MEDITERRANEAN ACTION PLAN
PRIORITY ACTIONS PROGRAMME

UNEP

UNITED NATIONS ENVIRONMENT PROGRAMME

PROCEEDINGS OF THE WORKSHOP ON APPLICATION OF INTEGRATED APPROACH TO DEVELOPMENT, MANAGEMENT AND USE OF WATER RESOURCES
(Marseilles, November 24-26, 1994)

ACTES DE L'ATELIER SUR L'APPLICATION D'UNE APPROCHE INTEGREE AU DEVELOPPEMENT, A LA GESTION ET A L'UTILISATION DES RESSOURCES EN EAU
(Marseille, 24-26 novembre 1994)

MAP Technical Reports Series No. 94

In cooperation with:

IME

Institut Méditerranéen de l'Eau

UNEP

Priority Actions Programme Regional Activity Centre
Split, 1995

This volume is the ninety-fourth issue of the Mediterranean Action Plan Technical Report Series.

This series will collect and disseminate selected scientific reports obtained through the implementation of the various MAP components: Pollution Monitoring and Research Programme (MED POL), Blue Plan, Priority Actions Programme, Specially Protected Areas, Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea, Environment Remote Sensing and Protection of Historic Sites.

Ce volume constitue le quatre-vingt quatorzième numéro de la série des Rapports techniques du Plan d'action pour la Méditerranée.

Cette série permettra de rassembler et de diffuser certains des rapports scientifiques établis dans le cadre de la mise en oeuvre des diverses composantes du PAM: Programme de surveillance continue et de recherche en matière de pollution (MED POL), Plan Bleu, Programme d'actions prioritaires, Aires spécialement protégées, Centre régional méditerranéen pour l'intervention d'urgence contre la pollution marine accidentelle, Centre méditerranéen de télédétection et Protection des sites historiques.

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PREFACE

The growing number of inhabitants and tourists in the Mediterranean region, and increased standard of living inevitably bring about an expanding land occupation, higher rates of resources exploitation, and environmental pollution. The strong demographic pressure and higher standard of living require more space for housing and traffic, more working places in industries and services, and more food and water. And the need for space for accommodation, traffic lines and food production is continuously growing, as well as the need for raw materials and energy. As a consequence, there is ever less space, raw materials and water available. Along with that, the increasing air, land and water pollution produces negative effects on human health and eco-systems, and reduces environmental capacities including water, land and other resources.

Water, the source of life and natural well being, is of utmost importance for the human health, food production, and social and economic development. Water is difficult to purify, expensive to transport, and impossible to replace. In most of the Mediterranean basin, and especially in the islands and isolated coastal areas, water is scarce and water supply is a long lasting problem. The Blue Plan analyses and assessment show that the index of exploitation could exceed 20% in 13 countries, and 50% in 6 (Malta, Libya, Israel, Egypt, Cyprus, and Tunisia); the indicated consumption could reach or even exceed 25% in 10 countries, and 50% in 6 by the year 2000.

The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in June 1992, defined, among others, activities to be implemented in the future in order to protect the quality and supply of the fresh water, namely: (a) integrated water resources development and management; (b) water resources assessment; (c) protection of water resources, water quality and aquatic eco-systems; (d) drinking-water supply and sanitation; (e) water and sustainable development; (f) water for sustainable food production and rural development; and (g) impacts of the expected climate change on water resources. The guiding principles behind these activities were drafted in the Chapter 18 of the "Agenda 21", a policy document adopted by a large number of governments. The basic recommendations of UNCED were fully adopted by the Tunis Conference (November 1994) which resulted in the "Agenda MED 21".

In order to realize the above objectives, many countries will need help in the preparation and implementation of the follow-up activities. UNEP/MAP/PAP will certainly provide their contribution; they have already launched some relevant activities.

The organization of the Workshop on Application of the Integrated Approach to development, Management and Use of Water Resources is also part of that contribution.

The purpose of the Workshop is to bring together specialists, administrators or other interested participants to consider and discuss the specific problems of the integrated development, management and use of water resources in the Mediterranean region. The objectives of the Workshop were:

a. to present, through national reports, the present practice and methods of integrated water resources development, management and use (IWRDM);

b. to review, discuss and amend the present practice of IWRDM in the Mediterranean region;

c. present an information on the contents and characteristics of the Agenda 21, Chapter 18 (UNCED document).

The main technical subjects of the Workshop included:

1. legal measures dealing with the issues of integrated planning of water resources exploitation in the country;
2. administrative structure of water resources management and the preparation of integrated water resources management plans;
3. examples of integrated planning of water resources exploitation in the country, if any, and experience gained in the preparation of water resources management plans;
4. problems already encountered, or that could be encountered, in the preparation of integrated water resources management plans (legislation, data, staff, administrative organization, methodology, financing, etc.);
5. proposals for enhancing cooperation within the Mediterranean region, especially through the activities of UNEP-MAP/PAP (training, pilot projects, expert assistance, etc.).

The Workshop, organized jointly by PAP/RAC and the Mediterranean Water Institute (IME) of Marseilles, was attended by 36 participants from 15 Mediterranean countries, as well as the representatives of UNEP, MAP, The World Bank, and 21 participants invited by IME. Fifteen national reports and two introductory papers were presented in the Workshop.

PAP/RAC wishes to thank all the participants for their contribution to the success of the Workshop.

Prof. Jure Margeta
Coordinator of the Priority Action
on Water Resources Management

PREFACE

L'augmentation du nombre d'habitants et de touristes en Méditerranée, associée à un niveau de vie plus élevé, provoque inévitablement une plus grande occupation des sols, des taux plus élevés d'exploitation des ressources et une pollution préoccupante de l'environnement. La forte poussée démographique et le haut niveau de vie exigent toujours plus d'espace pour les constructions nouvelles et les transports, plus d'emplois en industries et services, et plus de nourriture et d'eau. Et des demandes toujours croissantes de logement, de circulation des véhicules et de production des aliments, y compris les besoins accrus en matières premières et énergie. Cela entraîne une réduction permanente de l'espace vital, des matières premières et des eaux disponibles. En même temps, une pollution accrue de l'air, des sols et des eaux provoque des effets néfastes sur la santé humaine et les écosysthèmes, tout en réduisant les capacités environnementales, y compris les eaux, les sols et autres ressources.

L'eau -source de vie et bien naturel, social et économique- est d'une importance primordiale pour la santé des hommes, la production de la nourriture et le développement économique. Elle est difficile à épurer, coûteuse à transporter, et impossible à remplacer. Dans la plus grande partie du bassin méditerranéen, et tout particulièrement dans les îles et les zones côtières isolées, les problèmes liés à l'alimentation en eau sont de longue date et sont causés par la rareté traditionnelle des ressources. Les analyses et les évaluations du Plan Bleu montrent que les "indices d'exploitation" des ressources pourraient dépasser 20% dans 13 pays, et 50% dans 6 autres pays méditerranéens (Malte, Lybie, Israël, Egypte, Chypre et Tunisie). Jusqu'à l'an 2000, la consommation indiquée pourrait atteindre, voire même dépasser, 25% dans 10, et 50% dans 6 pays méditerranéens.

La Conférence des Nations Unies sur l'Environnement et le Développement (CNUED), qui s'est tenue à Rio de Janeiro en juin 1992, a défini *inter alia* les activités à mettre en oeuvre dans le but de protéger la qualité de l'eau douce et d'en assurer l'alimentation, à savoir: (a) le développement et la gestion intégrée des ressources en eau; (b) l'évaluation des ressources en eau; (c) la protection des ressources en eau, de la qualité des eaux et des systèmes aquatiques; (d) l'approvisionnement en eau potable et l'assainissement; (e) l'eau et le développement durable; (f) l'eau destinée à la production de la nourriture et au développement rural; et (g) l'impact des changements climatiques sur les ressources en eau. Les principes directeurs de ces activités sont esquissés au Chapitre 18 de l'Action 21, document de politique adopté par un grand nombre de gouvernements. Les recommandations de la CNUED ont été pleinement adoptées par la Conférence de Tunis (novembre 1994) dont le résultat est le document intitulé "Action MED 21".

Pour concrétiser les objectifs précités, un grand nombre de pays auront besoin d'une assistance dans la préparation et la mise en oeuvre de ces activités. Le Plan d'action pour la Méditerranée (PAM) et son Programme d'actions prioritaires (PAP/CAR) continueront à y apporter leur contribution.

L'Atelier sur l'application d'une approche intégrée au développement, à la gestion et à l'utilisation des ressources en eau, mis en place par le PAP/CAR, fait partie de cette contribution.

Le finalité de cet atelier a été de réunir des experts, des gestionnaires et autres intervenants concernés pour étudier et débattre les problèmes particuliers en matière de développement, de gestion et d'utilisation des ressources en eau dans la région méditerranéenne. Les objectifs de l'atelier ont été de:

a. présenter, à travers des rapports nationaux, les pratiques et les méthodes de développement, de gestion et d'exploitation intégrés des ressources en eau;

b. examiner, débattre et améliorer les pratiques de développement, de gestion et d'utilisation intégrés des ressources en eau dans la région méditerranéenne; et

c. présenter une information sur le contenu, les objectifs et les tâches de l'Action 21, Chapitre 18 (le document CNUED).

Les principaux thèmes de l'Atelier concernaient:

1. la législation nationale régissant les questions liées à la gestion intégrée de l'exploitation des ressources hydriques dans les différents pays;

2. la structure administrative dans le domaine de la gestion des ressources en eau et de l'élaboration de plans intégrés de gestion des eaux;

3. divers exemples de planification intégrée de l'exploitation des ressources en eau dans les pays individuels, s'il y en a, et l'expérience acquise dans l'élaboration des plans intégrés de gestion des eaux;

4. les problèmes déjà rencontrés ou pouvant surgir au cours de l'élaboration des plans intégrés des eaux (textes juridiques, données de base, personnel, structure administrative, méthodologie, financement, etc.); et

5. les propositions concernant le renforcement de la coopération régionale méditerranéenne, surtout à travers des activités du PNUE-PAM/PAP (formation, projets pilotes, assistance d'experts, etc.).

A l'Atelier, organisé par le PAP/CAR de concert avec l'Institut Méditerranéen de l'Eau (IME - Marseille), à Marseille, du 24 au 26 novembre 1994, ont pris part 36 participants venant de 15 pays méditerranéens, des représentants du PNUE, du PAM et de la Banque mondiale, et 21 participants invités par l'IME. Deux communications d'introduction et quinze rapports nationaux ont été présentés.

Le PAP/CAR exprime sa gratitude à tous les participants et les intervenants pour leur contribution à la réussite des travaux de l'Atelier.

Prof. Jure Margeta

Coordinateur de l'action prioritaire
sur la gestion des ressources en eau

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1. INTRODUCTION

1.1 WATER RESOURCES MANAGEMENT - PAP/MAP/UNEP EXPERIENCE

United Nations Environment Programme (UNEP) was established by the UN General Assembly resolution No. 2997 in 1972. UNEP implements one part of its activities through the Regional Seas Programme, the Mediterranean region being the first of the Regional Seas Programmes.

This regional programme of the Mediterranean has been implemented by the Mediterranean Action Plan (MAP), involving all of the Mediterranean countries and the European Union. MAP consists of four components (Scientific; Socio-Economic; Legal; and Institutional Arrangements), and is coordinated by the Coordinating unit for MAP in Athens.

The Socio-Economic component of MAP is expected to deal with the problems of development and its impacts on the environment. This component is implemented at two levels:

- Long-term development of the Mediterranean and the problems of development in relation to the environment (Blue Plan, Sophia Antipolis, France);
- Current and acute problems of development in the Mediterranean, rational use of resources, and impact of both factors on the state of the environment (Priority Actions Programme, Split, Croatia).

Water, as a very important element in the environment, has been one of the objects of the Blue Plan analyses and assessments. Their results show that in the future: shortage of water can be expected in all of the southern countries and most of the eastern ones.

The primary interest of PAP/RAC is integrated coastal management (ICAM). PAP implements its programme through six priority fields: water resources, human settlements, soil protection, tourism, aquaculture, and renewable sources of energy.

The PAP priority action on water resources management was, first, steered to the water supply problems and water resources management of the Mediterranean islands and water deficient (isolated) coastal zones. First results of that action were discussed in the Seminar on Water and Sanitation in Small Mediterranean Island and Isolated Coastal Areas organized in 1986 jointly by PAP/RAC and the Gobierno de la Comunidad Autonoma de las Islas Baleares, Consejeria de Obras Publicas y Ordenacion del Territorio. In the period 1986-87, the action expanded to include water resources development in large Mediterranean island and coastal zones. The first results of that action were presented in the Seminar on Water and Sanitation Problems in Big Mediterranean Island and Coastal Areas with Fluctuating Population Due to Tourism organized in 1986 in Malta. After that, the major activities of this action regarded wastewater reuse for agricultural and other purposes.

The results obtained in the period 1986-1988 were applied in practice through the Project of Water Resources Management for the Island of Malta.

In order to test 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 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. Those pilot projects grew later into the MAP Coastal Areas Management Programme (MAP CAMP).

So far, the following programmes have been completed within the MAP CAMP: The Syrian Coast, the Kastela Bay (Croatia) supported by the WB, and the Bay of Izmir (Turkey). The following programmes are in the 2nd phase of implementation: The Island of Rhodes (Greece) supported by the EIB, the Albanian coast (supported by the WB), and the Fuka region (Egypt). The programme for Sfax (Tunisia) is in the second phase, while those for Algeria, Morocco, Israel and Lebanon are in preparation. In all these programmes, the integrated management of water resources had a very important role.

The PAP/RAC experience gained in the period 1986-1994 can be summarized as follows:

- Water supply represents a long lasting problem in the Mediterranean region, and particularly in islands and isolated areas. This conclusion was reached after several years of dealing with these problems within the activities of UNEP-MAP Regional Activity Centre for the Priority Actions Programme (PAP/RAC). Shortage of water imposes increasing demands upon the water management and policy-makers, since this problem is not only technical, but is becoming a socio-economic issue of wide interest.
- A wide range of issues (socio-economic, physical, technical, environmental) should be taken into consideration when tackling problems of water resources management, but it has to be done in an organized manner integrating, on one hand, the development process and its water demand, and on the other hand, the natural characteristics and capacity of the water resources.
- The water resources management problems can be solved on a long-term basis only if considered and managed within an integrated approach. This is particularly true for the Mediterranean islands and coastal zones, where the environment is particularly vulnerable, and presents a natural basis for the development.
- Understanding that the protection and enhancement of coastal areas and their eco-systems can only be achieved 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".

1.2 STRUCTURE OF THE DOCUMENT

This book contains 15 national reports which were presented in the Workshop, and two introductory papers. Some of the reports are presented in English, and some in French, according to the authors' language abilities. After the two introductory papers, the national reports are presented in alphabetical order according to the names of the authors' countries of origin.

The purpose of the introductory papers was to provide the participants with a thorough yet brief information on the two basic concepts of the integrated development, management and use of water resources in the Mediterranean, and on the general methodology of preparation of a general water resources master plan. These papers were prepared by two longtime collaborators of PAP/RAC, renowned experts in the field.

The objective of the national reports was to present briefly the situation in the individual Mediterranean countries and the possibilities for the integrated development, management and use of water resources. The reports were prepared by the representatives of the countries nominated by the relative National Focal Points for PAP. Accordingly, the reports were written by experts with various professional backgrounds and knowledge. Therefore, the level of detail in which the situation is presented varies from one report to another.

Publication of national reports in such a form was deemed useful since it is difficult to find compiled in one volume the analysis and opinions on the solution of the problems relative to the integrated development, management and use of water resources of the Mediterranean countries. We, therefore, hope that this volume will be useful for the professionals dealing with, or interested in the solution of those problems in the region.

From the national reports it is clear that the integrated management of water resources does not have a long tradition in the Mediterranean. Only a small number of countries have some experience in the integrated development, management and use of water resources. In general, water resources management problems get due attention only when they grow so much as to present obstacle to a harmonious development. It is, however, important to notice that even the countries poor in water resources, which provide for most of their water requirements from non-conventional sources, have recognized the need for an integrated approach to water management, with a special emphasis on the issues of demand management, wastewater management, and water conservation. According to the reports, prerequisites of the application of the integrated development, management and use of water resources are personnel, information, and legislation. It appears that most of the Mediterranean countries lack these prerequisites, and a lot of time, effort and money will, thus be needed to make any significant progress.

It was concluded that inter-regional cooperation, or international cooperation in general, could contribute greatly to speeding up the practical application of the concept of Integrated Development, Management and Use of Water Resources. PAP/RAC will continue providing its contribution to the achievement of that objective.

The identified situation, and the proposals defined for its improvement, as well as for the application of the integrated development, management and use of water resources in the Mediterranean, are described in greater detail in the following chapter entitled "Conclusions and Recommendations".

1.3 CONCLUSIONS AND RECOMMENDATIONS OF THE WORKSHOP

Considering the activities, results and recommendations of the Genoa Declaration on the Second Decade of the Mediterranean Action Plan (1985), The declaration of Algiers Meeting on Water (1990), the Declaration of the International Conference on Water and Environment (Dublin 1992), the World Conference on Environment and Development (Rio

de Janeiro, 1992), the Conference on Water Demand Management in the Mediterranean Countries (Château d'Avignon, 1992), the Rome Meeting of the Mediterranean Ministers Responsible for Water and representatives of the European Community (1992), and the Tunis Conference of "MED 21" on Sustainable Development (1994), and on the basis of the hitherto activities and results of UNEP-MAP/PAP, the presented national reports and other documents, as well as discussions in the Workshop, we conclude:

1. Integrated coastal area planning and management is a prerequisite for a sustainable development of the Mediterranean region as a whole, and of the individual countries.
2. Integrated water development and management is of essential importance for the protection and enhancement of the Mediterranean coastal areas and their environment.
3. Many of the Mediterranean countries lack Water Resources Master Plans at the national level.
4. Many of the countries have some experience in Integrated Water Resources Development, Management and Use (IWRDMU) at the local level and for individual water works.
5. The hitherto practice of IWRDMU has not been satisfactory, and resulted in many cases in pollution, non rational use and undesirable or unpredicted effects on the water resources.
6. It would be desirable if the existing plans were further developed according to the generally accepted principles of sustainable development and integrated approach to coastal area management, including the water resources management and use.
7. The results of water resources plans preparation using the integrated approach have, within the MAP CAMP, shown that such an approach is particularly useful, resulting in sound plans with minimum problems. They are further useful for the transfer of experience and knowledge, and for the promotion of the concept of sustainable development.
8. Many of the countries lack legislation appropriate for the development and implementation of integrated water resources management and use.
9. Many of the countries lack institutional capacity and legal framework for the preparation of water resources plans.
10. In many countries, water resources management problems are covered by several ministries, regional organizations and local authorities whose activities are not sufficiently coordinated, which creates problems in the development, management and use of water resources.
11. Particularly pronounced is the problem of cooperation of lower management levels in the system of water management with central bodies, and especially with the end users of water resources and the general public.
12. There is a pronounced lack of sufficiently trained professional staff in most of the countries, which poses a great problem in the implementation of integrated approach to the development, management and use of water resources.

13. The staff in charge of IWRDMU has insufficient knowledge of the methodology of IWRDMU approach and most of them lack appropriate guidelines for applying this approach.

14. The differences in the characteristics of water resources, the water demand, and the achieved level of development among various parts of the Mediterranean region will require various approaches to the solution of the water resources management problems. However, these should not depart considerably from the well known and generally accepted principles.

15. There are pronounced differences within the countries as well. The coastal strip has to be particularly pointed out, since it is a zone where fresh water resources are in contact with sea water. These areas require a specific approach due to a constant great pressure on the use of those resources, as well as because of the importance and specific character of that environment.

16. Application of the IWRDMU approach in coastal areas will have to be quite comprehensive, and it will be necessary to provide an appropriate methodological document (guidelines), as well as trained staff.

17. Most of the organizations in charge of IWRDMU are understaffed and underequipped to be able to tackle these problems efficiently.

18. Lack of necessary data for IWRDMU presents a particularly big problem which will require great efforts and much time to make up for. Assessment of water resources and water demand is the basic prerequisite for the preparation of IWRDMU plans.

19. Insufficient funds, especially in the developing countries, present another great problem in the application of IWRMU.

20. There is a special need for the participation of the general public in the process of resolving IWRMU problems; without it, there will be no sufficient political will, nor correct decisions can be made in order to resolve water resources management problems.

21. The problem of determining appropriate water prices is of utmost importance with regard to both consumption rationalization and the social value of water.

Recommendations

A) General:

1. For the Mediterranean watersheds of individual countries, IWRDMU plans should be prepared as the basis for defining programmes aimed at achieving the goals of sustainable development.

2. For the most important areas and for the most vulnerable coastal zones, a detailed IWRDMU plan should be prepared to serve as the basis for categorizing possible projects by priorities.

3. Special attention should paid to the preparation of IWRDMU action plans for isolated coastal areas, islands and similar environmentally sensitive and threatened areas in order to give priority to their protection and conservation.

4. Legislative and regulatory measures necessary for integrated water and land resources management and use should be promoted.

5. Educational and training programmes should be prepared and implemented for experts, technical staff and others involved with the IWRDMU, in accordance with the concept of sustainable development and respecting the specific features of the Mediterranean.

6. Coordination at national, regional and local levels should be improved in order to secure a wider and more efficient participation in the preparation, implementation and monitoring of the national strategies of IWRDMU.

7. International support (financial and technical) should be secured for strengthening of institutions and organizations dealing with water management, and for the development of national management capacities in the region.

8. Since many projects are old and use poor technology, resulting in water losses, the countries should envisage their modernization and upgrading within the framework of the Integrated Water Resources Management Plans.

9. Within the preparation of a water resources master plan, special attention should be paid to measures of rational water management, such as reduction of losses in the network, use of water saving devices, pricing of water, etc. This refers particularly to the areas facing permanent water scarcity.

10. Special attention has to be paid to the solution of problems relative to the water resources shared by several countries so that those resources could be of maximum use for all of them, at the same time taking into consideration the principles of sustainable development.

B) MAP/PAP

The following current activities within the UNEP-MAP/PAP framework should be developed further:

1. transfer of knowledge and exchange of experience among the countries of the region;

2. consistent cooperation in the water domain, and in connection with the on-going Mediterranean programmes should be maintained;

3. implementation of projects in countries with pronounced water resources problems; this will contribute to achieving efficient transfer of knowledge and exchange of information, and to raising of the level of knowledge of the local staff relative to the preparation of IWRMU plans in accordance with the local natural, social, and economic characteristics, such as done within the ICAM projects; accordingly it is recommended that the preparation of IWRMU plans should be continued within individual CAMP projects;

4. cooperation and coordination with various agencies and institutions dealing with similar issues, such as IME, and with the on-going programmes, such as MEDWAN;

5. organization of courses, training activities and seminars for the promotion of IWRDMU, not only for professionals and technical staff, but also for decision makers;

6. preparation of guidelines for IWRDMU with a stress on coastal areas and islands;

7. identification of common water related problems and development of solution methods beneficial to all countries of the region;

8. identification of most urgent water related problems in the region, and organization of necessary measures (technical and financial) in order to start resolving them within the UNEP-MAP/PAP activities and in cooperation with other UN agencies and international institutions.

1. INTRODUCTION

1.1 GESTION DES RESSOURCES EN EAU - EXPERIENCE DU PAP/PAM/PNUE

Le Programme des Nations Unies pour l'Environnement (PNUE) a été établi en 1972 par la résolution No. 2997 de l'Assemblée Générale des Nations Unies. Le PNUE met en oeuvre une partie de ses activités à travers le Programme des mers régionales, la région méditerranéenne étant le premier des Programmes des mers régionales.

Ce programme régional de la Méditerranée est mis en oeuvre par le Plan d'action pour la Méditerranée (PAM), où interviennent tous les pays méditerranéens et l'Union Européenne. Le PAM consiste en quatre composantes (scientifique; socio-économique ou planification et gestion intégrée; légale; et arrangements institutionnels), ses activités étant coordonnées par l'Unité de coordination du PAM à Athènes.

La composante socio-économique du PAM se doit de s'occuper des problèmes de développement et de leurs impacts sur l'environnement. Cette composante est mise en oeuvre à deux niveaux:

- le développement de la Méditerranée à long terme et les problèmes de développement par rapport à l'environnement (Plan Bleu, Sophia Antipolis, France);
- les problèmes actuels et aigus de développement en Méditerranée, l'utilisation rationnelle des ressources et l'influence des deux facteurs sur l'état de l'environnement (Programme d'actions prioritaires, Split, Croatie).

L'eau, comme élément essentiel de l'environnement, est l'un des objets d'analyses et d'évaluations du Plan Bleu. Leurs résultats montrent que dans un proche avenir la disette d'eau peut survenir dans tous les pays du Sud et dans la plupart des pays de l'Est.

La principale préoccupation du PAP/CAR est la gestion intégrée des zones côtières (GIZC). Le PAP concrétise son programme à travers six domaines prioritaires: ressources en eau, établissements humains, protection des sols, tourisme, aquaculture et sources d'énergie renouvelables.

Au début, l'action prioritaire du PAP relative à la gestion des ressources en eau était centrée sur les problèmes d'alimentation en eau et la gestion des eaux dans les îles et zones côtières isolées méditerranéennes, déficitaires en eau. Les premiers résultats de cette action ont été examinés durant le Séminaire sur la gestion des eaux et l'assainissement dans les petites îles et zones côtières méditerranéennes, organisé à Palma de Majorque en 1986 par le PAP/CAR et le Gobierno de la Comunidad Autonoma de las Islas Baleares. Dans la période 1986-1987, l'action s'est éntendue pour englober les grandes îles et zones côtières méditerranéennes. Les premiers résultats de ces activités ont été présentés à la Réunion du Groupe de travail concernant les problèmes d'eau et d'assainissement dans les grandes îles et zones côtières isolées méditerranéennes à population variable due au tourisme, organisée à Malte en 1986. Dans la période qui a suivi, les activités majeures s'effectuant au sein de cette action concernaient la réutilisation des eaux usées pour l'agriculture et pour d'autres fins.

Les résultats obtenus dans la période 1986-1988 ont été mis en pratique au sein du Projet de gestion des ressources en eau pour les îles de Malte.

Pour vérifier en pratique les connaissances et les expériences acquises dans toutes les actions prioritaires, et s'appuyant sur le principe de planification et de gestion intégrée des ressources, le PAP a entamé en 1988 la mise en oeuvre de 4 projets pilotes par pays en tant que forme nouvelle de coopération intensifiée avec des institutions et experts nationaux et locaux, ceci dans le but de créer des conditions pour l'introduction ou l'évolution de la démarche de planification et de gestion intégrée des ressources côtières. Ces projets se sont ensuite transformés en Programmes d'Aménagement Côtier (PAC) du PAM.

Jusqu'à présent, les programmes suivants ont été achevés au sein des PAC PAM: La Côte Syrienne, la Baie de Kastela en Croatie (avec l'appui de la Banque mondiale) et la Baie d'Izmir en Turquie. Les programmes ci-après sont en cours de réalisation: L'Ile de Rhodes en Grèce (avec l'appui de la Banque Européenne d'investissements), la Côte Albannaise (avec l'appui de la Banque mondiale), la Région de Fuka (Egypte) et Sfax en Tunisie. Les programmes pour Algérie, Maroc, Israël et Liban sont en cours de préparation. Dans tous ces programmes, la gestion intégrée des ressources hydriques joue un rôle particulier.

L'expérience que le PAP/CAR a acquis dans la période 1986-1994 peut être récapitulée comme suit:

- L'alimentation en eau constitue un problème de longue date dans la région méditerranéenne, surtout dans les îles et zones côtières isolées. Les pénuries d'eau impliquent d'importantes contraintes sur la gestion des ressources hydriques et sur les responsables de la politique de l'eau du fait que ce problème, tout en demeurant technique, devient aussi une préoccupation socio-économique d'intérêt général.
- Un large éventeil des questions (socio-économiques, physiques, techniques, environnementales) sont à prendre en considération lorsqu'on s'attaque aux problèmes de gestion des ressources en eau, ceci de manière intégrant d'une part le processus de développement et les besoins en eau s'y rapportant, et d'autre part les caractéristiques naturelles des ressources en eau et leurs disponibilités.
- Les problèmes liés à la gestion des ressources en eau peuvent être résolus à long terme moyennant qu'ils soient examinés et traités dans le cadre d'une approche intégrée. C'est surtout vrai pour les îles et les zones côtières méditerranéennes où l'environnement est particulièrement vulnérable et constitute une base naturelle, quasiment unique, de développement.
- Conscient du fait que la protection et le progrès des zones côtières et de leurs écosystèmes ne sont réalisables qu'à travers un développement rationnel utilisant la planification intégrée comme instrument essentiel. le PAP/CAR a mis l'accent sur son action prioritaire "Planification et gestion intégrée des zones côtières méditerranéennes" .

1.2 STRUCTURE DU DOCUMENT

Ce volume englobe quinze rapports nationaux et deux communications d'introduction qui ont été présentés à l'Atelier. Certains rapports sont rédigés en anglais, et quelques-uns

en français, conformément aux capacités linguistiques de leurs auteurs. Après les deux communications d'introduction, les rapports nationaux sont présentés par ordre alphabétique des pays d'origine des auteurs.

Les communications d'introduction ont eu pour le but de fournir aux participants des renseignements -détaillés mais brefs- sur les deux concepts essentiels de développement, gestion et utilsation des ressources en eau dans la région méditerranéenne et sur la méthodologie générale d'établissement d'un schéma directeur des eaux. Ces documents ont été rédigés par les deux experts, confirmés dans le domaine, qui depuis de longues années travaillent avec le PAP/CAR.

L'objectif des rapports nationaux a été de présenter brièvement la situation dans les pays méditerranéens concernés et les possibilités de développement, gestion et utilisation de leurs ressources en eau. Les rapports ont écrit les représentants des pays, préalablement désignés par leurs structures focales nationales du PAP/CAR. En conséquence, les rapports ont été rédigés par les experts de différente formation et connaissances professionnelles. Pour cette raison, le niveau de détail décrivant l'état actuel varie d'un rapport à l'autre.

La publication des rapports nationaux sous une forme pareille a été jugée utile du fait qu'il est rare de trouver, recueillis dans un seul volume, l'analyse et les jugements sur la solution aux problèmes de développement, gestion et utilisation des ressources en eau des pays méditerranéens. Nous espérons donc que cet ouvrage aidera aux professionnels qui se sont consacrés à la tâche de résoudre ces problèmes dans la région.

D'après les rapports nationaux, il est évident que la problématique liée à la gestion intégrée des eaux n'a pas une longue tradition en Méditerranée. Seulement un petit nombre de pays possèdent une expérience dans le domaine. Dans la plupart des cas, on ne s'attaque globalement aux problèmes de développement, gestion et utilisation intégrés des eaux que lorsqu'ils se sont aggrandis à un tel degré où ils entravent le développement équilibré. Il importe toutefois de dire que même les pays souffrant de pénuries d'eau et assurant la plus grande partie de leurs besoins à travers des ressources en eau non conventionnelles, ont fini par reconnaître la nécessité d'une approche intégrée à la gestion des eaux, surtout en ce qui concerne la gestion de la demande, celle des eaux usées et la gestion parcimonieuse de l'eau. Selon les rapports, les conditions préalables de développement, gestion et utilisaiton des ressources en eau sont le personnel, l'information et la législation. Il paraît que la plupart des pays méditerranéens manquent de ces conditions et qu'on aura besoin de beaucoup de temps, d'efforts et de moyens financiers pour faire n'importe quel progrès sensible.

Il a été conclu que la coopération interrégionale, ou la coopération internationale en général, pourraient considérablement contribuer à l'accélération de la mise en pratique de la démarche de développement, gestion et utilisation intégrés des ressources en eau. Le PAP/CAR poursuivra à déployer ses efforts vers la réalisation de cet objectif.

L'état constaté et les propositions de son amélioration, ainsi que celles concernant l'application du développement, de la gestion et de l'utilisation intégrés des ressources hydriques en Méditerranée, sont décrits plus en détail dans le chapitre suivant intitulé "Conclusions et recommandations de l'Atelier".

1.3 CONCLUSION ET RECOMMANDATIONS DE L'ATELIER

Prenant en considération les activités, les résultats et les recommandations de la Déclaration de Gênes sur la Deuxième Décennie du Plan d'Action pour la Méditerranée (1985), de la Déclaration Commune des Ministres chargés de l'Hydraulique des Pays Méditerranéens (Alger, 1990), de la Déclaration de la Conférence Internationale sur l'Eau et l'Environnement (Dublin, 1992), de la Conférence Internationale sur l'Environnement et le Développement (Rio de Janeiro, 1992), du Colloque sur la Gestion de la Demande en Eau dans les Pays Méditerranéens (Château d'Avignon, 1992), de la Conférence des Ministres Méditerranéens responsables de l'Eau et des représentants de la Communauté Européenne (Rome, 1992), de la Conférence "MED 21" sur le Développement Durable en Méditerranée (Tunis, 1994), et s'appuyant sur les activités et les résultats du PNUE-PAM/PAP, les rapports nationaux et les autres documents présentés, ainsi que sur les débâts menés lors de l'atelier, nous concluons:

1. La planification et la gestion intégrées des zones côtières constituent une première condition de développement durable de l'entière région méditerranéenne et des pays particuliers.
2. Le développement et la gestion intégrés des ressources en eau ont une importance primordiale pour la protection et la promotion des zones côtières méditerranéennes et pour leur environnement.
3. Un grand nombre de pays méditerranéens ne sont pas dotés de Schémas Directeurs de gestion des ressources en eau au niveau national.
4. Un grand nombre de pays possèdent une certaine expérience en matière de développement, gestion et utilisation intégrés des ressources en eau à l'échelle locale et en ce qui concerne certains ouvrages hydrauliques.
5. Les pratiques de développement, gestion et utilisation intégrés des eaux n'ont pas abouti à des acquis satisfaisants, et ont souvent conduit à la pollution, à l'utilisation inconsidérée, ainsi qu'aux effets indésirables et imprévisibles sur les ressources en eau.
6. Il serait souhaitable que les plans existants soient mis au point en conformité avec les principes, généralement adoptés, de développement durable et d'approche intégrée à la gestion des zones côtières, y compris la gestion et l'utilisation des ressources en eau.
7. Les résultats d'élaboration de plans de gestion des ressources en eau utilisant une approche intégrée, obtenus au sein des PAC du PAM, prouvent que cette approche est extrêmement importante, résultant en établissement de plans valables et causant minimum de problèmes. En plus, ils sont utiles pour l'échange d'expériences et de connaissances et pour la promotion de la démarche de développement durable.
8. Un grand nombre de pays méditerranéens ne disposent pas de moyens juridiques appropriés au développement et à la mise en oeuvre de la gestion et de l'utilisation intégrées des ressources en eau.
9. Un grand nombre de pays ne sont pas dotés de mécanismes institutionnels et d'un cadre légal pour l'établissement de plans de gestion des ressources en eau.

10. Dans un grand nombre de pays, les questions portant sur gestion des eaux entrent dans la compétence de plusieurs ministères, organismes régionaux et collectivités locales dont les activités ne sont pas suffisamment coordonnées, ceci provoquant des problèmes en matiére de développement, gestion et utilisation des ressources en eau.

11. Il est particulièrement prononcé le problème de coopération aux niveaux inférieurs de gestion dans le système centralisé de gestion des eaux, surtout avec les usagers finaux des ressources en eau et le grand public.

12. Un manque considérable de personnel qualifié dans la plupart des pays constitue un grand problème dans la mise en oeuvre d'approche intégrée au développement, à la gestion et à l'utilisation des ressources en eau.

13. Le personnel responsable du développement, de la gestion et de l'utilisation des ressources en eau n'a pas une bonne connaissance de la méthodologie d'approche s'y rapportant, et la plupart entre eux ne disposent pas de lignes directrices pour l'application de cette approche.

14. Les disparités entre les rives Nord et Sud de la Méditerranée par rapport aux caractéristiques des ressources en eau, à la demande et au degré de développement exigeront des approches diverisifées aux solutions de problèmes posés par la gestion intégrée des eaux. Cependant, ces approches ne devraient pas s'écarter considérablement des principes notoirement reconnus.

15. Les contrastes existent également entre les pays eux-mêmes. Cela concerne particulièrement les bandes côtières comme des espaces où les ressources en eau douce entrent en contact avec l'eau de mer. D'où la nécessité d'une approche spécifique à l'aménagement de ces zones à cause d'une grande pression permanente sur l'exploitation de ces ressources, ainsi que du fait de l'importance et du caractére particulier de leur environnement.

16. L'application d'une approche intégrée à la gestion et à l'exploitation des ressources en eau dans les zones côtières devra être le plus globale possible, et il sera nécessaire de prévoir un document méthodologique correspondant (lignes directrices), ainsi qu'un personnel qualifié.

17. La plupart d'organismes responsables du développement, de la gestion et de l'utilisation intégrées des eaux manquent de personnel, d'équipement et de logiciel indispensables aux solutions de ces problèmes de manière efficace.

18. Un problème particulier est le manque de données pertinentes, exigeant de grands efforts à déployer à travers une longue période de temps. L'adéquation entre les besoins et les disponibilités des eaux est la première condition d'établissement de schémas de développement, gestion et utilisation intégrés des ressources en eau.

19. Le manque de moyens financiers, surtout dans les pays en développement, constitue un probléme à part rencontré dans l'application de la gestion intégrée des ressources en eau.

20. La participation du grand public à la recherche de solutions aux problèmes de gestion intégrée des ressources en eau s'avère indispensable, sans quoi on ne pourra pas aboutir à une volonté politique suffisante et une prise de décisions convenables si l'on veut résoudre les problèmes de gestion des eaux.

21. Les problèmes posés par la tarification de l'eau s'avèrent extrêmement importants du fait que l'eau constitue un bien social et économique et étant donné la nécessité d'éviter son gaspillage à travers une gestion parcimonieuse des ressources.

Recommandations

A) En général:

1. Pour les bassins versants méditerranéens des pays particuliers, des schémas de développement, gestion et utilisation intégrés des ressources en eau devraient être élaborés en tant que base de mise au point de programmes visant à atteindre les objectifs de développement durable.

2. Pour les aires les plus importantes et les zones côtières les plus vulnérables, un schéma détaillé de développement, gestion et utilisation intégrés des eaux devrait être élaboré pour servir de base de classification de projets par priorités.

3. Une attention particulière devrait être accordée à l'établissement de schémas opérationnels de développement, gestion et utilisation intégrés des eaux pour les zones côtières isolées, les îles et autres aires écologiquement vulnérables et menacées, dans le but de donner la priorité à leur protection et sauvegarde.

4. Les moyens juridiques et réglementaires nécessaires pour la gestion et l'utilisation intégrées des ressources en eau et en sol devraient être promus.

5. Programmes d'éducation et de formation devraient être préparés et mis en place; ils seront destinés aux spécialistes, aux techniciens et aux autres personnes concernées par la gestion des eaux, en conformité avec le concept de développement durable, tout en respectant les particularités méditerranéennes.

6. La coordination aux niveaux national, régional et local devrait être promue pour assurer une participation plus large et plus efficace à l'élaboration, à la mise en oeuvre et au suivi des stratégies nationales de développement, gestion et utilisation intégrés des eaux.

7. Un appui international (financier et technique) devrait être asssuré pour aider les institutions et organisations concernées par l'eau, ainsi que pour créer des structures nationales de gestion dans la région.

8. Vu qu'un grand nombre de projets sont vieux et utilisent de mauvaises technologies causant des pertes d'eau, les pays devraient prévoir leur modernisation et amélioration à réussir dans le cadre des schémas de développement, gestion et utilisation intégrés des eaux.

9. Au cours de l'établissement du schéma de gestion des eaux, particulièrement dans les pays souffrant de pénuries d'eau préoccupantes, une attention soutenue est à accorder aux mesures visant la gestion rationnelle des ressources en eau (économie de l'eau et lutte contre le gaspillage, réduction de pertes d'eau, utilisation d'appareils économisant l'eau, tarification judicieuse de l'eau etc.).

10. Une attention particulière devrait être prêtée à la gestion des ressources en eau transfrontières du fait de leur importance globale et dans le but de leur utilisation maximale, tout en tenant compte des principes de développement durable.

B) PAM/PAP

Les activités suivantes se réalisant au sein du PNUE-PAM/PAP devraient être continuées et élargies:

1. transfert de connaissances et échange d'expériences entre les pays de la région;
2. une coopération cohérente dans le domaine de l'eau et en liaison avec les programmes méditerranéens en cours devrait être maintenue;
3. mise en place de projets dans les pays se heurtant aux problèmes les plus aigus, pour réussir un transfert efficace de connaissances et un échanges d'informations et pour rehausser le niveau de l'expérience du personnel local en matière d'établissement des schémas de développement, gestion et utilisation intégrés des eaux selon les caractéristiques naturelle, sociale et économique, comme cela a été fait au sein des projets de gestion intégrée des zones côtières; dans cet esprit, il est à recommander que l'élaboration des schémas de développement, gestion et utilisation des eaux devraiit être poursuivie au sein des PAC particuliers du PAM;
4. coopération et coordination entre les différentes agences et institutions concernées par les préoccupations analogues (IME) et avec les programmes en cours (MEDWAN);
5. mise en place de stages, d'activités de formation et de séminaires visant la promotion du développement, de la gestion et de l'utilisation des ressources en eau, non seulement pour les professionnels et le personnel technique mais aussi pour les décideurs;
6. élaboration des lignes directrices en matière de développement, gestion et utilisation des ressources en eau, avec l'accent sur les zones côtières et les îles;
7. identification de problèmes communs de l'eau et développement de méthodes pour leur solution, qui seront favorables aux pays de la région;
8. identification des problèmes les plus urgents dans le domaine de l'eau et organisation d'activités (techniques et financières) dans le but d'entamer la recherche de solutions à ces problèmes au sein des activités du PNUE-PAM/PAP et en coopération avec les organismes spécialisés de l'ONU et les institutions internationales.

2. INTRODUCTORY PAPERS

2.1 INTEGRATED APPROACH TO THE DEVELOPMENT, MANAGEMENT AND USE OF WATER RESOURCES

Iacovos St. IACOVIDES(*)

2.1.1 Summary

The last thirty years have been years of rapid development of water resources and construction of waterworks characterized on many occasions by sectoral thinking in resource management.

The scarcity and pollution of freshwater, the social implications and use of these works, as well as the increasing financial implications in the continuous development of additional waterworks to keep in pace with the demand, led to a change of philosophy in the approach to the water resources development, management and use. The new approach that is gaining momentum is that of the integrated approach and recognition of the multisectoral and multidisciplinary nature of the water resources.

The current thinking on this approach is presented here in a summary form, both as put forward by the United Nations Conference on Environment and Development in 1992, known as Chapter 18 of the Agenda 21, as well as by specialists and experts in this field.

The concept and objectives of the integrated approach are discussed and put into perspective. The shift towards the era of the operational aspects of water resources systems already accomplished that we are currently entering is highlighted. This shift towards operation rather than new constructions is expected to be facilitated immensely through the application of the integrated approach to water resources management.

Finally, the future main challenges of water resources management are discussed, as well as the ways how the integrated approach could help resolve many management problems, if this approach is incorporated from the beginning in all the phases of development, management and use of the water resources.

2.1.2 Introduction

The scarcity and the gradual destruction by pollution of freshwater resources everywhere, but especially in the Mediterranean region, due to climate and concentration of people together with the large sums of funds required to be invested for waterworks, demand an integrated approach to the development, management and use of water resources. Such integration must include all the water resources of a country, surface and groundwater, and consider not only quantity, but quality aspects as well.

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The water resources development in itself is of a multisectoral nature in the context of socio-economic development. There is demand for its utilization by many sectors of economic life, like water supply and sanitation, agriculture, industry and other activities.

Management of the water resources should seek for their rational utilization and, water conservation and protection should be part of any surface and/or groundwater development scheme. The water resources development contributes immensely to economic development and social well-being since all social and economic activities rely heavily on the supply and quality of freshwater. As population and economic activities grow so much the demand for water grows rapidly, reaching conditions of water scarcity setting up limits to economic development. The integrated management of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programmes within the framework of national economic and social policy are of paramount importance for action in the present decade and beyond.

Fragmentation of responsibilities for water resources development among sectoral agencies is a great impediment to promoting integrated water resources development, management and use of water resources. Effective implementation and coordination mechanisms are required among these sectoral agencies to overcome these difficulties.

In this context, the integrated approach to water resources development and management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its use. To this end, the water resources have to be protected taking into account the functioning of aquatic ecosystems and the perenniality of the resource, so that the needs for water in human activities are satisfied and reconciled. Thus, in developing and using water resources, priority has to be given to the satisfaction of basic needs and the safeguarding of these water resources and of the ecosystems. Beyond these requirements, the use of water should be charged appropriately.

The continuing population growth and quest for further economic development will exert an ever increasing demand for water. The question that is usually posed is whether water resources management has the appropriate approaches to meet these rising demands and to deal with the impact of water related activities expected to accompany these rapid socio-economic and technologic changes. The answer to this is very important if sustainable development is to be maintained.

In Cyprus, as in many other countries of the Mediterranean, in the last 30 to 40 years the heavy pressure on available land and water resources resulting from the rapidly increasing standard of living of the population and pressure exerted by a thriving tourist industry and other economic activity have led to demands for water resources development projects mainly to provide reliable water supplies for irrigation, urban needs and industrial uses. As a result of these demands, over the past 30 years, a large number of medium to major water development projects have been planned, studied and constructed. The greatest users of water are agricultural users. Current marginal increases in demand are the result of increased irrigation activity, higher *per capita* consumption associated with increased incomes of Cypriot people, and only to a small extent to tourist developments.

The water resources development accomplished to date has been planned taking into account long-term needs up to the 2010-2015 time horizon. At that time horizon it is

expected that demand will exceed the supply and desalination will become the choice option. This rapid development of the water resources, although sound from the hydrological and engineering point of view, could not avoid the problems associated with the non application of a fully integrated approach.

An anthology of the kind of problems encountered listed not necessarily in a ranked order, are the following:

a) Environmental considerations which until recently, when awareness of them became a household item, were rather limited. As an example, the reduced replenishment of the coastal aquifers and annual "leaching" implemented through riverbed recharge, mainly cut off by high dams, has resulted in the decrease of water levels, propagation of sea intrusion, and what is most important, the increase of nitrate content and other elements in the ground water.

b) Quantities of stored water in reservoirs have to be released in a controlled manner for artificial recharge to maintain continuing activities relying on groundwater from downstream aquifers. The extent of this demand was not anticipated since it was expected that the largest part of groundwater users would revert to surface water supplied at the farm-gate. The cost difference between project water and groundwater is such that the latter constitutes the choice of the farmers.

c) The cropping pattern envisaged by the planners on the basis of soil surveys, water availability and market studies has proved not to be fully in accordance with the users' selection which is fully controlled by market forces and other economic reasons, or even traditional practice. As a result, the irrigation demands are not as planned, being higher in certain areas where banana plantation is the farmer's choice rather than table-grapes, or lower where marketability of the produce is reduced for a number of reasons.

d) In other project areas, the shift of the labour force from agriculture to tourism has affected the anticipated agricultural activity, and has exerted higher pressure and demand for domestic supply due to tourism.

e) The reuse of treated sewage effluent anticipated to cover part of the irrigation needs of certain coastal aquifers, whose recharge has been cut off by upstream dams, is still being looked upon by farmers with skepticism, and there is an apparent reluctance to accept this potential source of water which could allow high quality freshwater to be used for other purposes. Imaginative efforts have still to be made to bring this resource into stream.

f) Charging mechanisms that would reflect as close as possible the true cost of the developed water, and which would also be within the ability of the farmers and other users to pay, are still being considered and studied.

g) Maximum utilization of some of the existing projects as per the planned time horizons has not materialized mainly due to some of the problems mentioned above whilst the demand on others is greater than anticipated.

h) The water resources development in an arid to semi-arid country develops necessarily new demands beyond the traditional irrigation demands. Occurrence of droughts beyond those anticipated from the hydrologic record, or servicing of demands beyond

those planned, coupled with drier years results in greater economic repercussions and strain. The need of contingency plans in the case of drought has become more pronounced.

