be approached carefully. The following procedure, among others, might be adopted:

(a) An exposition of the subject, followed by expert discussion at the Cannes seminar in April 1978;

(b) A country analysis of the situation, with or without assistance from a consultant;

- (c) A comprehensive review of the problem in the Mediterranean basin by one or two specialists;
- (d) Planning of operations or projects, pilot or otherwise, considered to require priority.

26. MED/WATER 8. Urban water disposal and re-use of waste water

Methods of re-using waste water are at present being developed or applied in various coastal States. For example, attempts are being made in agriculture, in connexion with soil irrigation and fertilization, and various experiments are in progress in aquaculture, including the use of thermal discharges from energy production plants. The action needed is collection of information on the state of these activities and establishment of the links essential for co-operation.

27. MED/WATER 9. Tapping of coastal and submarine sources of fresh water

Such a project might interest Libya, Lebanon, Turkey, Greece, Yugoslavia, Malta, Italy and France. It has been foreshadowed in paragraph 23 (d) above in the form of a feasibility study. This topic has been of growing interest for nearly two decades and clearly calls for special treatment, in accordance with the following procedure:

- (a) A feasibility study based on the experience of Greece, Yugoslavia and France, necessitating consultation;
- (b) An analysis of the situation for each country concerned, with or without the assistance of a consultant and proposals for priority national activities;
- (c) Operation (b) above might lead not only to priority national action but also to a regional activity such as the simultaneous investigation of all relevant areas by the same infra-red photographic process.

(iii) Proposals for bilateral projects

28. A preliminary comment is necessary, based on the attitude taken by States at the United Nations Water Conference at Mar del Plata. It was unanimously considered that sharing of water resources common to two countries should be regulated by bilateral negotiation. The proposals that follow are therefore fairly hypothetical, although some aspects of bilateral agreements do seem to require international assistance: water legislation questions, for instance, a field in which specialists of worldwide reputation can make an acknowledged contribution to treaty preparation. This is the aspect which will receive attention provided States so request.

29. MED/WATER 10. Legal assistance in preparing water-sharing treaties

As a guide, and with a view to assistance in treaty preparation, the following cases are suggested for consideration by the States concerned:

- (a) The River Vadar between Yugoslavia and Greece;
- (b) The River Evros/Meriç between Greece and Turkey;

- (c) The River Orontes between Lebanon and Syria;
- (d) The underground reservoirs of the "intercalary and terminal continental" between Algeria and Tunisia;
- (e) The underground reservoir in the Nubian Sandstone between Egypt and Libya.

#### National projects of regional interest

30. As mentioned in paragraph 18, some activities undertaken at the national level may be of great interest regionally. In this connexion, the national water strategy of each coastal State is of major value, especially as regards the portion relating to the Mediterranean basin. Some countries, such as Algeria, Tunisia, Egypt, Israel, France and Spain, have made considerable progress in this direction. Without going as far as drawing up a national water plan, every coastal State which has not done so should prepare an outline for such a plan in the form of a water strategy as soon as possible. This operation would be neither lengthy (a few months) nor very costly for any country.

#### 31. MED/WATER 11. Preparation of national water strategies

These national water strategies, taking into serious consideration the future of the Mediterranean basin, should be formulated in the following countries (in geographical order): Morocco, Lebanon, Syria, Turkey, Greece, Yugoslavia and Italy. As regards the first six countries, a UNDP contribution might be forthcoming from the indicative planning figure for the country concerned.

### SECTION IV. ORGANIZATION OF THE PROGRAMME

#### 1. Duration

This will vary according to the activities considered; many of them will be completed within a year or less. The over-all duration should not exceed three years. However, such a programme will give rise to other activities, in the form either of extensions or follow-up action.

#### Financing

Since the Priority Actions Programme for fresh water is an integral part of the Mediterranean Action Plan (MAP), sponsored and co-ordinated by UNEP, it is suggested that UNEP, in consultation with UNDP and the Governments of the coastal States and with other organizations concerned, should seek means for financing the proposed programme.