The need of contingency plans in the case of drought has become more pronounced.

i) The need for building up institutional capacity to cope with the management and optimal operation is gaining importance, and improved legislative measures to cope with the new situation have become imperative.

The theme of this presentation, which is also the central theme of this Workshop, is an invitation to reflect on the advantages of an integrated approach to the water resources development, management and use.

The key words of "integrated approach", may suggest a concept of a system encompassing a large, somewhat undefined or unlimited, number of activities and considerations. This is not so since this could very well be delimited and put within the context of water resources management.

The integrated water resources management, together with most of the involved activities, has been put forward by the United Nations Conference on Environment and Development held in Rio de Janeiro in June 1992. This is presented in the text that follows together with the concepts and future challenges of this approach.

2.1.3 Integrated water resources management as put forward by the United Nations Conference on Environment and Development

In Chapter 18 of the Agenda 21 of the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in June 1992, the stipulated four principal **objectives** which should be pursued under integrated water resources management, including the integration of land- and water-related aspects and which should be carried out at the level of catchment basin or sub-basin, are:

(a) To promote a dynamic, interactive, iterative and multisectoral approach to water resources management, including the identification and protection of potential sources of freshwater supply, that integrates technological, socio-economic, environmental and human health considerations;

(b) To plan for the sustainable and rational utilization, protection, conservation and management of water resources based on community needs and priorities within the framework of national economic development policy;

(c) To design, implement and evaluate projects and programmes that are both economically efficient and socially appropriate within clearly defined strategies, based on an approach of full public participation, including that of women, youth, indigenous people and local communities in water management policy-making and decision-making;

(d) To identify and strengthen or develop, as required, in particular in developing countries, the appropriate institutional, legal and financial mechanisms to ensure that water policy and its implementation are a catalyst for sustainable social progress and economic growth.

Furthermore, the following **activities** are recommended to be implemented by each country to improve integrated water resources management:

(a) Formulation of coasted and targeted national action plans and investment programmes;

(b) Integration of measures for the protection and conservation of potential sources of freshwater supply, including an inventory of water resources, with land-use planning, forest resource utilization, protection of mountain slopes and riverbanks and other relevant development and conservation activities;

(c) Development of interactive databases, forecasting models, economic planning models and methods for water management and planning, including environmental impact assessment methods;

(d) Optimization of water resources allocation under physical and socio-economic constraints;

(e) Implementation of allocation decisions through demand management, pricing mechanisms and regulatory measures;

(f) Flood and drought management, including risk analysis and environmental and social impact assessment;

(g) Promotion of schemes for rational water use through public awareness-raising, educational programmes and levying of water tariffs and other economic instruments;

(h) Mobilization of water resources, particularly in arid and semi-arid areas;

(i) Promotion of international scientific research cooperation on freshwater resources;

(j) Development of new and alternative sources of water-supply such as sea-water desalination, artificial groundwater recharge, use of marginal-quality water, waste-water reuse and water recycling;

(k) Integration of water (including surface and underground water resources) quantity and quality management;

(l) Promotion of water conservation through improved water-use efficiency and wastage minimization schemes for all users, including the development of water-saving devices;

(m) Support to water-users groups to optimize local water resources management;

(n) Development of public participatory techniques and their implementation in decision-making, particularly the enhancement of the role of women in water resources planning and management;

(o) Development and strengthening, as appropriate, of cooperation, including mechanisms where appropriate, at all levels concerned, namely:

    (i) At the lowest appropriate level, delegation of water resources management, generally, to such a level, in accordance with national legislation, including decentralization of government services to local authorities, private enterprises and communities;

(ii) At the national level, integrated water resources planning and management in the framework of the national planning process and, where appropriate, establishment of independent regulation and monitoring of freshwater, based on national legislation and economic measures;

(iii) At the regional level, consideration, where appropriate, of the harmonization of national strategies and action programmes;

(iv) At the global level, improved delineation of responsibilities, division of labour and coordination of international organizations and programmes, including facilitating discussions and sharing of experiences in areas related to water resources management.

(p) Dissemination of information, including operational guidelines, and promotion of education for water users, including the consideration by the United Nations of a World Water Day.

The successful application of integrated water resources management can only be achieved through marshaling of

- improved scientific and technological means;
- human resources development; and
- capacity building.

To this effect and for successfully carrying out the activities recommended for improving integrated water resources management the following *inter alia* will be required:

2.1.3.1 Scientific and technological means

- Application of new techniques such as geographical information systems and expert systems, which can gather, assimilate, analyze and display multisectoral information, and optimize decision making.
- Innovative applied research involving the transfer, adaptation and diffusion of new techniques and technology, and development of endogenous capacity for the purpose of being able to deal with the added dimension of integrating engineering, economic, environmental and social aspects of water resources management and predicting the effects in terms of human impact.
- Evaluation and field-testing of the various available options for charging water users, further development of economic instruments that take into account opportunity costs and environmental externalities, and field studies on the willingness to pay should be conducted.

2.1.3.2 Human resources development

The delegation of water resources management to the lowest appropriate level necessitates educating and training water management staff at all levels and ensuring that women participate equally in the education and training programmes. Particular emphasis has to be placed on the introduction of public participatory techniques.

Skills related to various water management functions have to be developed by municipal, government and water authorities, as well as in the private sector, local/national

non-governmental organizations, cooperatives, corporations and other water-user groups. Education of the public regarding the importance of water and its proper management is also needed.

To implement the above, a community needs to have adequate capacity. The means needed to ensure building this capacity usually include:

(a) Awareness-creation programmes, including mobilizing commitment and support at all levels and initiating global and local action to promote such programmes;

(b) Training of water managers at all levels so that they have an appropriate understanding of all the elements necessary for their decision-making;

(c) Strengthening of training capacities in developing countries;

(d) Appropriate training of the necessary professionals, including extension workers;

(e) Improvement of career structures;

(f) Sharing of appropriate knowledge and technology, both for the collection of data and for the implementation of planned development including non-polluting technologies and the knowledge needed to extract the best performance from the existing investment system.

2.1.3.3 Capacity building

Institutional capacity for implementing integrated water management should be reviewed and developed when there is a clear demand. Existing administrative structures will often be quite capable of performing local water resources management, but the need may arise for new institutions based upon the perspective, for example, of river catchment areas, district development councils, and local community committees. Although water is managed at various levels in the socio-political system, demand-driven management requires the development of water-related institutions at appropriate levels, taking into account the need for integration with land-use management.

In creating the enabling environment for lowest-appropriate-level management, the role of Government includes mobilization of financial and human resources, legislation, standard-setting and other regulatory functions, monitoring and assessment of the use of water and land resources, and creating of opportunities for public participation.

2.1.4 The concept of integrated approach to the development, management and use of water resources

Integrated Water Resources Development, Management and Use has been gaining momentum in the last few years. This being a truly interdisciplinary concept, aiming to consider quality and quantity problems of both surface and ground waters simultaneously, requires the sustained cooperation of a variety of specialists.

The new "era" regarding water resources management, that we are currently entering, shows a definite shift towards **operational aspects** of water resources systems already accomplished. In this new era, attempts should bi made to overcome sectoral thinking in resource management which characterized and hampered previous developments. For this purpose, an integrated approach to water resources development, management and use is

necessary. However, a strict definition of it is difficult to put forward. For this reason, the general concept of this approach is further discussed herebelow.

Water resources management in itself summarizes all the well known activities of the preparatory phase (inception and planning), as well as those of the implementation phase (design, construction and operation) of a water resources system. The question, then, is why should the term **"integrated"** be added?

One answer to this could be that the term "integrated" creates the aura of high aspirations, promises quite clearly new approaches vis-a-vis the previous practice, and ultimately raises the expectation of "better" decisions and a more careful use of the water resources. The word **"integrated",** when used in association with water resources development and management, is meant to stress the multisectoral and multidisciplinary character of these processes. It also sharply distinguishes them from the more traditional sectoral development and planning approach. Linguistically and mathematically, the word "integrated" suggests completeness, since integrated water resources management can be thought of as an integration of water resources management considerations and efforts in space, over time, over social implications and sectoral water uses, etc.

Philosophical considerations may argue against the use of this word, since "integrated" in itself suggests no defined limits. This can be delimited though, by accepting the imperative of practicality which can place reasonable limits to the extent of endeavor in the integration that is to be implemented. Consequently, the justification of adding the word "integrated" to water resources management lies not only in the fact that the problem is studied in its multi-sectoral character, but rather that decisions made under the integrated water resources management have been achieved by systematically incorporating the conflicting aspirations of different decision makers along with the presence of competing agencies, institutions and representatives of the public into the process.

The integrated approach to the development, management and use of water resources endeavors to unite the entire set of conditions and means for the assessment, planning and development of water resources to satisfy the water demands in a rational manner. It involves comprehensive monitoring, effective protection, and conservation of water resources through their efficient operation and rational use. It strives to act in the best interest of the society and its sustainable development, taking into account the role of water in the formation and regulation of local and regional socio-economic and environmental processes. In other words, this approach:

a) tries to integrate the relevant knowledge in the natural, geoscience, engineering and social sciences, and to create the theoretical and practical basis for its integrated, problem- and object-oriented transformation and application on water resources; and

b) seeks to effect a change in the system, in the water and land use pattern, through the use of structural and institutional measures to obtain a specific goal, or to operate existing water systems in a most efficient way.

Water resources management, in developing countries especially, takes place in complex planning and policy settings that are changing as development proceeds and evolves. Typically, water resources are being developed in the context of overall national plans and programs of economic and social development. Experience, though, indicates

that most problems of reconciling water resources development and other objectives result from failure to consider them side by side.

Water resources activities are usually the responsibility of a multitude of government ministries, departments, commissions, etc. which creates difficulties for a coordinated action. Water Resources Management is a complex matter and requires not only interdisciplinary effort but also proper institutional framework, supporting legislation and clear allocation of jurisdiction.

To ensure a consistent approach to integrated water resources management, a decision making framework has to be established considering the feedback and negotiating mechanisms, involving the political leadership, the executive water resources management agencies and the affected public. Regional planners, engineers and decision makers need to become acquainted with systems analytical concepts and associated methods to be used in water resources management. Their capability to mediate and to solve conflicts inherent to water resources development and protection has to be enhanced, together with quantitative techniques within the realm of multi-criterion decision making.

2.1.4.1 The process of water resources management

The Management of water resources consists of two main stages, that of **planning** and that of **implementation** (fig. 1).

Planning usually refers to large scale, long-term strategic analyses concerning the development of water resources in a given area and the formulation of specific development plans. It subsequently continues with the design phase which comprises the detailed technical and engineering arrangements for implementing the recommendations of the plan. The latter leads to the implementation of the plan (fig. 2).

Implementation refers to the system installation, operation and maintenance (fig. 3).

Another way of looking at water resources management is that of a system shown in the center box of fig. 4 including a set of system management measures like:

- things to be done;
- implementation tools;
- ways of getting things done;
- institutional arrangements;
- organizational aspects, etc.

The development, operation and maintenance of a water resources management system requires **natural inputs** (water, energy, soils) and **human inputs** (labor, materials, capital, and management skills). The managed system yields **desired outputs** (intermediate, such as water for irrigation, industrial and municipal uses, or final in nature, such as flood protection, hydroelectric energy, etc.).

In addition, the system may generate environmental and social side-effects that may be undesired. These side-effects are shown on fig. 4 in terms of **undesired system** outputs.

Important points to be raised here in connection to the integrated approach are:

- The implementation stage, as compared to the planning stage, has received less attention although it presents more difficulties and problems. More emphasis is needed in developing sound approaches to water resources management.

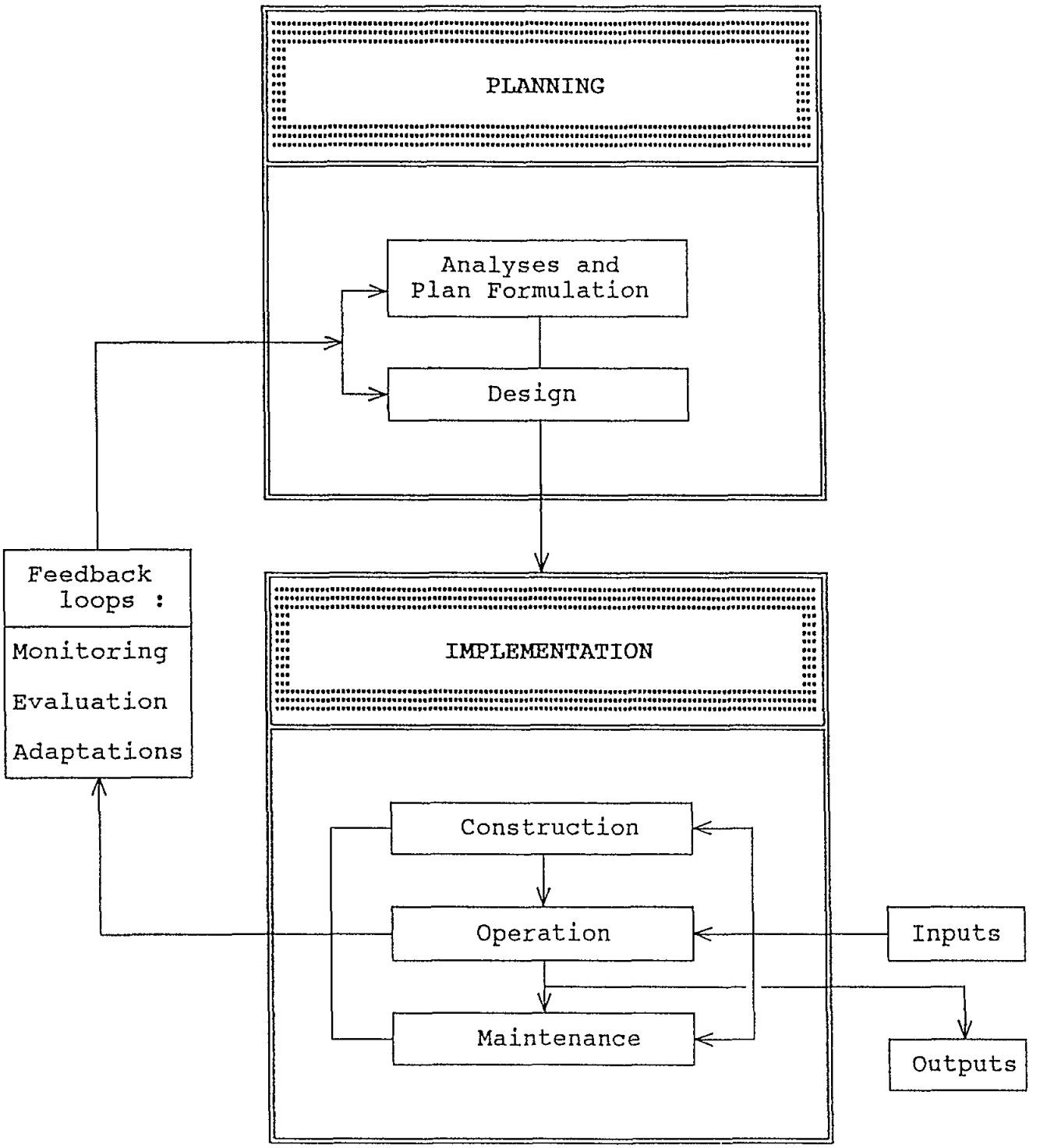

Figure 1. The Water Resources Management Process
(after Hutschmidt & Kindler)

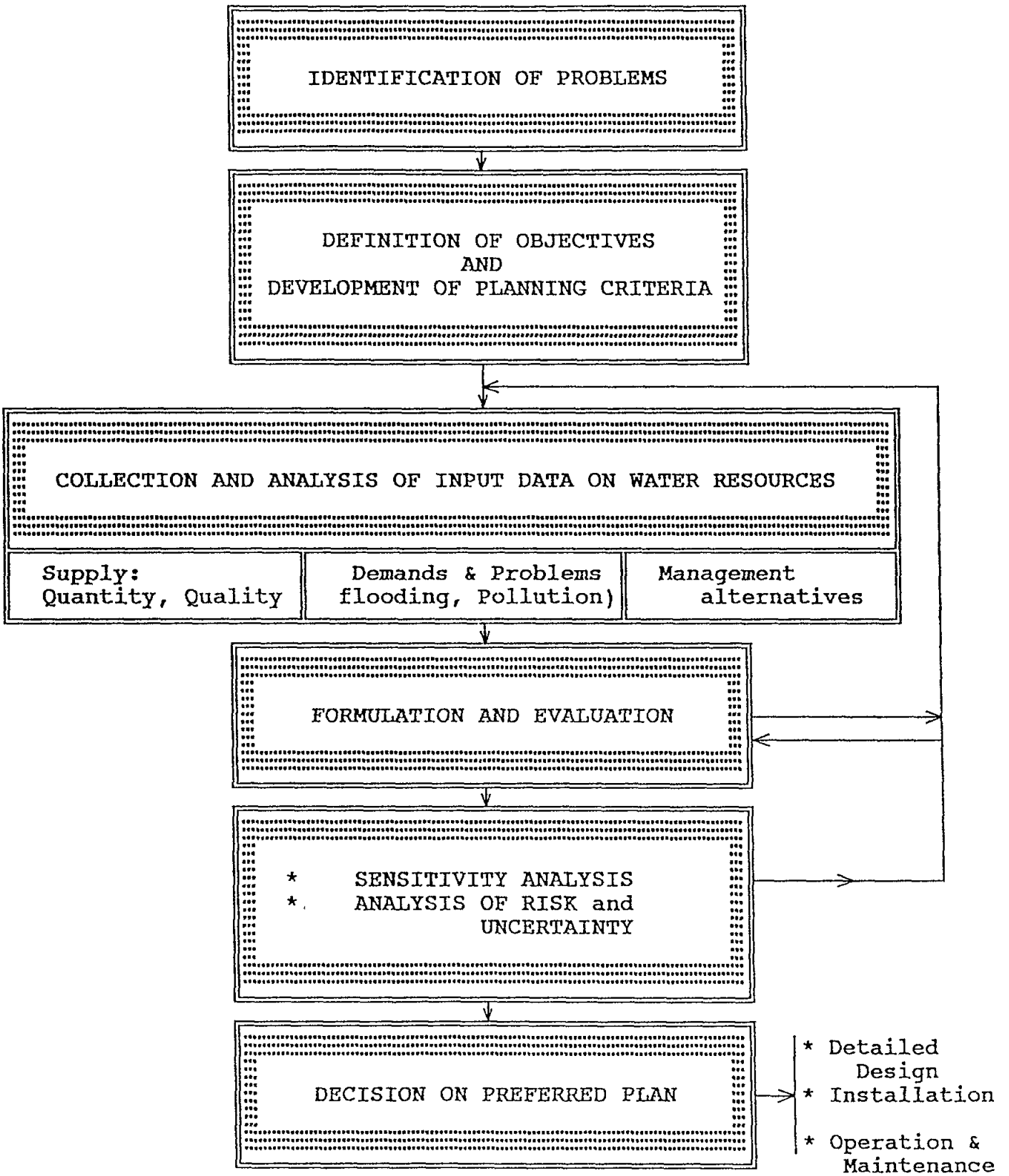

Figure 2. The Water Resources Planning Process
(after Hutschmidt & Kindler)

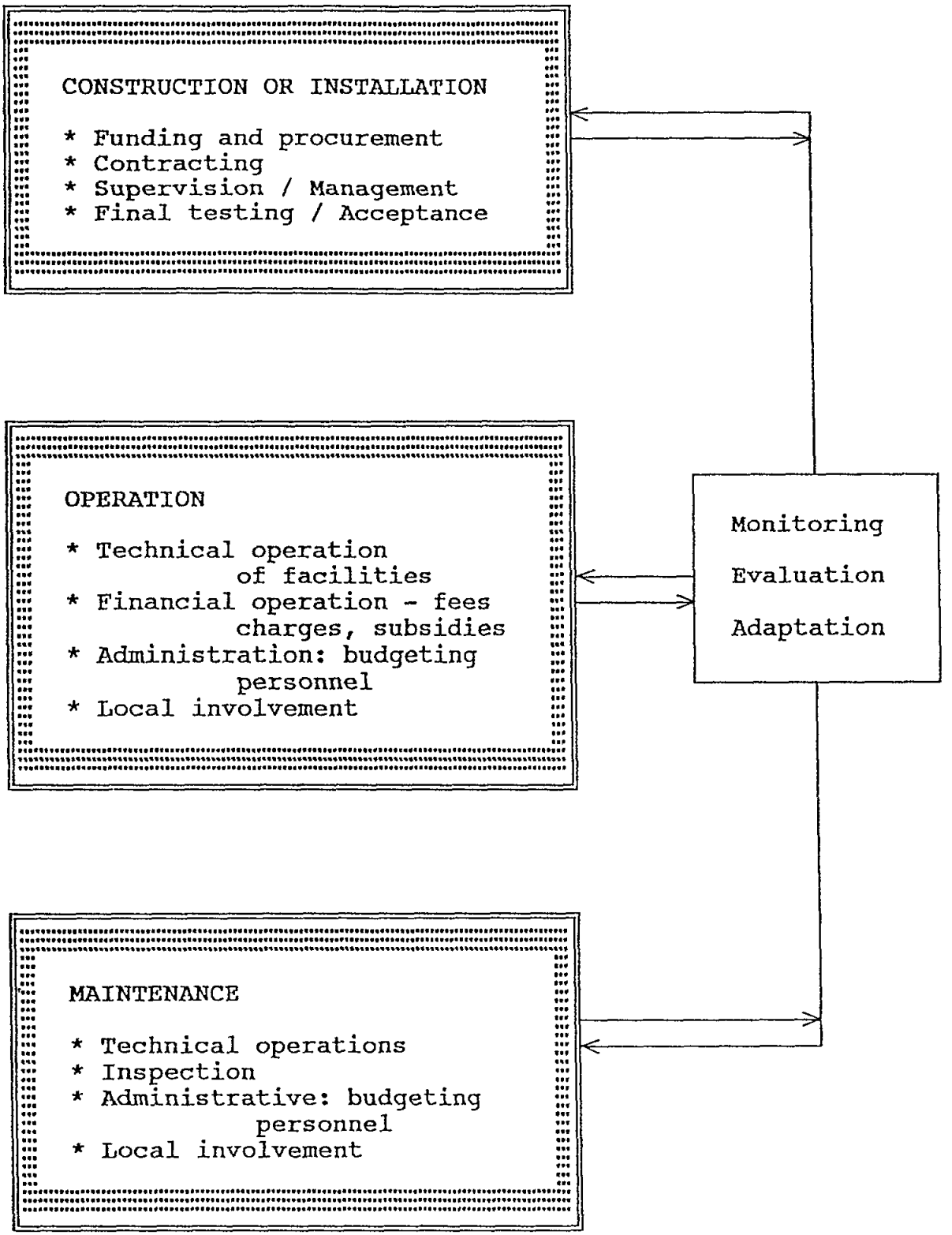

Figure 3. The Water Resources Implementation Process
(after Hutschmidt & Kindler)

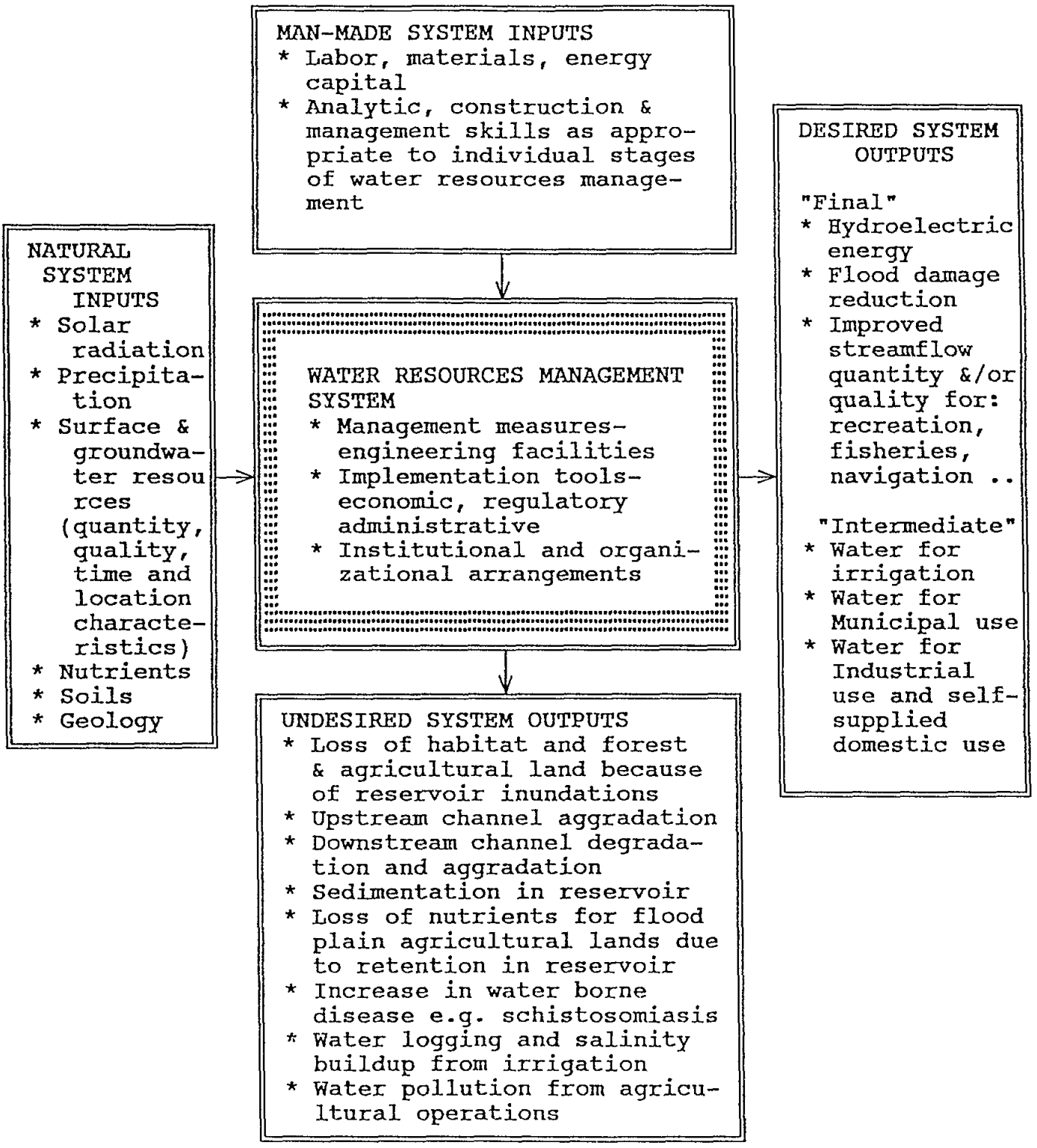

Figure 4. Input/output of a Water Resources Management System

- Critical to effective implementation is the development of a strategy which would link the implementation tools and the institutional and organizational arrangements (including legislative measures) with the management measures.
- Finally, the effective management of a water resources system requires that proper attention be given to all linked and associated activities and tasks.

2.1.4.2 Future challenges of Water Resources Management

In the past 30 to 40 years, the water resources management has been heavily preoccupied with the development and exploitation of water resources by major construction projects. The current trends, characterized by the increasing concern for the environmental and natural system aspects of water management, conservation of water, effective operation of completed water development projects and project maintenance, as well as the reducing number of economical reservoir sites and other water development projects, point to the need for major changes and shift in the approach to water resources management.

Water resources management will have to shift towards a balanced approach that emphasizes water conservation, demand management, changes in water uses, and efficient use of available supplies, along with continued development of new supplies where these are economically feasible and environmentally compatible. Emphasis will have to be placed on various issues for effective management, the main challenges being:

- environmental and social consequences;
- allocation of water among competing uses; and
- achievement of effective implementation of planned and existing water resources projects.

2.1.4.2.1 Environmental and social consequences

Since environmental issues first became development concerns, it has been recognized that an integrated approach to water resources development represents one of the best methods for a proper treatment of these issues. If environmental and social concerns can be systematically integrated into development planning from the outset many of the negative environmental impacts of water development projects would be avoided. The multisectoral approach to water development planning provides a useful framework for dealing with the many existing and potential resource-use conflicts that arise during implementation.

Thus, if environmental issues, as part of resource management considerations, are built into the planning process at an early stage, then, possibly, environmental impact assessments with their high cost and adversary nature can be avoided. The social well-being of the people living in the areas affected by the resource development should also be included in the environmental issues. Similarly, surface and groundwater quality should be covered as well as concerns for preservation and enhancement of aquatic and terrestrial ecosystems as typified by free-flowing streams, estuaries, marsh areas, etc. A closely related issue is also the land - water linkage in the river basin or watershed being developed, as for example, erosion and sedimentation control.

Broadly, three types of social and environmental consequences of water development can be recognized. These are:

- disruption of human settlements and human activities;
- physical and chemical changes in surface and groundwater regime due to alterations of land use; and finally
- effects on flora and fauna, and ecological impacts resulting from dam constructions.

2.1.4.2.2 Allocation of water among competing uses

The growing pressure of population and economic activity make the issue of rational water allocation increasingly important. As development of water becomes increasingly costly, involving highly adverse environmental and social consequences, the need for efficient use of existing supplies and their rational allocation for all relevant purposes is accentuated.

The competition amongst the various users for the limited water resources forces the water managers to deal with rational allocation of water to achieve efficiency, equity and environmental quality. Within this context, efforts to reduce water requirements through **"demand management"** are gaining ground. Such efforts are the pricing policy and changes in water-use technology.

Similarly, increased recycling of water in industrial plants, wastewater treatment and reuse, conjunctive surface and groundwater management, appropriate pricing for water supplies and wastewater pollution loads are some of the processes and techniques employed as a response to the increasing costs of developing new water supplies.

2.1.4.2.3 Achieving effective implementation

Experience so far has shown that there is a consideraable shift of actual results to those anticipated as output targets of project plans. This has been a usual phenomenon and it is the standard patern especially for irrigation projects. Furthemore, the follow-up of plans for handling social and environmental impacts of projects has often been relaxed or turned out to be ineffective.

As the potential gap between available supplies and increasing demands for water resources becomes larger, the importance of effective implementation becomes greater and greater. Ineffective implementation of plans and programs is often one of the major weaknesses of water resources management. Some major causes of this are:

- untimely institutional set-up;
- delayed or untimely promulgation of relevant legislation;
- inadequate financing of project operation and maintenance leading to deterioration of water control systems; and
- lack of involvement of local water users.

The implementation aspect of water resources management is of equal, if not of greater importance than the planning aspect. Nevertheless, the former appears to be much neglected. There is, thus, a great need for giving due importance to the implementation, including the need for changes in policies, procedures and approaches.

2.1.5 Conclusion

Water is absolutely crucial to any country, and as a result, many people and groups are interested in the policy of its development and management. In every area, there are pressure groups, political objectives, local factors and social effects that need to be taken into account in formulating a policy of water resources development.

The common critical need in all countries is for a more effective management of the renewable water resources using integrated approaches to regional water development, management and use. The goal of the integrated approach is the preparation of a rational plan in which all associated development sectors have been assessed for their effects on all other resources in a given geographic area. It implies significant coordination among sectors and flexibility to modify activities to avoid resource depletion and assure sustained economic productivity. It further assumes systematic incorporation of environmental issues.

The four principal objectives of Integrated Water Resources Management, as put forward by the United Nations Conference of Environment and Development in 1992 in Chapter 18 of Agenda 21, highlight the trends that need to be followed. The key words are:

- integrated approach;
- sustainable, rational utilization and protection of water resources;
- water projects which are economically efficient and socially appropriate with full public participation; and
- appropriate institutional, legal and financial mechanisms for sustainable social progress and economic growth.

The increasing severity and complexity of water resources problems suggest that, if the last 20 to 30 years have been the years of water resources **development,** the period that follows should become the age of water resources **management**. The integrated approach to the development, management and use of water resources will, among other issues, seek to deal effectively with:

- environmental and social consequences;
- rational water allocation; and
- effective implementation, which includes operation and maintenance of existing and future water resources projects.

The subject of the integrated approach to water resources management not only as a general subject, but also as it is practiced in many countries, is quite wide and can not be covered to any appreciable degree within the time limitations and extent of this presentation. It is hoped, though, that sufficient information has been provided for reflection and discussion.

References:

Bogardi, J.J. (1994). *The Concept of Integrated Water Resources Management as a Decision Making Problem.* Paris: UNESCO, Multicriteria Decision Analysis in Water Resources Management.

Dyck, S. (1993). *Integrated Planning and Management of Water Resources.* Split: UNEP-MAP-PAP.

Hutschmidt, M. & Kindler J. (1991). *Approaches to Integrated Water Resources Management in Humid Tropical, Arid and Semi-arid Zones in Developing Countries.* Technical Documents in Hydrology, IHP. Paris: UNESCO

Iacovides, I. (1993). *Groundwater Management and Legislative Measures in Cyprus.* FAO Workshop on Expert Consultation on Seawater Intrusion into Coastal Aquifers in the Mediterranean Basin and the Near East, (Cairo, October 1993)

UNCED, (1992). *Agenda 21.* New York: United Nations.

UNESCO, (1991). *Integrated Land-Use Planning and Groundwater Protection in Rural Areas. A Comparative Study of Planning and Management Methodologies.* Technical Documents in Hydrology.

2.2 DEVELOPMENT OF A NATIONAL/REGIONAL WATER RESOURCES MASTER PLAN

Jure MARGETA(*)

2.2.1 Introduction

Rapid growth of population and development of tourism, as well as higher levels of living standards inevitably cause greater exploitation of water resources, followed by environmental pollution. As a consequence of this trend, there is ever less raw materials and water available, and entire eco-systems are being destroyed. The scarcity of water will be felt more strongly, creating considerable problems, both among various economic sectors and between urban and rural areas. The management of water resources will be very difficult and will require considerable funds and knowledge, as well as application of innovative technologies. The solution to this problems can be summarized as the urgent need to meet today's challenges and clean up past environmental problems, while investing in the future, whis is the essence of the concept of sustainable development. This objective is reached through the application of system analysis to economic and environmental planning, development, and management. The basic prerequisite of a rational management of natural resources, including the water resources, is their integrated planning and management.

One of the important elements within this process is the Water Resources Master Plan. Master planning is the planning which for a particular time period and area gives the best possible solution in the particular time of problem solving.

It is a detailed and concrete plan which attempts to solve actual problems which have occurred or will occur in the course of the planning period in a specific area. The Master Plan gives the best solutions for the goals and objectives which should be reached in the planning process (planning to plan) when solving the problems of water resources management and use, starting from the current state of the water resources and planning environment.

Each problem and development of the plan for the management and use of the water resources represents a specific case with different characteristics so that it is always necessary to select the approach most suitable to that specific situation. The approach to be used in problem solving should be stated and selected in the plan of the study.

2.2.2 Planning environment and planning approach in water resources management

Generally speaking, each planning model can be described as follows (Helweg, 1985):

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1. **Determine the Objectives:** What does the client want to accomplish? These may be clarified and altered during the planning process.
2. **Design a Plan of Study (planning to plan):** What approach fits the present environment? How should the planner allocate the available resources (financial and other) to the various steps and tasks?
3. **Obtain the Data:** The correct quantity and quality of data are fundamental to any study.
4. **Formulate Alternatives:** What actions are feasible and can meet the objectives? Usually two or three should be presented to the client.
5. **Choose One Alternative as the Plan:** The alternatives are evaluated against the objectives. The client should make the final decision.
6. **Implement the Plan:** Often this is fit to a contractor and the planner's involvement is terminated with a report summarizing the first five steps; however, the planner should be involved in implementation.
7. **Conduct a Post Analysis:** This is seldom a part of a planning study and some would argue that it should not be a part of the planning model. When done, it compares the predicted results of the plan to the actual results and analyzes the differences.

Accordingly, it can be seen that each planning model in its early stages of realization, has two requirements: identification and definition of the project environment, and the selection of the planning approach. The analysis of the project environment and the possible planning approach best suited to a specific problem (situation) are the decisive factors for the successful plan development. Consequently, these two problems should be considered with special attention, particularly if the problem appears to be specific.

Subsequently, these two terms: planning environment and planning approach will be defined in detail.

2.2.2.1 Planning environment

Each planning study has a different environment and the planner tailors a planning approach to fit the environment at the beginning of the planning process. The planning environment can be described by three major elements:

1. The client's political jurisdictions,
2. The scope of the study,
3. The stage of the planning process.

Planning jurisdiction describes the main clients or governments responsible for the plan, and these can be: international (UN), federal, state, interstate, local, private.

The planning scope describes the breadth of the study. It is divided into multisectoral, sectoral, functional, and elemental structure. For example, multisectoral planning is a development plan; sectoral planning is a water resources plan within the multisectoral plan; functional planning is a plan for wastewater treatment, water supply, etc. as functions of the water resources sector; the distribution water system, reservoirs, pump stations and others are elements of the water supply function planning.

The planning stage of the planning study describes the level of necessary details and can range from a general to a specific stage. General stages of planning are: policy planning, framework planning, general appraisal planning, implementation planning and project design.

Policy planning identifies goals. Framework planning or sketch planning broadly identifies needs, opportunities, and data that recommend additional planning studies. General appraisal planning, such as river basin plan is still fairly broad but ends up with a recommended course of action and rough economic indicators to prioritize subsequent implementation planning. Implementation planning is detailed planning which evaluates the suggested implementation strategies and prepares the conceptual design. At the end we have a project design which produces bidding documents, specifications, and detailed design.

More comprehensive and complex problem planning should follow the same sequence of its development in order to avoid the repetition of the planning stages, and eventually, to reach reliable results. In minor projects these steps can be eliminated providing the objectives and results of the previous steps in the planning process have been clearly defined.

More detailed planning environment can be described by the following descriptors: political system, sociological systems, culture, institutions, client jurisdiction, scope of the study, stage of the study, geographic area of the study, objective of the study, technical constraints, financial situation, and economic situation.

The knowledge of the planning environment makes it possible to select an optimal planning approach and, at the same time, to define the feasible region into which the formulated alternatives should fit.

2.2.2.2 Planning approach

How to define and select the required planning approach? As previously stated, this approach depends upon the planning environment and particularly upon the planning scope. The planning approach has three significant dimensions: control, coverage, and rigidity.

Planning control determines how much control the planner has over goals, objectives, and conduct of the planning study. Frequently, the jurisdiction of a plan will determine the amounts of control the planner has, ranging from client controlled to planner controlled.

Planning coverage can be rational-comprehensive or disjoined-increment. The scope of the plan in general determines which coverage approach should be used. Multisectoral planning tends to require rational-comprehensive coverage, while functional and elemental plans require a disjoined-incremental approach.

Rigidity is the difference between general "blueprint planning" and "process planning". The stage determines the rigidity approach so that policy planning and framework planning are more "process planning" because sufficient information is not available. As the stage of planning proceeds through general appraisal, implementation, and project design, plans become more rigid, and tend towards "blueprint planning".

However, the transition from one process to another (blueprint) is flexible according to the project environment.

These statements refer to any type of planning and generally speaking, each planning process should take into account these planning elements in order to achieve optimal results. However, the effects of the planning approach and planning environment upon master planning and, in general, upon the water resources planning, will be discussed in the next chapter.

2.2.3 Water resources master planning

2.2.3.1 Main characteristics of the water resources master planning

Water resources planning can be defined as seeking a balance between water demand and the available water resources. It is a simple search for the solution of how to meet the demands with the available resources.

The overall purpose of the water resources planning should be to improve the overall quality of life through contributions to:

a) national economic development

b) environmental quality

c) regional economic development

d) other social effects

(US Water Resources Council "Principles and Standards for Planning Water and Related Land Resources", 1980.)

When plans for water resources management are developed, nowadays, special attention should be paid to the application of the sustainability concept.

Freshwater is largely a renewable resource. Accordingly, it is possible to manage water resources systems on a sustainable basis while achieving other objectives imposed by the society. Sustainable development of water resources requires that we respect the hydrologic cycle by using renewable water resources which are not diminished over the long term by that use.

Such approach may need to sacrifice some economic productivity at short time periods or for this generation in order to achieve sustainability for a long time period and for the next generation. A practical approach toward sustainability is to maintain and, if possible, increase the social value of water and water-related services over time, where the social value includes economic, environmental and equity values.

This approach accommodates -indeed requires- changes in the quantity, quality, and the spatial and temporal characteristics of the water resources, as well as changes in the specific mix of water and water- related services.

In this sense, we define and apply sustainability to water resources management as a concept that combines social, economic, and ecological, as well as physical elements.

Meeting the sustainability challenge for water resources development, especially in water lacking areas, will require an advanced level of management called Integrated Water Resource Management. The core concept of such management, i.e. the commonly held principles, includes the management for multiple purposes (domestic water supply, irrigation, enhancement of fishery and wildlife resources), for multiple objectives (economic productivity, environmental quality, social equity, and before everything else,

human health); and through the use of multiple means, such as physical structures, regulations, and economic incentives (Sustainability: Practical approach, M.M. Hufschmidt and K.G.Tejwan, UNESCO, 1993.).

Water Resources Management consists of three general systems: natural water resources system, human activity system, and water resources management system.

Integration is the act of forming or blending these items into a whole, or incorporating more subsystems into a larger overall system (Figure 1.).

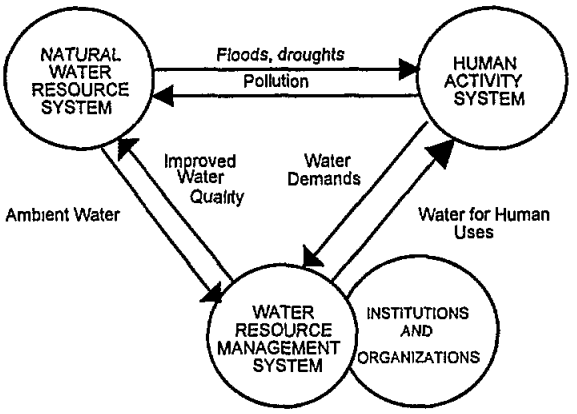

Figure 1. Integrated Water Resources Management (UNESCO, 1993)

The natural water resource system consists of the hydrologic cycle with its components: precipitation, evaporation and evapotranspiration, surface water runoff, and groundwater flows including and biota, soil, atmosphere and water. This system is the water and water-related natural resource endowment available for human uses and services.

The human activity system is composed of many human activities that affect, or are affected by the natural water resource system. These human activities comprise the demand side for water uses, such as domestic water supply, irrigation, waste disposal, hydroelectric power, navigation, fisheries, and recreation and for the reduction of damages from flooding, water pollution, and drought.

The water resource management system consists of the activities and relationships in the public and private sectors concerned with harmonizing the supply and demand sides so as to achieve the objectives of the society. An essential support to the water resources management system is the institutional framework for management, consisting of organizations, rules and codes governing the use and control of water resources.

What is the role of master planning in this concept of Integrated Water Resources Management? Master planning is the formulation of a phased development plan to: meet the estimated requirements for a single water resource purpose over a specific period of time; or exploit opportunities for single and multipurpose water resources projects in defined geographic area over a specific period of time or until all justified projects are completed.

Evidently, two facts can be stressed: a specified period of time, and a defined geographic area. Consequently, the Master Plan is one phase of Water Resources Planning, i.e. it is a plan for actual, previously defined conditions and a strictly defined planning environment with the initial state of water resources. It is a plan which, by jurisdiction or some other factors, becomes an obligation and has to be implemented, in stages or as a

whole, according to the stages of the plan realization and the realization of all its elements. Accordingly, master planning includes: planning jurisdiction, scope of planning, and planning stages.

Planning jurisdiction is generally regulated by laws and is most frequently under the control of water authorities within a respective ministry.

Water related master plan is always a sectoral plan, but one which must be integrated in multisectoral development plans. The multipurpose use of water for all types of human activities, as well as the need to both provide protection against the adverse impacts of water, and to protect water as an environment, clearly show that the planning, management and use of water resources are closely related to the planning and development of the entire economy and society in the broadest sense. Accordingly, the development of plans for the management and use of water resources must be regarded as part of an interactive process within the preparation of wider physical and economic development plans (Haimes, 1977).

The Master Plan, regarding the planning stages, is a more specific plan, which brings about concrete solutions so that it can be regarded as a general appraisal plan or an implementation plan.

The planning hierarchy should be strictly respected within master planning, considering both geographical aspects and stages of planning. This means that general master plans should be developed first, since they precede more detailed and specific plans. In addition, master plans should be developed first at the national level, followed by regional and lower levels. The same applies to development plans, but this has been the common practice (Figure 2). Exceptions can be small settlements and individual structures, as well as isolated areas (islands) due to their reduced dimensions and physical isolation.

An ideal situation for the master plan development is when administrative borders are the same as hydrological, as in the cases of river basins or islands. Unfortunately, these boundaries are rarely identical, which requires greater efforts in the plan development in order to bring into accordance the administrative and hydrological inputs. In these situations it is necessary to ensure beneficial cooperation in the boundary areas both during the plan development and its implementation.

Considering such planning environment it can be said that the planning approach for the master plan is: a) master planner control regarding the planning control, b) mostly disjoined-increment regarding the planning coverage, and c) mostly "blue print" regarding planning rigidity.

When developing a master plan, it is important to determine an appropriate solution that will allow the available water resources to be transformed into required resources for use and services, taking into account both the quantitative and qualitative aspects of water resources.

A water resources master plan should determine the most rational solution from the point of view of economy, society, environmental and health protection. When doing this transformation, it is important to ensure water protection and provide protection against adverse impact of water (flood, erosion, etc.). It is very important to take into account all physical plans and the social development plans of the area.

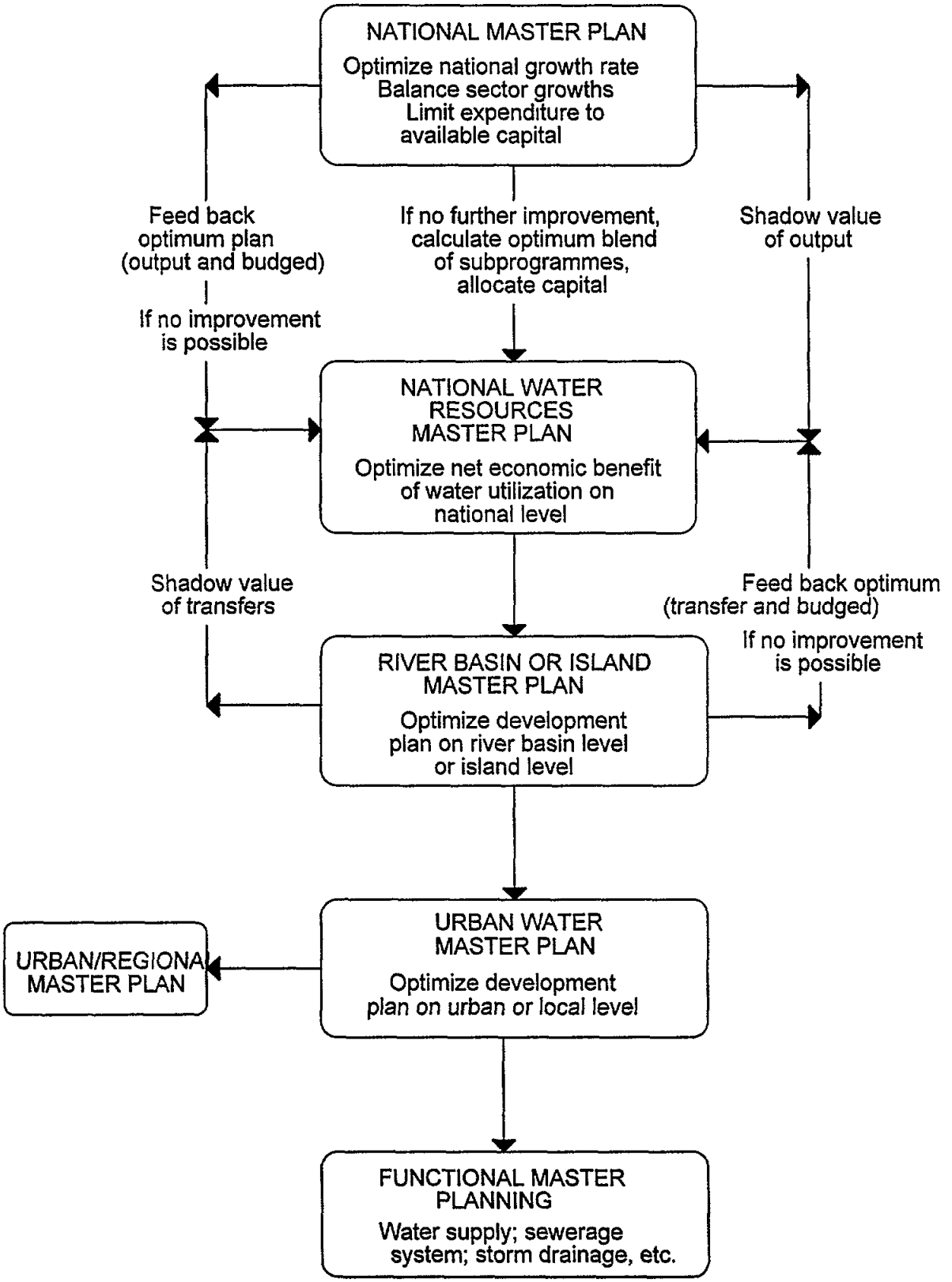

Figure 2. Flow diagram of multilevel Interactive Planning System

(Adapted from Haimes, 1977)

The transformation which is carried out essentially refers to the transformation of certain available water quantities (Qi), certain current quality (Ki), at a certain point (Li) during certain time period (Ti) into demand vectors (qj, kj, lj, tj), Figure 3.

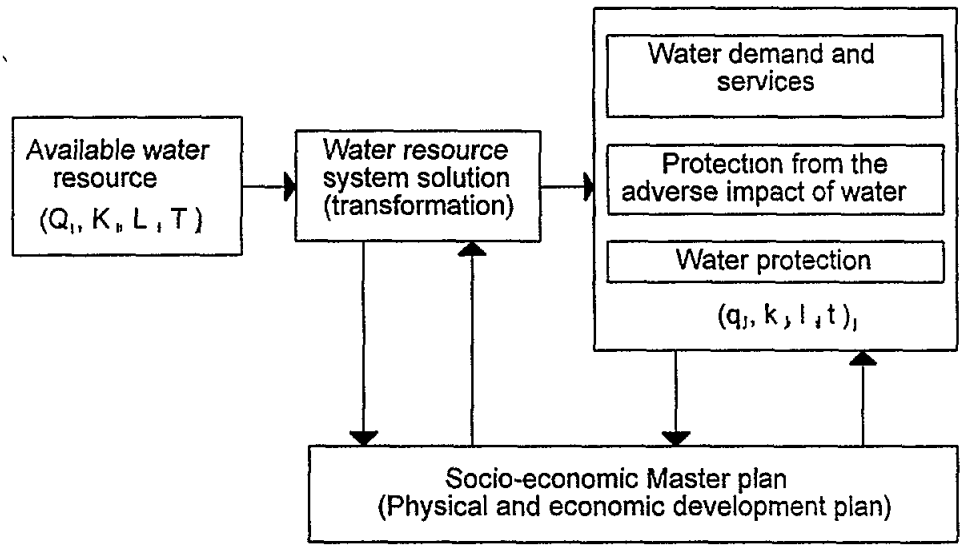

Figure 3. Objectives of Water Resources Master Plan

This transformation, i.e. development of solutions which satisfy the demands with the available water resources, can be achieved in such complex systems in several ways using several alternatives. However, it should be remembered that the main input into the hydrological system is precipitation, which is a typical stochastic phenomenon, i.e. the hydrological cycle is greatly subject to changes, so that water resources are a function of both time and space. The same applies to planning horizon as water demand changes in time and sometimes in space, so that the solution is not unique and it is difficult to find an optimal one. In order to facilitate the solution of the problem and the selection of the optimal solution, the water system is divided into simple subsystems. This decomposition of the system should be carried out by taking into account the characteristics of the water resources, the purpose of the water use, and the available space and time.

Generally, such problems can be successfully solved by applying the theory of system engineering. The main steps of the system approach are well known: (1) definition of goals and objectives; (2) compilation and analysis of information and data, and analysis of the problem; (3) analysis of the available water resources (Qi,Ki,Li,Ti); (4) analysis of the water demands and need for water protection and protection of negative water effects (qj, kj, lj, tj); (5) development and definition of alternative solutions; (6) generation of alternative solutions; (7) selection of the optimal solution. All these problems can be successfully solved by applying the methods and procedures of system analysis (optimization, simulation, etc.)

2.2.3.2 Functional elements of the water resources master plan

Main functional elements of a typical water resources master plan and their purpose are:

1. *Domestic and industrial water supply*

   Provision of water for domestic, industrial, commercial, municipal, and other uses.

2. *Irrigation*

   Agriculture production.

3. *Flood control*

   Flood damage prevention or reduction, protection of economic development, conservation, storage, river regulation, recharging groundwater, water supply, development of power, and protection of life.

4. *Hydroelectric power*

   Provision of power for economic development and improved living standard.

5. *Navigation*

   Transportation of goods and passengers.

6. *Drainage*

   Agricultural production, urban development, and protection of public health.

7. *Watershed management, soil conservation, and erosion control*

   Conservation and improvement of the soil, sediment abatement, runoff retardation, forests and grassland improvement, and protection of water supply.

8. *Recreational use of water*

   Increased well-being and health of the people.

9. *Aquatic ecosystem maintenance*

   Improvement of habitat for fish and wildlife, reduction or prevention of fish or wildlife losses associated with development, enhancement of sports opportunities, and provision of expansion of commercial fishing.

10. *Pollution abatement*

    Protection or improvement of water supplies for municipal, domestic, industrial, and agricultural use, and for aquatic life and recreation.

11. *Insect control*

    Public health, protection of recreation values, and protection of forests and crops.

12. *Sediment control*

    Reduction of silt load in streams and protection of reservoirs.

13. *Salinity control*

    Abatement or prevention of sea water contamination of agricultural, industrial, and municipal water supplies.

14. *Fresh water aquaculture*

    Production of fish in fish-breeding areas and improvement of the living standards.

Master planning must secure and maintain sustainable hydrologic systems which is complicated by the conflicts among the various water uses and related effects. An integrated plan requires a balanced consideration of a wide range of water uses and management purposes, as well as withdrawal uses and water problems, such as flooding and pollution.

2.2.3.3 Four steps of master planning development

Starting from the above stated main principles of the Master Plan, the planning process is essentially concentrated upon four main steps:

1. Inventory, forecast and analysis of available water resources;
2. Inventory, forecast and analysis of water demand;
3. Formulation of alternative solutions for satisfying water demands from the available water resources; and
4. Comparison and ranking of alternative plans.

Within these steps, engineering solutions make it possible to redistribute in time and space the water resources within the hydrologic cycle in order to achieve the desired effects.

Since water resources master planning is an integral part of the development planning process, the goals and objectives of the latter should be identified and defined before starting the work on the Master Plan.

The planning framework is illustrated in Figure 4.

I. Inventory, forecast and analysis of available water resources

This step of the planning process includes six major activities:

- Inventory and analysis of hydrometeorological data;
- Estimation of available groundwater and analyses of aquifer characteristics;
- Surface water analysis;
- Reservoirs and storages;
- Unconventional sources;
- Reservoir yield optimization;

The major purpose of this planning step is to estimate total water resources capacities (groundwater, surface water and non conventional water sources) for every hydrological unit (physical catchment boundaries) and water quality.

II. Inventory, forecast and analysis of water demand

Categories of water demand which belong to the categories of withdrawal type include public (domestic, commercial, industrial, public), rural (domestic, livestock), irrigation, and self supplied industrial uses (cooling, processing, thermoelectric and hydroelectric power). However, there are non withdrawal uses of water (services), such as quality control by dilution, recreation, navigation, aquatic ecosystem maintenance, pollution abatement, insect control, sediment control, and flood control.

The major purpose of this planning step is to estimate the total water demand (use and services) and required quality of water for every territorial unit, because development plans are made according the administrative division of the country.

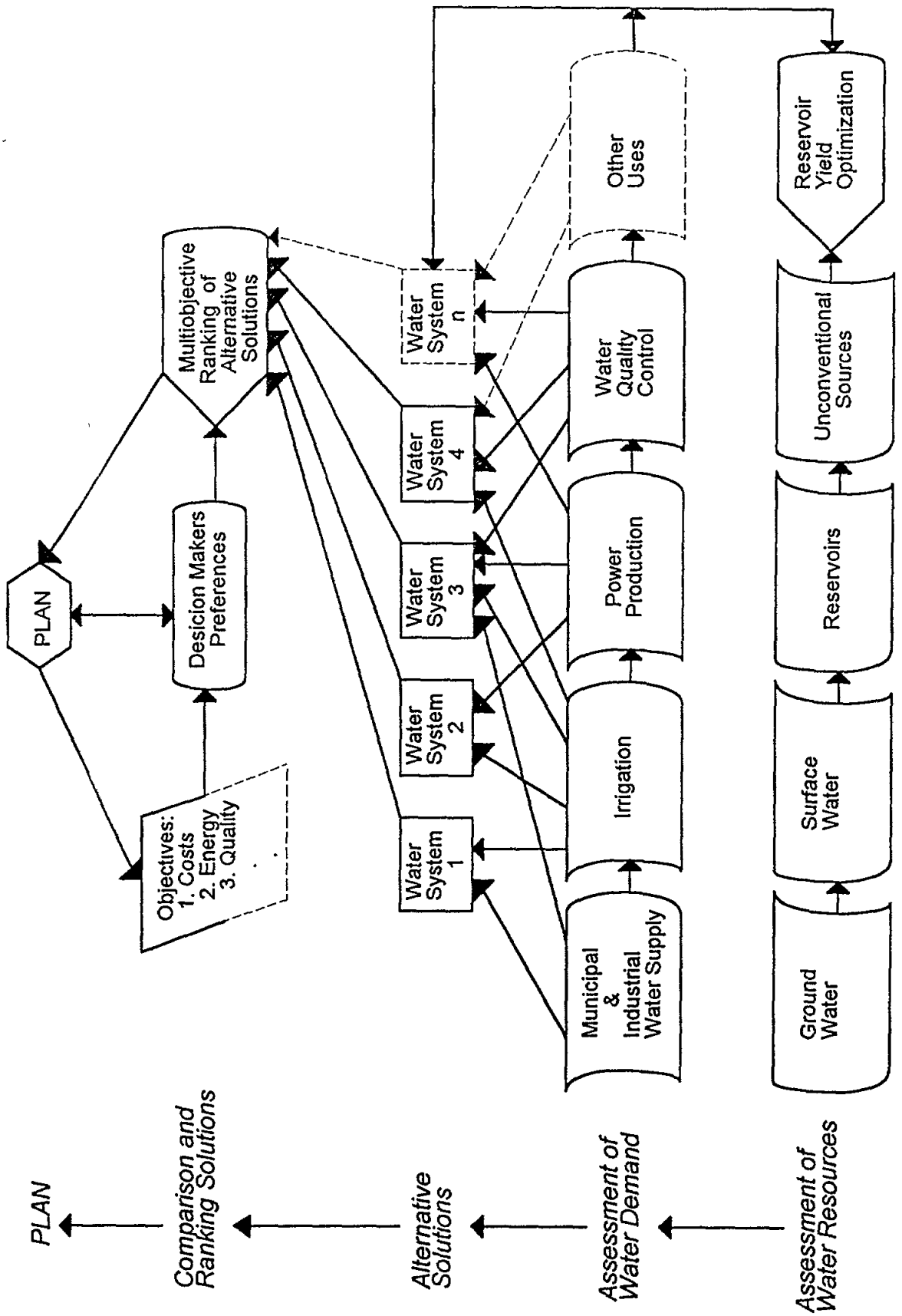

Figure 4. Four-step planning procedure (adopted from Simonovic, 1989.)

III/1 Formulating alternative solutions for satisfying water demands from available water resources

At this step, using the results of the previous two steps, it is necessary to make the water shortage-surplus map for each region under consideration.

The balance between the available resources and demand for the so called "water system" has to be developed. Water systems represent the territorial units inside which all of the demands can be satisfied with available resources. These systems are determined by aggregating the initial territorial units for which the demands and the available water resources (including water transfer) are defined, up to a level when the demands can be satisfied by available water. The major effort at this step of planning is to create a number of alternative technical solutions for satisfying water demands from the available water resources inside every "water system". The results are alternatives for each water system. These water systems are dependent neither on administrative boundaries nor on the physical catchment boundaries.

They are planning units applicable inside the planning region and considered time horizon.

III/2 Protection agains adverse impacts of water

Water resources, in a hydrological cycle, in a specific area have adverse effects such as surface floods, underground floods, and land erosion. In the Mediterranean area, floods can be particularly hazardous since they occur seldom, are of short duration and are very intensive. Erosion is the most significant among the adverse effects with long-term consequences, particularly in agricultural areas of the Mediterranean region. Consequently, a master plan should include solutions for the reduction of damage from floods and erosion as an integral part of other solutions.

III/3 Water protection

Integral parts of the Master Plan are the protection of water agains pollution, and the maintenance and enhancement of fish and wildlife habitat and biodiversity of ecosystems, in other words protection against environmental consequences of water development. Three types of undesirable environmental consequences of water development are particularly important:

- Creation of favorable habitats for parasitic and water-borne diseases by construction of poorly conceived reservoirs and irrigation systems;
- Adverse impacts on ecological systems, caused by erosion, pollution, and changes in stream regimes;
- Stream and reservoir sedimentation, soil salination, and water logging.

The environmental consequences can be assessed in a multiple objective planning approach which represents a true synthesis of the environmental and social fairness and economic values. A practical and common alternative is the environmental impact assessment approach. Such assessment should begin at the earliest stage of project planning, and continue to the final selection of a project. Means for avoiding or reducing adverse environmental effects should be included in the Master Plan.

IV. Comparison and ranking of alternative solutions

A comprehensive plan, such as Water Resources Master Plan, needs a multi objective analysis, since such planning involves numerous conflicting goals and objectives, especially regarding the sustainable approach to the management of natural resources.

Planning over a 30-year horizon is a complex issue involving different interests: economic, environmental, social, political, health, etc. Since most objectives are not in general, quantifiable in monetary or other units, it is necessary to use a multi-objective analysis.

The set of objectives which will be used is dependent on particular problem characteristics. The following objectives can be considered:

- minimization of alternative total costs;
- minimization of negative consequences of water development;
- minimization of energy consumption;
- maximization of positive effects of alternative plans on water quality;
- maximization of the national interests;
- maximization of regional (communities) interests;
- maximization of positive environmental effects of alternatives plans;
- maximization of the system reliability;
- maximization of system sutainability, and others.

By applying proper methods of multicriterional analysis it is possible to rank alternative solutions and present them to the decision makers in accordance with the characteristics of each solution and selected criteria.

2.2.3.4 Plan presentation

The quality of the plan is influenced, among others, by two factors: participation of all interested parties in the course of its development, and the technical and visual presentation of the completed plan. The Master Plan should, within its output, contain a series of data and information, including numerous maps such as: climatological, geological, hydrogeological, hydrological, vulnerability, land use, water system, ground water classification, surface water classification, of available water from the aquifer systems, water demand, water shortage-surplus, etc. These data must be presented as clearly and concisely as possible, so that information can be easily used by non-water specialists.

The plan should not only comply with international standards but should also satisfy, to the greatest possible extent, the requirements imposed by international, national and local organizations and institutions, which can be achieved only through a continuous cooperation among all interested parties, and not exclusively through direct contacts with one client.

2.2.3.5 Conclusion

The planning of complex water resources systems is a very difficult and responsible task. It requires careful and comprehensive study and analysis of all aspects of the problem. To develop high quality master plans for the development and management of water-resources systems, it is important to:

- Study carefully and define the objectives that need to be realized by planning.
- Assess carefully and comprehensively the available water resources, their capacity and quality.
- Analyze carefully and comprehensively, and define the water demand and need for water protection and protection against the adverse impact of water and water development, all based on the physical and economic development plans made for the same water resources planning time period.
- Analyze all possible alternative solutions that are important for the management and use of water resources, including the protection of water, and adverse effects of water and water development.
- Carefully select the most suitable and realistic solution considering the local, regional, national and other common interests of all users.

With a limited supply of water and rapidly increased demands for water and its services in the Mediterranean region, sustainability is becoming a difficult goal to achieve. Integrated Water Resources Management, which means making better use of the water resources to meet current and future demands, is a good answer to this problem, while Water Resources Master Plan is a prerequisite for such management of water resources.

References

Dyck, S. (1990). *Integrated Planning and Management of Water Resources.* Paris: UNESCO.

Grigg, N.S. (1985). *Water Resources Planning.* New York: McGraw-Hill.

Haimes, Y.Y. (1977). *Hierachical Analysis of Water Resources System.* New York: McGraw-Hill.

Haimes, Y.Y. (1992). *Sustainable Development:a Holistic Approach to Natural Resource Management.* Water International, Vol.17, No.4.

Helweg, O.J. (1985). *Water Resources Planning and Management.* New York: John Wiley.

Hufschmidt, H.H.., Tejwani, K.G. (1993). *Integrated Water Resources Management.* Paris: UNESCO.

Margeta, J. (1993). *Water Resources and Demand Management in the Mediterranean Region.* Split: UNEP-MAP-PAP. (Training Course on Selected Topics of Water Resources Management, Malta, November 1993).

Margeta, J., Trumbic, I. (1994). *Land and Water Resources Management in the Mediterranean Region: UNEP-MAP/PAP Experience.* Split: UNEP-MAP-PAP.

(International Conference on Land and Water Management in the Mediterranean Region, Bari, September, 1994).

Simonovic, S. (1989). *Application of Water Resources Systems Concept to the Formulation of a Water Master Plan.* Water International, Vol.14, No.1.

Turjoman, A.M., Helweg, O.J. (1988). *A Descriptive Structure for Water Resources Planning.* Water Resources Bulletin, Vol.24, No.2.

U.S.Water Resources Council. (1980). *Principles and Standards for Planning Water and Related Land Resources.* (Rev. September 1980).

3. NATIONAL REPORTS

3.1 REPORT ON INTEGRATED WATER RESOURCES MANAGEMENT IN ALBANIA

Franko SARA(*)

3.1.1 Summary

Following the Terms of Reference, the Part I of this Report describes briefly the Water Legislation in Albania with regard to water resources management in the past, and in the state of transition to free market economy.

In the second part of this report, the situation is analyzed with respect to the legal and institutional structure, with a description of the respective responsibilities of Ministries and institutions in the water sector, to identify the possibilities of the preparation of the integrated water resources management plans.

The third part of the report deals with some examples of integrated planning of water sources exploitation in Albania, namely "Buvilla", "Banja" and Selita.

In the fourth part of the report we tried to present briefly the problems encountered, and some considerations with respect to collaboration between Mediterranean countries.

In the end of the report we made some conclusions with respect to the water related legal and administrative structure situation in Albania today.

3.1.2 Legal situation in the country with respect to the water administration

Albanian transition to democracy started in the fourth quarter of 1990, but the fundamental transformation happened during the last three years. This transformation from a centrally managed economy to one governed by market forces also requires new approaches to the development and management of national water resources.

In the past there existed no proper water legislation, and many legal acts belonged to the old period, including a Civil Code of 1982. These acts have taken the form of Laws, Decrees, Decisions, Orders, Instructions and Regulations. Legal provisions governing the water resources were included in many legal texts without apparent coordination, so, as consequence, legislation was unknown or ignored.

There was no comprehensive water code which would clearly define the basic principles of water policy, water ownership, delimitation of functions among water institutions, authorities, etc.

There was no administrative system for recognizing or granting the right to use water. It is to be noted that still today, the water users do not pay any water rate, charge or fee for the use of public waters, except that for municipal drinking water.

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While in the past these acts mostly took the form of decisions, orders of the executive powers even of single persons in power, now there is a trend to introduce basic principles by Laws of Parliament. To the Council of Ministers (or single Ministers) are left implementation details with respect to the laws. During this period of transition, the most important law passed by the Parliament was that of "Construction, administration, sustaining and exploration of the irrigation and drainage systems" (Law no.7846, date 21.07.1994). The law establishes water rates taking into consideration subsiding irrigation and drainage, because in Albania agriculture is essential for the country's welfare. So, water charges for irrigation are in accordance with the farmers' ability to pay, or adjusted annually, in accordance with the market and weather conditions. A different payment base is also made according to the location of the land to be irrigated: low, hilly, and highlands. The greatest part of the investments are considered to be recovered by the state. Draft law of water is now being prepared by the Ministry of Building, Housing and Physical Planning in collaboration with a specialist of the World Bank. It is thought that by the mid-October this draft will be ready for discussion, and by the end of 1994 it will be submitted to the Parliament.

3.1.3 Administrative structure of water resources management

In Albania, as in many other countries, different Government Ministries, Departments and other semi-autonomous authorities share responsibilities directly or indirectly, with specific sectors of water resources development and conservation activities.

3.1.3.1 Existing institutional framework in Albania with respect to the administration of water resources.

1. The Ministry of Agriculture and Food is responsible for agricultural use of water. Its Directorate of Land and Water covers all the technical and investment operation in 82% of all irrigation and drainage structures, as well as pumping stations in the country.

   This Ministry supervises and finances:

   - The Institute for Studies and Design of Waterworks,
   - Water enterprises in all 36 districts of the country. There are 39 enterprises of two types: (i) those which direct and supervise irrigation and maintenance of water works and drainage networks, and (ii) those which have to deal with their construction. There exist also Water Users Associations. By 1990, the irrigated area was spreading to about 423,000 ha, but it has decreased since, due to land privatization, to about 350,000 ha. In about 280,000 ha artificial drainage is indispensable.

   In Albania, irrigation is by far the largest water uses, with annual withdrawals in order of 1 billion m^3 (1980). The half of this quantity was taken from the rivers and lakes and the other half from the small reservoirs.

2. The Ministry of Building, Housing and Physical Planning is responsible for water supply and sewerage in the country. The population of Albania is about 3.3 million, from which 40% urban and 60% rural. Municipal water supply amounts to 0.1 billion m^3 a year. The Ministry supervises and directs construction enterprises. It supervises the following institutions and enterprises:

- The Water Supply, Sewerage and Building Institute,
- The Hydrogeotechnical Institute,
- The Hydrogeological Enterprise,
- The Institute of Studies and Designs of Water Supply and Building,
- The district water supply and operations enterprises.

3. The Ministry of Industry, Mines and Energy - KESH, the energy corporation which is responsible for hydroelectricity production and distribution in the country, is under its supervision.
4. The Ministry of Transport has responsibilities with regard to water transport and navigation. It operates the ferry boats on the lakes of the dams of Koman and Fierze.
5. The Ministry of Health and Environment Protection is responsible for health aspects of water resources. Through its Department of Public Health it carries out the sanitary inspection of waters. The Committee for Environmental Protection and Preservation, recently created, has to act toward the protection of the environment. It is rather independent from the Ministry and has an Interministerial Committee composed of representatives of the various sectors of country's activities in the field of environment protection.
6. The Ministry of Foreign Affairs has responsibilities with respect to the international waters shared between Albania and its neighbors, such as those of rivers Drin and Vjose.
7. The Ministry of Finance - its duty is to assess and collect fees, taxes, charges and water rates for different purposes.
8. The Academy of Sciences provides the following services:
   - the laboratory of hydraulic research;
   - the Hydrometeorological Institute, which carries out the measurement of discharges, precipitation's temperatures, wind, humidity, sunshine, etc., in set up stations, throughout the country;
   - the studies on groundwater levels, oceanography, in the area of hydrometeorology;
   - publication of books, brochures and studies in the area of meteorology;
   - granting of scientific degrees for candidates in this field.
9. The district level - For irrigation purposes, there are some enterprises which provide water to farmers. At present, the functions and responsibilities with regard to water resources management at the lower level are not clear since they are in a state of transition.
10. The Municipalities - The responsibility to provide water and sewerage services at this level belongs to Water Enterprises, particularly in the cities as Tirana, Elbasan, Shkodra, etc.

In the past , there was a lack of coordinating mechanism to adjust present and future needs in the water demand for various purposes of utilization, as well as for allocation of funds and water among different users, areas and water developing agencies. As a consequence, it became difficult to formulate a national water resources policy. This policy should consider water availability versus present and future demands, priorities to choose among different types of utilization, priorities of water distribution among different areas of business, as well as priorities of projects among different institutions and users.

Each of above mentioned Ministries and institutions, or even enterprises, prepared and carried out individual water projects without an indisputable coordination and knowledge from the other interested water resources institutions, from an economic, technical, legal and social point of view. This often caused duplication or triplication of efforts, with waste of human, water, and financial capacities. Also, because of uncontrolled discharges of municipal and industrial waste waters, pollution of surface waters took place in the past. Ambient water quality is monitored, to a limited extent only, by the Institute of Hydrometeorology. At present, there are still no ambient water quality standards in Albania. In addition, the extent of ground water pollution is largely unknown, but it seems to be high in some rural regions because of misapplication of fertilizers, pesticides and other agricultural chemicals. In urban areas, pollution of groundwater is mostly attributed to liquid waste discharges, solid and hazardous wastes from industrial and mining operations (e.x. Metallurgic Combine of Elbasan, mines of Rubik).

This situation in respect to water resource administration and legislation, and the inadequacy of the inherited arrangement are well known to the senior officials of the Ministries and institutions of Albania. There is a growing recognition of the need for a modern legislation and a new administrative framework of water resources management for the preparation of a national water strategy in order to help guide the national, regional and local integrated planning of water resources exploitation in the country. The Government of Albania has requested the World Bank, through the National Environment Action Plan (NEAP), to provide the services of specialists in water law and in the sphere of development of National Water Strategy.

In February 1994 the Government established the National Water Council (NWC). This Council, chaired by the Prime Minister, is composed of Ministers and other high authorities having direct responsibilities for water resources development and management in Albania. This Council will serve as a decision-making body, promoting the national water strategy, and deciding on the ways of integrated management of the water resources all over the country.

In June, the Government appointed the Director of the Technical Secretariat of the NWC. This secretariat will have a function of executing the political decisions taken by NWC. It will be a technical and economic body, and at the same time, its most important task will be development of a New National Water Strategy. The Secretariat is attached to the Ministry of Building, Housing and Physical Planning.

3.1.4 Examples of integrated planning of water resources management

Generally, the lack of institutional coordination and the lack of the development and maintenance of infrastructure in all water using sectors, in the past, resulted in a severe

damage to most social and economic activities. Notwithstanding that, some integrated projects were prepared through great efforts of the experts of different water departments.

Let us have a look at 3 of them which, though of great importance to the economy of the country, had to fail due to lack of funds.

3.1.4.1 The reservoir of Buvilla

The project is a product of collaboration among many Project and Research Institutes of the Ministry of Building, Housing and Physical Planning, as well as those of the Ministry of Agriculture and Food. The implementation of these projects was also duty of the enterprises of the two above mentioned Ministries in coordination with the executive power of the district of Tirana.

The objectives of the enterprise are:

a) Creating of the reservoir of 80 million m^3 water by means of constructing the dam of Buvilla. As water to be stored will serve that of the Terkuza river and the waters stored until now in some little reservoirs scattered around the area of Buvilla. From this amount of water, 35.10 m^3 (1,100 l/sec) will be used as drinking water for the city of Tirana, sending it to the existing water supply network (which is by the way, in the process of reconstruction). To this end, in the project is foreseen the construction of the water treatment plant before sending it to the network. The dam will be constructed taking in consideration the possibility of its exploitation in the future for hydropower energy.

b) About 19,400 ha of agricultural land will be irrigated by means of irrigation systems, from which 11,200 ha in the Tirana district and 8,200 ha in the Durresi district. The project cost estimated at:

   1. For the dam and the reservoir $8.67x10^6$ US$;
   2. For the water treatment plant and pipelines $15x10^6$ US$;
   3. For the replacement of the village and the deviation of electric network $10x10^6$ US$.

The funds are secured through a credit by the Italian Government on request of the Albanian Government. Lastly the planners of the district advanced the idea already approved by the Government of using the irrigation water for the urbanism needs of the city of Tirana. As a matter of fact, through Tirana passes the river called Lana which, in reality, is a big cement dry canal.

By the idea of urbanists, the water of Buvilla will first pass through this bed, contributing efficiently to the reconstruction and embellishment of the city from the urbanism point of view. After that, the water will serve for irrigation of agricultural areas.

3.1.4.2 The hydro-power station of Banja

This project was launched in 1988, but was abandoned because of lack of funds. The idea of the project was:

- Building of a high dam in the bed of the river of Devoll. The water stored in the reservoir of Banja will:

a) Produce 250 million kw/h a year by means of a 90 m fall of 85 m^3/sec water. The installed power of the station will be 60 MW (2 turbines of 30 MW).

b) Irrigate, in the first stage, 35,000 ha agricultural land by gravity way. For this purpose are to be used 250 million m^3 water. The fund for the irrigation of the area are ready now (Irrigation network).

In the second stage, a 55,000 ha area will be irrigated. The fund for this irrigation are to be secured in the future. This year, the Government of Albania made efforts in way of negotiating with representatives of the Austrian Government for a possible Austrian credit to finish this project. The full cost of the project seemed to be 205 million US$, of which only 39% have been secured so far. This project is also an integrated one, completed by a number of study and research institutes of the Ministry of Agriculture and Food, as well as the Ministry of Building, Housing and Physical Planning.

3.1.4.3 The spring of "Gura-Bardha"

During the last year, among the water specialists, the idea became popular of using this spring for many purposes. It is situated about 23 km North-East of Tirana. It is of a karstic type with a minimum discharge of 150 l/sec and a maximum 3-4 m^3/sec.

The idea is to open a 5 km tunnel in the calcareous rocks for capturing the spring, and, by means of 1 km pipelines, to send the water into the hydropower station with a fall of 110 km. From these the water will be sent to a captage of a spring of Selita, which has served for years as one of the sources of water supply of Tirana. From the captage of Selita the water will pass by the old pipeline, which is capable for transmitting this additional water.

Besides this, there is a hydropower station in this pipeline with a fall of 650 m. There is enough to add another turbine to exploit all the volume of water for producing electric energy. And so, in total, it is estimated that the profit in the 2 stations will be additional 25 million kw/h and the average addition of drinking water for the capital of about 17 million m^3 (540 l/sec), so needed for the population. A great economic profit will result after the implementation of this project by the way of switching the pumps installed in many drilling wells for water around Tirana. The total cost of implementation of the project is estimated to be of the order of 10-12 million US$. All these of course are a little local experience but, it will serve as a basis for the future in the sphere of integrated planning of water resources.

3.1.5 Problems encountered and some proposals

From the situation described above it is easy to understand that to conduct a sound policy towards water resources exploitation is difficult.

Institutions and organizations can not perform their duties if they do not consider economic and financial aspects, nor can they implement their policies without adequate powers and procedures, which have to be established on the basis of sound water legislation. *Vice versa*, economic and financial considerations by themselves can't lead to efficient implementation without appropriate institutions and organizations, and without legislation to incarnate decisions taken by the water policy making institutions and organizations. Finally any water legislation, sound as it may be, would fail to control water

utilization without adequate institutions and organizations. In this manner all the aspects of water policy:

1. Institutions and organizations;
2. Economic and financial problems;
3. Construction and maintenance of projects at the user's level;
4. Water legislation;

are interrelated and should be considered in their entirety.

In Albania, there still does not exist a proper water legislation. Generally, there is no coordination among Government Ministries and Departments dealing with various aspects of water resources. Besides this, autonomous or semi-autonomous agencies are directly responsible for specific uses of water, such as irrigation, domestic water supply, etc.

The Government of Albania has, therefore, decided to develop a National Water Strategy to help guide policies, programs and projects in the water sector. But in view of current budgetary constrains, the Government is unable to support financially a National Water Strategy Team. The World Bank is examining the possibilities of a foreign grant by finding potential donor agencies.

Due to lack of experience, the assistance to the team by international consultants is necessary. The need to train Albanian experts in the way of considering the integrated development of water resources management is indisputable, and the help of the international experts will consist in bringing the new methodology in water policy.

Consistent with UNEP-PAP/RAC programs, during the last year a project was implemented dealing with the environmental situation of the tourist Adriatic zone. It is a pity that the specialized Albanian Research and Design Institutions did not participate in this project. It would have served as a pilot project for them, and provided them with good experience for the future duties in the sphere of development of water strategy.

It would be desirable that in the future, activities be organized between Albanian institutions and other specialized ones of other Mediterranean regions, in order to train and give expert assistance to Albanian staff of experts in the water integrated planning of water resources.

3.1.6 Conclusions

Making these considerations we can conclude:

1. Although Albania is a water rich country, the lack of institutional coordination and of development of infrastructure in water using sectors, as well as the lack of a proper legislation, have resulted in a disintegrated exploitation of water resources in the country, most social activities being severely constrained by lack of water.
2. The radical transformation of Albania from a centrally managed economy to one of free market requires new approaches to the development and integrated management of national water resources.
3. It is imperative to enact a water law as soon as possible. The Albanian Government, conscious of that, is trying to submit the draft law to the Parliament by the end of this year.

4. It is indispensable to create a modern administrative structure of water resources management in order to prepare integrated water resources management plans. After the Government decision to establish the National Water Council, it remains to create an Albanian team of experts, able to formulate a New Water Strategy for the country and to organize the new Water Administration throughout the country.

5. Financing is a very important issue. It is necessary to continue with the efforts, by intermediation of the World Bank, to secure funds from potential donor agencies, in order to support the new team of Albanian experts to perform the National Water Strategy.

6. Another important issue is the training and the capacity building for the introduction of new approaches, methods and techniques. Beside local and foreign individual training programs, hands-on training in implementing of specific project tasks is necessary, with participation of foreign experts and international consultants. A good experience would be here the cooperation with the Mediterranean countries through the activities of UNEP-MAP/PAP, especially in the implementation of some pilot projects.

3.2. LA GESTION DES RESSOURCES EN EAU EN ALGERIE

Slimane ZAOUCHE (*)

3.2.1 Introduction

L'Algerie fait face à des situations géoclimatiques défavorables, ce qui aujourd'hui plus qu'hier pose le problème de la gestion de l'eau disponible, tant dans sa mobilisation, son stockage et son transport mais aussi dans son utilisation. Ceci nous amène à être confrontés aux inéluctables problèmes liés à la nécessaire lutte contre le gaspillage et contre la pollution de la ressource.

Ceci est d'autant plus ardu que l'Algérie fait également face à des accroissements diversifiés de la demande et amorce un tournant décisif, tant au plan politique qu'économique.

La volonté réelle de l'Algérie, d'associer tous les acteurs et opérateurs pour une politique rationnelle des ressources en eau, est présente car il y a nécessité pour que tous les pays du monde gèrent de manière intégrée leurs ressources.

Cet engagement a été pris à Rio et réaffirmé à Tunis.

Il importe maintenant de définir les voies et moyens pour arriver le plus rapidement possible à gérer de façon optimale nos ressources en eau et faire en sorte que la stratégie développée s'inscrive dans un axe fondé sur la durabilité du développement car, après plus de 30 années d'efforts importants en matière de développement et d'investisssements, l'Algerie ne semble pas avoir réussi à créer cette condition.

3.2.2 Données

3.2.2.1 Caractéristiques géographiques

Avec 2.381.741 km², l'Algerie est le plus grand pays du bassin méditerranéen mais la grande majorité de sa superficie se situe en climat semi-aride et aride. Sa population dépasse les 26 millions d'habitants et la majorité de cette dernière se trouve sur la frange littorale qui offre les conditions de vie et les potentialités agricoles les plus favorables.

La pluviométrie varie de plus de 2000 mm/an sur les hauts reliefs en bordure de la mer Méditerranée à moins de 100 mm/an au nord du Sahara. Cependant, on note également des écarts notables entre l'Est et l'Ouest qui se traduisent par une plus faible pluviométrie à l'Ouest. Il faut noter que la pluviométrie a imprimé les grands traits de la répartition générale des ressources en eau superficielles et souterraines et explique en grande partie les différences régionales.

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3.2.2.2 Ressources conventionnelles

3.2.2.2.1 Les eaux souterraines

Les potentialités en eau souterraine directement accessibles par les forages sont évaluées à 1.750 millions de m^3 dans la région située au nord de l'Atlas saharien et à près de 5.000 millions de m^3 pour le Sahara, essentiellement les nappes du Sahara septentrional (nappes de l'Albien et du complexe terminal) qui devraient normalement être préservées.

Les resssources en eau souterraines des hautes plaines sont encore mal connues car basée sur la relation pluie/infiltration. Ces ressources, puisées jusqu'à 90%, ont constitué l'essentiel de la distribution de l'eau, ce qui a rendu nécessaire la mobilisation des eaux superficielles.

3.2.2.2.2 Les eaux superficielles

Les écoulements superficiels sont évalués à 15.80 milliards de m^3 répartis dans les bassins méditerrranéens, les bassins fermés des hautes plaines et les bassins sahariens. Ces écoulements sont inégalement répartis du Nord vers le Sud et de l'Est vers l'Ouest:

- La zone du Tell, qui ne représente que 7% de la superficie du pays, reçoit à elle seule, plus de 90% de l'écoulement total;
- La même hétérogénéité est observée d'Ouest en Est dans le Tell, puisque les bassins du Centre et de l'Est reçoivent 80% de l'apport total de cette zone;
- Dans les régions steppiques et sahariennes, les écoulements superficiels sont très faibles et se manifestent généralement sous forme de crues épisodiques mais violentes.

Les possibilités de mobilisation en 2010 sont évaluées à partir de la connaissance actuelle des sites de barrages. Sur cette base on estime ainsi, le volume en eau superficielle mobilisable, à 6.68 millards de m^3, représentant un taux de mobilisation de près de 42% de l'écoulement annuel moyen.

La mobilisation de ces ressources devrait se réaliser pour 3066 Mm^3 par 41 barrages existants, 1556 Mm^3 par 18 barrages en construction et 2061 Mm^3 par 27 barrages à réaliser. Toutefois, il faut signaler que la majorité des barrages en exploitation sont envasés à plus de 50%, ce qui réduit leur capacité utile à moins de 1500 Mm^3.

3.2.2.3 Ressources non conventionnelles

3.2.2.3.1 Le dessalement

Le dessalement de l'eau de mer introduit un élément très appréciable de régularité dans la disponibilité de la ressource, qui constitue actuellement une solution techniquement possible et cela même si son développement reste tributaire du prix de revient du m^3 d'eau produit, encore trop élevé.

Il n'est pas exclu que des unités soient installées pour améliorer la fourniture d'eau et augmenter la sécurité d'approvisonnement d'unités industrielles ou même de centres urbains, situés dans des régions deficitaires en eau, particulièrement sensibles aux phenomènes de sécheresses.

Actuellement, les petites unités de dessalement existant dans les unités et complexes industriels capitalisent une production maximale de 100.000 m^3/j.

3.2.2.3.2 Les eaux usées

A terme, l'utilisation des eaux usées, surtout pour l'agriculture, paraît être inéluctable, en particulier pour des pays à ressources limitées comme l'Algérie. Elle suppose cependant la maîtrise totale de l'épuration et des problèmes liés à l'utilisation de l'eau, en particulier ceux de sa qualité.

Les prévisions de rejet d'eaux usées des agglomérations urbaines sont évaluées à près de 2.432 Milliards de m^3 en 2010, mais on estime les possibilités de réutilisation à 600 Mm^3/an environ, dont 209 Mm^3 seront destinés à l'irrigation. Toutefois, ces previsions doivent être pondérées en raison essentiellement de l'état de vétusté des réseaux d'assainissement, aussi faut-il adopter des réserves quant à la réutilisation des eaux usées en agriculture qui reste encore un domaine mal connu.

Le parc d'installations d'épuration se compose d'une soixantaine de stations d'épuration allant de 1.000 à 750.000 eqh (Alger 1989). Les capacités de traitement installées sont estimées à fin 1993 à près de 140 Mm^3/an. Hormis quelques exceptions, la plupart des installations sont, soit à l'arrêt, soit dans de mauvaises conditions de fonctionnement.

3.2.2.4 Les besoins et l'utilisation de l'eau

Les besoins en eau potable et industrielle de 450 centres urbains sont estimés à 2380 Mm^3 dont 66.4 % proviennent des eaux superficielles et le reste des eaux souterraines.

Le secteur agricole reste de loin le plus grand consommateur des ressources en eau. Les superficies irriguées s'èleveront à 476.000 ha sur 1.347.700 ha de terres irrigables et sur une superficie de 6.500.000 ha de ressources en sol inventoriées. Les ressources en eau utilisées pour l'irrigation sont estimées à 2688 Mm^3 à partir d'eaux souterraines (86.2%), à 209 Mm^3 à partir d'eaux recyclées (6.5%) et à 333 Mm^3 (10.3%) à partir des ressources souterraines.

3.2.3 Les objectifs

- Assurer la satisfaction des besoins en eau nécessaires aux activités économiques et aux populations;
- Economiser l'eau, peu abondante, et lutter contre son gaspillage;
- Accroître les ressources en eau par l'indroduction de l'usage des eaux non conventionnelles;
- Protéger les ressources contre la pollution afin d'éviter la détérioration de plus en plus importante de la qualité de l'eau;
- Introduire des techniques nouvelles d'irrigation et de nouvelles méthodes culturales;
- Introduire des procédés de fabrication industrielle propre et peu consommateurs d'eau.

L'atteinte de ces objectifs nécessite un cadre législatif. Qu'en est-il en Algérie ?.

Deux lois cadres existent pour gérer le système Eau-Environnement. Il s'agit de la loi relative à la protection de l'environnement et du Code des Eaux publiées en 1983, et tous

les deux ont prevu des organes de contrôle de la qualité et de la rationalisation de la demande en eau.

Si le corps des Inspecteurs de l'Environnement existe aujourd'hui, il est peu opérationnel et nécessite un renforcement tant en qualité qu'en moyens humains et matériels. La police des eaux prévue par le Code des Eaux, pourtant absolument necessaire pour l'application des textes réglementaires du secteur de l'hydraulique, n'est pas encore opérationnelle.

Aussi l'utilisation de l'eau par la population, l'industrie et l'agriculture se fait de manière inconsidérée, en l'absence d'outils d'application de la loi et en l'absence de réglements précis quant à son utilisation.

Bien qu'il soit fait obligation pour les collectivités locales et l'industrie d'épurer leurs effluents, cette activité n'en est pas moins à ses tous premiers pas. Le fait de ne pas épurer et réutiliser les eaux usées de la ville de Mostaganem et les effluents de ses usines de cellulose, de laiterie et de sucrerie est une erreur qui pèse gravement sur les ressources en eau, déjà maigres, de cette région aux potentialités agricoles très importantes.

Pour assurer la durabilité des ressources en eau nul doute que des moyens institutionnels appropriés, qui permettent de gérer les demandes, la rareté ou l'abondance de l'eau, favoriseront également l'optimisation des impacts socio-économiques et donc une meilleure gestion du systeme Eau-Environnement-Economie.

En Algérie, la politique de l'eau est assurée par le Ministère de l'Equipement et de l'Aménagement du Territoire et celle de la protection de l'environnement est dévolue au Ministère de l'Intérieur, des Collectivités Locales, de l'Environnement et de la Réforme Administrative.

Les outils de la politique du secteur de l'équipement qui comprend les sous-secteurs de l'hydraulique et des travaux publics sont, pour qui est de l'hydraulique, l'Agence de l'eau potable (AGEP), des établissements de l'eau (EPE), de l'Agence Nationale des barrages (ANB), de l'Agence Nationale des ressources hydrauliques (ANRH) et de l'Agence Nationale de l'aménagement du territoire.

L'AGEP met en oeuvre la politique de l'eau potable et de l'assainissement au plan national. Elle réalise des projets d'envergure qui couvrent un ensemble de wilaya ou une région.

Les 35 établissements de l'eau existant sur le territoire national ont fait l'objet d'une attention particulière au cours de l'année 1993 pour l'évaluation du plan d'exécution et du plan d'action d'urgence établi par le Ministère de l'Equipement. Ce dernier comporte notamment:

- la reconnaissance du réseau d'eau potable dans chaque wilaya et son report sur carte;
- la réhabilitation des réseaux défectueux;
- la lutte contre les fuites d'eau et l'éradication des points noirs (quartiers mal approvisionnés);
- un programme volontariste d'installation des compteurs;

- l'amélioration de la gestion commerciale (facturation, recouvrement des créances, relations avec la clientèle).

De ces bilans, il est ressorti l'inéxistence des bilans de gestion des stocks.

Aussi les plans de développement à moyen terme (1993-1995) des établissement de l'eau prévoient des indicateurs de gestion qui porteront sur:

- les ressources humaines;
- le ratio masse salariale sur chiffre d'affaires;
- le rendement des réseaux;
- le comptage et la réduction de la facturation au forfait;
- la situation de la trésorerie de l'établissement;
- le recouvrement des créances;
- le niveau de prise en charge des réseaux des communes;
- le niveau d'endettement de l'établissement;
- les résultats d'exploitation;
- la gestion de la qualité de l'eau.

Les problèmes de gestion de ces entreprises sont dus essentiellement au non paiement de l'eau par les abonnés aux EPE d'une part et au faible prix de l'eau d'autre part. En Algérie, le prix de l'eau était de 0.60 DA le m^3 en 1985, puis de 1 DA en 1990, de 1.55 DA en 1994, pour passer à 1.65 en 1993 et de 2.20 DA à 12 DA en 1994, soit 1.50 FF dans le meilleur des cas.

La taxe de l'assainissement, qui est en fait une taxe de déversement à l'égoût, est perçue au prorata de 20% sur le volume d'eau consommé par l'abonné (elle était de 10% et non perçue durant l'année 1993).

A partir de 1995, il sera instauré une redevance de gestion des installations hydrauliques qui alimentera le fond national de l'eau créé à cet effet.

Actuellement, la réflexion est lancée pour un paiement de l'eau à la source, c'est à dire à la sortie de l'eau du barrage; l'agence chargée de l'exploitation des barrages (ANB) la vendrai aux EPE qui seront contraints alors de mieux gérer la ressource en la considérant comme un produit marchand; ceci amenera un contrôle de l'abonné et conduira à une gestion plus équilibrée de la ressource en eau.

Egalement, une restructuration du secteur de l'hydraulique est en cours. Le Nord du pays sera divisé par 4 grands bassins versants et amenera la prise en charge globale des problèmes liés à la gestion de l'eau. Cette gestion sera confiée à quatre agences et la cinquième, spécifique au Sud, devra gérer au mieux les ressources en eau fossiles.

L'ANRH, établissement public à caractere administratif et à vocation scientifique et technique, a pour principal objectif l'inventaire systématique des ressources en eau et en sols irrigués. Elle est structureé en une direction centrale avec 5 départements techniques, quatre directions régionales situées à Blida, Constantine, Oran et Ouargla et 25 secteurs couvrant l'ensemble du territoire.

Les perspectives de développement de l'ANRH, nécessaires outils pour la connaissance réelle de nos ressources, gravitent autour de la:

- modernisation de son réseau hydroclimatologique;
- maîtrise des connaissances (écoulements, eaux souterraines);
- synthèse cartographique;
- mise en place d'un système d'information intégré sur les ressources en eau et en sol;
- maîtrise des technologies modernes d'investigation;
- etude sur les ressources en eau et sol du Sud;
- développement de l'acitvité expertise;
- études d'impact sur l'environnement des grands aménagements hydrauliques.

La necessité d'assurer les activités de recherche par un auto-financement implique le changement de son statut juridique et de son organisation.

La protection de l'environnement, gerée aujourd'hui par le Ministère de l'Intérieur, permet aux wilaya d'assurer la puissance publique de l'environnement au niveau décentralisé mais aussi de doter, en moyens humains et matériels, les services de l'environnement qui ont toujours souffert de l'instabilité de leur structure.

Cette situation a donc été contraignante chaque fois qu'il était question de faire appliquer la loi relative à l'environnement dont les outils réglementaires normalisent les rejets d'effluents industriels et huiles usagées dans les réseaux d'assainissement et les milieux récepteurs.

La création récente d'une Direction Générale de l'Environnement avec 4 directions techniques avec, comme support, des laboratoires spécialisés en analyse de polluants permettront la surveillance de la qualité de l'eau notamment.