#### 3. Procedure

It is recommended that the programme should be executed by using the proved structural links already employed, in regard to co-ordination and operations, for other activities sponsored and co-ordinated by UNEP under the Mediterranean Action Plan. In particular, it is suggested that:

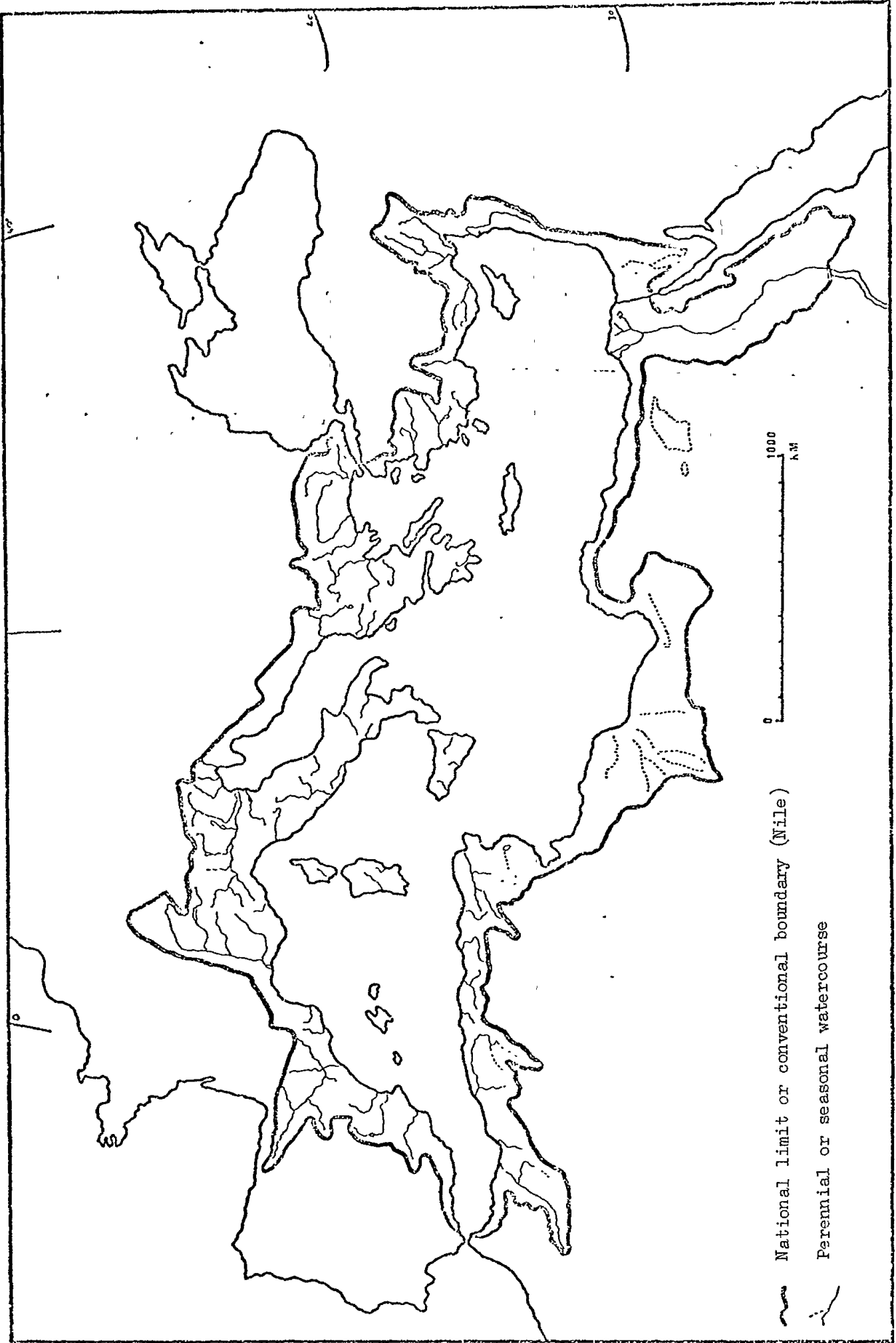
- (a) Technical focal points specializing in water matters should be established in each country;
- (b) A regional co-ordinating organization specializing in water management should be selected.

Technical relations will be established between the technical focal points of States and the regional co-ordinating organization, while other relations will be established directly with UNEP.

4. Liaison and co-ordination centre

Some activities might be carried out by those countries which have the most experience or are most willing to undertake a particular activity. However, the necessary co-ordination (see paragraph 3 above) requires that a liaison base be chosen.

MEDITERRANEAN FRESH WATER CATCHMENT BASIN



— National limit or conventional boundary (Nile)

- - - Perennial or seasonal watercourse