L'éfficacité d'une telle organisation n'est pas encore prouvée mais elle permet au moins l'unicité de décisions en matière de protection de l'environnement. La decision de créer, au niveau de toutes les wilaya du pays, une Inspection de l'Environnement avec des services techniques allant selon les wilaya de 2 à 7, permettra la prise en charge des problèmes de pollution au niveau local et régional, et notamment par:

- l'obligation aux agglomérations et industries d'épurer leurs effluents;
- la surveillance acrue des milieux récepteurs liquides par le contrôle des rejets;
- l'acheminement vers la transition démographique par le changement des mentalités (éducation et sensibilisation du public);
- étude d'impact sur l'environnement pour toute installation industrielle et grands projets.

Il faut également noter que la Loi de Finance 1990 a permis la création du Fond National de l'Environnement qui, bien que non encore opérationnel, a permis la collecte du produit des amendes et taxes sur les activités polluantes.

Les difficultés sur le plan juridique résident dans le fait qu'il y a eu profusion de lois et réglements dans le domaine de la protection de l'environnement; et que mainteant il y a necessité de revoir la majorité des textes de manière à ce qu'ils soient homogènes. Ceci permettra d'une part une adéquation aux options économiques de l'heure et d'autre part la concordance des lois Algériennes avec celles de la communauté régionale et internationale.

3.2.4 Le développement de la gestion intégrée des ressources en eau

L'Algérie amorce un tournant décisif tant dans sa vie politique qu'économique.

L'eau étant source de vie, les décideurs et techniciens savent aujourd'hui l'importance de la préservation de la ressource en eau. De leur longue expérience, ils se sont aperçu que les institutions et organes ne pourront gérer convenablement la ressource que si les outils nécessaires à sa gestion financière pérenne étaient mis en place.

Pour cela, des dispositions législatives sont prises pour que, peu à peu, le prix de l'eau réflète sa disponibilité et sa qualité. Ceci permettra également d'assurer le financement des réseaux d'assainissement et des stations d'épuration mais aussi leurs gestions quotidiennes.

L'acquisition de connaissances et de technicité permettra la maîtrise de gestion des réseaux d'alimentation en eau mais aussi celles relatives aux choix des techniques d'épuration.

La maîtrise des EIE permettra les transferts de technologie propres ou écologiquement rationnelle d'une part mais aussi l'économie de l'eau.

L'éducation et la sensibilisation des utilisateurs de l'eau permettront une économie de l'eau mais aussi une diminution de la pollution notamment agricole.

La gestion de l'eau à partir de grands bassins versants amenera une gestion de la ressource qui prenne aussi en compte l'érosion des sols et la prévention des envasements de barrages.

3.2.5 Au plan international

Les travaux de la Conférence Ministérielle de l'Eau d'Alger en 1990, ceux de Rome en 1992 et de Valencia en 1993, pour la promotion de la Charte de l'Eau en Méditerranée, les déclarations récentes des pays mediterranéens, et notament celle de Tunis, permettent d'espérer que la coopération en Méditerranée est sur la bonne voie. La récente réunion d'experts à Barcelone pour l'examen des projets d'amendement à la Convention de Barcelone et le projet de création de la Commission Méditerranéenne pour le développement durable prouve que la volonté intergouvernementale des pays riverains de la Mediterranée existe; il nous appartient ici de les approuver et d'oeuvrer pour qu'elles soient renforcées.

La coopération régionale et MEDEXP'EAU, l'étude institutionnelle, les pratiques de gestion des eaux usées en Méditerranée et l'étude sur la gestion de l'eau sont à encourager.

Aider et encourager la concertation des spécialistes de l'eau et porter à la connaissance du public les résultats des travaux des comités régionaux et nationaux pour l'élaboration de strategie idoine dans le domaine de l'eau est une obligation pour tous.

Encourager et aider à la sensibilisation et à l'information du public est un devoir pour chacun de nous.

Aider les organismes gestionnaires de l'eau, les centres de recherche et les universités par des mises en situation professionnelles et par des protocoles de coopération dans tous les domaines et notamment ceux inhérents à la connaissance des variations des ressources en eau, doit être un objectif omniprésent.

Amener les bailleurs de fond à s'intéresser d'avantage aux problèmes de l'eau par la création d'entreprises spécialisées créatrices d'emplois dans les pays de la rive Sud est une preuve réelle de la coopération Nord-Sud rénovée.

3.3. INTEGRATED WATER RESOURCES MANAGEMENT IN CROATIA

Jure MARGETA(*)

3.3.1 Basic characteristics of water resources in Croatia

3.3.1.1 Water resources in Croatia

Croatia is one of the few Mediterranean countries rich in water. Average rainfall is about 975 mm. That amount of rainfall suffices for an average annual amount of water of about 45.23 cubic kilometers. According to the 1991 Census, the available amount of water on the territory of Croatia was 9,502 cubic meters/inhabitant. However, total water resources of Croatia are somewhat larger, due to the considerable inflow of water from the neighboring areas into Croatia.

Water resources of Croatia are not evenly distributed. Their distribution depends on the climate. topography, hydrogeology and other characteristics of each particular area. The highest rainfall occurs in the coastal parts of the Southern Croatia (more than 1,500 mm) while the smallest rainfall occurs in the Pannonian plain (about 500 mm). Besides, the precipitation is regularly heavier in the mountains than in the plains. However, the run-off is not in proportion with the rainfall, which is quite understandable, because run-off depends on the local conditions of each individual area. The largest run-off is in coastal areas (the run-off coefficient is 0.62) and the lowest in Pannonia (the run-off coefficient is 0.26). Because of this we can say that water resources in Croatia are diverse.

The area of Croatia belongs to the Adriatic- and Black-Sea watersheds. The Black-Sea watershed is larger (37,360 square kilometers) than the Adriatic-Sea watershed (19,178 square kilometers), Figure 1.

As seen from the Figure 1., the river network of Croatia is quite large. The most important rivers are: Sava, Drava, Mura, Kupa, Danube, Krka, Cetina. Zrmanja and Neretva; some of them, such as Danube, Drava, Mura and Neretva flow to Croatia from other countries. The most important watersheds on the territory of Croatia are the Sava watershed and the watersheds of the rivers that flow to the Adriatic Sea: Cetina, Zrmanja, Krka and other.

The territory of Croatia is rich in groundwater. Most of the groundwater comes from the so-called compact type of water source and the karst source (about 95% of all groundwater), while the remaining groundwater comes from artesian sources and the cracks.

Specific characteristics of the water resources in Croatia result from specific hydrological and hydrogeological characteristics of the karst which covers a great deal of Croatian territory.

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Regarding the topography of the territory of Croatia three basic areas can be identified: the Pannonian, coastal, and mountainous areas. The largest among them is the Pannonian area (Slavonia), and the smallest is the mountainous area.

Characteristics of the water resources in each of these areas differ among each other in accordance with different local factors.

In spite of numerous investigations carried out so far, the knowledge of the water resources characteristics is not sufficient, particularly the knowledge of groundwater and the quality of the surface and groundwater.

3.3.1.2 Water resources balance

Richness of water resources depends on the relation between the precipitation, run-off and evaporation and a whole series of other factors. A complete water balance has not been made for the territory of Croatia and it cannot be referred to in detail. Generally speaking, the Adriatic-Sea watershed has the heaviest rainfall, while the Black-sea watershed has lighter rainfall. The mountainous area of Gorski Kotar has the heaviest rainfall while the lightest rainfall occur in eastern Slavonia.

Total evaporation (505 mm) on the territory of Croatia is larger than the run-off (470 mm). The biggest run-off is in the Adriatic and the smallest in the Black-sea watershed. This is due primarily to favorable distribution of the precipitation in relation to the temperature (the biggest precipitation is during the winter period when the temperature is the lowest) and to the geology of the area. Namely, the greatest part of the Adriatic watershed is karst which enables quick run-off of rainfall into the subterrain thus preventing quick evaporation. The run- off coefficient is smallest in the Pannonian plain (about 0.26).

To form surface flows with permanent run-off into the Black- sea watershed there must be at least 500 mm of rainfall, or 520 mm of rainfall for the Adriatic watershed. Since these amounts cannot be reached in some areas, some water streams dry up in certain periods of the year.

Due to complexity and hifh cost of investigations of groundwater, the groundwater resources are the least known. Thorough investigation of groundwater has been carried out only in areas short of water. Therefore, we can talk about the groundwater balance of Croatia only in general.

3.3.1.3 Water uses and water balance

Although Croatia is very rich in water, the level of water exploitation is low due to the low level of development.

The most important aspect of water use is water supply. According to Marusic, in 1989 about 59.3% of the population of Croatia was connected to water supply system, which is quite a high average.

As shown in the Table I, the situation differs by areas and is the most satisfactory in Istria and the coastal region.

Table I

Watershed	Number of communes	Communes connected to water supply system	
		range (%)	average (%)
Sava river	55	8.1 - 84.0	52.3
Drava & Danube rivers	16	7.5 - 88.2	52.7
Rivers in Istrian peninsula and coastal region	19	45.0 - 89.0	79.8
Rivers in Dalmatian region	25	18.3 - 100.0	69.8

The biggest water consumers are industry and mining. They use water mainly for cooling and in production processes. Sanitary and other uses account for only about 18% of consumption. Only 25% of total water used in industry is contained in a product itself, while the remaining amount is discharged as waste water.

Table II

River basin	Total population	Water consumption x 10^6 cubic meters		
		Population	Industry	Total
Sava river	2,247,560	71.68	149.59	221.27
Drava & Danube rivers	886,590	26.51	32.42	58.93
Rivers in Istrian peninsula and coastal region	559,065	50.37	28 42	78.79
Rivers in Dalmatian region	917,194	40.39	57.63	98.02
Total	**4,610,409**	**188.95**	**268.06**	**457.01**

Table II shows the consumption of water in different areas both by the population and industry. As indicated in the Table II, water consumption by the population is of only 112 l/person day which reflects the standard of living.

Another big water consumer is agriculture. However, in Croatia agriculture is not a big water consumer as only small amount of agricultural land is being irrigated (only 0.8% in 1988). Total available arable land suitable for irrigation is large, and it is to expect that more water will be used for irrigation in the future.

Hydroenergy is certainly the most exploited element of water resources use, although the situation in this sector is not satisfactory either. Total available hydroenergy potential in Croatia is estimated to 12,000 GWh; 54.3% out of it is being used at present.

Other aspects of water uses, such as navigation, recreation, sports, etc., are also very important. They will be even more important in the future, and their share in total water use will increase. Croatia has developed quite extensive fish-farming industry; total area of fish-ponds is about 15,210 hectares and the amount of water in them is estimated at 445,300 cubic meters/year.

According to Marusic, the following water resources structures have been developed up to 1988:

- length of regulated rivers 30.4%
- dikes against flood 61.0%
- accumulations 28.0%
- surface drainage systems 33.5%

- underground drainage systems 19.6%
- waterways for navigation 38.0%
- urban and industrial sewerage systems 29.9%

The use of water resources as recipients for waste water is another big problem. As water resources are often used as recipients for waste water, they are extensively polluted. The quality of water is affected, and the possibility of their use for other purposes is reduced. The situation is quite serious as many of our rivers and groundwaters do not meet the acceptable drinking water standards: this situation is not likely to improve in the future. Unfortunately, the pollution trend is increasing and the same problem occurs in the rivers flowing to the territory of Croatia from other countries.

As we can see, the water resources management in Croatia is not satisfactory. Although the country is rich in water, its use is neither sufficient nor optimal.

Water resources pollution is another serious problem. As more extensive use of water resources is expected in the future, it will certainly cause conflicts between different users. Heavier water pollution is also expected. It will be very difficult and very expensive to secure sufficient amount of water acceptable for use. This calls for a more intensive investigation of water resources and the ways of their optimal exploitation.

3.3.2 Legal measures and administrative structure in water resources management

The problems of integrated water resources planning, as well as administrative structures of water resources management and integrated water resources management plans in Croatia are clearly defined by legal acts. Basic law dealing entirely with the water resources management problems is the Water Law (1990). This Law encompasses all aspects of water resources management such as: organization of water authorities; responsibility of administration; regime of water; requirements for projects, approval of projects and permits for operation issued by water authorities; water structures; prevention of harmful effects of water; development and maintenance of hydrotechnic drainage systems: water pollution protection; water exploitation; institutional arrangement and functional aspect of water authorities; documentation prepared by water authorities; control, monitoring and management; finance and penalty clauses.

A separate chapter of this Law covers the problem of water resources management planning and water resources master plan (WRMP). This chapter specifies the following: goals of WRMP, contents of WRMP, approval procedure, coordination and financing of WRMP. According to the provisions of this Law, authors of WRMP are obliged to coordinate the plan with the land use plan and the plan of natural resources exploitation and protection.

WRMP is done for the whole country and for large watersheds (the Adriatic Sea-Black Sea watersheds). Those plans are approved and accepted by the Parliament of the Republic of Croatia as the supreme legislative body. Lower lever plans (regional plans and plans for river tributaries) are approved and accepted by communal or county assemblies.

Organization and preparation of all levels of WRMP is under the competence of the public company called "Croatian Water Authorities". WRMP is financed either through public or Government funds, depending on whether the plan is done at the state, county, communal or municipal level. Financing of WRMP may also be provided by other

institutions or companies, depending on their interest in having such a plan, but with full cooperation, control and supervision of water authorities who always stand as official initiators and proposers of WRMP to the decision-makers who either approve or reject it.

From this basic Water Law, other acts are derived dealing in more detail with specific problems of water resources management in Croatia.

The Law is very explicit about the integration of land use and water resources management which should be obtained through coordination of water resources plans and land-use plan. Under the provisions of this Law, an integrated plan of water resources management in Croatia must be prepared and approved in accordance with the laws defining the preparation and approval of physical plans. This is all to ensure a rational use of natural resources of the country.

The new environmental protection law, which is in the procedure of being enacted, is very explicit about this. This law encompasses all the basic strategies stated in Agenda 21, as well as an integrated planning and sustainable development concept, and the use of natural resources.

The existing laws and those in the course of preparation cover all the problems related to integrated water resources management plan. However, there is a need at present for relevant guidelines or a similar document which would explain in detail all the elements and contents of the integrated plan, as well as the procedure and goals of integration. In other words, a document containing relevant methodology should be prepared and an adequate training course organized for experts to be involved in the WRMP preparation. This will certainly guarantee the quality of plans and ensure that they are prepared in a uniform way and based on world experience.

The only relevant document available at this moment is Agenda 21; it can be consulted at least for the explanation of the basic strategy; therefore, Agenda 21 has been translated and distributed to some of the experts involved in this matter.

3.3.3 Examples of integrated plans

Water Resources Master Plan for the whole Republic of Croatia has been prepared within the Physical Plan for the Republic. This plan has been approached to in an integrated manner from the very beginning to its completion - it has been done together and coordinated with the land-use plan and the environmental protection plan (Fig. 2). The plan has been adopted by the Parliament of the Republic of Croatia and become a law and full obligation for all dealing with the exploitation of water resources and all other relevant resources.

Based on this plan, detailed plans for some watersheds and towns have been prepared, but not for the whole country and all towns. For example, a detail plan for the Drava-Danube watershed on the territory of Croatia has been prepared. Unfortunately, such plan has not been made for either the Adriatic-Sea watershed or the islands (there are more than 1,000 islands in Croatia). Such plan has not been made for any bigger town except for Zagreb which is the only town in Croatia to have WRMP.

A detailed water supply study for the whole country has been made within the general water resources plan of Croatia. This study provides a detailed analysis of the water

supply, future demand and waterworks. Detail hydrological and hydrogeological maps of the country have also been prepared.

As understood from the afore-stated facts, the situation in Croatia is quite satisfactory, since the whole country is covered by a general water resources master plan. Certain experience useful for the plan preparation has also been acquired. Plans have so far been prepared by consulting organizations or engineering firms in cooperation with water authorities.

These plans have proved useful in many cases; most of the large industrial developments and engineering works have been done in accordance with this basic plan. On the other hand, it is very difficult to come to satisfactory solutions in water resources management on lower levels, as detail plans for counties, communes and towns have not been made so far. Such difficulties are encountered in the construction of small-scale industries and infrastructure objects.

Unfortunately, the situation in the coastal region and islands is even worse. Detailed plans of water resources management, as a prerequisite for sustainable management of natural resources, have not been made for these areas, and a lot of work will be required to get it done.

3.3.4 Problems encountered in the preparation of integrated water resources use and management plans

The biggest problem at this moment is the lack of integrated water resources use and management plans of the coastal region and islands. This is easy to explain. Namely, the preparation of WRMP for continental areas is "traditional" and there are no specific problems to be dealt with; there is enough experience both in Croatia and abroad to rely on in the preparation of such plans. Problems to be solved by water resources management in these areas are related mainly to the problems of flood flow, the regulation of flood flow and the water protection; only to some extent the problems relate to water supply.

The situation in the coastal region and islands is much more complex. These areas have the extreme hydrologic and climatic characteristics (extremely rainy winters and extremely dry summers); on the other hand, the extreme water demand for both fresh and saline waters is in summer. So, conflicts between water demand and water supply are evident. Besides, due to the karst geological characteristics, natural conditions for accumulation of water do not exist, and natural possibilities for time distribution of water are very limited. Consequently, these areas are very sensitive from the environmental point of view, which makes water resources management problems even more complex.

Coastal region is very attractive for both housing and tourism. It results in overexploitation of land and a high pressure on water resources managers in terms of water supply and water protection problems. Therefore, the solutions to water supply problems are very complex, very expensive and sometimes quite imaginative.

Due to the karst geological conditions, water filtration is very large, and the possibility of natural protection of water resources very small. This causes serious problems in the water protection and spatial definition of sanitary zones; in this case, water resources management problems are very difficult to solve.

The sea, as a natural element of water resources system, is very important for tourism in this region; yet, the preparation of WRMP for the sea, as a saline water resource, brings about some confusion. Namely, different experts hold different opinions on whether to consider the sea and freshwater resources separately or to consider the sea as an integral part of a hydrologic cycle of an area. In my opinion, saline and freshwater resources should be treated in an integral manner, as in this region they are in direct permanent contact, separated only because of their physical characteristics - density. Their contact is dynamic and its balancing is one of the important problems of water resources management in coastal areas.

Therefore, the basic characteristic of this region is high oscillation, both in input (precipitation) and in output (seasonal demand), which, in turn, results in high oscillation of waste water discharge into water resources (summer-winter oscillation 2 - 20 times). All this makes the situation very specific and not easy to manage.

The biggest obstacle to a successful solution to these problems is the lack of experience and of relevant methodological documents in compliance with the propositions of Agenda 21 (integrated and sustainable approach). Another serious problem is the lack of hydrologic and other information, particularly for the islands, which is not due only to the complex situation in the area but also to the shortage of finance for monitoring and preparation of plans.

3.3.5 Proposals for enhanced regional cooperation

It would be very useful to prepare for the coastal region and islands, an appropriate methodological document for the preparation of water resources master plan in accordance with the propositions of Agenda 21. This particularly applies to specific problems such as management of aquifers, both those in contact with the sea water, and the karst aquifers, and to determination of sanitary zones in such aquifers.

It would also be useful to ensure the transfer of knowledge in this particular field among Mediterranean countries, organize training courses or even specialized training in which trainees would be awarded a diploma.

If no adequate experience is available for specific situations such as for small islands or isolated coastal areas, it would be useful to organize pilot projects for acquiring such experience.

The possibility of using the available global data obtained by remote sensing or other countries should be sought.

In this sense, a better regional cooperation in carrying out the tasks proposed by Agenda 21 is of primary importance; UNEP-MAP/PAP are expected to give their contribution.

However, it would be useful if specialized regional Mediterranean agencies whose activities correspond to those proposed by Agenda 21, offered their full cooperation in order to realize the integrated approach concept by concerted action.

Figure 1. Water Resources of Croatia

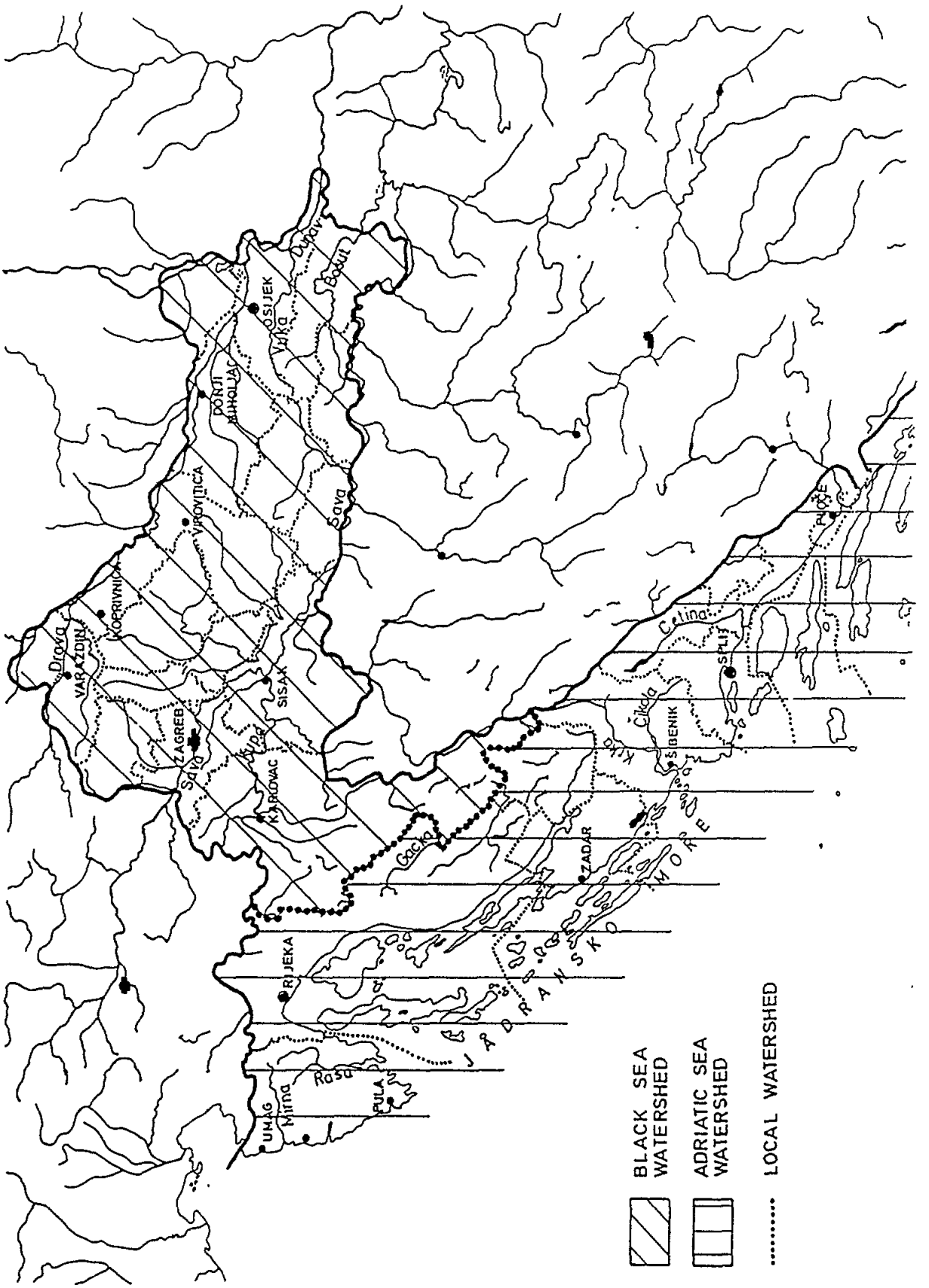
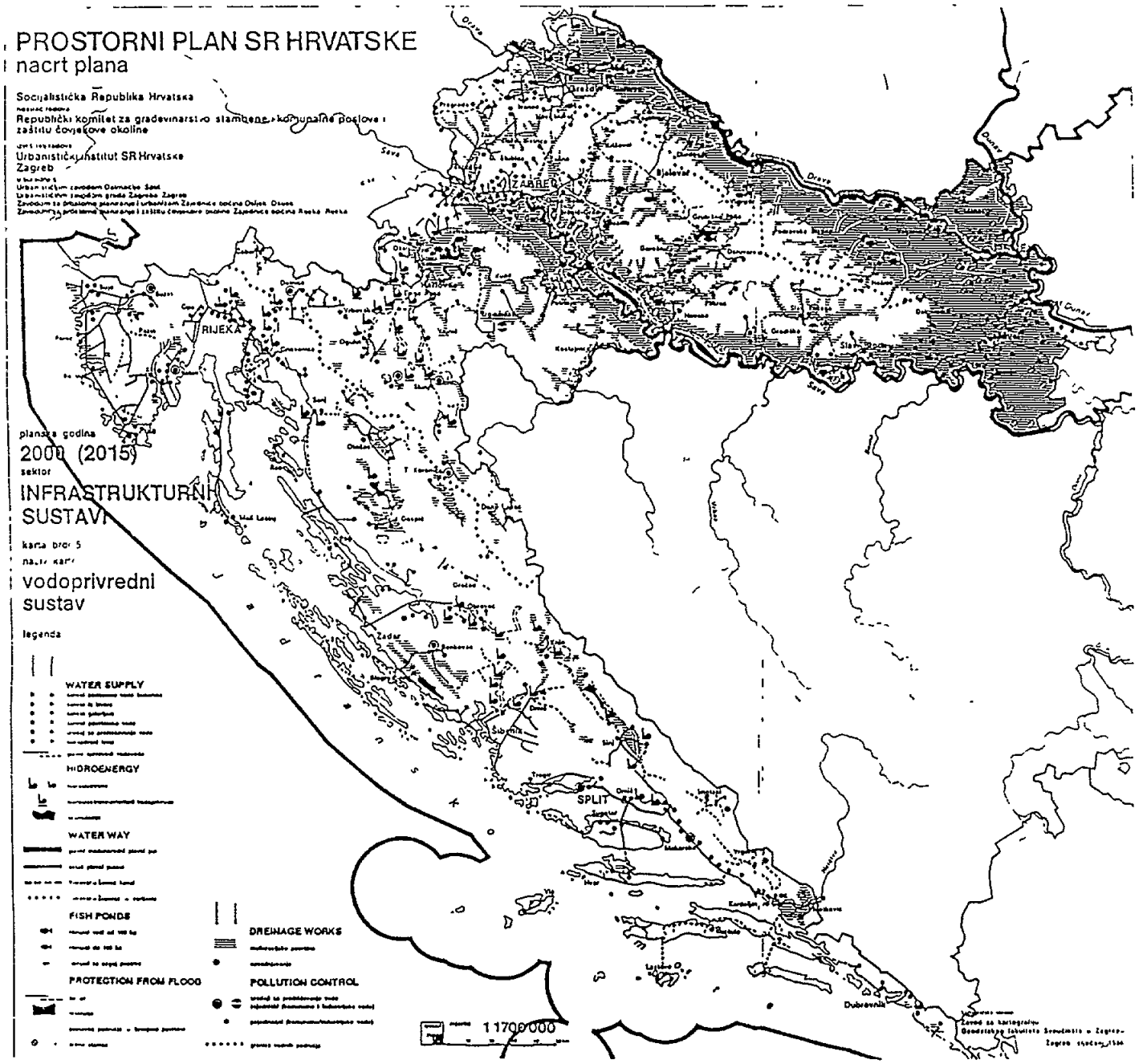


Figure 2. General water resources plan of Croatia



3.4. NATIONAL REPORT ON INTEGRATED WATER RESOURCES MANAGEMENT IN CYPRUS

Nicos TSIOURTIS(*)

3.4.1 Summary

Cyprus, with its semi-dry climate has limited water resources whose utilization must be carried out in the most efficient way. Water Legislation is comparatively old, dating before 1960, giving the right to the Government to construct waterworks and sell water. At the same time the laws do not define an administrative authority to evaluate, keep an inventory and provide control of the available water resources. The council of Ministers has the ultimate responsibility for all policy on water resources, and at the executive level, the responsibility is divided between the Ministry of Agriculture, which has the responsibility of formulating the water resources development policy (in an advisory capacity) through the Water Development Department, and that of Interior which has the legal power mainly through the District Officers. For the last twenty years Cyprus has been implementing a water master plan prepared during the period 1967-1971. A total of four integrated water resources development projects are under implementation.

Water resource plans present difficulties mainly in data availability, qualified and experienced staff shortage, legislation deficiencies and lack of administrative organizations capable to undertake such tasks.

Enhancing cooperation within the Mediterranean region may be made by organizing more workshops, encourage participation to seminars, conferences and symposiums, provide expert assistance and provide on-the-job training of engineers and managers.

3.4.2 Introduction

Cyprus is the third largest island in the eastern Mediterranean, with a total area of around 9,250 square kilometers. In the center of the island lies the Troodos range which rises to an attitude of nearly 2,000 meters, whereas on the Northern part runs the Pendadaklylos limestone range rising to an attitude of just over 1,000 meters. Between these two ranges lies the Mesaoria plain which, together with the narrow alluvial plain along the coast, makes the bulk of the agricultural land (see figure 1). Cyprus has many small rivers, originating mainly from the Troodos mountain, with deep alluvial river beds in which substantial quantities of groundwater can be stored. The rivers are not perennial, flowing mainly in winter and spring months while summer flows occur only in the upper reaches of the rivers in the Troodos range.

The island's climate is of the typical Mediterranean type, with mild and rainy winters and hot dry summers, with temperatures reaching an average minimum of 9°C in December, (being the coolest month), and an average maximum of 35°C in August, (being the hottest month).

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The overall annual average rainfall is around 500 mm, ranging from 290 mm in the plains to 1,100 mm on the Troodos range, this mostly occurring in the months of October to April. Rainfall in the warmer months May-September is very small.

The evaporation in the island varies from 1,722 mm/year in the areas of elevation 0-300 m a.m.s.l. to 1,243 mm/year in areas over 900 m a.m.s.l., with about 75% occurring in the months of May to October. Sunshine on the island is abundant during the whole year and particularly from April to September, when the average duration of bright sunshine exceeds 11 hours per day.

Generally the rainfall and evaporation pattern along with sunshine, humidity and wind, make necessary the supply of stored water for both domestic use and irrigation.

3.4.3 Water resources

Cyprus, being an island, does not have water sources other than those that result from direct rainfall on the island's surface, plus any water that is recycled or desalinated. From analysis of the rainfall pattern it has been concluded that, after deducting evapotranspiration and other losses, the conventional water resources, surface and ground water for a normal year amount to approximately 900 million cubic meters, 600 millions cubic meters being surface water and the remaining 300 millions cubic meters being groundwater. Recycled water is at present very limited, while desalinated water is limited to very small plants.

3.4.4 Water resources legislation

The water resources legislation in Cyprus has been enacted during the colonial era and still remains in force by virtue of the provisions of Article 188 of the Constitution. Additions and modifications were made on the legislation to take into account the changes.

The existing Laws totaling to around fifteen, have the following provisions:

- All groundwater resources and all surface water and wastewater are vested to the state.
- The Government has the power to construct waterworks and sell water at a price fixed by the Government and the Parliament.
- The water rights are protected and *ab-antiquo* rights are given to those who can prove that they own such rights.
- The Laws give the right to private individuals to sink or construct wells, after getting a permit from the District Officer, for groundwater abstraction.
- The Laws give the right to individuals to form Irrigation Divisions or Associations to construct irrigation works.
- The Laws give the right to villages and towns to form their own commissions for constructing their own waterworks for domestic supply.
- The Laws give the right to town or villages to form their own sewage and drainage Boards for the collection, treatment, and disposal of sewage effluent.
- The Laws do not cover environmental issues.

- The Laws, excepts in the cases of Irrigation Division, Association, Commission and Sewage Boards, do not mention the administrative authority for the water resources inventory, evaluation, allocation and control of use. This is a basic setback of the water legislation.

A total of fourteen laws, relating to water resources and waterworks are at present in force. Following are the most important clauses of the most important Laws.

i) Government Waterworks Law (Cap. 341)

This Law empowers the government to plan, design, construct, operate and maintain any waterworks, to sell water, to buy water rights, to assess water and to collect water sale bills. It also gives to the Government the powers to acquire land and decide on the water price to be charged to the consumers.

The Law vests the groundwater, surface water and waste water to the Government. However the original laws fail to mention the administrative authority for the water resources and waterworks management. An amendment made in 1968 enables the creation, by the Government, of a Committee to administer dams in accordance to Regulations defined by the Council of Ministers and ratified by the Parliament. The law also gives the authority to the Government to authorize the Director of the Water Development to define the area to be benefited by any waterworks, and to construct the necessary waterworks, for the development of the water resources, their regulation, distribution, and management of all water resources that are controlled by the said waterworks.

This law is the most important water resources law but it really fails its purpose, since it does not define **one** administrative authority for effective overall responsibility of the water resources and waterworks. The law instead bears the fragmentary nature which sure results in mismanagement of water resources.

ii) Wells Law (cap 351)

The original law gives the power to the District Officers to issue permits for the sinking or construction of a well for abstraction of groundwater, regardless of the availability of water, and not defining an authority responsible for the inventory of groundwater resources. This law was partly remedied by the Water Supply (Special Measures Law) Law of 1964 which gave to the Government the power to declare and define special measure areas for groundwater, and limited the power of the District Officers who may issue a permit for the sinking or construction of a well, within the special measure area, with the concurrence of the Director of the Water Development Department.

iii) Irrigation Division (Villages) Law (Cap 342)

This law is administered by the District Officer and he is empowered to form Irrigation Division, at his own instance or upon the written request of not less than ten land proprietors, for the purpose of carrying irrigation works. The proprietors at a general assembly decide to form a Division and elect their Irrigation Committee which, under the chairmanship of the District Officer, takes appropriate decisions. The Committee, at the approval of the District Officer, has the power to appoint a competent person or persons for the planning, design, construction, operation and

maintenance of irrigation works for the distribution of water to the proprietors' lands. Under this law, the water is linked to the land and not to the proprietors.

This Law is widely applied to small irrigation projects in the country, either for groundwater or surface water.

iv) Irrigation (Private Water) Association Law (Cap 115)

This Law is basically the same as the previous law, with the basic difference that the proprietors must have water rights.

v) Water Supply (Municipal and Other Areas) Law (Cap 350)

This Law provides for the creation of Water Boards for the four main towns of Cyprus under the chairmanship of the District Officer. Under the Law, the Water Board, governed by a Board of Directors under the chairmanship of the District Officer, has the power to build its own waterworks for water development and water distribution. However, the practice has been to limit their activities within the distribution systems and leave the rest of the water development works to the Water Development Department.

vi) Water (Development and Distribution) Law (Cap 348)

This Law provides for the creation of Committees for the purpose of taking over waterworks and managing them to safeguard availability of water for domestic purpose. To my knowledge this law has not been enacted for the last 50 years.

vii) Water (Domestic Purposes) Village Supplies Law (Cap 349)

This Law provides for the creation of village water commissions for village water supply. This law is again administered by the District Officer, and all requests are forwarded to the Water Development Department which formulates and implements the water supply projects.

viii) The Sewage and Drainage Law (1 of 1972)

This Law provides for the creation of Sewage Boards for the collection, treatment and disposal of sewage effluent and drainage water from areas defined by the Council of Ministers as "Sewage and Drainage Law Areas". The Sewage Boards are responsible for the planning, design, construction, operation and maintenance of all works required.

The Board members, in case of cities, are the city Board of Directors, elected by the citizens, chaired by the major of the city. Otherwise, the Board members and chairman are appointed by the Council of Ministers.

ix) Public Health (Marsh Areas) Law (Cap 258)

This Law provides for the drainage and reclamation of marshy areas and their conversion to agricultural or other uses. This law has not been enacted for a long time.

3.4.5 Administrative structure of water resources management

3.4.5.1 General

Water Administration means all non-physical measures that are taken to provide beneficial and effective use of water resources, and to prevent harmful effects. Such measures include legislation, which has been dealt with in the previous section, and the institutional arrangement (physical organization), required to implement the law.

3.4.5.2 Organization

The Organization chart representing the existing arrangements (as depicted in the relevant Laws) for water resources administration in Cyprus, is shown in figure 2. The chart shows three levels of activity i.e. the policy level, the executive level and the water user level.

a) Policy Level: The ultimate responsibility for the overall policy on water resources administration is with the Council of Ministers composed of eleven Ministers and joined by various independent services, such as the Attorney General, the Audit Office, and the Planning Bureau. In forming the water policy, four ministries are involved quite closely: the Ministry of Agriculture, Natural Resources and Environment, the Ministry of Interior, the Ministry of Finance, and the Ministry of Commerce and Industry. The Planning Bureau is the economic coordinator of all development budget of the Government.

b) Executive Level: Responsibilities for water administration at the executive level are primarily divided between the Ministry of Agriculture, Natural Resources and the Environment, and the Ministry of Interior. The Ministry of Agriculture, through the Water Development Department, a competent technical organization, formulates the water resources development policy, but usually in an advisory capacity. This Department is responsible for formulating and executing the overall Government policy on water resources planning, design, and construction on the island. It also operates and maintains all Government Waterwoks, and gives advice to other local organizations with regard to the operation, maintenance and management of local projects. Other Departments of the Ministry of Agriculture are the Department of Agriculture, closely concerned with irrigation matters, and the Geological Survey Department, dealing with groundwater exploration.

   The Ministry of Interior has the Legal power, mainly through the District Officers.

c) User Level: At the Water User Level, we have the following organizations:

   - Town Water Boards: These manage domestic water supplies (mainly distribution) to major towns in Cyprus. These are chaired by the District Officer of the Ministry of Interior.
   - Improvement Boards, and Village Water Committees: These manage domestic water supplies to towns and villages. These are chaired by the District Officer of the Ministry of Interior.
   - Municipal Water Supply and Sewage Boards: These manage town water supplies and town sewage collection, treatment and disposal, and are chaired by the town mayors.

- Irrigation Divisions and Associations: These manage irrigation water supplies to small systems, and are chaired by the District Officer of the Ministry of Interior.
- Waterworks Committees: These manage Government Waterworks for the supply of irrigation water (mainly large projects), and they are chaired by the District Officer of the Ministry of Interior.
- Major Waterworks (Irrigation) Division of W.D.D.: This manages the majority of Irrigation Projects delivering water to the farmers, and is managed by the Water Development Department.
- Major Waterworks (Domestic Water Supply) of W.D.D.: This manages the water treatment plants and the water conveyance pipelines which deliver domestic water to Water Boards, village water committees and other organizations, and is managed by the Water Development Department.

3.4.5.3 Execution of Water Resources Plans

The Department of Water Development, Ministry of Agriculture, Natural Resources and the Environment, is responsible for formulating and executing the overall Government policy on water resources, planning, design and construction. The plans prepared by the Water Development Department are approved and financed by the Council of Ministers. For the Government Waterworks and Irrigation Division projects, village water supplies and town water supplies financing is either through Government Funds or through loans from international financing organizations, such as The World Bank, Kuwait Fund, or the European Investment Bank. In case of sewage projects of the Sewage Boards, or works of the Water Boards the plans are prepared by the individual organizations, and their financing is done by the organizations themselves.

Generally, the Water Development Department, although not legally defined as the administrative authority for water resources management, acts like one, carrying out water resources evaluation, keeping water resources inventory, and, to some extent, excersizing control over water supplies and groundwater abstraction.

3.4.6 Water Resources Management Plans

Being a semi-arid country, Cyprus suffers from water shortage, and the groundwater resources are easier to use were developed first. By 1960, most of the aquifers were overpumped, with sea intrusion occurring in the coastal aquifers. Due to this and the fact that water demand for both domestic and irrigation uses was increasing, the Government of the Republic, with the technical assistance of FAO and U.N.D.P., embarked on an integrated water resources planning project, entitled "Surveys, Demonstrations and Planning of Water Resources Utilization Project", with a short title "Cyprus Water Planning Project" (C.W.P.P.). The objective of the plan of operation was to undertake a reconnaissance survey of the island's watershed for establishing an inventory of ground and surface resources, to estimate water demand (domestic, irrigation, and industrial) with a view of optimum use of land and water resources, to identify development projects (dams, conveyance distribution systems, and water treatment), to make broad estimates of the costs and benefits, and finally, to undertake feasibility studies of selected projects. The aspects to be studied included hydrology, soils and crops, agricultural practices, water

rights and land tenure practice, as well as existing engineering works. On the basis of these studies a phased water resources development programme was to be prepared including preliminary design for the construction of water resources development structures.

For the process of the integrated planning of water resources exploitation in the whole of the island, the island was divided into six areas, and studies on the following were carried out:

- Potential water resources: Both surface and groundwater resources were evaluated using daily meteorological data from 50 stations for the period 1916-1967, and the monthly and annual runoff into the river was computed using a specially developed mathematical watershed model.
- Available water resources: Frequency studies of streamflows of selected rivers and reservoir operation studies were carried out on the 51 years' series of hydrological data. The studies gave results as to the available surface water resources.
- Soil and land suitability: Semi detailed soil surveys were carried out by the Department of Agriculture, and suitable soils for agricultural development were selected.
- Land and water use: The current land and water uses were registered, using various ground surveys and aerial photographs. Surveys covered the water use methods and estimates of the volume of water utilized. The proposed cropping pattern for the future was based on land suitability, local climate conditions, farmers' experience and practices, profitability, market prospects, and water availability.
- Water demand (irrigation domestic and industrial): The present and future water demands for irrigation and domestic uses were estimated.
- Engineering investigations: A systematic inventory of potential dam sites throughout the island was undertaken using aerial photographs, and reconnaissance reports were prepared for 104 dam sites. Geological reports, preliminary designs and cost estimates were prepared for the most promising sites.

The integrated study was carried during the period 1967-1991 and based on the surveys, studies and investigations. Five regional major projects were identified, and later implemented as follows:

- Paphos Irrigation Project: This was implemented and its construction was completed in 1983. It provides irrigation water for an area of 5,000 ha.
- Vasilikos Pendaskinos Project: This was completed in 1986 and supplies water for the irrigation of some 1,500 ha, and domestic water for towns and villages.
- The Morphou Tylliria Project: Its feasibility study was completed in 1974 but its construction had to be shelved due to the Turkish invasion and occupation of most of the area involved in the project.
- Khrysokhou Irrigation Project: The construction of this project started in 1984 and it is expected to be completed in 1996, supplying water for irrigation to an area of 3,000 ha.

- Southern Conveyor Project: This poject, the largest single project ever undertaken by the Government, extends from Paphos in theSouth Western to Famagusta in the South Eastern part of Cyprus. It will provide water for irrigation to an area of 13,500 ha, and domestic water for towns and villages. The project is expected to be completed by 1996.

The experience gained in the preparation of the projects, their implementation and later, on their management, operation and maintenance has been great. However, beyond the technical experience there remains the fact that planning is always upset or invalidated by changes in the social, economic and other parameters, because of the great time span between the decision to implement, construction and operation of the project. Cost rises, water demands change, social conditions change, farmers preferences change, environmental requirements become more demanding, and generally, the project is not any more the one originally planned.

3.4.7 Problems encountered in the preparation of Integrated Water Resources Management Plans

The problems that are faced during the preparation of an integrated water resources management plan are the following:

- Lack of Data: Meteorological, hydrological, soil, etc.
- Staff Shortage: Lack of qualified staff at all levels of input, such as engineers, managers and technicians.
- Administrative Organization: Preparation of an integrated water resources management requires the establishment of a special multidisciplinary administrative organization to deal with all aspects.
- Legislation: Lacks in the legislation are immediately reflected in the speed of carrying out the investigation. Such deficiencies may be the right of ways, the water right definitions, the organization powers, recruitment of personnel, consultant and services, and provision of equipment and machinery.
- Financing: Financing of a project is a major item which is usually dealt with at a higher or other parallel levels of the Government, and does not constitute a serious problem.
- Methodology: The methodology of carrying out the study has been well defined with the assistance of FAO experts. Of course, methodologies are dynamic and changes depend on the availability of means and ways, such as computer hardware and software.

3.4.8 Proposals for enhancing cooperation within Mediterranean region

Cyprus has gained experience in integrated water resources planning and construction, and, at present, is working on the operation, maintenance and management of completed projects. For the last five years, the operation of the water projects in Cyprus was carried out under severe water shortage conditions which were the result of droughts.

Cooperation within the Mediterranean region could be enhanced in the following ways, beyond the workshop organized by P.A.P:

- Organize more workshops to encourage more experts and engineers to get interested in the subject.
- Encourage participation to seminars, conferences and symposiums, organized in the Mediterranean region on subjects related to integrated water resources planning under the Mediterranean conditions. This can be done by financing participation.
- Provide expert assistance to countries that require such assistance. This can be done through UNEP-MAP/PAP by recruiting experts on various subjects.
- The best way to transfer know-how and expertise to countries and individuals is on-the-job training of experts, by appointing international experts to carry out actual studies on pilot projects jointly with local counterparts.

Fig. 1

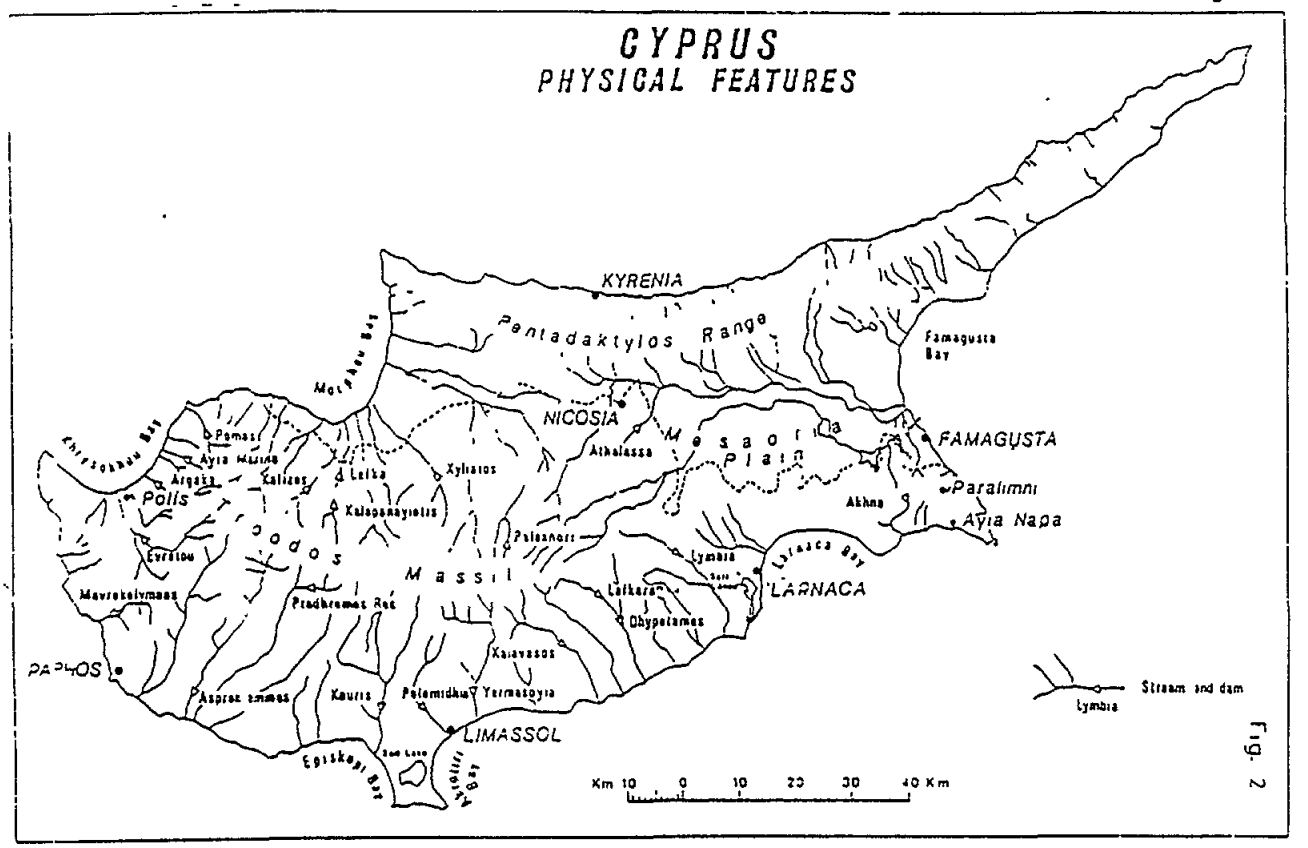
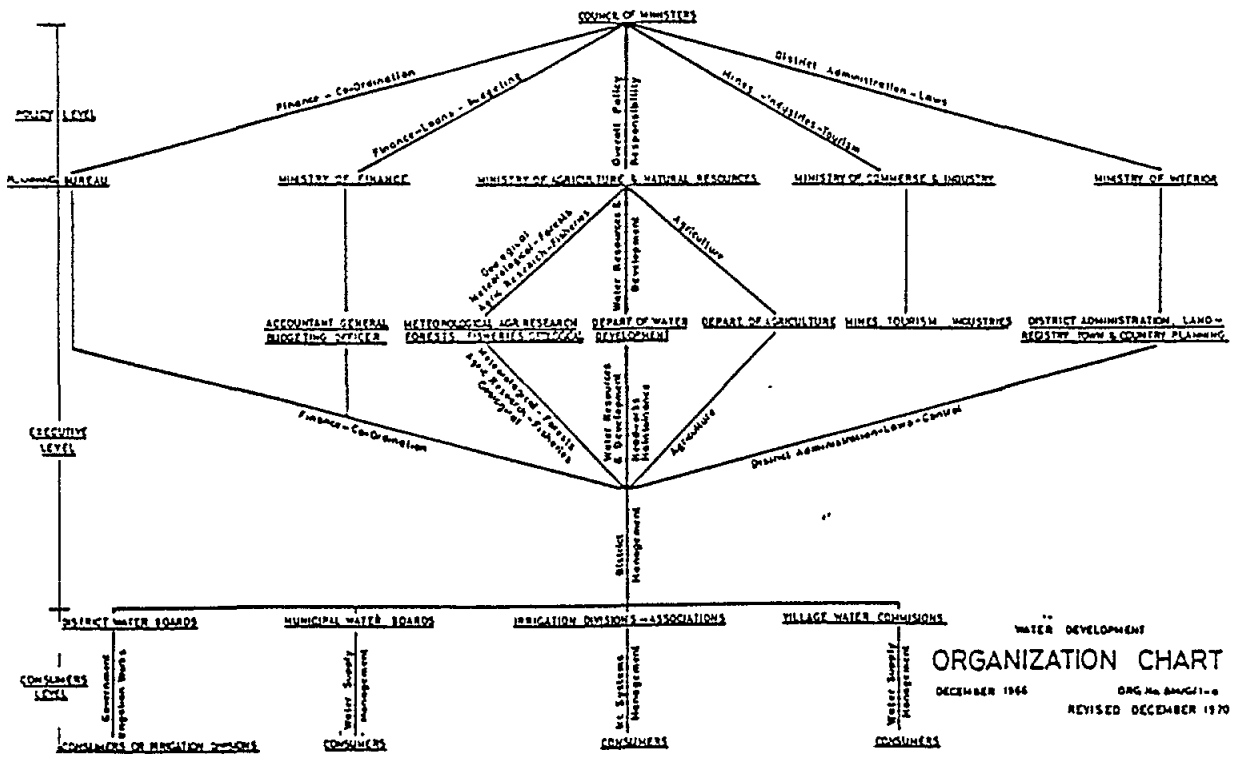

CYPRUS
PHYSICAL FEATURES
KYRENIA
Pentadaktylos Range
Morfou Bay
NICOSIA
Famagusta Bay
Chrysochou Bay
Pomos
Ayia Marina
Argaka
Kalizoes
Polis
Lefka
Xylotos
Kalogeneyiotis
Athalassa
Mesaoria Plain
FAMAGUSTA
Paralimni
Akhna
Ayia Napa
Evrykou
Troodos Massif
Psematismenos
Lymbia
Larnaca Bay
LARNACA
Mavrokolymnos
Pradhromos Res
Lefkara
Dhypelamos
PAPHOS
Asprokremmos
Kouris
Polemidhia
Yermasoyia
Kalavasos
LIMASSOL
Episkopi Bay
Sea Level
Km 10 0 10 20 30 40 Km
Stream and dam
Lymbia
Fig. 2

Fig. 2


COUNCIL OF MINISTERS
POLICY LEVEL
Finance - Co-Ordination
Finance - Loans - Budgeting
Current Policy Responsibility
Mines - Industries - Tourism
District Administration - Laws
PLANNING BUREAU
MINISTRY OF FINANCE
MINISTRY OF AGRICULTURE & NATURAL RESOURCES
MINISTRY OF COMMERCE & INDUSTRY
MINISTRY OF INTERIOR
Geological - Meteorological - Forests - Agric. Research - Fisheries
Water Resources & Development
Agriculture
ACCOUNTANT GENERAL BUDGETING OFFICER
METEOROLOGICAL SERVICE AGR. RESEARCH FORESTS FISHERIES GEOLOGICAL
DEPART. OF WATER DEVELOPMENT
DEPART. OF AGRICULTURE
MINES TOURISM INDUSTRIES
DISTRICT ADMINISTRATION, LAND - REGISTRY TOWN & COUNTRY PLANNING
EXECUTIVE LEVEL
Finance - Co-Ordination
District Administration - Laws - Control
District Management
DISTRICT WATER BOARDS
MUNICIPAL WATER BOARDS
IRRIGATION DIVISIONS - ASSOCIATIONS
VILLAGE WATER COMMISIONS
CONSUMERS LEVEL
Government irrigation Works
Water Supply Management
Irr. Systems Management
CONSUMERS OR IRRIGATION DIVISIONS
CONSUMERS
CONSUMERS
CONSUMERS
WATER DEVELOPMENT
ORGANIZATION CHART
DECEMBER 1966
REVISED DECEMBER 1970

3.5 LE SYSTEME DE GESTION INTEGREE DE L'EAU EN FRANCE: Les S.A.G.E. et les S.D.A.G.E.

Jean-Loïc NICOLAZO(*)

La nécessité, officiellement reconnue par la loi, d'inscrire la politique de l'eau dans une démarche de gestion intégrée est, en France, très récente. C'est l'un des objectifs majeurs retenus par **la loi sur l'eau du 3 janvier 1992.**

Dorénavant, contrairement aux pratiques antérieures, l'eau partie intégrante du **patrimoine commun de la Nation**, doit faire l'objet d'une gestion équilibrée. Cette gestion équilibrée vise à assurer la préservation des écosystèmes aquatiques de manière à satisfaire et concilier les usages économiques et plus généralement, l'ensemble des activités humaines. Les références aux objectifs de développement durable sont claires: c'est par une gestion intégrée de l'eau que les usages économiques pourront continuer à s'exercer et la préservation intelligente des écosystèmes aquatiques constitue un préalable parce qu'elle est la garantie de l'avenir que ces usages économiques peuvent légitimement revendiquer.

La gestion équilibrée - ou intégrée - des ressources en eau s'inscrit donc dans une nouvelle dynamique. Elle bénéficie en France d'un cadre - le bassin hydrographique - et d'outils nouveaux de planification - les SDAGE et les SAGE. Ces outils se mettent actuellement en place.

3.5.1 Le bassin hydrographique: un cadre précurseur de la gestion intégrée en France

La gestion intégrée des eaux suppose un cadre institutionnel ou d'organisation de décision qui puisse précisément répondre à l'ensemble des contraintes à prendre en compte. D'où l'intérêt primordial de l'approche par bassin hydrographique dans une démarche de gestion intégrée : l'eau ne connaît pas de frontières, encore moins de limites administratives. La réalité physique hydrographique exige de pouvoir être en mesure d'apprécier les effets sur l'aval de toutes décisions prises en amont.

Il se trouve que la France, avec la loi du 16 décembre 1964, s'est dotée depuis déjà 30 ans d'institutions de bassin: les agences et comités de bassin. Ces organismes, répartis à l'échelle des six grands bassins hydrographiques (voir carte ci-jointe) représentent des mécanismes d'intervention tout à fait à part dans le contexte administratif français.

Les agences de bassin - communément appelées agences de l'eau - sont des établissements publics de l'Etat placés sous la tutelle technique du Ministère de l'Environnement et le contrôle financier du Ministère du Budget. Leurs mécanismes de fonctionnement sont en pratique très souples et les décisions qu'elles prennent dans les aides financières qu'elles attribuent sont systématiquement prises avec l'accord des représentants des usagers industriels et des représentants des collectivités locales. Ces

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derniers sont membres du Conseil d'Administration après avoir été désignés par le collège correspondant du Comité de Bassin.

Le Comité de bassin représente le pouvoir délibératif. Il est composé de représentants de l'Etat, de représentants des collectivités locales et de représentants d'usagers selon une répartition où ces deux derniers collèges dominent systématiquement comme le montre le tableau en annexe 1.

Le rôle essentiel des comités de bassin, prévu par la loi du 16 décembre 1964, est de procéder à l'adoption d'un programme pluriannuel d'intervention d'une durée de 5 ans, proposé par les agences de l'eau. Il consiste surtout à autoriser la perception de redevances (frappant principalement la pollution et les prélèvements d'eau) qui vont, sur cette période, permettre de réaliser les investissements nécessaires. Le Comité de Bassin, toutes proportions gardées, constitue un "Parlement de l'Eau" qui comme tel joue un rôle majeur dans l'adoption de ces "impôts" particuliers que sont les redevances perçues par les Agences de l'Eau. Chaque Comité de Bassin s'est doté d'un Président issu du collège des élus locaux. Cette prééminence des élus locaux est tout à fait cohérente avec le parti pris d'intégrer ces mécanismes dans une démarche de décentralisation.

Ce bref rappel est utile pour constater qu'au moment où sont apparues les exigences nouvelles d'une gestion intégrée des eaux, la France disposait de cet acquis indispensable que représentent les organismes de bassin. Elle bénéficierait ainsi de structures où déjà la solidarité de bassin était présente et où surtout l'ensemble des forces économiques représentant les partenaires d'une gestion équilibrée avait pris l'habitude de se concerter en vue de prendre des décisions d'intérêt commun. Ces partenaires avaient aussi pris l'habitude et la pratique d'une vision programmatique des investissements à réaliser dans le domaine de l'eau. La logique de programme d'intervention qui rythme tous les cinq ans la politique des agences, était très proche d'une démarche de planification. C'est cette démarche que la loi du 3 janvier 1992 a délibérément décidé de favoriser à travers des outils nouveaux de planification des ressources en eau. **L'option prise en France est en effet d'associer étroitement gestion intégrée des eaux et planification.**

3.5.2 Les SDAGE et les SAGE: outils de planification et de gestion intégrée

L'idée de départ des auteurs du texte, qui devait par la suite devenir la loi sur l'eau du 3 janvier 1992, était d'organiser une démarche locale à l'échelle d'une rivière ou d'un petit bassin associant l'ensemble des usagers de l'eau. L'ambition était de réunir les partenaires afin qu'ils s'associent dans un projet commun. De la sorte, une autre voie que celle autoritaire de l'administration, ou contentieuse représentée par les tribunaux, pouvait être trouvée dans le règlement des conflits d'usage. C'est ainsi que furent conçus les Schémas d'Aménagement et de Gestion des Eaux, très directement inspirés des Schémas Directeurs d'Aménagement et d'Urbanisme. Les parlementaires considèrent toutefois que ces SAGE devaient s'inscrire dans une logique plus large: celle des bassins hydrographiques mis en place par la loi du 16 décembre 1964.

C'est ainsi que nous disposons désormais en France de deux mécanismes de planification et de gestion intégrée très proches:

- les Schémas Directeurs d'Aménagement et de Gestion des Eaux : les SDAGE
- et les Schémas d'Aménagement et de Gestion des Eaux : les SAGE

Si ces deux outils procèdent d'une démarche similaire, la différence d'échelle à laquelle ils sont appelés à intervenir induit des modalités d'élaboration particulières.

3.5.2.1 Les SDAGE s'établissent au niveau de chacun des 6 bassins

Leur élaboration est confiée à chacun des Comités de Bassin - en réalité les services de l'Agence de l'Eau en liaison avec la Direction Régionale de l'Environnement - Déléguée de Bassin (voir tableau structures administratives dans le domaine de l'eau, annexe II). Sont associés à cette élaboration, les représentants de l'Etat, des conseils généraux et régionaux. Le SDAGE doit définir les orientations fondamentales d'une gestion équilibrée de la ressource en eau. Il prend ainsi en compte les principaux programmes arrêtés par les collectivités publiques et définit les objectifs de quantité et de qualité des eaux ainsi que les aménagements à réaliser pour les atteindre. Les programmes et les décisions administratives dans le domaine de l'eau doivent être compatibles ou rendus compatibles avec leurs dispositions. Le SDAGE doit être adopté par le Comité de Bassin et approuvé par l'autorité administrative. Il est mis à la disposition du public.

La loi impose que les SDAGE devront intervenir dans un délai de cinq ans à compter de sa publication. Le tableau de marche d'élaboration de ces documents laisse penser que cette obligation sera simplement respectée (voir annexe III). Le lancement des travaux a conduit à préciser certains points.

La force juridique du SDAGE: la mise en oeuvre d'un SDAGE va poser à cet égard plusieurs questions. Tout d'abord, le caractère d'opposabilité aux tiers et du niveau contraignant du SDAGE. Le SDAGE sera un acte administratif dans lequel l'Etat se sera engagé par son approbation. Les options qu'il prendra constitueront une "règle du jeu" qu'il aura -en tant que partenaire - à faire respecter. La difficulté est que cette "règle du jeu" prend comme échelle le bassin alors que, dans la plupart des cas, les décisions d'autorité (la police administrative) se prennent au niveau départemental. La cohérence de ces deux niveaux, d'échelle très nettement différente, est sauvegardée en termes de **compatibilité**: les décisions locales ne doivent pas, à leur échelle, mettre en cause le déroulement du SDAGE. Cette notion de compatibilité est délibérément souple et bien souvent elle sera affaire d'appréciation soumise en cas de contentieux à la sanction des tribunaux administratifs. Inversement, il ne faut pas que le SDAGE descende à une échelle trop petite, celle à laquelle se prennent ces décisions. Sans quoi la capacité d'appréciation des situations de terrains par les échelons départementaux se verrait remise en cause. Il y a là un équilibre à trouver.

Le coût économique du SDAGE: il faut garantir une entière crédibilité du SDAGE. Pour éviter qu'il devienne un catalogue de bonnes intentions, le réalisme du coût des orientations qu'il propose s'impose. Il ne s'agit pas d'établir un devis ou un bilan coût-avantage très détaillé, mais il importe de rester dans des évaluations crédibles qui permettent à tout moment aux prescripteurs de rester réalistes.

La durée du SDAGE: chacun sait qu'en matière d'eau les investissements ont des "retours" très longs et que le coût moyen est, en comparaison avec d'autres types d'investissements, assez lourd. Ces contraintes entraînent une durée de prévision de l'ordre de dix ans. Cette durée a été choisie parce qu'elle correspond opportunément à la période couverte par deux programmes d'intervention des Agences de l'Eau. Or, il ne fait aucun

doute que les Agences se verront fortement impliquées (elle en sont les co-auteurs intellectuels) par les SDAGE.

Ces trois éléments caractérisent assez bien la démarche des SDAGE; ils ont pour vocation d'établir une planification souple à l'échelle d'un bassin, qui engage les trois partenaires traditionnels que sont l'Etat, les collectivités locales et les usagers de l'eau.

3.5.2.2 Les SAGE interviennent à l'initiative locale

A l'échelle d'un sous-bassin, d'une vallée ou d'une rivière, la loi a prévu des SAGE. Ces documents sont de même nature et proposent une démarche comparable, adaptée à leur périmètre, que les SDAGE. Ils sont toutefois soumis à une procédure très précise.

La phase préliminaire d'initiation d'un SAGE sur un périmètre donné, que celui-ci ait été pré-identifié ou non par le SDAGE. Cette phase préliminaire à l'établissement du SAGE peut être à l'initiative ou à la demande :

- d'acteurs institutionnels (préfets, organismes de bassin),
- ou d'acteurs locaux qui "spontanément" ressentent la nécessité d'une telle démarche (collectivités territoriales, associations locales, groupes d'usagers,...).

Elle est appuyée par un **dossier argumentaire** qui débouchera sur des arrêtés préfectoraux:

- de délimitation du périmètre par le (ou les) préfet(s) concerné(s), précisant en outre le préfet chargé de la procédure,
- de constitution d'une Commission Locale de l'Eau (CLE) sur la base de propositions et de consultations des acteurs locaux concernés.

Dans cette phase, le (ou les) préfet(s) concerné(s) a (ont) un rôle décisif d'accompagnement puis de relais des initiatives locales.

La phase d'élaboration du SAGE, conduisant de l'analyse de l'existant, en termes d'usages et de fonctionnement du milieu aquatique, à la définition d'une stratégie globale établie collectivement, et à sa traduction en orientation de gestion et d'actions. Cette phase majeure de l'établissement du SAGE se subdivise en deux parties distinctes:

- la conception du projet de SAGE par la CLE en six séquences successives : état des lieux/Diagnostic global/Tendances et scénarios/Choix de la stratégie/Les produits du SAGE/Validation finale,
- son approbation par le préfet concerné après sa mise à disposition du public.

L'approche intégrée voulue par la loi, de la préservation des milieux aquatiques et de la valorisation de la ressource, implique la connaissance du fonctionnement des écosystèmes ainsi que celle de la totalité de la ressource, et de l'ensemble des usages. Elle implique également l'évaluation de l'impact économique des principales orientations de mise en valeur envisagées.

La phase de mise en oeuvre et de suivi qui, à l'aide d'un tableau de bord, permet à la CLE un suivi permanent des actions, des résultats sur le milieu,...

A noter que le **comité de bassin donnera un avis** sur le projet de périmètre et son argumentation à l'issue de la phase préliminaire, et sur le projet de SAGE avant son

approbation par l'autorité préfectorale. De plus, il sera tenu informé sur la mise en oeuvre du SAGE en veillant au respect des orientations et contraintes, notamment des paramètres de continuité définis par le SDAGE.

A l'issue de son élaboration, le **SAGE affichera clairement les objectifs à atteindre** en termes de milieux et d'usages retenus par les membres de la CLE. En vue des objectifs le SAGE devra déboucher sur différentes sorties dont, notamment :

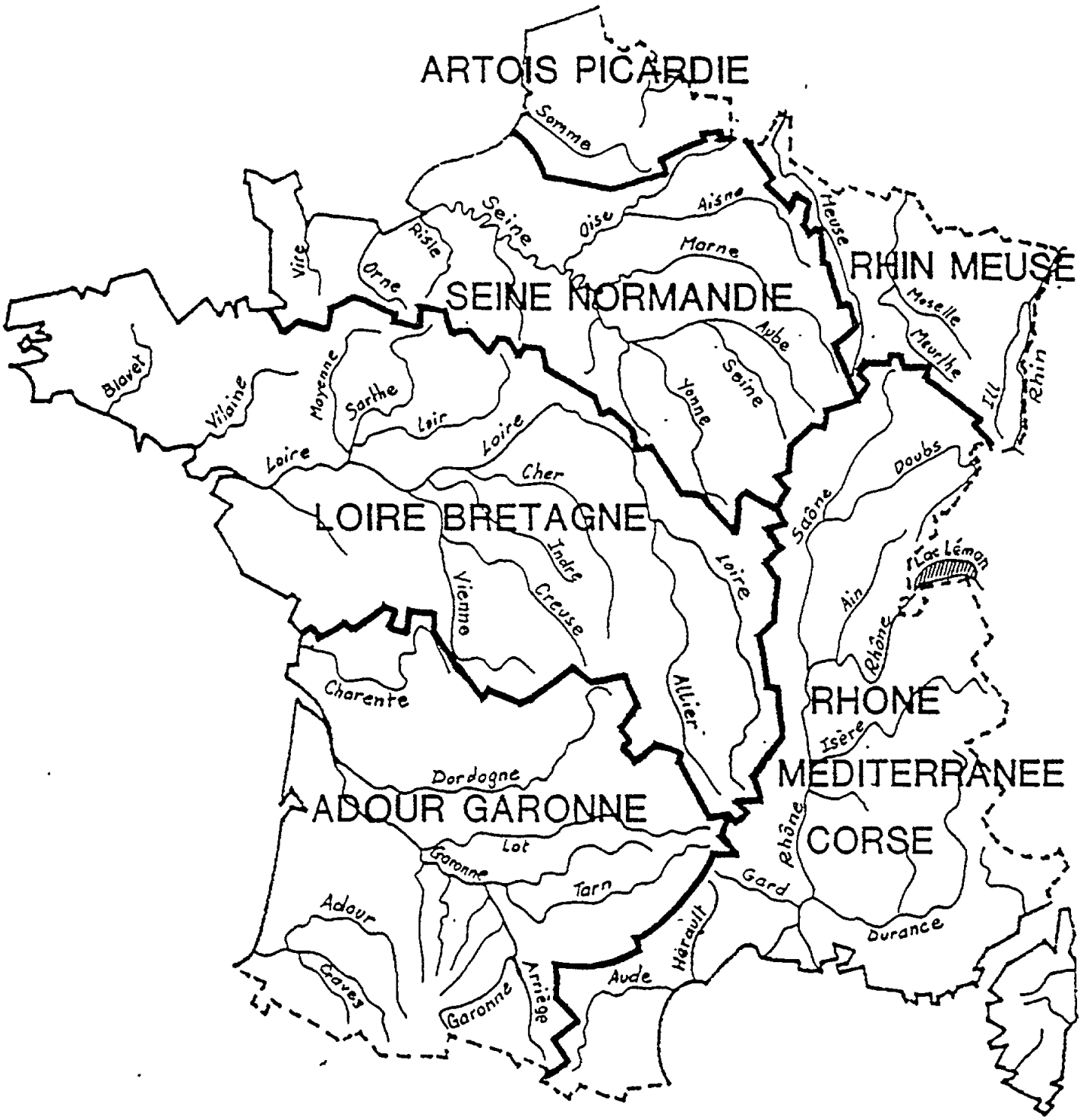
- **Les orientations de gestion**: les préconisations et recommandations établies collectivement sont l'expression de la stratégie adoptée en termes de gestion. Ces dispositions deviendront après les adoptions la nouvelle traduction locale de la réglementation qui sert de cadre à l'exercice de la police des eaux et des milieux. Elles s'imposeront aux décisions et actions de police de l'Etat, et ne pourront pas être moins contraignantes que celles fixées par la réglementation générale en matière d'eau.

  Tous les acteurs et les programmes en relation avec les milieux aquatiques et la ressources en eau en particulier auront à les respecter. Le schéma identifiera, en outre, les conséquences de ces dispositions sur les décisions administratives prises dans le domaine de l'eau.

- **Les orientations d'aménagement:** Le SAGE, outil opérationnel, débouchera également sur des orientations en termes de programmation des actions sur le terrain. Ces orientations pourront se traduire concrètement par des programmes d'aménagement (opérations de dépollution, d'aménagement ou de restauration de rivière, d'exploitation-protection de nappe, etc....) nécessaires pour atteindre les objectifs retenus avec évaluation des principales phases de réalisation et des moyens financiers correspondants.

  Ces programmes pourront faire l'objet de contrats entre les maîtres d'ouvrage concernés et les financeurs potentiels: Etat, collectivités, agence de l'eau, notamment au travers **des contrats de rivière et de baie.**

L'état d'avancement des SAGE, limité à leur phase préliminaire d'élaboration, est présenté dans l'annexe IV.

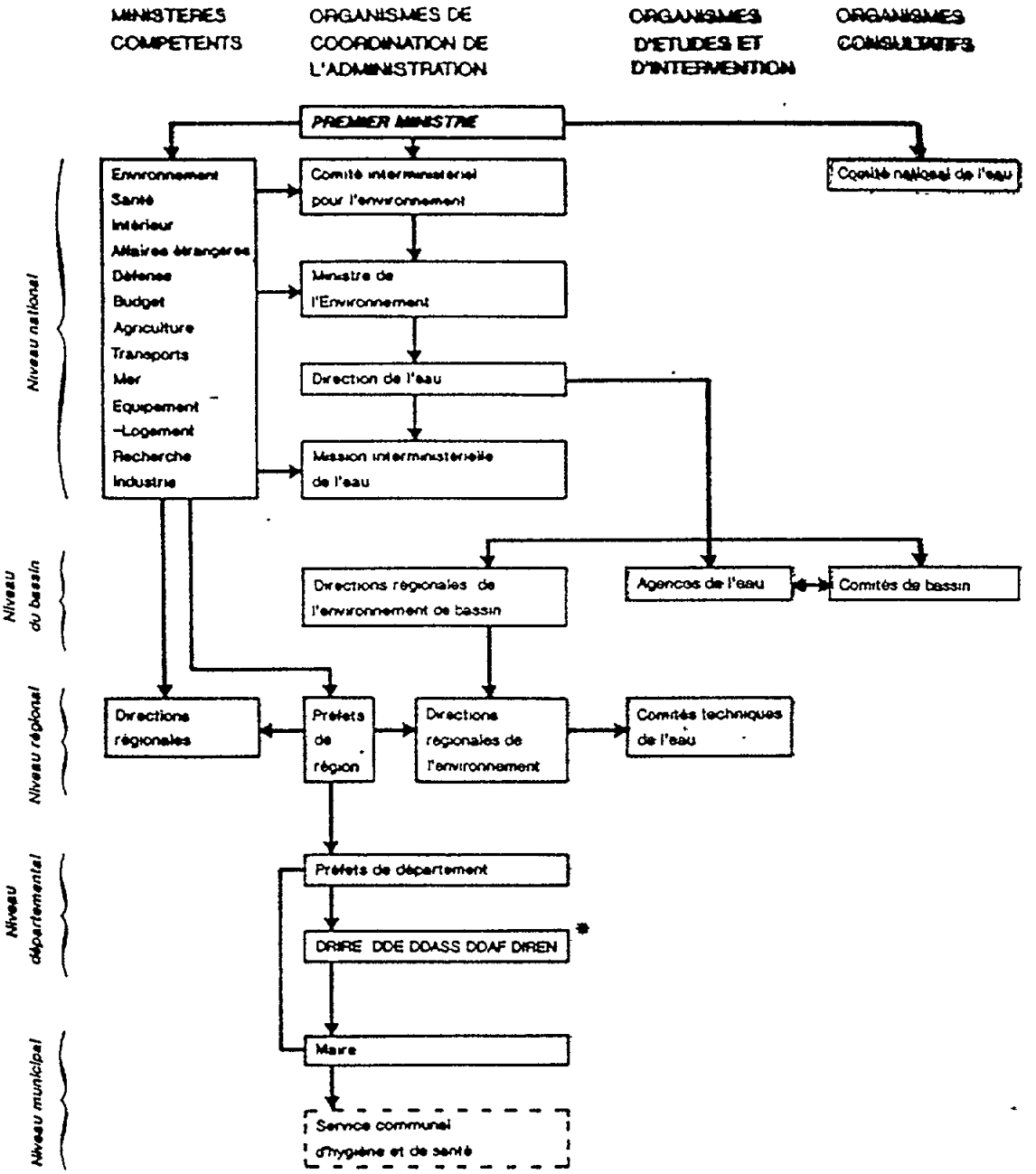

ARTOIS PICARDIE
Somme
Seine
Oise
Aisne
Meuse
Marne
RHIN MEUSE
Vire
Risle
Orne
SEINE NORMANDIE
Moselle
Meurthe
Ill
Rhin
Aube
Seine
Yonne
Blavet
Vilaine
Mayenne
Sarthe
Loir
Loire
Loire
Cher
Doubs
Saône
LOIRE BRETAGNE
Indre
Creuse
Vienne
Loire
Lac Léman
Ain
Rhône
Charente
Allier
RHONE
MEDITERRANEE
CORSE
Isère
Dordogne
ADOUR GARONNE
Lot
Garonne
Tarn
Rhône
Gard
Durance
Adour
Hérault
Aude
Ariège
Garonne
Gaves

ANNEXE I

COMPOSITION DES COMITÉS DE BASSIN

Représentants des circonscriptions de Bassin	Régions	Départements	Communes	Usagers et personnes compétentes	Milieux socio-professionnels	Administrations de l'État	TOTAL des membres
Adour-Garonne	6	18	6	30	6	18	84
Artois-Picardie	3	17	5	25	2	14	66
Loire-Bretagne	8	28	6	42	8	22	114
Rhin-Meuse	3	14	5	22	3	14	61
Rhône-Méditerranée-Corse	6	28	6	40	6	21	107
Seine-Normandie	7	25	6	38	7	20	103

STUCTURES ADMINISTRATIVES DANS LE DOMAINE DE L'EAU



* DRIRE —— *Direction régionale de l'industrie et de la recherche*
DDE —— *Direction départementale de l'équipement*
DDASS —— *Direction départementale de l'action sanitaire et sociale*
DDAF —— *Direction départementale de l'agriculture et des forêts*
DIREN —— *Direction régionale de l'environnement*

PROCEDURE D'ELABORATION DES SDAGE DANS LES SIX GRANDS BASSINS FRANCAIS

BASSINS	ADOUR-GARONNE	ARTOIS-PICARDIE	LOIRE-BRETAGNE	RHIN-MEUSE	RHONE-MEDIT.-CORSE	SEINE-NORMANDIE
ELABORATION	UNE COMMISSION SPECIALISEE QUI AGIT POUR LE COMPTE DU COMITE DE BASSIN					
METHODE DE TRAVAIL	8 Commissions géographiques	2 Commissions géographiques	7 Commissions géographiques 7 Commissions thématiques	6 Commissions thématiques	10 Commissions géographiques	5 Commissions géographiques + 1 inter-groupe
ETAT D'AVANCEM. (FIN 1993)	Avant-projet SDAGE	* Premières orientations SDAGE * Approfondissements thématiques	Document provisoire d'orientation du SDAGE	* Première esquisse SDAGE * Croisement avec approche géographique	* Atlas du bassin RMC * Identification de 7 thèmes génériques majeurs	* Document d'orientation du SDAGE * Identification thèmes à approfondir
CALENDRIER PREVISIONNEL	1er semestre 1994 : Préparation avant-projet SDAGE 2ème semestre 1994 : Elaboration projet définitif 1995 : Consultation officielle des collectivités régionales et départementales 1996 : Adoption et approbation SDAGE	1er semestre 1994 Préparation document provisoire 2ème semestre 1994 : Elaboration projet 1995 : Consultation officielle conseils régionaux et conseils généraux Fin 1995 : Adoption et approbation SDAGE	1994 : Association des services de l'état, des régions et des départements 1995 : * Projet SDAGE * Consultation officielle conseils régionaux et conseils généraux 1996 : Adoption et approbation SDAGE	1994 : * Poursuite approche géographique Elaboration deuxième esquisse SDAGE 1995 : Consultation officielle conseils régionaux et conseils généraux 1996 : Adoption et approbation SDAGE	1er semestre 1994 Premières propositions d'orientation SDAGE fin 1994 : Première version juridique du SDAGE 1995 : Consultation officielle conseils régionaux et conseils généraux 1996 : Adoption et approbation SDAGE	1994 * Approfondissements thématiques et géographiques * Synthèse sous forme d'un projet de SDAGE 1995 : Consultation officielle conseils régionaux et conseils généraux 1996 : Adoption et approbation SDAGE

ANNEXE IV

ETAT D'AVANCEMENT DES SAGE

(situation à fin septembre 1994)

BASSINS	PHASE D'EMERGENCE	PHASE INSTRUCTION (avis CB sur périmètre)	PHASE ELABORATION CLE constituée	TOTAL
ADOUR-GARONNE	7	-	-	7
ARTOIS-PICARDIE	2	1 (1)	-	3
LOIRE-BRETAGNE	15	4 (3)	-	19
RHIN-MEUSE	1	2 (1)	-	3
RHONE-MEDIT-CORSE	11	9 (6)	3	23
SEINE-NORMANDIE	10	1	1	12
ENSEMBLE METROPOLE	46	17 (11)	4	67

PERIMETRES SAGE ARRETES

DESIGNATION	SURFACE (km^2)	NBRE. DE COMMUNES	PROBLEMES - ENJEUX
BASSIN ARTOIS-PICARDIE AUDOMAROIS	668	72	Protection de milieux remarquables Développement des usages
BASSIN LOIRE-BRETAGNE VIENNE	6 850	308	Gestion de la ressource - Irrigation - AEP Hydroélectricité
VILAINE	10 900	515	Gestion de la ressource - Irrigation AEP
LAC DE GRANDLIEU	850	44	Protection de milieux remarquables Eutrophisation - Dépollution
BASSIN RHIN-MEUSE BASSIN FERRIFERE	2 729	234	Gestion systèmes aquifères et superficiels AEP
BASSIN RHONE-MEDIT.-CORSE HAUT DOUBS - HAUTE LOUE	2 325	201	Protection de milieux remarquables Eutrophisation - Gestion ressources
DRANSES	530	32	Gestion cohérente avec le Léman Hydroélectricité - Dépollution
DROME	1 700	83	Gestion de la ressource - Irrigation Tourisme - Extraction Protection de milieux remarquables
GARDONS	2 157	148	Gestion de la ressource - Irrigation - AEP Extraction - Protection contre les inondations
BASSE VALLEE DU VAR	346	20	Préservation qualitative de la ressource Maîtrise de l'urbanisme Lutte contre les inondations
ETANG BIGUGLIA	180	15	Préservation milieux remarquables Gestion de la ressource/dépollution Maîtrise fonctionnement hydraulique
ARC PROVENCAL	727	30	Protection des milieux - Dépollution - Lutte contre inondations-Dépollution-Lien avec Berr
PETITE CAMARGUE GARDOISE	377	8	Protection milieux aquatiques remarquables Maîtrise fonctionnement hydraulique Restauration qualité eaux souterraines et superficielles
LEZ/MOSSON/ETANGS PALAVASIENS	536	43	Préservation milieux aquatiques Dépollution - Lutte contre inondations
BASSIN SEINE-NORMANDIE LA MAULDRE	539	66	Dépollution - AEP Protection contre les inondations

3.6 INTEGRATED WATER RESOURCES MANAGEMENT IN GREECE

George D. KOUNIS (*)

It is very well known that water, apart from its vital and unique value for living beings, constitutes the natural asset that enters, and is highly demanded in almost every human activity.

Water resources and life must be considered as a tightly linked natural system that can tolerate no violation.

There is no development, production, consumption, social or economic growth without water being the basic resource. It largely influences productivity; it offers the possibilities towards new activities and processes.

Taking into account these vital facts, policy and decision making on water resources must be given the maximum attention, significance and priority.

Water resources, on the other hand, are associated with a number of problems, in many cases serious, that are of natural, engineering, environmental, financial, legal or social natures. And this because water resources are an economic asset, i.e asset to which choice and scarcity are associated. The latter should be understood as absolute, brought about by some natural causes (drought, unfavourable hydrogeology, etc.) or as relative, man-made causes (price policy, excess of water demand, etc.).

To face these problems in an efficient way, it was recognized in my country, that a national water policy, based on a rational water resource management, was an imperative need. And this need is well understood in our days when water demands, development, shortages, environmental constraints and conflicts are maximal. Consequently, water resources cannot be otherwise considered but in their integrated aspect and significance.

The Law on the Management of Water Resources, in force since 1987, is thought as the most efficient tool to this aim. A law that replaced past water legislation and regulations, at least in that they did not define, or cope with, a generalized structure or framework.

Procedures and bodies exerting water resources management at national and regional levels have been established, and focus on two poles:

- the one, predominantly natural i.e the water abstraction and supply, the returns and impact on the natural environment;
- the other, predominantly socio-economic, i.e the water demand and use.

More specific actions are directed towards the targets of:

- correcting and adjusting in space and time the natural supply deficit;

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- concerning and intervening on the damages associated with surplus of water;
- minimizing the supply-demand gap;
- avoiding or settling the conflict between competitive uses;
- channeling the demand to those uses that are compatible with the development plans.

These targets are achieved by means of planning the water resource transfer, regulation and preservation, and through interventions, with socio-economic criteria, to the resource supply, the environmental characteristics, and to the demand for every use.

In this context, the water resources management of my country has well understood the need for a simultaneous and coordinated action within four components:

- legal and organizational structure;
- economics and financing (determination of needs through development plans, allocation of economic resources to the various uses, etc);
- socio-environmental (behaviour study and stimulating, environmental protection, etc);
- technologic (modern infrastructure plans incorporated in the national policies, etc.);

However, two major categories of problems still exist and make difficult the water resources management. These are:

- the water supply and demand unevenly distributed in space and time;
- the geographically unbalanced development; and
- the general organizational structure that prevented coordination and a uniform policy.

Water resources are largely in scarcity and this is quite well shown by:

- the conflict among big users, e.g. in the Aliakmon, river between irrigation (Ministry of Agriculture) and hydropower (Public Power Corporation);
- the necessity for large schemes (e.g. the distant Mornos and Evinos reservoirs for the water supply of Athens, the deviation of Aliakmon river to the Thessaly plain, etc); and
- the necessity for bilateral agreements concerning trans-boundery rivers, etc.

Water in Greece is characterized as a natural asset to serve the needs of the Greek society. The management is exerted by the state, and social partners participate in the regional planning.

The whole of the country is divided in 14 Water Districts to serve as regional administrative units for the water resources (shown in the attached map).

The Ministry of Industry, Energy and Technology (MIET) with its Central and Regional Services for Water and Natural Resources, acts as a governing body in the water resources management.

As consultancy bodies, act an Interministerial Committee for Water (ICW) in the MIET, and Regional Water Committees, one in each Water District (RWC).

Decisions at the political level are made jointly by the Ministers, principally those of the Interior (MI), National Economy (MNE), Agriculture (MA), Environment and Public Works (MEPW), and Industry (MIET), and others if the case demands.

The following authorities are competent for the water use and exploitation:

- The Ministry of Agriculture for irrigation, livestock, fishery, rural industry;
- The Ministry of Interior: for the domestic and municipal use except for the water supply of Athens and Thessaloniki for which the Ministry of Environment and Public Works is competent;
- The Ministry of Environment and Public Works: for use associated with the protection of the water resources;
- The Ministry of Industry, Energy and Technology: for industrial and power use, as well as for other uses not included in this list;
- The Ministry of Transports and Communications: for navigation;
- The Ministry of Culture: for water use in sports;
- The National Tourist Organization: for the recreational use and the spas.

Concerning the exploration and assessment of water resources, the competent authorities are:

- The Ministries of Interior, Agriculture, Health, Environment, Industry;
- The Institute of Geology and Mineral Exploration;
- The Public Power Corporation;
- The National Meteorological Service;
- The National Centre for Sea Research;
- Universities and other research institutes.

The MIET, with its Water Resources Services, is competent for the elaboration and submission to approval of the development plans for the water resources.

The plans are distinguished in:

- long-term national plans (longer than 5 years);
- national, short-term;
- local, short-term, and plans for specific purposes.

The long-term plans are worked out in the Central Service of the MIET, after proposals have been made by the Exploration, Exploitation and Use Authorities, and are approved by the above listed Ministers, deciding at the political level.

Procedures for the short-term plans are similar to the long term, after proposals and consultation of the local Water Committees and Services. Approved short-run national water plans are incorporated in the socio-economic development plans.

Water development plans, either nation- or water-district-wide, are further specified and adapted to the particularities of the river basins, aquifers, etc. by the Regional Water Services.

Control is foreseen is for the cases when the adaptation and specification fall outside the approved plans framework.

An indicative budget is included in the short-run water plans, while the enrollment of the water resources projects into the budget of public investments or other financing scheme is duty of the respective executive authorities.

Supervision of the application of the water resources planning is made centrally and regionally by the MIET.

Through planning, the water resources are allocated by the same Ministry to the various uses, and thus, it is expected that competence overlapping will be minimized, as well as the wasting of financial, water and human resources.

The exploitation of water resources is carried out in accordance with the existing legislation for public works, but it is the concern of the authorities managing the relevant water use to look after all exploitation phases (study-supervision-execution). Exploitation works are permitted if they are harmonized with, and incorporated in the water resources development plans.

In the cases of national multipurpose schemes, where more than one authority is involved, the management terms, and the way the funds for the construction and operation are allocated, are decided by the group of Ministers, pertinent to the scheme. If schemes are of regional importance, the Regional Water Resource Service defines the management and funding. In either case, the opinion of the respective Consultative Committee is required.

Apart from the public sector (Public Utilities, Public Enterprises, etc.), exploitation is allowed to everybody interested, provided that exploitation is accordant with the development programmes, and that no more than real needs are satisfied by the exploitation work. If the public interest and utility are served, the possibility is open for the work to exploit water more than the real needs, while provision exists for the relevant procedures and management. For the case, requirements and limitations in water needs, and other relevant data are elaborated and prescribed by the Water Resources Management Services of the MIET.

License is a prerequisite for the exploitation of water resources by the private sector, and this is issued by the authority respective to the aimed water use, unless the latter is multi-purpose, when it is the MIET that issues the license.

License for water use is required in all cases, except for individual or family needs, and only if no violation is committed.

In the cases of both water work construction and water use, a single license is issued.

License for use may be partially or totally recalled if the specific water resource is required to satisfy the needs of a higher utility, provided that sufficient water of proper quality from other source is assured for the beneficiary, at the same or lower cost.

Domestic use predominates over the rest of uses, and this priority is canceled by the MIET or the Prefect, if needs can be satisfied by Public Utilities, and if the use is in excess of necessary.

The right for water use is limited to the maximum of the real water needs, while the surplus of water is reserved by the Regional Water Management Service for other uses. Everyone interested may apply for the use of water resources, but the decision is made by the competent Prefect, provided that consultation is given by the respective Regional or Central Committees.

Real needs, in each case, are prescribed by the MIET within a predetermined range of quantity and quality, so that a rational use of the water resources is assured.

Restrictions to the water use, re-allocation of water resources, and modification of plans are possible when quantities and/or quality are naturally reduced.

In serious cases, when elaborating a water resource plan, the necessity for water transfer from one water district to another is ascertained, the decision of ME, MPW, MNE, MA, MIET is a prerequisite, after consultation with Consultancy Committees. Environmental impacts from water transfer are taken into account after carrying out the relative studies.

Compensation of the benefits lost is foreseen and commonly owed to the water resources supplying region.

The price policy is an efficient management tool, that has been well understood and introduced, and by means of which the water demand can be conveniently oriented to development programmes. In addition, a fair allocation of the water production cost to the various sectors is achieved, and their productivity checked.

In protecting water resources from over exploitation, or in preserving the quality at a specified level, a certain amount of water is bound to this purpose and is counted to the development programmes by the Regional WR Service of MIET, MA and MEPW. Relative procedures, safety limits, penalties, etc. are defined jointly by the MIET, MA, MEPW. The MI, Health, and MIET jointly, or the Prefect, in local cases, decide on the measures to be taken to protect the water resources intended for domestic use from undue exploitation or other activities.

After proposals of the Regional WR Services, restrictions in use, or other measures may be lain down by the Prefect in order to keep the water resources within the quantity and quality limits that serve properly the public benefit and needs.

The MIET, jointly with some other competent Ministers, are those who decide on these restrictions, unless lain down otherwise within two months.

Spectacular steps towards an integrated planning of water resources within the new managerial environment set by the new water Law have not been made. The reasons, apart from those already mentioned, are:

- the transition period needed to fit the new regulations, and to complete the whole organizational and functional structure foreseen by the new Law;
- the fact that until now integrated assessment of water resources was rarely made, so that an information deficit prevented decisions to be made for funding and subsequent planning of integrated exploitation and development;
- the prevalent idea and tactics was for many areas to meet water needs, sometimes urgently, as, for example, in the case of the last drought, when water was taken from existing or new resources regardless of their water balance situation, which is of cardinal significance in integrated planning;
- the fact that monitoring network for many hydrological components, and water quality factors over large parts of the Country are missing, as well as data on deep hydrogeological and other natural factors and conditions, and hence background information for an integrated water resources planning;
- the lack of proper financial support.

I think that a new period for the water resources management in Greece has already started. The integrated water resources planning, assessment and exploitation seems to have been understood as the choice for optimal solutions.

With the financial support of the EEC, it is well expected that within the broader regional programmes, a significant part of needs for the integrated water resources planning will be satisfied, so that in a comparatively short period of time the water resources potential will be wellknown and able to support further planning and development.

However, good examples of integrated assessment and study of local water resource systems are those of Epirus, Crete and Rhodes, not all coming out of the application of the new water Law.

In Epirus (Louros and Arachtos pilot study) the following was aimed at:

- interrrelation of hydraulics with water resources management;
- conclusions on river management;
- identification of further investigations;
- development of a methodology for planning water management that could also be applied elsewhere in Greece.

The effort was run through:

- the inception phase (existing situation, problems, measures, planning objectives, constraints, criteria, assumptions);
- the analytical approach (water distribution, hydrometeorology, water use and demand, relationships, impacts);
- the preparation phase; and

- the analysis phase (existing situation, future situation, quantification of water resources problems, potential measures, formulation of strategies, impact assessment, evaluation of strategies and sensitivity analysis).

The work being done in the island of Rhodes within the PAP/MAP programme must be mentioned. In reality, it shows a fully integrated approach to water resources, not only in terms of strategy, but also for the sequential process of information and data production.

More specifically, in this project the following is attempted in space and time, with proposals for further details and accuracy:

- assessment of the various hydrometeorological factors and quantities that enter the hydrological computations and balance;
- assessment of the surface water resources and of their quality regime;
- assessment of ground water resources and their quality regime;
- laying down of the natural water balance;
- assessment of the natural environment that influences, or participates in, the water resources system;
- assessment of the socio-economic environment to the extent it influences the water resources system and particularly the water demand;
- the existing or anticipated water storage and its influence on the water resource regime;
- study of the required protection against waters;
- assessment of sewerage systems;
- study of the required protection of the water resources;
- study of the existing and anticipated water resources exploitation in relation to water demand trends; and
- analysis of alternatives, and the choice of the water supply solutions, measures and activities for the best allocation and use of the water resources of the island.

Lastly, we will consider the particularly fruitful cooperation within all the activities of UNEP-MAP/PAP, directly with PAP and with any other interested institution. More specifically, cooperation is proposed towards:

i) Planning and implementation of pilot projects in areas where the water problem is acute because of an excessive water demand, especially during the dry, largely tourist, season, or where water resources, although apparently abundant, are either misallocated or not integrally studied, exploited and managed. Pilot areas with these characteristics, and therefore proposed, are:

   - The islands of Chios, Lesvos and Samos in the Aegean Sea, and Kephallonia and Corfou in the Ionian Sea. Touristic and agricultural waters make the largest part of the water demand;

- The coastal zone of the northern Peloponnesus (Achaia and Korinthia), where all-purpose water demand is very high under severe environmental constraints, particularly in the industrial Zone of Achaia;
- The western Peloponnesus coastal zone (i.e. Ilia Messinia), where agricultural demand is high and the touristic industry shows expansive perspective.
- The Chalkidiki peninsula, where agricultural and touristic needs are high, under some primary environmental limitations for the domestic use.

ii). Training and expert assistance is of primary importance for, and welcome to the various Ministries and institutions involved in the water exploration, exploitation and management. Particularly interested is the IGME (Institute of Geology and Mineral Exploration), the principal institute in Greece that is called up, with its three Directorates of Hydrogeology, to tackle water resources problems in coastal and water deficient areas.

Training and assistance could be effectuated at the maximum efficiency within some of the previous pilot project areas.

Figure 1. SYNOPTIC ORGANIZATIONAL STRUCTURE OF THE WATER RESOURCES MANAGEMENT IN GREECE

	BOARD OF MINISTERS INTERIOR (MI), NATIONAL ECONOMY (MNE) AGRICULTURE (MA), ENVIRONMENT & PUBLIC WORKS (MEPW) INDUSTRY & ENERGY (MIET), OTHER OCCASIONALLY *Decision making* *Political, Strategic, National, Long-run*	MINISTRY OF AGRICULTURE MINISTRY OF INTERIOR MINISTRY OF ENVIRONMENT INSTITUTE OF GEOLOGY & MINERAL EXPLORATION ATHENS WATER SUPPLY Co PUBLIC POWER CORPORATION NATIONAL METEOROLOGICAL SERVICE NATIONAL TOURIST ORGANIZATION, etc.
WATER RESOURCES INTERMINISTERIAL COMMITTEE *Consultancy*	MINISTRY OF INDUSTRY, ENERGY & TECHNOLOGY (MIET) ... CENTRAL WATER RESOURCES SERVICE *Policy Elaboration, Planning, Coordination, Control, Data base, Licenses*	*Research* *Proposals* *Assessment* *Exploitation* *Development* *Uses* *Licenses*
WATER RESOURCES REGIONAL COMMITTEE *Consultancy regional*	REGIONAL WATER RESOURCES SERVICES (RWRS) (WATER DISTRICTS) *Planning, Control, Coordination, Licenses*	etc.

3.7 INTEGRATED WATER RESOURCES MANAGEMENT IN ISRAEL

Yeshayahu BAR-OR(*)

3.7.1 Summary

Limited water resources on the one hand, and rapid population and economic increase on the other, have forced Israel to manage its water resources in a centralized, highly controlled fashion.

By law, water belongs to the state, which bears responsibility for supplying adequate quantities at appropriate qualities to the urban, agricultural and industrial sectors.

Allocation of water is handled by the water commissioner's office, which is also responsible for preparation of masterplans for utilization of water resources and determination of annual levels of pumpage from surface and groundwater.

Tahal, Israel's national water planning company, has planned most of the major national water projects, notably the national water carrier which combines all the major water reservoirs and delivers water from the Sea of Galilee in the north to Haifa and Tel Aviv, as well as to the Negev region in the south.

Mekorot, Israel's national water company, constructed and has been operating most of Israel's water pumping and distribution systems, together with several regional water organizations.

The Ministry of the Environment is responsible for prevention of water pollution. Its activities include control over dumping sites for solid waste, regulation of hazardous substances and wastes, levels of treatment and discharge of urban and industrial wastewater, management of agricultural wastes, etc.

Israel has been reusing some 70% of its wastewater for restricted irrigation of cotton, silage and the like. The Tel Aviv area treatment plant receives some 100 million m^3 wastewater annually and treats it to a high secondary level. The effluents seep through sand basins, mix with local groundwater, and are re-pumped. Water quality is then very high, and the water is used for unrestricted irrigation, thus augmenting Israel's scarce resources.

3.7.2 Climate, geography and hydrology

Israel's water sources are limited by the country's climate, geography and hydrology. Seventy-five percent of the annual rainfall is concentrated into four winter months, with at least six rainless months. Rainfall averages 1,000 millimeters per year in some parts of Galilee in the north in contrast to 25 millimeters in the southern Negev. Even greater variations occur from year to year, with periods of drought or near-drought interspersed with periods of heavy rainfall. The total mean annual precipitation over the catchment areas feeding Israel's various water sources amounts to 10,000 million cubic meters (MCM); of this, only 18% is utilizable, with the rest lost to the atmosphere or to the Mediterranean and Dead Seas. Finally, while water demand is greatest in the heavily populated coastal regions

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and in the southern half of the country, rainfall, water storage reservoirs and water resources are largely concentrated in the north.

These climatic, geographic and hydrologic constraints necessitate a water management policy which is based on the maintenance of a long-term reserve for water regulation and use, the ability to cut allocations for water use in drought years, and the development and use of unconventional water sources.

3.7.3 Legal framework for water protection

The Water Law of 1959 establishes the framework for the control and protection of Israel's water resources. The law states that all water sources in Israel are public property and that every person is entitled to use water, as long as that use does not cause the salination or depletion of the water resource. In 1971, the law was amended to include prohibitions against direct or indirect water pollution, regardless of the state of the water beforehand.

The provisions of the Water Law were originally executed by the Minister of Agriculture, the Water Commissioner and the Water Board. After the establishment of the Ministry of the Environment, authority was transferred to the Minister of the Environment to protect water quality, to prevent water pollution, and to promulgate regulations on such.

3.7.4 Administration

According to the Water Law (1959), all water resources in Israel belong to the State. Management decisions on water quantity, production and supply rest with the Water Commissioner who reports to the Minister of Agriculture. The Ministry of Environment is responsible for the prevention of pollution of water resources and the Ministry of Health for the quality of drinking water. The Ministry of the Interior and local authorities bear responsibility for construction and operation of urban wastewater treatment plants.

The Water Commissioner allocates water to local authorities and other large users. The local authorities are in turn responsible for developing, maintaining and operating the water supply systems within their jurisdiction. This includes metering residential, public, commercial and industrial use, levying progressive water charges, and publishing information designed to encourage efficient water use.

The Water Commission has two main operational arms: Mekorot, the national water company and Tahal, the water planning company. Mekorot is a public corporation which owns and is responsible for the water supply infrastructure, including pumping stations, wells, irrigation projects and the National Water Carrier. Tahal is a government corporation with responsibility for overall planning and consulting in issues of water resource management.

The Ministry of the Environment is responsible for preventing pollution of Israel's water sources. It compiles data on potential sources of pollution, undertakes supervision and control over human activity which may damage water resources (in the urban, industrial and agricultural sectors), and initiates and implements plans for the preservation and restoration of rivers and inland water bodies. Several government agencies, including the Ministry of the Environment, are currently cooperating in order to establish a central laboratory for testing groundwater quality as well as an information center on water quality to facilitate data exchange among the relevant bodies.

Supervision and authority over wastewater treatment and reuse is divided among four government ministries: Interior, Environment, Health and Agriculture while local authorities are responsible for collection, treatment and disposal of wastewater. While local authorities are required by law to install sewage systems, wastewater is treated to varying degrees by different municipalities. In the past, opposing considerations guided the numerous bodies responsible for sewage, especially with regard to the location of treatment plants, the level of treatment and the utilization of the effluent for agriculture. The recent establishment of the National Sewage Administration is thus of special significance. The administration is composed of representatives of local government and relevant government ministries headed by the Ministry of the Interior. The administration is responsible for formulating a national wastewater planning policy, as follows:

- Preparation of national masterplans for wastewater treatment and effluent utilization in agriculture;
- Approval and preparation of programs for wastewater treatment;
- Allocation of budgets for implementation of wastewater treatment programs.

3.7.5 Water consumption

Israel's primary consumer of water is agriculture. Throughout the 1970s and 1980s, water allocations to agriculture stood at about 1,200 MCM annually, about 75% of total consumption. Drought-enforced reductions in allocations to the agricultural sector are responsible for much of the drop in consumption in recent years.

Domestic and municipal uses account for just under a quarter of total use while industry accounts for less than 7% of consumption. Consumption is expected to continue to rise due to growth in population and economic output.

In 1993, Israel's total water consumption stood at 1,679 (MCM), as opposed to 1,541 MCM in the previous year. Agricultural consumption increased by 10.2%, from 940.5 MCM in 1992 to 1,035.5 MCM in 1993; industrial demand grew by 3.7% from 102.7 to 106.5 MCM; and domestic use rose by 12% from 498 to 536 MCM.

3.7.6 Principal water sources

Israel's renewable water resources equal approximately 1,600 MCM per year. Shortage of water is reflected in Israel's per capita water potential - about 330 cubic meters per annum, among the lowest in the world. As the quality of effluents improves by construction of new treatment plants, more reclaimed water will be diverted for agricultural use while freshwater will be directed toward urban and industrial use. By the year 2000, total water consumption is expected to reach 2,025 MCM - 1,470 MCM freshwater, 160 MCM saline water and 395 MCM effluents.

About two-thirds of Israel's annual fresh water potential are derived from the three major reservoirs: Lake Kinneret (the Sea of Galilee), the coastal aquifer and the inland, mountain aquifer (Yarkon-Tanninim). Lake Kinneret, Israel's only natural surface storage reservoir, has a utilizable water yield of about 470 MCM, the Yarkon-Tanninim aquifer has a total safe yield of about 300 MCM while the coastal aquifer has a total safe yield of 240-300 MCM. The remaining aquifers are more limited in size and are generally exploited locally.

The coastal aquifer extends over 120 kilometers of Israel's Mediterranean coast; its width varies from 3-10 kilometers in the north to 20 kilometers in the south. It is composed of sandstone and sand layers of Pliocene-Pleistocene age. The mountain aquifer is named after its two main natural outlets: the Yarkon Springs, which rise 15 kilometers east of Tel Aviv, and the Tanninim Springs, 60 kilometers to the north. It consists of Cenomanian and Turonian dolomite and limestone rock strata, dipping from their outcrops in the highlands of the West Bank mountains in the administered territories to depths of a few tens to a few hundred meters below the Eocene foothills and the Pliocene-Recent Pleistocene coastal plain.

Lake Kinneret, which divides the upper and lower portions of the Jordan River system, is the only fresh water lake in Israel. It has a catchment area of 2,730 square kilometers; its area is 170 square kilometers; its maximum depth is 43 meters; and its maximal volume is about 4,300 MCM.

Israel's widely dispersed water resources have been consolidated into an integrated water supply network serving all but the extreme southern tip of the country. The 130 kilometer-long National Water Carrier, composed of canals, tunnels, pipes and reservoirs, constitutes the principal leg of this system. While Lake Kinneret is the main surface storage reservoir of the system, water pumped from aquifers and from other sources is added to the main stream of the Carrier as it flows southward. Most of Israel's regional supply networks are linked to the National Water Carrier, which can transport some 1.4 million cubic meters a day from Lake Kinneret for distribution to coastal areas and the Negev desert. When water demand is low due to rainfall, water from the Carrier is used to artificially recharge groundwater sources. The system thus serves to improve the country's hydrological situation by making up for seasonal changes.

3.7.7 Supplemental sources

Since surface and groundwater sources can no longer meet the demands of a growing population and economy, Israel is increasing its development and use of treated wastewater, brackish water and water harvesting (collection, storage and use of storm runoff).

Recycled wastewater now accounts for almost 20% of total supply for irrigation, up from 3% two decades ago. Nearly 70% of the wastewater collected in sewers is treated and reused for agricultural purposes, mainly for the irrigation of non-food crops and animal fodder, in accordance with permits issued by the Ministry of Health. By the end of the century, recycled wastewater may theoretically provide 400 MCM of water per year for irrigation purposes.

Of the total volume of wastewater produced in Israel, about 90% is collected by means of central sewage systems, 80% is treated and nearly 70% is reclaimed for reuse. Of the total wastewater volume, a third is treated to a high level in the Dan (Tel Aviv) Region Wastewater Treatment Project, another third is treated to lower levels in mechanical plants, and the remaining third is left more or less untreated.

The Dan Region Wastewater Project is a sophisticated system serving an area of 220 km^2 which encompasses the large metropolis of Tel Aviv-Jaffa and seven other municipalities, with a population of 1.3 million. Ninety percent of the wastewater processed comes from households and 10% from industry. In 1993, 87 MCM of

wastewater were treated at the plant, of which 75 MCM were recharged and about 100 MCM (together with groundwater) were supplied for agricultural irrigation in the Negev. The Dan Project provides for biological treatment of wastewater including nutrient removal (to a level of 20-25 mg/liter BOD and 30-40 mg/liter suspended solids). The secondary effluent is then recharged into the groundwater aquifer by means of spreading sand basins for additional polishing and long-term storage. The water is eventually pumped and used for unrestricted irrigation in Israel's arid Negev desert. The high quality of the treated water after recharge conforms to drinking water standards, but is not used for this purpose. An extensive hydrological and water quality monitoring program, carried out by means of a network of observation wells and recovery wells surrounding the recharge basins, has confirmed the high quality of the reclaimed water.

Increased awareness is resulting in improvements in existing plants and in the planning of new treatment plants throughout the country which conform to new Israeli standards on effluents. Effluent regulations, promulgated in 1993, require secondary treatment to a level of 20 mg/liter BOD and 30 mg/liter suspended solids as a minimum baseline level. Higher degrees of treatment are required by the Ministry of the Environment if effluents are to be discharged into rivers rather than for agricultural use. In such cases, nutrient removal and disinfection are prescribed.

Surface runoff in most watersheds in Israel occurs for only a few days a year, after heavy rains. The total mean annual exploitable yield is estimated at 100 MCM per year. Several schemes have been set up for the collection of floodwater, some used for artificial recharge of the coastal aquifer and others as surface water impounding reservoirs.

Brackish water from aquifers is used to irrigate salt-tolerant crops developed in Israel. Israel already uses some 180 MCM of saline water a year for agricultural and industrial purposes. Olive, fig and date trees can tolerate salty water as can broccoli, tomato, spinach, beet and other vegetables, provided sufficient flushing of the salts from the soil is provided.

3.7.8 Water conservation

In the agricultural sector, substantial savings have been achieved through technological improvements in irrigation methods, including micro-sprinklers, drip irrigation and computerized and automated control systems. Israeli agricultural research has led to the introduction of crops requiring a minimal amount of water, or able to thrive on brackish water without diminished yield.

In the domestic sector, low-flow household faucets and low and variable-flow toilets have cut water use. Municipalities have increased efforts to improve the water system itself: reducing pressure, maintaining valves and repairing leaks. Water-saving devices are now required in all new buildings in Israel; throughout the country, municipalities are initiating improved watering techniques for public lawns and gardens and have expedited the replacement and maintenance of pipes to prevent leaks and explosions.

In the industrial sector, techniques such as process metering, mapping of pipes, pressure reductions and heat recovery have yielded savings. Water is conserved by the recirculation of cooling water and steam, pressure reducers, and reuse of treated industrial wastewater. Despite the accelerated growth in industrial activity in Israel, industrial use of water has not increased substantially.

3.7.9 Effluent reuse

The combination of severe water shortage, contamination of water resources, densely-populated urban areas and highly intensive irrigated agriculture, makes it essential that Israel put wastewater treatment and reuse high on its list of national priorities. Effluents constitute the most readily available and cheapest source of additional water, and provide a viable partial solution to Israel's water scarcity problem.

By the beginning of the next century, a significant increase in water demand is expected. As a result, the volumes of fresh water now diverted for agriculture will decrease to about half that supplied in the past. This will create an increasing demand for effluents for irrigation in the agricultural sector. By the year 2000, some 400 MCM of effluent may be reused for irrigation in agriculture; at the same time, fresh water demand for urban consumption (domestic and industrial) will increase considerably, to 730 MCM.

At the request of the Water Commission, Israel's water planning company, Tahal, has recently prepared a national masterplan for effluent reclamation, describing present conditions and prescribing a program for future development. The plan constitutes a framework for preparation of national and regional masterplans for effluent reclamation including flow forecasts, principal treatment sites, principal schemes planned, projected interregional transfers and estimates of investments in effluent reclamation in Israel. The aim is to achieve maximum treatment in order to prevent environmental nuisances and to enable effluent reuse in agriculture throughout the country.

Studies on the human health consequences of permissible effluent irrigation have shown that no negative effects have resulted from the reuse of treated wastewater practiced in Israel over the last thirty years. The Ministry of Health maintains a permit system designed to ensure that irrigation with effluents is limited to crops such as cotton, corn for fodder, etc. Only highly treated effluents, after chlorination, are used for irrigation of orchards and other edible crops in which there is no contact of fruit with the water. Effluents are never used for irrigation of vegetables or other crops which may be consumed directly without cooking, or which come in direct contact with the water.

3.7.10 Effluent reservoirs

The large-scale reclamation of effluents practiced in Israel makes it necessary to store the effluent in seasonal reservoirs (100 thousand to 3 million cubic meters in volume). The reservoirs, some 160 in number, are a part of numerous small reuse schemes in Israel, as well as of large-scale projects such as those in the Haifa region (the Kishon scheme). The reservoir is filled throughout the year with effluent at a relatively constant flow, while water is withdrawn only during the dry months. The reservoirs are often used as a "polishing" step in the treatment of the wastewater and are then used for the irrigation of cotton, silage and other non-food crops. During the retention period in the reservoir, which varies from two to several months, a series of physical, chemical and biological processes take place, affecting water quality.

3.7.11 Problems encountered

As mentioned above, in many cases there are no clear-cut distinctions between various ministries regarding prevention of water pollution. This has resulted in several independent databases on water quality which, as yet, are not linked together. Recently it

was decided to create a national information center which will allow exchange of information between data producers and users. Thus, for example, data on contaminated drinking water from the Ministry of Health will serve the Ministry of the Environment in locating and stopping the source of pollution.

3.7.12 Proposal for enhanced regional cooperation

Use of reclaimed water for irrigation is widespread in Israel. However, most of this water is used by Jewish farmers, whereas Arab farmers reject this practice due to religious and psychological reasons. This often leads to the discharge of partially treated wastewater into streams, as well as to the pollution of groundwater.

The environmental unit in the Arab town of Sakhnin (in the lower Galilee), recently established by the Ministry of the Environment, has expressed its willingness to cooperate with the Ministry and experts from academia in order to enhance use of treated wastewater in the Arab sector. Several local farmers have agreed to take part in this project. Currently, wastewater from Sakhnin is discharged to an anaerobic pond, then to two facultative lagoons, and finally flows into a nearby wadi. There are extensive fruit orchards adjacent to the treatment plant.

It is proposed to establish an on-site training center which will serve the following purposes:

1. Monitor water quality along the chain of existing and planned treatment processes.
2. Instruct local farmers on the benefits of using reclaimed water, as well as on the necessary precautions to be taken and the limitations on permitted crops that may be irrigated.
3. Present results obtained by use of reclaimed water in Sakhnin to farmers from other parts of Israel and farmers from Jordan, Egypt and other water-deficient countries.
4. Serve as an information center on irrigation techniques, water quality requirements and low-cost technologies for extending the use of reclaimed water in the Arab sector in Israel and in adjacent Arab countries.

3.8 INTEGRATED WATER RESOURCES MANAGEMENT IN ITALY

Mauro MOLINARI (*)

3.8.1 Introduction

The aspects of the integrated management of water resources have been object of a recent legislative evolution in Italy, in order to make an adequate improvements to the Territory Protection demand and the rational exploitation of Natural Resources.

Law 183/89, Standards for the Organisational and Functional Rearrangement of Soil Protection, defines the topics as well as the distribution of competences between the "State" and Local Organisations.

Law 36/94, which should represent a sort of guidelines for the application of the previous Law, is intended as a standard for the correct use and protection of the waters; it innovates radically the doctrine in the subject, which is dated, with the **"Unique text of Waters and Electrical Plants"**, dating back to 1933.

Law 36 starts with the important novelty of affirming that all the waters, surface and groundwaters, are public, and constitute a kind of resource that must be safeguarded, used under criteria of cooperation and, in any case, principally destined for human consumption.

3.8.2 The law for the protection of the soil

Law 183/89, Standards for the Organisational and Functional Rearrangement of Soil Protection, determines the hydrographic basin as the reference physical environment unit for the Physical Planning.

In that way the problems of fragmentation and coordination between administrative regions have been overcome.

For each of the hydrographic basins identified at regional, interregional, provincial and national levels, Law 183/89 foresees the adoption of a basin plan, whose objectives are the programming of works, and the definition of managerial rules for the protection and valorization of soil and the quality of water.

The Law requires that the hydrographic basin concept shall present a continuous examination of problems arising and their solutions, in addition to their value in ascertaining the resources availability and programming of works.

In that way, the hydrographic basin concept becomes an advanced reference point to which the other concepts of physical planning must be adapted.

This now allows for a cooperation at several institutional levels, such as the State, the hydrographic basin authority, the regions, the provinces.

Within the programme contents of the basin plans, the programming and utilization of hydrological resources are expressly pointed out, together with the guidelines to which

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the use of waters must conform. In addition, the first-rate territorial units must be identified for its management by means of the compulsory consortium of Public Services, Sewages, Collection and Treatment of Wastewaters.

3.8.3 Legal and administrative aspects

At the Ministry of Public Works, the National Committee for the Protection of the Soil has been constituted, composed of experts in the soil protection coming from various Ministries, research corporations, province authorities, and the Presidency of the Council l of Ministers.

This Committee makes comments and proposals regarding the basins plans, voices its own opinions both on the State competence intervention plans (for the national relevance basins), or on the allotment of funds, among the subjects appointed to the public works and the interventions defined by the basins plans, which have already been authorized by each of the Triennial Programmes.

As the Presidency of the Council of Ministers, a group of Technical National Services: Hydrographic, Sea-graphic, Seismic, Dykes and Geological, has been established.

These Technical National Services have to provide assistance and advice to whoever needs it; they are also supposed to organize and manage an Information System of Survey and Surveillance of the National Territory, which must be unique.

The regions set boundaries of the hydrographic basins within their competence, collaborate in the projects of national relevance basin plans, provide the achievement and accomplishment of both the province and interprovincial relevance basin plans, as well as for the approval and fulfillment of the work projects.

In the national relevance basins, the "Basin Authorities" have been established by a Decree of the President of the Council.

These authorities are composed of an Institutional-Technical Committee which, in turn, establishes the leading criteria for the formulation of the basin plans, points out the timings and the adoption modalities, giving assurance that a proper coordination is provided between the remedy plans and the protection of the waters.

The basin plan is valuable as a Sectorial Territory Plan and constitutes the instrument of acknowledgment, standard and technical-operational tool, through which, actions and utilisation rules are planned. At the same, time it takes into account that the expressed concepts must lead to the preservation, protection and valorisation of the soils, together with the correct exploitation of waters.

This will be carried out basically focusing on the physical and environmental characteristics of the pertaining territory.

The Basin Plan includes the cognitive frame of the area, identification and quantification of the degrading situations, main lines for the basin plan policy to which the sound concept of soil protection must conform, as well as hydrogeological and hydraulic arrangements, together with the actual uses of water and soil.

In the same context, the basin plan will have indications of the needed works, in accordance with the risk of floods, the planning and relevant exploitation of the hydrological, agricultural, forest and extractive resources.

The national relevance basin plans are worked our by technical committees which have been adopted by the Institutional Committees already approved by the President of the Council of Ministers, upon proposal of either the Minister of Public Works or the Minister of the Environment.

At that point, the Regions, following the observation by the National Committee for the Protection of the Soil, approve the basin plans of regional relevance.

The basin plans are accomplished through the Triennial Programmes of Works that are completely financed by the State. On the other hand, either the Regions, the Provinces, the Municipalities, the Mountain Communities or other Public Organisations can contribute with their own funds to the realisation of works and interventions envisaged by the basin plans.

3.8.4 Problems arising

Although the general lines of the Law 183/89 can appear fairly coherent and organically well shaped, bringing to the normal use the affirmation of a real "Basin Culture", together with a good management and planning of hydrological resources (through the plan itself, as a valid instrument which allows the proper harmonization between the Italian Legislation and that of other European countries), a large number of conflicts of a constitutional/accomplishment nature have been arising, since the very first legislative step (already passed through three consecutive legislatures).

The above conflicts, sprout mainly due to the fact that after several deep modifications, a whole set of debate motives has been left open, such as:

- the problem of competence between the State and the regions regarding the distribution of financial resources for the realisation of hydraulic works;
- the "Protection of the Soil" concept and its exact delimitation with respect to the juridical point of view;
- the forecast of a plurality of central public actors, exerting contemporary several managerial functions with respect to the hydrographic basins (particularly the Ministry of Public Works and the Ministry of the Environment);
- the introduction of the national relevance basin concept (as a third one...), in addition to the regional and interregional relevance basins;
- the constitution of the basin authorities, divided between the State and the Regions, contributing in that way to a very difficult management situation.

The system of relationship between the State and the Regions, in fact, appears to be strongly unbalanced in favour of the Central Administration, not only due to the strengthening of the role of the Ministry of Public Works (together with the active sharing of the Ministry of the Environment), but principally because of the form and structure of the national relevance basin authorities, which cover an important part of the national

territory (actually, fifteen Regions of a total of twenty, where the Regional Organisations' role has been greatly reduced).

Finally, it should not be forgotten than, in a basin culture policy, it results undoubtedly anachronistic to maintain a separation of competencies between the concession of both the main and the small derivations of Public Waters.

Indeed, the former competence is of the State Authority, while the second one belongs to the Regions. The Basin Authority, for instance, should contemplate the Public Interests evaluation, granting the relative concessions.

3.8.5 Planning examples

The distribution of competencies between the Center and the Periphery of a basin is reflected in the Law development.

This fragmentation weighs heavily on the environmental aspects of different basins (besides the competence conflicts raised at the Constitutional Court), because the planning of it concerns the protection of the waters and the soil against pollution. Also, the basin planning itself constitutes a reference point for the hydrogeological rearrangement and administration of water resources, as stated before.

The first Triennium experience in programming and preparation of the basin Plan suggests pthe adoption of a gradual approach and testing criteria regarding the institution of the first-rate territorial units.

It is possible that those first-rate territorial units will have to be modified in the future, following the gradual development of the remedial action of the waste waters plan, together with the aqueduct plan.

The Piedmont Region, for example, within its own competencies field, has already completed the General Scheme of the Regional Master Plan for the Supply of Drinking Water and Integrated Use of the Hydrological Resources approved by the Regional Council at the end of 1992 and actually under revision, due to the necessity to accept the observations presented already during the consulting phase.

The Master Plan focuses the regional policies (within the Department of the Municipal Hydrological Services) on the sources of drinking waters, and the waste waters treatment.

The revision of Hydrological Services is actually in process, together with de delimitation of the first-rate territorial units for the organisation of the Integrated Hydrological Service, as well as the establishment of the cooperation between municipalities and provinces relative to each one of the defined units, together with Regional Conference for the Hydrological Resources Institution.

3.9 LEBANON REPORT ON INTEGRATED WATER RESOURCES MANAGEMENT

Hratch H. KOUYOUMJIAN & A. RABBAT(*)

The main objective of this presentation is to give a concise report on the situation and management problems related to fresh water in Lebanon. I must impress upon you that in a country like Lebanon which is coming out of 16 years of civil war and destruction, it has proved very difficult to obtain recent information and figures relevant to this presentation. Please note that most of the accurate information refers to the year 1975 when the war started. One has to mention, nevertheless, that as regards the distribution of water, it was an absolute miracle that the system coped with the demands of 16 chaotic years without any major catastrophes.

3.9.1 Description of the country

General

Lebanon is situated on the eastern shores or what is commonly referred to as the Levantine Basin of the Mediterranean Sea. It has a surface area of about 10,400 sq. km. The country is mountainous; the 2 mountain ranges, the Lebanon range and the dryer anti-Lebanon mountain range, run north-south along the length of the country. Sandwiched in between these ranges there is the fertile Bekaa valley referred to as the granary of the country since the Roman times. The coastal strip, where most of the human settlements are located, is but a narrow strip under extreme pressure of urbanisation, and hence, degradation.

Climate

The climate is temperate Mediterranean, with wet winters and hot summers when relative humidity along the coast is very high . Due to its topography, there are various microclimates: coasta,l and at higher altitudes. Annual rainfall is about 1,600 mm on the Lebanon range, while this figure drops to about 250 mm on the anti-Lebanon range. The mountains are usually snow-covered between December and April .

In certain quarters, Lebanon is considered to be one of the few countries in the eastern and southern Mediterranean Basin that is not deficient in water; and this, they claim, has been traditionally one of the major reasons why the question of water management has not been a major preoccupation of the authorities. Recent projections refute this notion completely. Hence, there are no justifiable reasons for Lebanon's neighbours to assume that they could have automatic access to some of these resources.

Water and human settlements

Most of the population (about 3.5 million) is along the coastal strip (about 200 Km long) which is very narrow. In certain regions its width does not exceed 500 m. There is

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thus an acute demand for water resources in a relatively limited zone which the authorities have to meet.

Hot summers, and at times an archaic and obsolete system of distribution and management, cause rationing in summer months. This induces consumers to drill wells in order to supplement water for domestic and industrial use. In coastal zones this has now created salt water diffusion in otherwise fresh water wells. Additionally it creates considerable problems for households with regard to water use and plumbing maintenance.

According to the most recent official data available (1975), 97% of all settlements in Lebanon were supplied with drinking water: 98 % of urban population and 85% of the rural population had access to piped water. In this regard, the standard activities were much higher than WHO targets for 1980. Regionally, however, the populations of North Lebanon and the Bekaa valley were relatively deprived of piped drinking water to the tune of 10% and 4% respectively.

Consumption rate is about 100 l/p/d in villages and about 200 l/p/d in cities. Accurate estimate of sources used from wells is not available, although it could be considerable in certain parts of the major cities.

In total there are about 1,500 sources of exploited drinking water. 75% were springs and 25% were wells. The latter are generally considered to be mildly contaminated. This phenomenon is aggravated in certain parts of the country, particularly during the dry season, where, at times, levels of contamination, taste and even odour become objectionable.

Resource status

The total amount of precipitation in the form of rain and snow is estimated to be 9,700 M.m.^{3}/year. About 45% of this is lost due to evaporation, and the rest goes into surface and subsurface systems. With a few exceptions fresh waters from all sources are generally characterized by moderate salinity and mineral content.

Surface waters

This is the main source of utilisable water in the country. The total amount of surface water is estimated to be 4025 M.m.^{3}. This includes the 3 major international rivers of Orontes (El Asi), El Kabeer and El Hasbani. All 3 together yield about 650 M.m.^{3}. Lebanon is expected to be able to use some of these resources pending recent agreements.

As regards the national rivers, their amount is estimated to be about 3,375 M.m.^{3}. Of this only about 665 M.m.^{3} are being utilized for irrigation, 550 M.m.^{3} for industry and 10 M.m.^{3} for domestic purposes. The remaining quantity of about 2,710 M.m.^{3} is lost to the sea. The Table below summarizes the situation:

	Ground water		Surface water		Total	
	M.m^3	%	M.m^3	%	M.m^3	%
Exploited	160	20.5	665	16.5	825	17.2
Unexploited/available	420	53.5	2,925	72.7	3.345	69.6

(adapted from UNEP State of the Environment 1980)

Of all these surface water resources, only about 825 M.m^3 are utilized as follows: 145 M.m.^{3} for domestic use, 40 M.m.^{3} for industrial use. and 640 M.m.^{3} for agricultural purposes. As regards ground water, a total of 160 M.m.3 is used as follows: 40 M.m.^{3} for domestic uses, 30 M.m.^{3} for industry and 90 M.m.^{3} for agriculture.

Quality control

At the onset of the war in 1975, there were about 19 water stations and about 120 chlorination points in operation. Chlorination is the only control technique used in Lebanon. Only when the systems breaks down and there are scares, authorities initiate a campaign in order to boil the drinking water. The system was at its breaking point, as the 1978 scare proved. At the time it was obvious that there were no competent authorities within the water industry to tackle an environmental scare that occurred suddenly. The only response that the authorities could cone up with was very high doses of chlorination. Fortunately a concerted effort by all concerned including, in particular the Marine Research Centre, remedied the situation.

3.9.2 Whose responsibility is it ?

The main authority responsible for water management is the Ministry of Hydraulic and Electric Resources. The Ministry operates primarily through regional offices. The Ministries of Health and Environment also have a direct stake on the quality of water available to the consumers. Since the civil war we have welcomed the involvement of various UN organisations, such as UNDP and UNICEF, in activities related to water distribution and management.

3.9.3 The current situation

The current situation is anything but satisfactory. It does not meet the demands of the consumer in more aspects than one. The supply is not regular nor is the water quality assured. The legal framework under which the system operates is archaic and there is a lack of adequate personnel.

Lebanon is in its new phase of reconstruction, and therefore, this is an ideal opportunity to remedy the situation in light of modern requirements and guidelines. The Ministry of Hydraulic and Electric Resources is aware of this acute need and has already embarked on remedial action in order to overhaul and modernise the whole system. The approach which is being conducted has inputs from various sources, including renowned international companies.. The Ministry is trying to initiate an integrated approach to the whole question. The major elements are the following:

Diagnosis

Extensive studies and interviews highlight the chaotic nature of the system. There is a lack of a global overview, and the need for integrated planning. The system of resource management is not compatible with international guidelines of sustainable development in this very important sector. There is also a total lack of recent reliable information.

The need for collaboration with the Industry and Agriculture sectors will be of utmost importance in order to plan ahead. This of course necessitates an important review of available resources: the efficient use of what is available, and a gradual increase in the amount and quality of the resources put at the disposal of all end users.

Manpower

Currently, there is a governmental directive not to employ any additional staff in most governmental departments. This has created an acute problem, particularly in manpower intensive ministries, such as the Ministry of Hydraulic and Electric Resources. Additionally, the concept of training has breen eroded as a result of financial restrictions and the war. The Ministry faces a situation where the experienced staff will soon retire without having overseen the recruitment of younger and better trained replacements. This is an important aspect that will have to be remedied. In this regard, the question of incentives and renumerations is also being looked into.

Legal framework

The current legislation is in need of modernisation. The aspects of legislation that need to be reviewed are numerous: jurisdiction, law enforcement, delegation of authority, recruitment, financial matters, *etc.*, all have to be considered in the light of modern requirements

Development of scenarios

For the first time various scenarios are being proposed, and accordingly, medium-term and long-term planning is envisaged. The scenarios take into account population dynamics and demographic changes; the needs of agriculture, industry and households for adequate water of a desired quality; the allocation of financial resources as part of the overall requirements for an adequate developoment of Lebanon in the post-war period; *etc.*

On a short-term basis, a number of emergency micro-actions are envisaged in order to start the process of modernisation.

As regards the medium and long terms, the Government intends to use the integrated approach in major sectors of the country, like the Akkar Region in the north, in order to put into opeation the suggested plan of action which, in particular, takes the following into consideration:

- Rehabilitaion of the infrastructure as part of the Natinal Emergency Recovery Plan;
- Inventory of resources, production distribution, water quality, management, training of personnel and end users. This is expected to result in a Master Plan of resources;
- Reorganisation of relevant water offices: to include expertise in proper management, studies, laboratory analysis, *etc.* Training, which must be extensive, has to be of vital importance;
- Finances: All of this action is in need of finacial resources which are in short supply. Taxation, coupled with the initiation of the public into the problems involved, minimising waste and introducion of recycling of used water will need concerted effort by all parties. Removal of any direct or indirect subsidies and an appreciation of the real cost of the service necessitates the introduction of public campaigns and education.

Furthermore, action is being contemplatd with the National Council for Scientific Research and the Ministry of Agriculture within the context of their anticipated action on the Development of a Research Strategy for the Lebanese Agriculture Sector.

The success of all this depends on the identification of financial sources, efficient administration, enlightened public, and above all, well-educated partners. All of the latter that I mentioned are partners in such an endeavour where water is a limited resource and is becoming scarcer and scarcer to such an extent that states could be a state of conflict as a result of water shortages. This is a time to act. Collaboration with various international authorities and the United Nations, such as the workshop here today, is important, particulary in order to set guidelines for an integrated approach.

It is not easy to find an ideal blue print for this because of the differing charcteristics and needs of each country in the Mediterranean Basin. Lebanon has its particular problems, even though, as regards resources, we could be considered slightly priviledged. However, there are various fields where cooperation and joint action could be envisaged, *e.g.* in the field of tapping of underground sources of fresh water that seep directly from coastal zones into the sea.

I have given a resume of the situation in Lebanon and proposed action as regards the envisaged integrated approach to this problem. I hope you find the information relevant.

3.10 APPLICATION OF INTEGRATED APPROACH TO DEVELOPMENT, MANAGEMENT AND USE OF WATER RESOURCES IN MALTA

John MANGION(*)

3.10.1 Introduction

Providing the Maltese islands with sufficient amounts of potable water has been historically one of the major constraints which the Maltese have had to overcome in quest of sustainable development. The smallness of the country with limited natural resources obliged its inhabitants to explore all the possible ways to ensure their survival and to support their essential needs, water being one of the most important. This necessity in itself created an integrated science on a miniature scale, encompassing, among others, basic methods of harnessing water for various purposes.

Through the years the development of water supplies evolved from a primitive rural one, completely dependent on the few natural springs and on stored rainwater, to a modern hi-tech system based on the latest desalination and water treatment methods, which, albeit expensive in terms of energy costs, are the only means of ensuring a consistent supply to meet the demands of a rapidly developing nation set to achieve the goals of modern European countries.

The integration of interrelated systems leading to a rational water management approach is today performed by the Water Services Corporation constituted in January 1992. This report outlines the ways how this Corporation achieves an integrated management process in a concept of sustainability.

The Maltese Archipelago is located in the central part of the Mediterranean Sea between latitude 36°05' and 35°48'N and longitude 14°11' and 14°34'E, at a distance of about 90 km south of Sicily, 300 km east of Tunisia and 350 km north of Libya. The Archipelago consists of 3 main islands, Malta, Gozo and Comino, and some islets (Cominotto, Filfla) which are uninhabited.

The main characteristics of the inhabited islands are:

		Population		
	Area (km^2)	1987	1993	Density pop./km^2
Malta	246	320,474	339,262	1,300
Gozo	67	25,162	27,258	370
Comino	3			
TOTAL	**316**	**346,000**	**366,484**	**1,123**

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Due to its geographical location, the archipelago enjoys a typical Mediterranean climate characterized by hot and dry summers and mild and humid winters. The rainy season is between September and March with the last rainfalls in April. The average annual rainfall is around 500 mm, and temperature varies between 7°C and 15°C in January to between 25°C and 35°C in August. A peak temperature of 42°C has been recorded in August this year.

Malta has no perennial rivers. Surface flow occurs after heavy torrential rain and lasts at the most, a few weeks per year.

3.10.2 Present water resources

Due to its semi-arid climatic conditions, Malta's natural resources are poor and today support only 35% of the demand. The remainder is obtained from five Reverse Osmosis facilities, which, although cheaper than other less economical desalination systems, are still drastically more expensive (about three times) to operate and maintain than groundwater resources.

Groundwater has been throughout the years overdeveloped and subjected to the deleterious effects of urban, industrial and agricultural development. Before the advent of desalination in Malta, groundwater was the only source of potable water, and consequently over extraction had to be resorted to.

Depleting quality trends are today a cause for concern, and thus oblige an urgent rehabilitation in a scientific way.

Over-extraction from the Mean Sea Level Aquifer (A Ghyben Herzberg fresh water lens contained within the Lower Coralline Limestone Formation) has led to saline water intrusion and to a severe deterioration of this aquifer which today accounts for 95% of the total groundwater production.

Its recharge area, which covers over 70% of the whole territory, inspite of stringent protective measures, is the venue of competitive use and is being continuously encroached and disturbed by rapid urban development and pollution originating from industrial and agricultural activities.

The perched aquifer which occurs in the Western and North Western regions is a very restricted resource within the Upper Coralline Limestone, and though not susceptible to saline intrusion, it is highly contaminated by organic pollutants and nitrates derived from massive application of fertilizers. It offers very poor possibilities of further exploitation except for agricultural and non-potable purposes.

The decline of groundwater is therefore a reality, and the only way to satisfy our water supply requirements is by the conjunctive use of this with the water produced by desalination methods.

3.10.3 *Optimization*

Today, around 65% of the daily demand is provided by five Reverse Osmosis plants, this being the best available and most economical technology to supply wholesome water to the Maltese consumer. As mentioned earlier, this does not rule out groundwater exploitation, but on the contrary, warrants a more scientific understanding of the

hydrologic continuum to ensure the sustainable use of this cheap but precious natural resource.

A recent study has shown that it is necessary to:

(i) optimize the exploitable groundwater resources in terms of quantity and quality, by implementing a 40% cut-back from 1991 extraction figures, and

(ii) protect the aquifers from pollution by the application and enforcement of more stringent protective measures and regulations.

Although these measures would bring about an improvement in groundwater quality, this would still lag behind European standards.

The solution lies in producing sufficient quantities of desalinated water by R.O. systems, together with a smaller amount of very pure distilled water by means of thermal desalination. The latter has a high blending potential and is highly suitable to correct undesired quality parameters from any source, to acceptable potable levels.

Blending of these sources, is not a straightforward task and requires the simulation of various optimization scenarios, taking into consideration a wide range of future economic constraints, to arrive ultimately at the most feasible, and most cost-effective blend. We consider this to be the most sensible approach.

3.10.4 Legal framework

The institutional framework to support the water resource management system is provided by the Water Services Corporation Act 1991 which led to the establishment of a public corporation in January 1992, to perform integrally all the activities concerned with supply and demand, in full cognizance of environmental constraints and national socio-economic requirements. This Corporation will also be responsible, once the relative parts of the Act come in force, for waste water collection and treatment.

The Act clearly defines all the Corporate functions and duties leading to integrated planning. Some related excerpts are reproduced hereunder to demonstrate this.

Functions

a) "to acquire, produce, keep, distribute, sell, export or otherwise dispose of water (other than bottled table water) for domestic, commercial, industrial and other purposes;

b) to conserve, augment and operate water resources and sources of water supply;

c) to undertake and perform such other functions relating to water conservation supply and distribution as it may deem appropriate;

d) to provide for the treatment and for the disposal or re-use of sewage and waste water;

e) to provide as appropriate for the use of storm water run-off from urban and rural areas."

Duties:

a) *"to develop, maintain and promote a safe and efficient production and distribution system in order to satisfy, as economically as possible, all reasonable demands for water;*

b) *to determine the short-term and the long term objectives in relation to water supply, disposal and re-use and to develop the necessary strategy and policies to reach these objectives;*

c) *(i) to provide, improve and extend such a system of public sewers and to cleanse and maintain these sewers so as to ensure that the drainage system operates and continues to operate safely;*

(ii) to make provisions for the operation of these sewers and such further provisions as are necessary from time to time for effectively dealing with the contents of these sewers by means of sewage treatment and disposal works or otherwise;

d) *to have regard in performing its duty under this subsection of the need to provide for the treatment and disposal or otherwise of trade effluent;*

e) *to promote the proper disposal of waste water and storm water run-off;*

f) *to consider and advise any minister on any matter relating to the formulation of an overall national policy for water and on all matters relating to any of its functions under the Act.*

g) *to manage and operate all undertakings and other installations and property transferred to and vested in the corporation by virtue of this Act or otherwise acquired by the board for the purposes of any of its functions;*

h) *to hold and administer and , if and when it thinks fit to realize any assets it may hold from time to time;*

i) *to promote the reasonable use of water and encourage the conservation and appropriate re-use of water resources;*

j) *to carry out tests and to make regulations relating to water fittings for the purpose of preventing waste, undue consumption, misuse, erroneous measurement, or contamination nod water;*

k) *to provide training courses and other schemes in connection with the furthering of science and technology of water management;*

l) *to collaborate with other local organisations in placing and coordinating services including water purification, electrical power, telecommunications, road services, agriculture and industry; and*

m) *to promote and undertake alone or in collaboration with other institutions the research and development of new technology and new ideas in the production and treatment of water, in distribution and disposal networks, water desalination and polishing, sewage treatment, disposal and re-use, plant transport and equipment,* water resources management and water catchment management.

It can be seen that the Water Services Act is the legislative backbone supporting sustainable water resources management, and providing for a rational utilisation of water

among the various users by maintaining a balance between supply and demand without harming the environment.

It does not, however, prescribe either management methodologies or funding procedures. A global masterplan is now being drafted to integrate strategies with socio-economic constraints to ensure sustainability.

3.10.5 Strategies

Let us now review the management strategies aimed at achieving the sustainability objectives laid down in the Act. Sustainable development of water resources implies extended criteria for planning, designing, operating and maintaining water resources systems, this being only achievable by an appropriate administrative structure which guarantees the availability of an uninterrupted supply of water, at all times, in a cost-effective manner. This is truly the essence of the mission of the new Corporation.

3.10.5.1 Production development

As mentioned earlier on, the necessity to reduce groundwater extraction and supplement this slack by desalination sources is a costly process but it is the only way with which the Corporation can supply wholesome water to its consumers.

Desalinated water already makes up 65% of our supply, and further development is envisaged.

Discussions are today in progress with the Planning Authority to identify another suitable location for the siting of a sixth Reverse Osmosis facility in southern Malta, where most of the groundwater cutback will be implemented and where more water will be needed to improve the present supply.

Natural resources will however not be abandoned but instead, they will be protected from further deterioration by reducing abstraction rates, by improving groundwater regulations, and by better enforcement of the latter, in particular within the aquifer protected areas which have been recently revised on the bases of flow models.

3.10.5.1.1 Groundwater models and pollution control

To predict the behavior of groundwater flow and contaminant transport, a finite element (Galerkin method) model has been recently developed. This is a valuable management tool which is already being used in the implementation of groundwater reductions to predict piezometric recovery under reduced abstraction conditions.

The model is also used for predicting migration and concentration of contaminant plumes towards abstraction points. It has been recently employed to predict the migration behavior of a hypothetical contaminant flowing through an underground storm water gallery (constructed by the Roads Department), and hence to define the stretch of gallery which had to be imperatively lined to prevent any accidental leaching into nearby sources.

Pollution protection and prevention measures are not being limited to groundwater sources.

The sea is the raw source of all our R.O. process water.

The intrusion of any seaborne oil pollutant in an R.O. plant has to be absolutely prevented, since this would cause irreparable damage to the permeators, a delicate and

sensitive component of the plant which in practice accounts for 50% of its entire capital cost. We are therefore aware of the extreme vulnerability of such a situation.

Since Malta lies in an area of the Mediterranean where more than 80% of all shipping from the Gulf sails before reaching Western Europe, sea-borne oil pollution can strangle the local water supply at any time.

A study on R.O.-beach protection has been just completed and proposals were submitted identifying ways of defending sensitive shorelines from damage in case of oil-slicks and catastrophical sea-borne pollution.

3.10.5.2 Distribution and conservation

This is another area which is under continuous improvement and modernisation. With the spread of urban and industrial development, the old rural network failed to perform efficiently and meet today's more demanding requirements in various sectors. New, wide diameter pipelines are now being laid to deliver directly from storage points to heavy consumption areas without fail even during peak periods.

Better storage facilities, *i.e.* reservoirs, are currently in the design stage, and these will, when operational, absorb production shortfalls and ensure an uninterrupted supply. This is the only way to eliminate wasteful investment in spare production facilities and consequently, the high down-time costs whenever this spare plant is not running.

Conservation and efficient use are essential for achieving a balance between growing demand and finite supplies.

Unaccounted-for water is still a major concern, as well as a significant loss of revenue to the Corporation. To reduce this we are actively engaged in;

a) a meter replacement campaign wherein old meters prone to under-registration are being substituted by more sensitive types which are accurate also at low flow regimes;

b) a zoning exercise in which a known supply into a given area is compared with metered (billed) consumption;

c) extensive leak-detection programmes utilising the best available technology;

d) training of staff in modern leak-detection techniques.

3.10.5.2.1 Tariffs

All the aforementioned efforts to reduce wastes would ultimately prove futile without a realistic tariff structure - a valuable tool for demand management. The old practice of subsidising, by as much as 90%, any amounts of water consumed in a private household, has now been superseded by a new structure which grants a 90% subsidy only on the first 10 gallons consumed daily by every person in a household, followed by a 75% subsidy on the next 10 gallons. Any excess consumption over this will be paid at full cost.

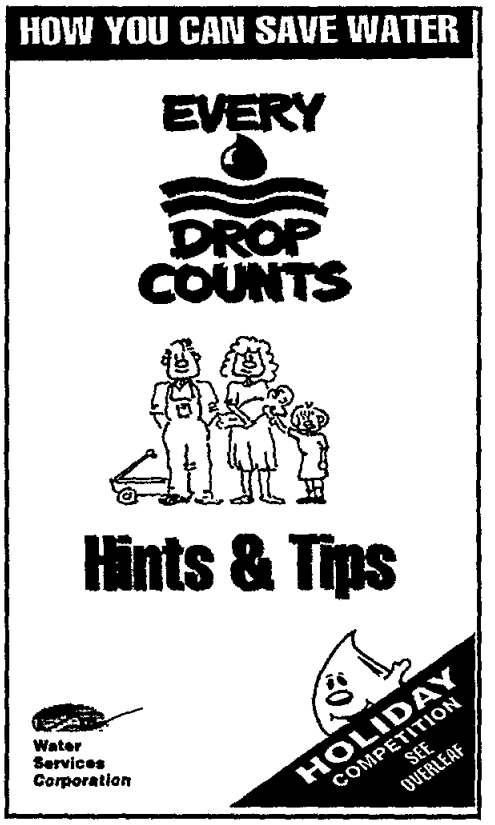
This system is therefore fair and guarantees an essential quota at a low social price to all consumers.

New Tariff Scales and Subsidised Quotas for Consumption of Water In Domestic Households	
Meter rent	Lm 1.20 per meter every four months.
Water consumption	Lm 0.75 per m^3.
Subsidy	67c5 per m^3 for the first 5.5 m^3 per person consumed in every period of 4 months. 56c3 per m^3 for the next 5.5 m^3 per person consumed in every period of 4 months. In addition, consumers with special needs are allowed additional subsidies.

3.10.5.3 Public awareness

Consumer education is another major activity to educate the citizen in rational and economical use of the water supply, and to promote simultaneously public involvement in water issues on a national scale.

A publicity campaign in all media promotes the importance of water economy and encourages the consumer not to waste for his own, and for the common good. Thousands of promotional aids, e.g. leaflets explaining water-saving measures, stickers and shirts bearing "water-saving" logos, are distributed regularly at schools and other public venues. Local manufacturing companies have been highly cooperative by printing these logos on household products (detergents, toiletries, etc.;) thus inviting the local housewife to economise too.



1994 Water Conservation Logo & Educational Leaflet

Above all, the campaign has been consistently promoted in schools where short water saving animations are regularly performed to stimulate water saving awareness among the younger generation.

Although it is too early to assess the benefits of this campaign, we are sure that public awareness on national water problems is being gradually heightened, this being an important step towards waste reduction.

3.10.5.4 Information systems

Throughout its activities, the Water Services Corporation has generated a multitude of data: statistical, hydrological, geological, climatological, financial, etc. Without good-quality data, easily retrievable from user friendly databases, scientifically based projections and predictions cannot be performed, and, most important of all, integrated water resources management would be severely handicapped.

The Corporation has therefore equipped and staffed a new "Management and Information Systems" to ensure that IT needs of the Corporation are fully met, contributing to the organisation's performance and future growth. Besides catering for data management and internal information transfer, the Branch is also responsible for anticipating corporate requirements, and providing cost-effective advantages through the intelligent use of IT resources.

Data collection is also being upgraded and improved. Three new hydroclimatological stations have now been commissioned and are steadily recording weather parameters in real time.

A more ambitious project is in the pipeline. This envisages a physical link *via* a telemetric network between all strategic out-stations (production, storage and distribution) and a centralised computer (based at headquarters) which would allow collection and processing of data promptly and efficiently.

3.10.5.5 Training

Training of personnel, technical and professional, is an essential requisite in integrated water management. The Institute of Water Technology (I.W.T.) provides both in-service training and specialised courses, mainly in topics like groundwater hydrology, R.O. technology, water treatment, computer training, etc. Corporation staff are regularly encouraged to improve their skills and are offered better career opportunities on the results achieved in their training.

Promising graduates are also encouraged to follow post-graduate courses, locally and abroad, to acquire expertise in specific fields.

Finally, education and training courses are regularly reviewed and upgraded by a board of independent experts to ensure that only the best training, tailored for corporate needs, is given to the students at the I.W.T.

3.10.5.6 Water reuse

With increasing demand for water, re-use of treated waste water effluent is becoming increasingly important in our water resources strategy. Reclaimed water is a reliable resource, even during the dry season, and can thus substitute potable water for non-potable uses.

More treated effluent will be made available as from the end of next year (80% of all sewage produced will be treated by 1998), and the Water Services Corporation will be also including regulations and tariffs for secondary water in its master-plan to promote its rational use and avoid wastage of good quality potable water.

In the absence of related data, however, several unknowns remain to be solved on the impact of treated effluent applications (e.g. irrigation and artificial recharge) on groundwater. In a fractured karstic aquifer overlain by a thin soil cover, travel times and retention both in the soil and in the unsaturated zone, are extremely hard to predict. Therefore the application of treated effluent for irrigation and recharge purposes has to be carefully studied to asses quality impacts of this process on groundwater and to safeguard public health.

A project proposal has now been launched, and this foresees the implementation of four reuse schemes aimed at throwing light on these unknowns. The project includes:

a) artificial recharge/irrigation with treated effluent in an agricultural area outside the aquifer protected zone;

b) artificial recharge scheme utilising treated effluent and storm water run-off in an urbanised area;

c) reuse scheme for industry;

d) artificial recharge/re-use scheme in an area within the protected zone utilising good quality surface run-off.

International financing is being sought for this project to support its implementation.

3.10.6 Examples of integrated planning and problems encountered

Groundwater exploitation and protection is heavily affected by several types of land-uses: farming, industry, and urban development. One can easily comprehend the diversity of interests and conflicting demands imposed by the various users on the local natural resources, and hence, groundwater conservation issues have to be necessarily considered under very different and binding constraints.

A committee composed of representatives of the Water Services Corporation, the Ministry of Food and Agriculture, the Ministry of Health, and three other independent members experienced in water and environmental issues, meet regularly to discuss groundwater exploitation permits and licenses, and also to review usership rights. The involvement of officials from different government bodies has promoted a better understanding of all groundwater issues and an improvement in intersectorial communications.

Lately this committee has commissioned a survey of the protected zones, by appointing three inspectors from different departments. The ultimate aim of these joint inspections is the assessment of catchment conditions, and the implementation of feasible and cost-effective remedial measures in the course of this exercise.

Users are being approached and encouraged to observe good operating practices, to reduce pollution and to respect environmental policies. Practical advice to attain improvements is also given. This collective effort is giving positive results since it thrives

at convincing the different types of consumers in the long-term benefits of correct operational practices.

Problems to achieve the aforementioned goals are not lacking.

To satisfy fairly all consumers, the Water Services Corporation carries out the difficult task of optimising its supplies among conflicting public demands amidst constraints set by the natural limitations.

Private groundwater abstraction by third parties is still free from any form of tax or levies, and this renders this resource highly attractive to agricultural and industrial entrepreneurs. Conflicts are frequent, with different parties claiming diverse interests and priorities over an essentially fragile resource.

A new suite of groundwater regulations is about to be issued. This will prioritise users, legislate protection boundaries, and protect the aquifers from misuse.

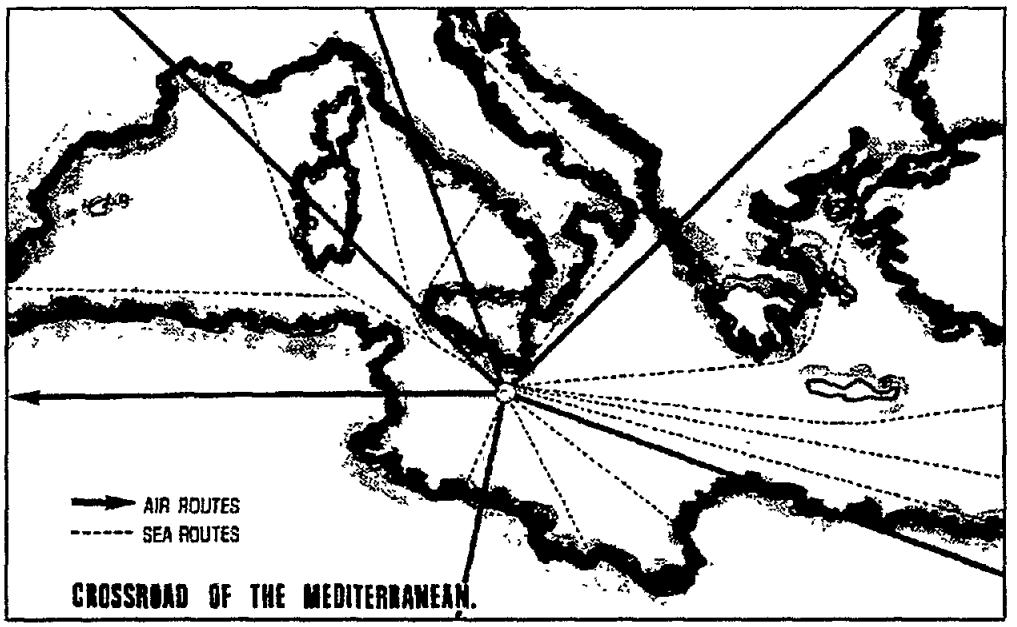
3.10.7 Proposals for enhancing cooperation

Successful development of water resources management requires a multidiciplinary approach in a wide range of water related fields. Every endeavor should be made so that the experience accrued in water resources development is disseminated elsewhere to the benefit of those countries where knowledge is lacking hitherto.

Mediterranean islands have rather peculiar hydrological conditions, and hence, each stand to gain by reciprocal transfer of knowledge and information. Though many books have been written on water resources planning, very few elaborate on the methodologies to perform integrated water resources management of small islands. Knowledge in this field is scarce, at times inadequate, and thus warrants further research. In most cases sufficient data are lacking or completely missing, which means that any assumption made may deviate from reality.

The development of IWRM planning methods for Mediterranean islands with water scarcity problems is therefore being proposed. These methods should be included in a reference document, or better a manual, covering related scientific concepts tied to various case studies performed in Mediterranean islands.

In this respect Malta lends itself as an ideal "laboratory" wherein these methods have been tested and results achieved. It is one of the countries which have intricate water management problems stemming from limited resources, high population density, and rapid economic development, and where conjunctive use of groundwater, desalinated waters, and treated effluent has proved to be the only solution to satisfy demand.



Also, Malta could well host a Mediterranean regional centre for IWRM studies, by virtue of its geographical location, political and economic stability, friendliness with European and African nations, fluency in the English language, hospitality, excellent communications, and highly qualified work force. Moreover, the smallness of the country allows the visiting scientists to gain acquaintance in a relatively short time, with several types of production facilities, as well as with all the aspects of water resources management. This centre would offer training facilities in water related fields and would be the venue for engineers and scientists from different countries to share their experiences in IWRM.

Finally, it would also enhance U.N.'s links with the Mediterranean intellectual and scientific community, and promote international team effort and research cooperation, so essential for the successful implementation of Integrated Water Resources Management.

3.11 GESTION DES RESSOURCES EN EAU - LE CAS DU MAROC

Abdellah GAIZ(*)

3.11.1 Résumé

Conscient de l'importance stratégique de l'eau, le Royaume du Maroc s'est lancé trés tôt dans la mise en oeuvre d'une politique audacieuse de valorisation de ses potentialités hydriques qui constituent aujourd'hui un des piliers de base de l'économie du pays.

Le potentiel mobilisable estimé à 21 milliards de m^3 en année moyenne, est maîtrisé actuellement à plus de 50% grâce à la réalisation de nombreuses infrastructures hydrauliques qui permettent de satisfaire largement nos besoins en eau actuels.

L'une des préoccupations majeures du pays est d'assurer en permanence l'adéquation des ressources en eau disponibles aux besoins exprimés, aussi bien pour la génération actuelle que future.

C'est ainsi que la mise en valeur de nos ressources se poursuivra conformément à la stratégie élaborée et adoptée par le Maroc, en vue de permettre un développement économique et social durable du pays, en concrétisant d'importantes actions sur les plans institutionnel, législatif, de la planification, de la gestion et de la sauvegarde du patrimoine hydraulique.

3.11.2 Introduction

L'eau, bien naturel dont la dimension économique est de plus en plus évidente, est indispensable en tant que source d'approvisionnement pour l'eau potable des populations, facteur essentiel de développement des activités agricoles et industrielles et élément indispensable à l'équilibre écologique du milieu naturel.

En raison de ses spécificités naturelles, le Royaume du Maroc, qui a fait de la mise en valeur de ses potentialités hydrauliques une base essentielle de son développement économique et social, fait face à une croissance rapide des besoins en eau et à des risques de plus en plus évidents de dégradation de ses ressources en eau, en raison des impacts négatifs des activités de l'homme.

Conscient des enjeux stratégiques liés au développement du secteur de l'eau, le Royaume du Maroc a mis en oeuvre une stratégie de développement des ressources en eau qui, tout en permettant de répondre aux besoins en eau du pays, constitue un sérieux atout pour atténuer les effets négatifs des sécheresses chroniques qui affectent le climat du pays.

Cependant et malgré les efforts consentis, les résultats acquis restent à consolider et à intensifier, pour répondre aux besoins considérables en eau d'une population dont le doublement est attendu dans une trentaine d'années. Cet accroissement sans précédent illustre la pression croissante et continuelle à laquelle seront soumises les ressources en eau et les risques d'épuisement quantitatif et qualitatif qui y sont liés.

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3.11.3 Les ressources en eau du Maroc et leur utilisation

3.11.3.1 Aperçu sur les ressources en eau

La variété climatique et la diversité des contextes physiques des différentes régions du Maroc se traduisent par une disparité marquée de la disponibilité de l'eau à travers le pays.

Ainsi les précipitations moyennes annuelles varient:

- de 500 à 2,000 mm dans la zone la plus arrosée du Nord-Ouest soumise à l'influence atlantique;
- de 200 à 1,000 mm dans le Nord-Est soumis à l'influence méditerranéenne;
- de 100 à 200 mm dans la partie orientale du pays à l'Est des montagnes de l'Atlas;
- à moins de 100 mm dans les zones arides du Sud du pays.

Les précipitations totales sur l'ensemble du territoire sont évaluées en année moyenne à prés de 150 milliards de m^3 dont 120 milliards de m^3 sont repris par l'évaporation et l'évapotranspiration du couvert végétal.

On estime donc à prés de 30 milliards de m^3 la part ruisselée de la pluie, véhiculée par les cours d'eau et infiltrée dans le sous-sol pour alimenter les nappes d'eau souterraine.

- L'écoulement souterrain représente 10 milliards de m^3 dont 3 milliards ont comme exutoire les cours d'eau et en constituent donc l'écoulement de base. Prés de 2 milliards de m^3 sont perdus par évaporation ou déversement dans la mer. Seuls 5 milliards de m^3 constituent la ressource en eau pouvant faire l'objet d'un prélèvement.
- L'écoulement superficiel estimé à 23 milliards m^3 (y compris 3 milliards de m^3 d'écoulement souterrain contribuant à l'alimentation des cours d'eau).

Dans l'ensemble, une grande irrégularité spaciale caractérise ces eaux de surface. Ainsi, l'écoulement superficiel spécifique exprimé en $m^3/km^2/an$ varie dans le rapport de 1 à 20 entre le bassin du ZIZ (15,000 $m^3/km^2/an$) et le bassin du Loukkos (300,000 $m^3/km^2/an$).

Le régime des écoulements superficiels est également caractérisé par les grandes variabilités saisonnières et annuelles (étiages prononcés à débit nul, crues courtes et violentes causant des dégâts).

3.11.3.2 Etat de l'aménagement et de la mise en valeur des ressources en eau

Le développement économique et social du Maroc a nécessité l'intensification du développement des ressources en eau. Depuis plusieurs décennies, les différents plans de développement économique ont accordé une grande priorité au secteur de l'eau, permettant ainsi un accroissement significatif des disponibilités en eau.

Ainsi, les efforts développés en matière d'étude et de réalisation d'infrastructures hydrauliques permettent de disposer actuellement en année moyenne d'un volume de l'ordre de 11.5 milliards de m^3 répartis globalement entre 1/3 d'eau souterraine et 2/3 d'eau de surface.

Sur le plan des utilisations de l'eau, c'est le secteur de l'agriculture irriguée qui est le plus gros usager avec prés de 93% des eaux mobilisées, alors que le secteur de l'eau potable et industrielle ne représente que 7% au total.

L'eau de surface contribue pour 60% à la satisfaction des besoins en eau potable et industrielle et 73% à ceux de l'agriculture, alors que l'eau souterraine intervient pour respectivement 40 et 27%.

Par ailleurs, les effort réalisés également en matière d'énergie électrique (puissance installée de 655.9 MW en 1991) permet d'espérer en année moyenne une contribution à l'ensemble de la production nationale d'énergie électrique à hauteur de 30% environ. Toutefois, cette contribution est tombée à moins de 6% pendant les années de sécheresse et n'a depuis jamais dépassé 15%.

Les volumes alloués aux différents secteurs usagers permettent d'assurer:

- l'irrigation de près de 850,000 ha d'une manière pérenne dont 400,000 hectares en petite et moyenne hydraulique;
- la production de près de 800 Mm^3/an pour l'alimentation en eau potable et industrielle;
- la production annuelle de 1,500 GWh/an;
- la protection contre les crues de certaines régions du Maroc.

3.11.4 Administration de l'eau

En matière de gestion de l'eau, la difficulté essentielle réside dans la nécessité de faire évoluer le cadre institutionnel dans ses volets législatif, économique et organisationnel, en vue d'assurer la durabilité des efforts de développement des ressources en eau.

3.11.4.1 Organisation du secteur de l'eau

Les départements et les organismes publics intervenant dans le secteur de l'eau sont nombreux, mais possèdent des prérogatives variées et complémentaires:

- Le Ministère des Travaux Publics, de la Formation Professionnelle et de la Formation des Cadres/Administration de l'Hydraulique: est chargée de définir la politique du Gouvernement dans le domaine de l'eau. Dans ce cadre elle assure:
  - la gestion du domaine public hydraulique;
  - l'inventaire, le dégagement, la planification et le contrôle tant quantitatif que qualitatif de l'usage de l'eau;
  - l'étude, la réalisation et la maintenance des grands ouvrages hydrauliques.
- L'office National de l'Eau Potable (ONEP): est chargé de la planification de l'approvisionnement en eau potable du Royaume. Il assure la production dans le secteur urbain essentiellement et la distribution pour le compte des communes quand elles le demandent.
- Le Ministère d'Etat à l'Intérieur et à l'Information/Direction Générale des Collectivités Locales /Direction de l'Eau et de l'Assainissement: placées sous tutelle de ce Ministère. Les collectivités locales sont chargées de:
  - la distribution d'eau potable en milieu urbain;

- la production et la distribution d'eau potable en milieu rural.

Les communes font intervenir des Régies de Distribution (au nombre de 16) dans les plus grandes villes et l'ONEP dans un certain nombre de petits centres. Les Régies conservent toujours les productions réalisées avant la création de l'ONEP.

- Le Ministère de l'Agriculture et de la Mise en Valeur Agricole (MAMVA) : Il est chargé d'élaborer et de mettre en oeuvre la politique agricole du Gouvernement. Dans le domaine de l'irrigation, le service central compétent du MAMVA est l'Administration du Génie Rural créés en 1993 à l'occasion de la réorganisation de la Direction de l'Equipement Rural. En outre, cette Administration intervient en milieu rural par la réalisation de projets d'eau potable dans le cadre de projets integrés agricoles ou d'élevage ou pour l'assistance technique aux communes.
- Ministère de l'Energie et des Mines : Il assure par le biais de l'Office National de l'Electricité le service public relatif à la production et au transport de l'énergie éléctrique, d'origine thermique et hydro-électrique sur tout le territoire national.
- Ministère de la Santé Publique : Il intervient dans le secteur pour assurer le contrôle de la qualité de l'eau de boisson et contribue à orienter les investissements de base vers les zones sanitaires prioritaires.
- Le Conseil Supérieur de l'Eau et du Climat : Pour coordonner les interventions des différents départements ministériels au niveau national, le Maroc s'est doté d'un organisme original, le Conseil Supérieur de l'Eau et du Climat, présidé par Sa Majesté le Roi Hassan II et chargé de définir la politique nationale dans ce domaine. Cette institution a pour mission:
  - de formuler les orientations générales de la politique nationale de l'eau;
  - d'examiner les plans directeurs d'aménagement integrés des bassins hydrauliques;
  - d'examiner les projets d'aménagements du territoire susceptibles d'avoir un impact sur les ressources en eau;
  - d'examiner tout projet de texte relatif à la légistation de l'eau.

Ce Conseil, qui tient une réunion annuelle, regroupe tous les départements ministériels concernés par les problèmes de l'eau, les élus, les usagers de l'eau, les organisations socio-professionnelles et experts divers, constitue un cadre de réflexion et de concertation pour la définition des grandes orientations nationales à moyen et à long terme en matière de planification, d'affectation et de gestion des ressource en eau.

Le secrétariat général du Conseil est assuré par le Ministre des Travaux Publics, de la Formation Professionnelle et de la Formation des Cadres et son secrétariat technique par l'Administration de l'Hydraulique.

3.11.4.2 Législation et réglementation dans le domaine de l'eau

Dès le début du siècle, le Maroc a pris des dispositions législatives pour organiser l'utilisation de l'eau et assurer sa protection en déclarant la domanialité publique des ressources en eau et en confiant la gestion à l'Etat. Un ensemble d'instruments réglementaires a été mis en place à l'époque en fonction des besoins. Il a subi depuis divers amendements et continue aujourd'hui à servir de base juridique au contrôle de l'utilisation de l'eau.

Les ressources en eau ne peuvent donc pas faire l'objet d'une appropriation privative à l'exception de celles sur lesquelles des droits ont été acquis. Leur utilisation se trouve donc soumise à un certain nombre de règles destinées à assurer leur préservation.

Toutefois, ces régles étant établies pour la plupart au début du siècle, où les ressources en eau étaitent beaucoup moins sollicitées que de nos jours, en raison des besoins limités et des techniques de mobilisation relativement peu performantes, elles ne sont plus adaptées à l'organisation moderne du pays et ne répondent plus aux besoins de son développement socio-économique.

C'est dans ce but que le projet de Code National de l'Eau a été élaboré et fait l'objet de nombreux débats et discussions tant au niveau des instances gouvernementales qu'au niveau du Conseil Supérieur de l'Eau et du Climat. Parmi les dispositions nouvelles que ce projet introduit figurent justement celles relatives à la mobilisation optimale des ressources en eau, à leur protection quantitative et qualitative et à la réglementation des prélèvements et des rejets:

- La planification cohérente et souple des ressources en eau tant à l'échelon du bassin qu'à l'échelon national, avec la définition de l'organisme responsable de la réalisation du plan, des aspects à traiter, de l'horizon de planification ainsi que la périodicité de la révision des plans directeurs;
- Le principe de la déclaration de la demande de prélévement d'eau ou de rejet d'eau usée permettra à l'administration d'assurer un contrôle et un suivi de l'utilisation de l'eau (prélèvement, consommation, rejet) sur les aspects aussi bien quantitatifs que qualitatifs;
- L'adoption des principes "préleveur-payeur" et "pollueur-payeur" permettra à l'Etat d'instituer une politique de recouvrement qui favorise la contribution aux importants investissements à faire dans l'avenir et l'instauration d'une véritable politique d'incitation à la conservation et à la protection des ressources en eau;
- L'introduction de la notion de ressources non conventionnelles ouvrira la voie à la prise en compte dans le processus de planification de potentialités en eau jusqu'à présent négligées et auxquelles le Maroc aura, à terme, recours pour équilibrer son bilan ressources-besoins;

  C'est le cas notamment des eaux usées dont la réglementation prochaine de l'usage permettra d'améliorer les conditions sanitaires d'utilisation.
- L'institution d'une police des eaux destinée à faire respecter la réglementation relative aux ressources en eau.

3.11.5 La planification des ressources en eau

Devant l'accroissement trés rapide des besoins en eau consécutivement à la forte croissance démographique, à l'amélioration du niveau de vie de la population et, plus généralement, aux nécessités du développement économique et social, une trés nette prise de conscience s'est faite, jour sur l'obligation d'opérer un développement des ressources en eau intégré et organisé:

- Les conflits d'allocation de l'eau qui sont apparus ont imposé le passage d'une planification sectorielle ou par projet, vers une planification plus intégrée prenant en compte l'ensemble des ressources et des besoins en eau;
- La sécheresse sévère du début des années 1980 a entraîné une perception plus aigue de l'importance de l'eau, bien économique rare dont il convient d'assurer une gestion efficiente et économe;
- L'importance croissante de la pollution générée par les activités humaines et la dégradation de l'eau qu'elle entraîne se traduit par la déperdition des efforts d'aménagement de l'eau et des côuts sociaux liés aux risques sanitaires sur les populations;
- L'élévation continuelle des coûts de mobilisation de l'eau est devenue une préoccupation essentielle des pouvoirs publics.

Devant les risques d'un développement anarchique des ressources en eau, le Maroc a entrepris une démarche de la planification intégrée de ses potentialités hydriques. La démarche ainsi entreprise constitue un axe stratégique essentiel de la politique de développement suivie qui vise à faire de l'eau un véritable outil d'aménagement du territoire national. Ainsi, grâce à la politique volontariste entreprise dans ce domaine, de véritables pôles de développement régionaux ont vu le jour autour de projets de mise en valeur des ressources en eau contribuant à une répartition plus équilibrée des activités économiques dans l'espace national. Cette tendance s'est accélérée au cours des dernières décennies avec le recours de plus en plus massif aux eaux de surface et la réalisation d'ouvrages hydrauliques structurants du territoire national pour le stockage ou le transport de l'eau.

Sur le plan méthodologique, le processus de planification s'étend depuis l'identification des problèmes d'approvisionnement en eau jusqu'à l'exploitation des équipements hydrauliques réalisés. Mais l'étape d'initialisation des processus est fondamentale, car de par les options qu'elle permet de définir pour le moyen et le long terme, elle donne la possibilité d'agir sur le futur. C'est en effet au cours de cette phase qu'est faite la sélection des meilleurs scénarios de développement de l'eau pour satisfaire les divers objectifs visés.

Les analyses sont généralement faites au niveau du bassin hydrologique, cadre naturel privilégié de la confrontation entre besoins et ressources en eau.

Les difficultés rencontrées lors de l'établissement des plans directeurs sont essentiellement de deux types:

- Les études de plans directeurs nécessitent une masse de données laborieuses et des études sectorielles relatives à l'eau potable, l'agriculture, l'énérgie... souvent non disponibles ou ne sont pas au même niveau de détail;
- Plusieurs départements interviennent dans le domaine de gestion des ressources en eau (MTP-Agriculture-Industrie-Intérieur...), ce qui nécessite une coordination étroite entre ces organismes durant l'élaboration du plan directeur. Cette difficulté a été résolue au Maroc par l'instauration d'un Comité de Suivi *ad hoc*.

Enfin, compte tenu des délais relativement longs de mise en oeuvre des projets hydrauliques, les horizons de planification sont de l'ordre de 30 à 40 ans.

Mener à bonne fin un tel processus de planification n'est pas une chose aisée, vu que les ressources en eau sont sujettes à des variations naturelles, d'autant plus importantes dans nos régions arides, que l'évaluation des changements futurs, tant démographiques qu'économiques ou technologiques, reste empreinte de nombreux aléas et que le caractére, souvent irréversible, des actions d'aménagement de l'eau impose un sucroît de prudence dans la prise de décision.

Ces éléments d'incertitude et de risque qui caractérisent le processus de planification de l'eau font qu'il doit être empreint de la souplesse nécessaire pour s'adapter aux changements et aux modifications qui pourraient intervenir.

Ceci étant, la planification est surtout un outil de concrétisation de la réalisation des objectifs nationaux de développement avec lesquels une cohérence et une intégration parfaites sont indispensables:

- au niveau régional où l'essentiel est d'identifier les besoins à satisfaire, de concevoir les ouvrages structurants nécessaires et de recommander une allocation optimale de l'eau conforme aux options de développement nationales ainsi qu'à celles de la région concernée;
- au niveau national, pour tenir compte des priorités de développement du pays et des plans sectoriels qui en découlent. A ce niveau également est réalisée l'intégration des différents plans régionaux de l'eau, en vue d'assurer un accès équilibré à l'eau à toutes les régions et de veiller à la cohérence de la planification au niveau national.

A l'heure actuelle, des études prospectives des bilans besoins-ressources en eau à des horizons de 10, 20 et 30 années ont été établies ou sont en cours d'achèvement pour l'ensemble des bassins hydrologiques du pays.

Ces plans directeurs de bassins sont une étape essentielle dans l'établissement d'un **plan national de l'eau** dont l'objectif est par ailleurs de veiller à un accés équilibré à l'eau entre les différentes régions du pays et de définir les dispositions communes d'ordre administratif, législatif, économique et financier.

A l'heure actuelle, les études de planification entreprises montrent que la demande globale en eau des secteurs usagers va pratiquement doubler à l'horizon 2020 pour atteindre 20 milliards de m^3 environ.

Pour faire face à cette demande de l'horizon 2020, les études montrent qu'il convient de prévoir la mobilisation de 8 milliards de m^3 d'eau de surface et de 1.5 milliard de m^3 d'eau souterraine. Cet effort de mobilisation nécessitera:

- la réalisation de plus de 60 grands barrages de stockage d'eau de surface;
- la réalisation d'une moyenne annuelle de 100 km de forages et puits pour l'exploration et le captage d'eau souterraine, en particulier profonde;
- l'adoption d'une stratégie efficace et le développement des efforts pour la conservation et la lutte contre la pollution de l'eau;
- le développement de la recharge des nappes souterraines, en vue d'assurer une meilleure gestion conjointe des eaux de surface et des eaux souterraines;

- le recours aux ressources en eau non conventionnelles, telles que les eaux usées et les eaux saumâtres.

Le processus de planification est aussi un préalable à la mise en oeuvre d'une gestion rationnelle et efficiente de l'eau. En effet, face à la pression de la demande croissante en eau et à la raréfaction qu'elle entraîne en milieu aride, face également aux coûts croissants de mobilisation ou d'adéquation de la qualité de l'eau, aux différents usages, il devient vital de mettre en oeuvre des solutions économes d'utilisation de l'eau. C'est dans ce sens que le Maroc, comme de nombreux pays caractérisés par l'aridité de leur climat, se doit de relever dans l'avenir le défi de la gestion rationnelle de l'eau.

La mobilisation des ressources en eau devra comprendre des actions cohérentes visant la sauvegarde et la préservation des ressources en eau et par conséquent un développement harmonieux et durable. Ces actions devront être axées principalement sur:

- la lutte contre l'érosion et l'envasement des infrastructures. Les projets d'aménagements hydrauliques devront désormais comprendre une composante aménagement du bassin versant;
- des mesures d'économie d'eau par la sensibilisation de l'ensemble des usagers de l'eau;
- une mise au point et une application rigoureuse de la réglementation de l'eau que constituera le Code National de l'Eau après sa promulgation et de ses textes d'application après leur publication. Cette réglementation fera au besoin l'objet d'actualisation;
- l'instauration de redevances d'utilisation de l'eau (prélèvement ou déversement) pour pouvoir disposer de fonds, en vue de préserver et restaurer le domaine public hydraulique;
- la création au niveau des bassins versants d'Agences de Bassins qui devraient être des structures administratives autonomes, chargées de la mise en oeuvre de la politique nationale de l'eau et pouvant jouer un rôle de concertation entre usagers de l'eau et de promotion de la gestion rationnelle des ressources en eau.

3.11.6 La gestion de l'eau

La gestion de l'eau concerne toutes les pratiques et mesures techniques, économiques et socio-politiques de nature à contribuer à une utilisation efficiente de l'eau. Elle concerne les actions prises au quotidien pour suivre et évaluer les ressources disponibles, contrôler leur utilisation et veiller à leur protection et leur conservation en quantité et qualité. Une utilisation efficiente de l'eau suppose une gestion correcte de l'offre et de la demande en eau.

3.11.6.1 La gestion de l'offre

Elle concerne l'identification, la mobilisation et l'exploitation des ressources en eau, c'est à dire toutes les actions entreprises avant l'entrée en action des réseaux de distribution aux usagers. La gestion de l'offre en eau fait appel à:

- Des outils techniques

  Les modèles de simulation constituent des outils efficaces d'aide aux décisions et de pilotage de la gestion conjointe des eaux souterraines et des eaux de surface quand cela est possible.

  De tels outils sont élaborés ou en voie de l'être pour les principaux bassins et nappes d'eau souterraines du Maroc. Il permettent une gestion optimale des systèmes hydrauliques, consistant à satisfaire au mieux les différents usages d'eau.

- Des mesures structurelles

  - A l'extrême aval de certains bassins, des ouvrages sont réalisés pour récupérer les écoulements et éviter les pertes d'eau à la mer.
  - Les dispositifs qui concourent à une meilleure gestion conjointe des eaux de surface et des eaux souterraines sont également envisagés pour mieux maîtriser les apports de crues à l'aval des barrages. C'est le cas notamment du complexe de Charf El Akab dans la région de Tanger où l'excédent d'eau de surface est traité et injecté dans un aquifère pour être repompé en été.
  - La compatibilité de la modulation des demandes en eau des divers usagers est également recherchée en vue d'éviter les lachers d'eau inutiles à partir des retenues de barrage.
  - Des mesures spécifiques peuvent également être prises lors d'épisodes de sécheresse pour améliorer l'efficience de la gestion de l'eau: digues fusibles...
  - Des plans de gestion des pénuries conjoncturelles d'eau sont également adoptés pour n'orienter l'offre limitée d'eau que vers les besoins prioritaires. Des mesures spécifiques d'allocation de l'eau, et/ou de restriction de la fourniture de l'eau aux différents usages sont alors mises en oeuvre.
  - Une attention particulière est accordée à la gestion de la qualité de l'eau qui s'est concrétisée par les efforts consentis au niveau des moyens techniques deployés (laboratoires régionaux de qualité), et au niveau des études entreprises pour définir les actions à mettre en oeuvre à même de lutter contre la pollution (schémas d'objectifs de qualité des eaux des bassins, plans directeurs d'assainissement des grandes villes,...)
  - La gestion de l'offre tient compte aussi du phénomène de l'érosion qui génère dans les bassins hydrographiques marocains des fortes charges en sédiments qui compliquent l'exploitation des ouvrages hydrauliques et rencherissent leurs coûts de réalisation et de maintenance. Face à ces impacts négatifs sur une bonne gestion de l'eau, le conseil supérieur de l'eau a recommandé lors de sa 5ème session en 1991, une meilleure intégration des politiques de gestion des ressources en eau et des ressources en sol à l'échelon des bassins versants.

3.11.6.2 La gestion de la demande

Elle concerne les pratiques et les mesures non structurelles visant à accrôitre l'efficience de l'utilisation de l'eau par les usagers et à lutter contre son gaspillage. L'utilisation de l'eau comprend toutes les pratiques relatives au prélèvement, à l'usage et au rejet de l'eau dans le milieu naturel.

La gestion de la demande englobe toutes les actions orientées vers l'exploitation des réseaux de distribution et le comportement de l'usager consommateur d'eau.

Elle vise en premier lieu à agir sur la demande en eau pour maîtriser la croissance et, si possible, réduire l'importance des projets de mobilisation d'eau nécessaires ou du moins à différer leur échéance de réalisation.

Elle s'appuie sur les mesures techniques propres à chacun des usages pour améliorer l'efficience des utilisations au niveau des réseaux de distribution et de l'usager, et pour promouvoir les technologies qui consomment le moins d'eau.

Elle s'appuie également sur les dispositions d'accompagnement d'ordre économique et réglementaire pour contrôler l'utilisation de l'eau et favoriser l'économie dans sa consommation.

3.11.7 Conclusions

Bien que les étapes franchies par le Maroc dans le développement de ses ressources en eau aient jusqu'à présent répondu de manière satisfaisante à l'évolution des besoins, il est nécessaire de consolider le progrès réalisé et de développer des efforts pour relever le défi de l'accroissement continuel et de plus en plus rapide des besoins des usagers alors que l'offre des ressources en eau, malgré tout limitée, est confrontée à des menaces plus fréquentes de dégradation et d'épuisement.

Si la moitié des ressources potentielles est déjà mobilisée, les solutions techniques seront désormais plus complexes et les investissements plus lourds pour mobiliser la moitié qui reste, accroître les ressources disponibles par une gestion conjointe et integrée de toutes les ressources en eau disponibles et aboutir à leur gestion rationnelle.

Le processus de planification et de gestion rationnelle des ressources en eau déjà mis en oeuvre ouvre la voie à une utilisation optimale de l'eau pour le développement économique et social du pays. Il est vital également que soit définie une stratégie relative à l'économie d'eau dans le cadre d'une vision intégrée des aspects techniques, économiques, juridiques et environnementaux, de manière à garantir la cohérence des actions menées par l'ensemble des acteurs au profit d'une mise en valeur durable des ressources en eau du pays.

3.12 REPORT ON INTEGRATED WATER RESOURCES MANAGEMENT IN SLOVENIA

Mitja RISMAL(*)

3.12.1 Summary

In this report short description of administrative structure of water resources management in the Republic of Slovenia is given. The lack of adequate integrated water resources planning and management is stressed and explained on two examples. In the new Water Law that is in preparation, the introduction of integrated water resources management should be prescribed. Some proposals for enhancing co-operation within the Mediterranean region are suggested.

3.12.2 Short introduction

Slovenia is water rich country with over 1,000 mm per year average precipitation, the population of 2,000,000, and about 20,000 km^2 surface area.

The main part of the country belongs to the Danube, and only about 1/4 to the Adriatic sea catchment areas.

Because of the predominantly karstic character of this region, there are severe drinking water supply problems. This calls for prudent, ecologically and economically sound integrated planning, management and exploitation of the limited water resources available.

In the other water rich parts of Slovenia in the past, mainly the problems of flood control, river regulations, hydroelectric power production, land amelioration, and partly, irrigation were seen as priority task of water management authorities.

Until recently there has been sufficient high quality spring and ground water available for drinking water supply.

This is the reason why water resources management has primarily been orientated to water quantity, rather than quality problems.

But in recent time, the clean water springs have mainly reached the limit of exploitability, and the ground water quality is more and more exposed to pollution from intensive land use and from polluted rivers.

As a consequence, the need is realised for better integrated water resources planning and management, equally considering the water quantity and water quality problems.

The coast and the karstic region already mentioned, with its drinking water supply deficiencies, demand already today unconditionally complex, integrated planning and management of the scarce water resources.

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In this case (as well as in many others) it is evident that by integrated approach only, the drinking water, and also other uses of water, can be solved efficiently. In this way essential improvement of the quality of the existing water resources, and significant savings in investment and operational costs of water exploitation, are possible to achieve.

The main obstacle to introduce integrated planning of water resources exploitation in Slovenia seems not to be the lack of financial means (it certainly exists, too), but the lack of adequate knowledge, and of administrative and operational water resources management.

The consequence is that unproportional amount of money in relation to the results has already been spent.

There is every probability that this unsatisfactory practice will continue until adequate integrated water resources planning and management is introduced.

After explaining some legal and administrative features of the Slovenian water resources planning and management, this report explains briefly the problems of water resources planning and management in the Slovenian coastal and karst region.

3.12.3 Administrative structure of water resources management and the preparation of integrated water resources management plans

The responsible institution for water resources planning, management and exploitation in Slovenia is the Ministry of Environmental Protection and Physical Planning (MEPPP). The general organisational scheme of the Ministry is given in Picture 1.

From that scheme it follows that the water resources planning and management is organised in three departments: "Environmental Protection and Water Management Regime Agency (EPWRA)", the "National Direction of Environmental Protection and Water Management (NDEPWM)", and the "National Water Management Inspectorat (NWMI)".

The EPWRA includes, along with other functions given in the picture, the Environmental Protection Division, and Water Management and Planning Division.

The NDEPWM has operational role and is responsible for the execution of the accepted Water Resources Management Plans, and the maintenance of the existing water structures of public character and ownership.

The NWMI is an independent governmental institution to control the legal execution in all fields of water resources planning, management and construction.

The organisational structure of the NDEPWM, that has the main role in execution of the accepted Water Management Plans, is presented in the Picture 2.

The water management plans are prepared in cooperation between EPWRA and NDPEWM, in coordination with Regional Offices and local authorities dealing with flood control, amelioration, water supply, wastewater disposal plans, etc.

Permissions for the execution of all projects of water resources exploitation and protection, with the, by water law, predetermined size and importance, are issued by the MEPPP.

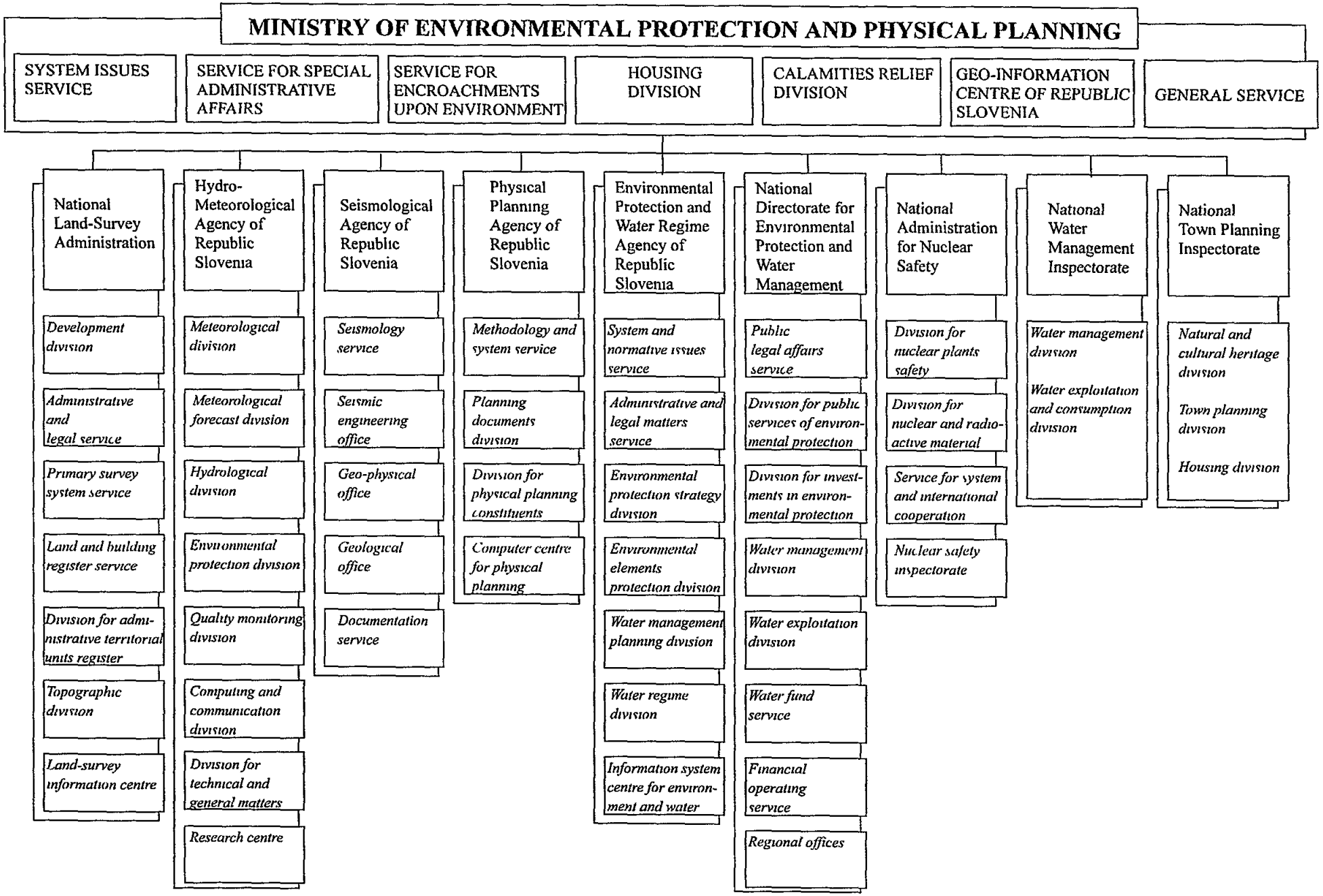
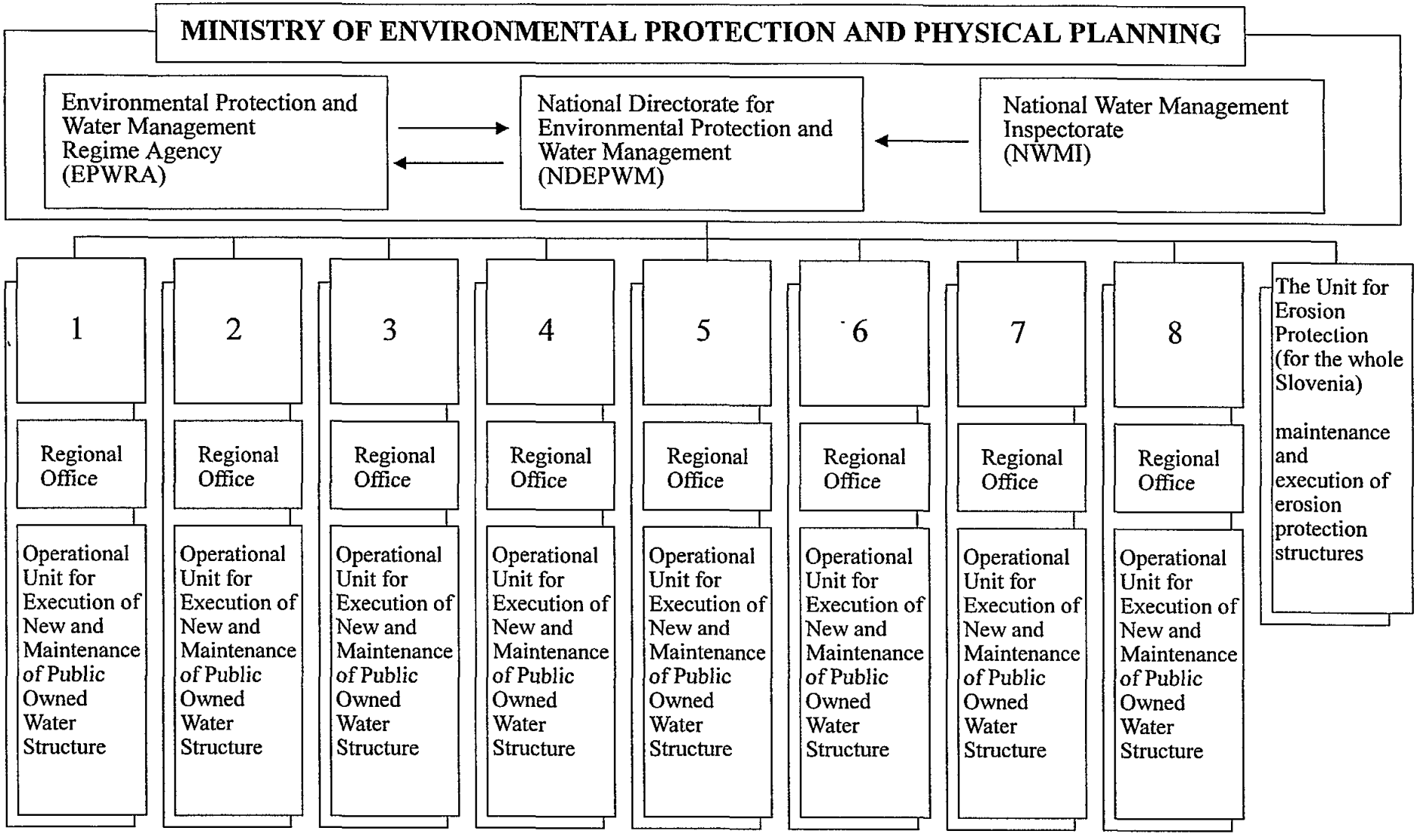


Figure 1. The organisational scheme of the Ministry of Environmental Protection and Physical Planning



The whole Slovenia is divided in 8 water catchment areas (regions) with their own Regional Offices and Operational Units. The Unit for Erosion Control covers the whole Slovenia.

Figure 2

The water resources management projects are financed by:

- Governmental budget;
- Local authorities or individuals (industry, etc.);
- Banks; and
- Ecological Foundation that was established to support implementation of Environmental Protection Plans.

3.12.4 Examples of integrated planning of water resources exploitation - experience gained in the water resources management

So far, the integrated planning of water resources in Slovenia has been restricted mainly to flood control, water storage, land amelioration (irrigation), and hydroelectric power exploitation.

The more complex, integrated planning and management, taking into account also water quality control and drinking water supply, recreational exploitation of water for fishery, etc., using also the possible positive impacts on water quality and quantity achieved by artificial changes to the existing water flow patterns by construction of new water reservoirs, river impoundments, improvement of wastewater treatment and control of dispersed pollution, do not exist yet, although efforts in this direction have been made by the individual institutions over the past 15 years or so.

Not only in the karst and coastal region, where the integrated water resources management is actually indispensable, but also in other parts of Slovenia richer in water, introduction of integrated water resources planning and management could have substantially reduced the costs, at the same time ensuring ecologically beneficial water resources exploitation.

An example of economically and ecologically damaging consequences of the prevailing partial, instead of integrated approach, represents the planning of hydroelectric impoundments on our water-rich rivers Mura and Sava.

Except for energy production, the impoundments, if properly designed, could be profitably used for irrigation, for river water quality improvement, and extension of wet lands, etc., improvement of groundwater quality and quantity for water supply and irrigation purposes. All these possibilities have not been, or at least not properly, evaluated against the present landscape and biotop changes caused by the impoundments.

The negative consequence was the prevention of ecologically and economically optimal energy production. Instead of hydroelectric power plants, thermal electric power stations were constructed causing thermal water pollution, and because of bad coal used, also an intensive air pollution.

The existing, and partly already executed plans for drinking water of the mentioned Slovenian coastal and karst region make another example where the integrated approach is strongly missed and urgently calls for reconsideration of the existing plans:

3.12.4.1 Possible alternative solution of drinking water supply of the Slovenian coast and karst region

The existing master plan and water supply project for the whole region are based on local water resources Rižana and Sečovlje, as well as on the karst springs of Malni and Brestovica belonging to the watersheds of the rivers Ljubljanica and Soča, both about 50 to

65 km respectively away from the centre of the consumption. Until now, only the karst water wells of Rižana and Sečovlje, and the water transport system from Brestovica, constructed over the past 10 years, have been completed.

The basic features of that existing project could be defined as follows:

a) From the economic point of view:

- High investment cost of the long (50 - 65) transportation pipes of over 1.00 m^3/s capacity from the karst springs to the consumption area.
- Very high investment thresholds bec,ause of long pipes that should be mainly constructed for the final capacity.
- High energy costs (Brestovica) for pumping 250 l/s water about 600 m high, and expensive, about 35 km long, transport pipe.

b) From the ecological point of view:

- The transfer of water from other watersheds of specific and ecologically valuable water sources (karst springs Malni-Unec) is not in line with either ecological or economic considerations, as so long as there is sufficient surface water of river Notranjska reka available much nearer, between the main water consumption centres of Koper - Portorož and Sežana.
- From the ecological, as well as economic points of view, it would be more consistent and sound to use the huge investments, instead for long transport pipes, to improve and protect the existing local water sources of the Notranjska reka that could be used, if properly treated, for the water supply of the whole region.
- It should also be mentioned that the Notranjska reka flows into the Škocjan karst cave, which is under the World protection as natural monument of a unique ecological and landscape value.

The aim of this paper is to present shortly the possible alternative solutions of the water supply of the whole region in question.

On the tributories of the river Notranjska reka, two water reservoirs of about 8,000,000 m^3 capacity have been constructed already, with the main purpose to increase the low water of the river, to improve its quality, and to protect the specific biotop of the karst cave.

The possibility to use this already existing river water augmentation of low river discharges of 1.00 m^3/s (and more, if additional reservoirs capacities are constructed when needed) for water supply has not been considered because about 17 km upstream of the possible water extraction for water supply there is a small city of Ilirska Bistrica with 5,000 inhabitants, that does not treat its waste waters yet.

It was not believed that the waste water of this town could be treated efficiently enough to secure, 17 km downstream, the necessary quality of the river water as a raw water source for drinking water supply. Such opinions are questionable, because the analyses of the river water, even today, without waste water treatment, show a relatively good quality.

It is worthwhile mentioning that the relatively small differences in quality between this river water and the extremely expensive water from the karst springs of Malni and Brestovica (which should be transported by over 50 km long transport pipes) and the water of the already exploited karst well of Rižana, could be easily overcome already with the same conventional drinking water purification technology as for karst springs, provided the waste water treatment plant of the upstream town of Ilirska Bistrica is constructed. The qualities of these waters are given in the table below.

The quality of drinking water sources in question:
River Notranjska reka (1.00 l/s possible extraction of drinking water)

		03.03.93	**13.05.93**	**10.06.93**	**13.07.93**	**22.09.93**	**26.10.93**
$KMnO_4$	mgO_2/l	4.3	6.1	4.2	3.2	2.3	2.4
$K_2Cr_2O_7$	mgO_2/l	11.1	15.8	6.4	4.9	6.9	6.0
BOD_5	mgO_2/l	2.5	2.3	2.1	1.7	1.1	1.5
FAECAL BACT.		0	0	0	+	0	++
COLIFORM BACT.-TOTAL	MPN/l	2.0E03	<2.0E03	<2.0E03	2.0E03	<2.0E03	8.0E04

The planned Karst spring Malni-Unec (1.00 l/s)

		09.03.93	**26.05.93**	**16.06.93**	**03.08.93**	**11.08.93**	**17.11.93**
$KMnO_4$	mgO_2/l	1.4	1.4	1.6	1.9	1.7	2.6
$K_2Cr_2O_7$	mgO_2/l	2.3	4.0	1.9	4.0	2.7	2.8
BOD_5	mgO_2/l	1.1	1.3	0.9	1.0	0.6	1.0
FAECAL BACT.		0	0	0	0	0	0
COLIFORM BACT.-TOTAL	MPN/l	<2.0E03	<2.0E03	<2.0E03	<2.0E03	<2.0E03	<2.0E03

The already exploited karst well Rižana (min capacity 300 l/s)

		03.03.93	**13.05.93**	**09.06.93**	**13.07.93**	**26.10.93**	**17.11.93**
$KMnO_4$	mgO_2/l	1.7	3.1	1.3	2.3	2.2	2.5
$K_2Cr_2O_7$	mgO_2/l	2.6	7.6	4.8	4.8	3.2	3.2
BOD_5	mgO_2/l	0.7	0.9	1 5	1.2	1.4	0.5
FAECAL BACT.		0	0	0	0	+	+
COLIFORM BACT.-TOTAL	MPN/l	<2.0E03	<2.0E03	<2.0E03	<2.0E03	4.0E03	4.0E03

All the three water sources are according to saprobian indexes between I. and II. category - olygosaprob to beta metasaprob.

The difference in investment costs amounts to over 40,000,000 DEM. And with the energy for 600 m high pumping of 250 l/s drinking water from the Brestovica spring, it would be possible to cover the pumping costs for water supply and wastewater treatment together of the whole region with about 250,000 inhabitants.

In the existing drinking water supply plan of the region in question, the possibilities of water reuse (after treatment of waste water, the water could be profitably used for irrigation, street cleaning, industrial water, etc.), which could noticeably reduce the depletion of the scarce water resources available, is completely neglected.

Evidently, by the implementation of an integrated approach to water resources exploitation and protection, very considerable investment, operational and ecological benefits could be achieved.

The main obstacle to obtain this could be seen in the lack of the adequate knowledge necessary for integrated planning, and deficient knowledge of ensuring the necessary quality of drinking water from surface water. These deficiencies are mainly of subjective character.

The objective factor is the lack of adequate organisational structure that would be capable of insuring and implementing the integrated plans, and of maintaining the necessary ecological order to insure the quality of drinking water resource of the Notranjska reka.

In the appendix the scheme of the water is given.

3.12.5 Problems already encountered in the preparation of integrated water resources managment plans (legislation, data staff, administrative organisation, methodology, financing)

As it was shwon, there are strong deficiencies regarding the effective implementation of integrated water resources planning, management and exploitation.

It is hoped that the new water law will prescribe, and also secure financial possibility for what is necessary to be done to improve the existent deficiencies.

It is questionable if the lack of adequate legislation and adequate data is the main reason for not satisfactory water resources planning, management and exploitation.

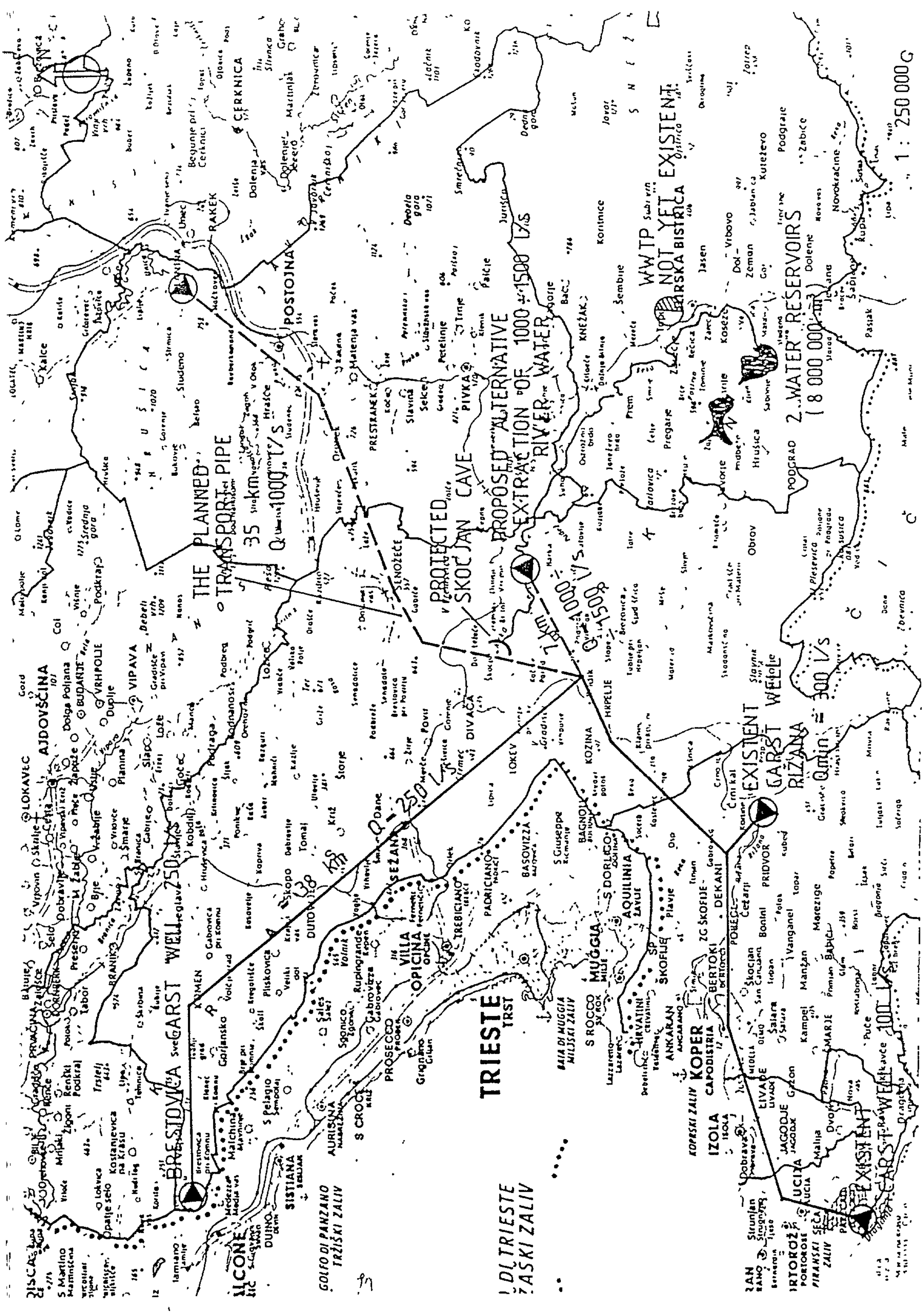
More than that, the consoderable lack of the adequate staff, capable to deal with the complex problems of water resources planning and management, could be seen as the main obstacle for satisfactory planning and management.

Another unresolved problem is the issue of effective cooperation in planning, management and execution between local communities, the existing water authorities and the individual users of water. Without effective co-operation between those, the integrated plans can hardly be successfully implemented.

3.12.6 Proposals for enchancing cooperation within the Mediterranean region through activities of UNEP/ MAP/PAP

To improve the existing water resources planning and management, and to introduce an integrated approach, the following measures should be practical and efficient:

- First of all, the assistance of experts, who should be engaged on the most acute cases of water resources planning and decision making, especially about technological questions and judgment of usability of different raw water quality for drinking water supply and other uses.
- Start of cooperation on the pilot project of integrated water resources planning for Slovenian coastal and karst region which was shortly described in this report, and which represents an example where the integrated planning is needed and could be effectively taught.
- Establishment of cooperation in the development of "appropriate" technologies for water reuse as a positive contribution to rational water resources exploitation and protection.



THE PLANNED TRANSPORT PIPE
35 km
Q = 1000 l/s
PROJECTED SKOCJAN CAVE
PROPOSED ALTERNATIVE EXTRACTION OF 1000 ÷ 1500 l/s RIVER WATER
WWTP NOT YET EXISTENT
2 WATER RESERVOIRS
1 : 250 000
BRESTOVICA GARST WELL 250 l/s
38 km
Q = 250 l/s
EXISTENT GARST WELL RIŽANA
Qmin = 300 l/s
EXISTENT GARST WELL
TRIESTE
POSTOJNA
PIVKA
SEŽANA
KOPER
IZOLA
AJDOVŠČINA
CERKNICA
RAKEK

3.13 STRATEGIES DE GESTION DES EAUX EN ESPAGNE

Ricardo SEGURA GRAINO(*)

3.13.1 Introduction

Une très grande partie du territoire d'Espagne présente des caractéristiques du climat méditerranéen. Là, l'eau est le facteur limitatif du développement; donc on a acquis une technologie basée sur une maîtrise et une gestion des eaux perfectionnées au cours des siècles.

L'importance exceptionnelle que les ressources en eau ont pris pour le développement a donné lieu à la promulgation d'une nouvelle Loi sur les Eaux (Loi 29/1985), en substitution de l'ancienne Loi de 1879. Cette nouvelle Loi et ses dispositions réglementaires configurent les procédés et les méthodes opératives avec lesquelles on développe les stratégies de gestion des eaux en Espagne. Le cadre légal est basé sur les six grands principes:

1. En Espagne, toutes les ressources en eau renouvelables sont sous le domaine public, même les eaux souterraines.
2. **L'unité de gestion** du bassin hydrographique avec la participation des usagers.
3. L'Administration publique des eaux doit concilier la traditionnelle **organisation administrative** (comprenant treize bassins) selon les déterminations de la Constitution de 1978, qui a créé les Communautés autonomes avec un important ensemble de compétences. Neuf bassins sont sous la compétence de l'Etat et quatre sous les Communautés autonomes (Figure no. 1).
4. Il n'a pas été possible d'introduire un prix de l'eau[1] , mais les usagers doivent payer une redevance destinée à l'amortissement des ouvrages hydrauliques: barrages, canaux, systèmes d'épuration, etc. Néanmoins, cette taxe, excepté en ce qui concerne les consommateurs des grandes villes, est très réduite et elle n'est pas généralement évaluée en concordance avec le débit réel utilisé.
5. On doit promouvoir une croissance soutenable, respectant, en tout cas, le milieu naturel.
6. La Loi souligne le rôle fondamental des travaux de planification hydrologique.

3.13.2 Bilan hydrique actuel

Les dernières études publiées à cet égard dans le Plan Hydrologique National recueillent une panoramique globale du secteur. On résume ensuite, dans le cadre no.1, les données les plus remarquables, et tout particulièrement celles relatives au bilan ressources

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(1) L'introduction d'un prix de l'eau est encouragée par le Ministère des Finances mais, pour contre, il y a une oposition générale de tous les usagers.

garanties/besoins en eau. D'une première analyse, on perçoit l'existence, en ce moment, d'un déficit concentré aux bassins du fleuve Segura (sud-est). Le grand transfert d'eau "Tajo-Segura" tâche de corriger ce déficit moyennant la destination des ressources du fleuve Tajo au bassin du Segura (0,9 km^3/an). La sécheresse de la période 1988-1993 n'a permis que le transfert de 0,3 km^3/an.

Dans le même cadre no. 1, on remarque la grande importance de l'irrigation en Espagne (3,300, 000 ha irrigés), tandis que la sufrace agricole utile est de 20,000,000 ha. Cet usage atteint environ 80% de la consommation totale.

Au moyen terme, la situation actuelle deviendrait épouvantable, sauf qu'on envisage les problèmes hydriques actuels, moyennant la planification hydrologique.

3.13.3 Planification hydrologique

La nouvelle Loi sur les Eau réglemente la planification hydrologique, ayant pour l'objectif de parvenir à une meilleure satisfaction des demandes en eau, ainsi que d'équilibrer et d'harmoniser le développement régional et sectoriel, en augmentant les disponibilités des ressources, protégeant la qualité de l'eau, économisant son emploi et rationalisant ses usages en harmonie avec l'environnement et les autres ressources naturelles.

Cette planification se faira par le biais des Plans Hydrologiques de Bassin et du Plan Hydrologique National. Les premiers sont élaborés par l'organisme du bassin concerné, avec la participation des usagers, des Communautés autonomes et d'autres Ministères intéressés, le cas échéant, à l'approbation finale par le Gouvernement.

Par la nouvelle loi on a institué le Conseil National des Eaux qui doit émettre son avis au regard de tous les travaux législatifs et de planification. Pourtant, un grand nombre de membres du Conseil (plus de quatre-vingt dix personnes) rend les travaux très diffciles.

Les Plans Hydrologiques de Bassin sont établis en deux étapes. La première comprend deux documents essentiels:

- documentation de base, y compris toutes informations disponibles;
- projet de lignes directrices, synthétisant les ressources, les besoins en eau et les solutions altternatives possibles.

La deuxième étape doit perfectionner les documents de la première, tout en présentant une proposition définie pour le Plan Hydrologique de Bassin. En ce moment, on travaille activement sur l'achèvement de tous ces plans de sorte qu'en janvier 1995 ils seront prêts pour l'approbation finale par le Gouvernement, s'il y a lieu.

L'horizon temporel des Plans étudiera deux situations, respectivement à dix et à vingt ans. La planification est faite pour chaque système d'exploitation, y compris l'identification de leurs ressources, besoins, bilans et règles d'exploitation.

Les Plans Hydrologiques de Bassin comporteront obligatoirement:

- l'inventaire des ressources hydrauliques;
- les usages et les demandes, existants et prévisibles;

- les critères de priorité et de compatibilité d'usages, ainsi que l'ordre de préférence entre les différents usages et exploitations, à savoir: eau potable, irrigation, hydroélectricité, industrie;
- l'assignation et la réserve des ressources pour des usages et des demandes actuels et futurs, ainsi que pour la conservation ou la récupération du milieu naturel;
- les caractéristiques fondamentales de qualité des eaux et de l'aménagement des déversements des eaux résudiaires;
- les normes fondamentales d'amélioration et de transformation en terres irriguées pour assurer une meilleure exploitation de l'ensemble des ressources hydrauliques et des terrains disponibles;
- les périmètres de protection et les mesures de conservation et de récupération des ressources et de l'environnement affectés;
- les Plans hydrologiques-forestiers et de conservation des sols qui devront être réalisés par l'Administration;
- les directives pour la recharge et la protection des nappes aquifères, vu les graves problèmes de surexploitation et de pollution des nappes;
- les infrastructures de base requises par le Plan;
- les critères d'évaluation des exploitations énergétiques et la fixation des conditions requises par leur exécution;
- les critères concernant les études, actions et travaux nécessaires pour prévenir et éviter les dommages dus aux innondations, aux crues et aux autres phénomènes hydrauliques.

Le Plan Hydrologique Naitonal a été élaboré par le Ministère des Travaux Publics, également en coopération avec d'autres Ministères intéressés.

Le Plan Hydrologique National contiendra, en toute hypothèse:

- les mesures nécessaires pour la coordination des différents Plans Hydrologiques de Bassin;
- la solution pour les éventuelles alternatives que ceux-ci offriraient;
- la prévision et les conditions de transferts des ressources hydrauliques dans les cadres territoriaux de différents Plans Hydrologiques de Bassin;
- les modifications prévues par la planification de l'utilisation des ressources, et qui affecteront des exploitations existantes pour l'approvisionnement de localités ou de terres irriguées.

En avril 1993, le Plan a été présenté au Conseil Naitonal des Eaux qui a exprimé son avis le 20 juillet 1994. Suivant l'avis du Conseil, des modications remarquables sont à introduire dans le Plan Hydrologique National concernant: la stratégie de planification; l'évaluation des besoins en eau; l'utilisation des ressources non conventionnelles; l'économie de l'eau; la justification soigneuse des nouveaux périmètres d'irrigation et des

transferts d'eau; l'intensification des mesures de protection de l'environnement; et finalement, la reconsidération du régime économique pour l'utilisation privée de l'eau.

En ce moment, le Ministère est en train de développer un processus de rédéfinition du Plan pour le présenter au Gouvernement qui, le cas échéant, le soumettra au Parlement pour l'approbation officelle.

La méthode de travail suivie dans la planifcation est toujours la même: à partir de la situation actuelle, faire une estimation ou pronostic des besoins futurs et prévoir les ressources nécessaires pour équilibrer le bilan. Dans le cadre no. 2 on résume les estimations prévues dans le Plan pour l'an 2012.

Les études comprises dans les travaux de planification montrent les problèmes, présents et futurs, dans le secteur hydrique. Il y a des problèmes quantitatifs, mais l'Espagne a aussi des problèmes liés à la qualité des eaux. La planification doit résoudre tous ces problèmes, et même ceux d'innondations dérivées de redoutables crues des fleuves, rivières, ruisseaux et torrents.

3.13.4 Lutte contre la sécheresse

Suivant la Commission Internationale d'Irrigation et de Drainage, la sécheresse est un hazard et un désastre qu'il sera possible de défier à travers une approche intégrée.

En développant les activités de planification, le Ministère des Travaux Publics doit prévoir, envisager et réduire les effets de la sécheresse. En Espagne, la sécheresse s'avère trop inégale dans différentes régions. C'est dans le sud et le sud-est où la dite sécheresse atteint la pire intensité, tandis que le nord-est n'a point de sécheresse.

La durée de la période de pluies réduites et de ruissellements minimaux est exceptionnelle. Le volume d'eau retenu actuellement dans les barrages du sud-ouest est environ 10% de la capacité des réservoirs. Les aquifères de ces régions-là sont soumis à surexploitation, puisque les extractions dans les dernières ans excèdent les ressources renouvelables. Les nouveaux barrages sont tout à fait inutiles, jusqu'au moment où les pluies surmontent la sécheresse.

L'expérience pratique acquise durant cette période peut se resumer en sept sujets:

1. Tout d'abord, l'utilisation des remarquables réserves d'eau des aquifères pendant la sécheresse, permettant d'extraire, bien sûr de façon provisoire, des volumes d'eau excédant ceux renouvelables.
2. Il faut assurer l'alimentation en eau des villes, même en assignant à ce but les ressources d'eau utilisées traditionnellement dans les aires irriguées avoisinantes; celles-ci doivent recevoir une compénsation économique ou faire usage à son tour des eaux épurées des villes. Des études stratégiques ont été élaborées pour garantir l'approvisionnement en eau des grandes villes. S'il faut, les villes de Madrid, Sevilla et bien d'autres peuvent être fournies des ressources provenant des zones irriguées avoisinantes. Dans le cas de Madrid, le débit des égoûts est épuré et peut être utilisé pour l'irrigation moyennant une station de pompage (figure 2).
3. L'économie de l'eau doit être encouragée par le changement des comportements des usagers. Concernant l'eau potable, l'exemple de Madrid est très curieux où l'on a réussi une grande diminution de la consommation (de 600 hm^3/an à 500 hm^3/an

environ) moyennant l'interdiction d'irriguer les jardins, la réduction de pertes, la tarification progressive, la divulgation des problèmes hydriques, et même la sensibilisation des écoliers.

4. On doit promouvoir la mise en exploitation des puits pour contribuer à l'alimentation en eau des villes. Lorsque le traditionnel usage des eaux superficielles devient insuffisant pour l'approvisionnement, on peut introduire l'exploitation conjointe des eaux souterraines. Pendant une piriode limitée (deux ou trois ans), il est possible d'extraire des puits des quantités d'eau supérieures à celles des ressources renouvelables du fait que, la secheresse une fois finie, l'alimentation ne sera faite qu'avec des eaux superficielles.

5. Il faut remarquer que, pendant les périodes de sécheresse, les budgets des organismes chargés de la gestion du bassin subiront très forts déficits; donc, il faut le prévoir pour assurer leur fonctionnement. D'abord, les frais seront, bien sûr, plus grands; d'autre part, les redevances seront plus petites. L'Administration centrale doit y contribuer avec une subvention, le cas échéant.

6. La participation active des Communautés d'Arroseurs dans la répartition des ressources insuffisantes est absolument fondamentale pour diminuer les contraintes dues aux restrictions de l'usage.

7. D'après l'auteur du présent rapport, l'application -en toute liberté- de nouvelles techniques par les agriculteurs doit être encouragée.

3.13.5 Conclusion

En guise d'épilogue, il faut remarquer les problèmes déjà rencontrés dans les travaux de planification hydrologique:

1. Les difficultés pour concilier les propos des différentes Communautés autonomes, et tout particulièrement l'opposition des territoires excédentaires d'eau aux transferts dans des aires déficitaires.

2. L'importance de la participation des usagers entraînant des procédures de grande lenteur. Par exemple, la rédaction du rapport du Conseil National des Eaux concernant le Plan National a duré 18 mois.

3. L'augmentaiton des problèmes dus à la coïncidence des travaux de planification avec une période de très forte sécheresse.

4. La répartition des compétences parmi les Administrations -nationale, régionale et locale- et les structures -travaux publics, agriculture, aménagement du territoire, énergie.

5. L'importance des investissements prévus pour les travaux hydrauliques.

Il faut conclure en soulignant les grands problèmes et les difficultés concernant les travaux de planification hydrologique mais aussi en remarquant les grands avantages d'une utilisation de l'eau subordonnée à l'intérêt général, en fonction des directives de planification économique et conformément aux prévisions réclamées par la propre dynamique sociale.

CADRE Nº 1

LE BILAN HYDRIQUE 1992	
A) LES RESSOURCES	
La Précipitation moyenne	340 km^3/année.
L'Evaporation moyenne	-226 km^3/année
L'Ecoulement moyen	114 km^3/année
L'Ecoulement disponible (même des eaux souterraines)	47 km^3/année
Les deversements utiles	8 km^3/année
Les ressources disponibles	55 km^3/année
B) LES USAGES CONSOMPTIFS	
L'alimentation des villes	4,3 km^3/année
L'usage industriel	1,9 km^3/année
L'usage agraire	24,2 km^3/année
Les usages diverses (refroidissement, milieu naturel,...)	9,8 km^3/année
	40,2 km^3/année
C) LES BILANS	
L'Excedent global	14,8 km^3/année
Les Déficits localisés	-3,0 km^3/année

CADRE Nº 2

LE BILAN HYDRIQUE. EVALUATION 2012		
A) LES USAGES CONSUMPTIFS		
USAGES	ANNEE 1992	ANNEE 2012
L'Alimentation des villes	4,3 km^3/a	6,3 km^3/a
L'usage industriel	1,9 km^3/a	2,4 km^3/a
L'usage agraire	24,2 km^3/a	27,6 km^3/a
Les usages diverses	9,8 km^3/a	10,5 km^3/a
TOTAL	40,2 km^3/a	46,8 km^3/a

B) RESSOURCES DISPONIBLES	
Les ressources actuelles	47,0 km^3/a
L'augmentation	7,8 km^3/a
Les deversements utiles	9,4 km^3/a
Déssalement et Reusage	0,8 km^3/a
TOTAL	65,0 km^3/a

C) BILAN	
L'excedent global	19,2 km^3/a
Les déficits localisés	0
Les transferts maximum	3,8 km^3/a

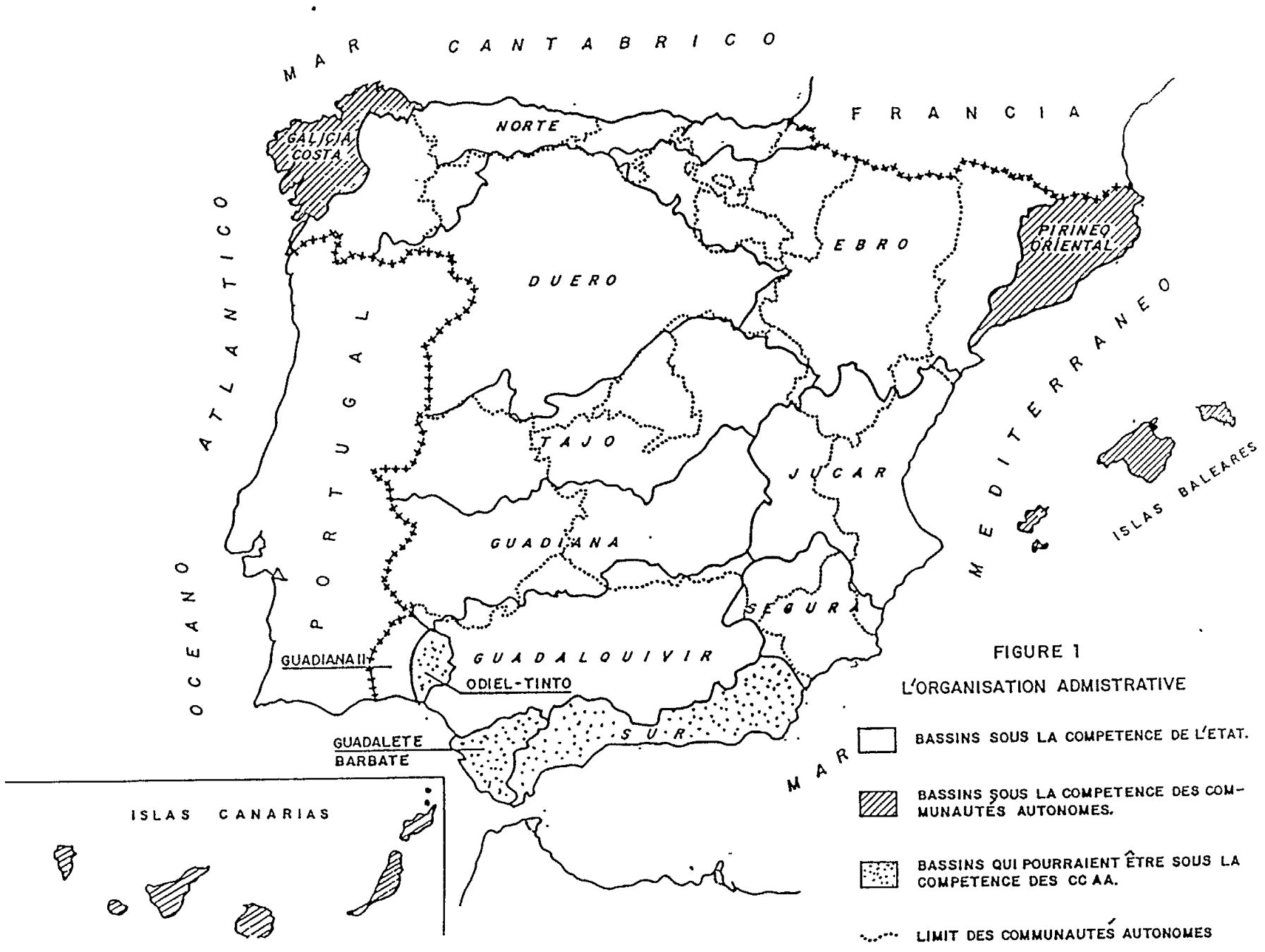

FIGURE 1

L'ORGANISATION ADMISTRATIVE

BASSINS SOUS LA COMPETENCE DE L'ETAT.

BASSINS SOUS LA COMPETENCE DES COMMUNAUTÉS AUTONOMES.

BASSINS QUI POURRAIENT ÊTRE SOUS LA COMPETENCE DES CC AA.

LIMIT DES COMMUNAUTÉS AUTONOMES

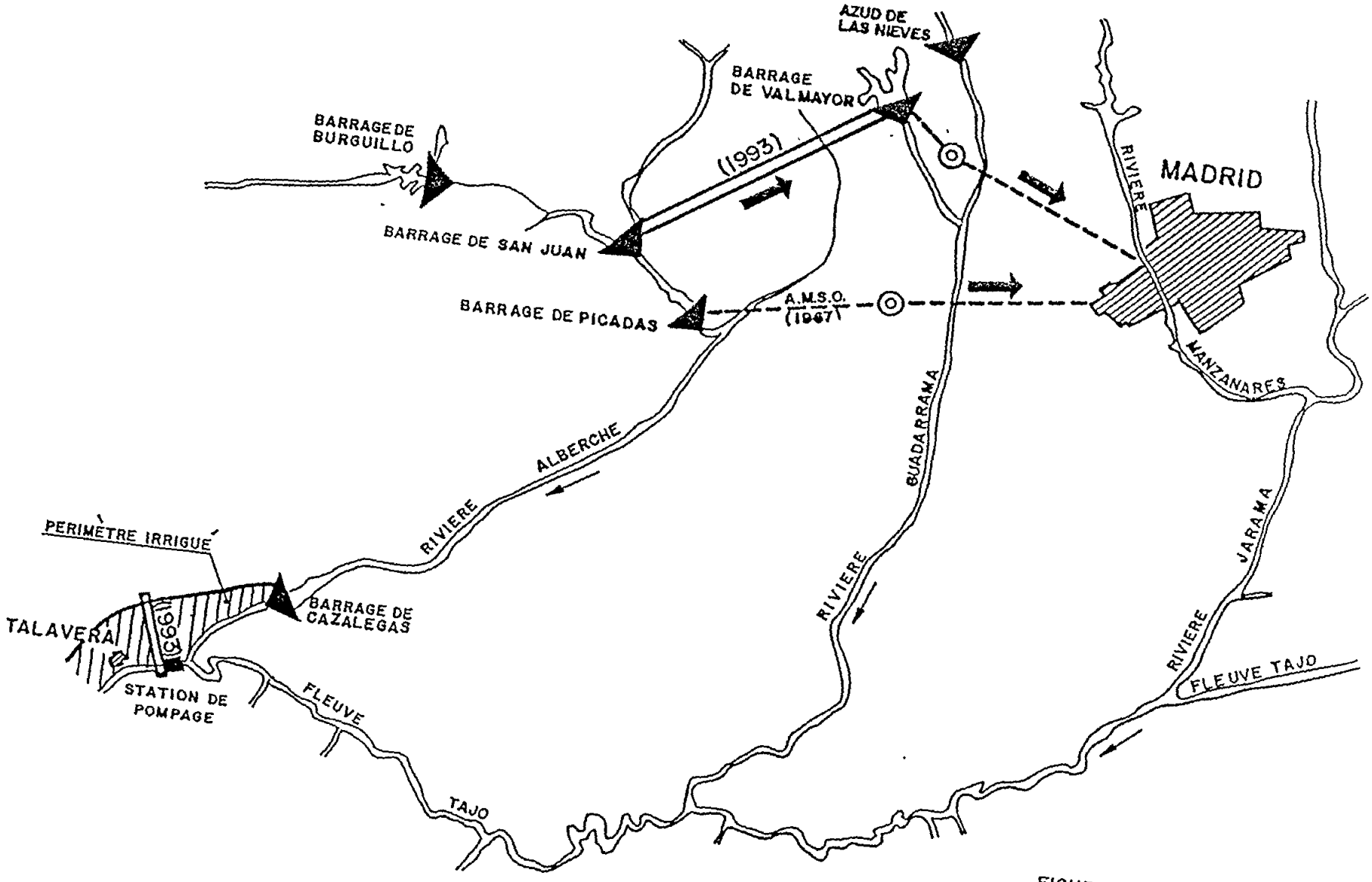

FIGURE 2
L'UTILISATION A MADRID DES RESSOURCES D'EAU DU PERIMETRE D'IRRIGATION DE TALAVERA

3.14 LA GESTION INTEGREE DES RESSOURCES EN EAU EN TUNISIE

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3.14.1 Abrégé

La ressource en eau en Tunisie est précieuse, et l'objectif de sa bonne gestion constitue un facteur primordial pour assurer le développement durable du pays. La mobilisation de ces ressources en eau et leur gestion se réalisent grâce à une banque de données alimentée par un réseau dense de stations de mesures pluviométriques, hydrologiques et piézométriques, dans le cadre d'une multitude de plans directeurs nationaux et locaux. Conformément à l'esprit du Code des Eaux (promulgué en Mars 1975), les Plans Directeurs des Eaux du Nord, du Centre et du Sud ont été établis sur les principes suivants:

- protéger les nappes contre l'intrusion des eaux marines et salées des lacs intérieurs et contre le rabattement excessif;
- garantir l'équilibre du bilan;
- lutter contre la pollution hydrique.

En Tunisie, le transfert des eaux et l'interconnexion des bassins dans le cadre du projet du Plan Directeur des Eaux du Nord a permis de mieux répartir la ressource à travers les régions du pays.

La répartition de la ressource en eau tient compte de sa capacité limite. Ainsi pour la sauvegarde et la création des oasis dans le cadre du Plan Directeur des Eaux du Sud, les capacités limitées des nappes du complexe terminal et le continental intercalaire ont été fixées et ont servi pour déterminer les quotas à allouer pour les Oasis anciennes et les superficies des nouvelles Oasis. Dans certaines zones du pays, des décrets d'interdiction ou de sauvegarde sont promulgués.

La base juridique disponible et les arsenaux réglementaires et les cadres institutionnels ont facilité la réalisation des projets définis par une planification intégrée. Le renforcement des associations d'intérêt collectif (AIC), surtout dans le domaine de l'irrigation et l'eau potable rurale, a permis une meilleure implication des bénéficiaires.

La maîtrise des techniques du traitement et de la réutilisation des eaux usées urbaines dans l'irrigation, le dessalement des eaux, l'économie de l'eau et la lutte contre le gaspillage sont les défis majeurs que la Tunisie devra relever dans le cadre d'une coopération régionale entre les pays riverains de la Méditerranée.

3.14.2 Planification et développement des ressources

3.14.2.1 Planification intégrée des ressources hydrauliques

L'intérêt public pour le secteur de l'eau est né réellement en Tunisie dans les années 1930 avec la création de forages profonds destinés à renforcer l'irrigation dans les oasis du Sud. Les difficultés sociales et économiques des années 1950 ont déterminé

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l'Administration à mettre en oeuvre des grands travaux hydrauliques d'aménagement des terres pour l'irrigation et l'alimentation en eau potable de la région de Tunis. De même, la politique des grands barrages, déjà pratiquée depuis de nombreuses années en Algérie et au Maroc, a trouvé un champ d'application, favorable dans la vallée de la Medjerdah, fleuve le plus important du pays.

Dépassant cette approche sectorielle, la Tunisie a opté dès les années 1970 pour une démarche de planification intégrée des ressources, en vue d'en éviter la mise en valeur anarchique et d'assurer une adéquation permanente entre les besoins et les disponibilités en eau. Cette planification de l'eau constitue une composante importante des plans de développement économique et social, et contribue de manière décisive à la réalisation des objectifs nationaux majeurs en matière d'accès à l'eau potable des populations, de production agricole, en vue de l'autosuffisance alimentaire et de développement des zones défavorisées.

Trois Plans Directeurs de l'Utilisation des Eaux intéressant les grandes régions géographiques du pays ont été entrepris:

- Le Plan Directeur de l'Utilisation des Eaux du Nord et de l'Extrême Nord a permis d'intégrer les bassins de la vallée de la Medjerda, de l'Extrême Nord, de l'Ichkeul, du Cap Bon et du Sahel pour l'eau potable et l'irrigation.
- Le Plan Directeur du Centre a identifié et mis en valeur les ressources de surface et souterraines de toute la Tunisie Centrale.
- Le Plan Directeur du Sud a intégré plus particulièrement les ressources souterraines du Complexe Terminal et du Continental Intercalaire pour la sauvegarde et l'extension des anciennes oasis, tout en assurant l'alimentation en eau potable des centres urbains.

Les principes retenus dans le cadre de cette planification sont principalement:

- la possibilité d'interconnexion entre les barrages situés dans un même bassin versant et l'utilisation combinée des ressources stockées dans des barrages appartenant à des bassins indépendants;
- le transfert de l'eau des régions bien pourvues vers d'autres régions accusant un déficit sur les plans quantitatifs ou qualitatifs (sauvegarde des agrumes du Cap-Bon, alimentation en eau potable de la ville de Sfax...);
- l'utilisation intégrée des ressources de surface et souterraines.

Des plans directeurs à un niveau régional plus restreint sont en cours d'élaboration, en vue d'affiner les connaissances concernant la dualité ressources-emplois à l'échelle des gouvernorats et des délégations, et d'étudier les moyens à mettre en oeuvre pour optimiser l'exploitation des ressources en eau disponibles.

3.14.2.2 Situation actuelle du développement des ressources en eau

Dans le cadre de cette planification, la mobilisation des ressources hydrauliques a revêtu une importance majeure aussi bien pour les pouvoirs publics que pour le secteur privé. Les investissements dans le domaine de l'eau se sont situés au cours des deux dernières décennies à environ 40% des investissements du secteur agricole.

Le pays s'est doté ainsi d'une infrastructure hydraulique importante, composée essentiellement de 17 barrages, 34 barrages collinaires, 180 lacs collinaires, 2 000 forages profonds et 85 000 puits de surface.

Globalement, le niveau de mobilisation atteint 63% des ressources potentielles conventionnelles permettant de disposer de 2,820 millions de m^3 répartis de la manière suivante:

- Eaux de surface: 1,285 Mm^3
- Eaux souterraines: 1,535 Mm^3

Grâce à ce potentiel disponible, des réalisations à caractère économique et social ont pu être accomplies:

- *Aménagement Hydro-Agricole*: de 50,000 ha en 1960, la superficie irrigable a progressé à 303,000 ha en irrigation intensive et 91,000 ha en irrigation de complément et par épandage. La demande en eau de ce secteur est évaluée à 1,575 Mm^3 (85% de la demande totale), et sa production se situe actuellement à un niveau de 30% en valeur de la production agricole totale et 13% du PNB.
- *Eau potable*: Le taux de desserte en eau potable de la population tunisienne est de 86% (100% en milieu urbain, 66% en milieu rural). La demande de ce secteur est estimée à 276 Mm^3, dont 240 Mm^3 pour l'eau domestique, 20 Mm^3 le tourisme et 80 Mm^3 destinés au secteur industriel.

3.14.2.3 Problématique de l'eau

Outre le gap à mobiliser (1,650 Mm^3), lequel nécessitera des investissements considérables, la ressource hydrique subit l'influence de contraintes qui menacent sa pérennité et celle des secteurs qui lui sont associés.

Ces contraintes qui traduisent la rareté de l'eau dans le pays sont notamment:

- l'envasement des barrages;
- la fragilité du système hydro-géologique (irrégularité de l'alimentation des nappes, exploitation excessive, caractère fossile), la variabilité inter annuelle des apports et leur qualité (salinité excessive);
- le gaspillage des ressources dans les différents secteurs d'usage.

3.14.3 La structure administrative

Conformément au Code des Eaux, le domaine public hydraulique est administré par le Ministère de l'Agriculture, lequel est assisté d'un Comité National de l'Eau et d'une Commission du Domaine Public Hydraulique. Les aspects en relation avec l'environnement hydrique (prévention, contrôle et suivi, actions curatives...) sont confiés au Ministère de l'Environnement et de l'Aménagement du Territoire, créé en 1991.

Au plan national, l'Administration de l'Agriculture est chargée particulièrement- de la planification, des études, du suivi et de l'évaluation des projets à caractère hydraulique, de la réalisation des barrages et des grands aménagements hydro- agricoles, et de la gestion des eaux dans les grands barrages.

Au plan régional, les commissariats régionaux au développement agricole (CRDA), organismes à caractère administratif ayant repris les missions des ex-offices de mise en valeur des périmètres irrigués depuis 1989, constituent des structures décentralisées au

niveau des gouvernorats et ont pour tâche essentielle de promouvoir la gestion de l'eau au double plan quantitatif et qualitatif.

Le secteur de l'eau potable urbaine, et en partie rurale, est confié à la Société Nationale de l'Exploitation et de la Distribution des Eaux (SONEDE) qui se charge de la gestion de toutes les composantes du secteur.

La gestion de certains ouvrages de transfert inter régionaux du Nord est confiée à la Société d'Exploitation du Canal et des Adductions du Nord (SECAN) qui assure la fourniture d'eau potable et d'irrigation aux organismes distributeurs (SONEDE, CRDA du Nord).

En outre, le Ministère de l'Environnement et de l'Aménagement du Territoire est doté de deux organismes spécialisés: l'Office National de l'Assainissement (ONAS) chargé de la gestion de l'assainissement urbain, et l'Agence Nationale de Protection de l'Environnement (ANPE).

L'expérience de la Tunisie en matière d'organisation du secteur de l'eau a permis d'accomplir certains progrès:

- La mise en oeuvre d'une politique cohérente de planification et de développement des ressources, avec une autorité unique capable de coordonner entre les différents intervenants et trancher, en temps opportun, les conflits entre les secteurs usagers.
- La constitution d'organismes spécialisés et financièrement autonomes (SONDE, ONAS, SECAN), ce qui a permis de s'apercevoir très tôt des aspects économiques en relation avec la gestion de l'eau.
- Depuis plusieurs années, le cadre institutionnel établi dans le secteur agricole a décentralisé la gestion vers les CRDA et les AIC. Les CRDA sont responsables de la redevance d'eau dans leurs régions respectives. Les AIC prennent des responsabilités toujours plus grandes dans les domaines de l'exploitation et de la maintenance des systèmes d'eau.

Certains aspects peuvent cependant constituer à l'avenir des contraintes majeures pour s'adapter aux conditions encore plus sévères de la gestion de l'eau:

- Le Comité National de l'Eau, devant impliquer plusieurs partenaires (Administration, élus, usagers, organismes socio-professionnels, experts...) et permettre un débat plus vaste des orientations et des choix stratégiques de la politique nationale de l'eau, n'est pas encore opérationnel.
- La décentralisation a épousé le découpage administratif au niveau des gouvernorats, ce qui ôte toute possibilité de gestion intégrée des ressources à l'échelle des bassins ou des régions naturelles du pays sans intervention directe de l'Administration.
- Les relations entre les divers intervenants dans le domaine de l'eau restent encore peu structurées, particulièrement au niveau de l'allocation des ressources, de la coordination avec l'aménagement du territoire et entre les secteurs de l'eau potable, de l'irrigation et de l'assainissement, de l'impact des rejets, etc.

En effet, la mutation vers la décentralisation exige un niveau de planification et de réglementation qui tient compte de l'interdépendance des ressources disponibles et des interactions de plus en plus complexes des divers secteurs. L'élaboration de mécanismes de

coordination mieux adaptés et la mise en place de systèmes d'information s'imposent comme moyens privilégiés pour rationaliser la gestion de l'eau.

Il y a lieu de considérer également les relations de plus en plus vastes du secteur de l'eau avec les autres secteurs socio-économiques:

- *la Planification Nationale*: intégration du secteur de l'eau dans le cadre des plans de développement économique et social, et de la programmation des investissements;
- *les Finances Publiques*: subventions éventuelles de fonctionnement des organismes gestionnaires (CRDA) et encouragements financiers, etc.;
- *la Santé Publique*: impact sanitaire de l'eau potable, de l'utilisation des eaux épurées, et des rejets;
- *les industries et le commerce de services*: fabrication et importation de divers équipements hydrauliques, service après vente, service de maintenance, etc.
- *Les Organisations non gouvernementales et associations d'usagers, l'éducation, la formation et la sensibilisation*: au niveau des opérateurs et du public dans son ensemble.

Tableau N° 1: Ressources en eau en Tunisie

	Potentielles Mm^3	Mobilisées Mm^3	%
a - Ressources de surface			
Bassin de la Medjerdah	1,000	866	87
Extrême Nord	910	157	17
Cap-Bon - Miliane	210	75	36
Tunisie Centrale	370	187	50
Sahel et Sud	140	-	-
Sous-total 1	**2,630**	**1,285**	**49**
b - Ressources Souterraines			
Tunisie du Nord	555	453	82
Tunisie du Centre	454	396	87
Tunisie du Sud	831	685	82
Sous-total 2	**1,840(1)**	**1,535**	**83**
Total Tunisie	**4,470(2)**	**2,820**	**63**

(1): Dont 669 Mm^3 à partir des nappes phréatiques et 1,171 Mm^3 à partir des nappes profondes: les ressources fossiles provenant des nappes profondes sont de 631 Mm^3.

(2): 50% des ressources en eau de la Tunisie ont une salinité RS < 1,5 g/l permettant divers usages; 23% sont de qualité RS > 3 g/l (jugée médiocre), nécessitant précaution d'emploi en irrigation et adoucissement pour l'eau potable.

3.14.4 Un exemple d'élaboration de plan intégré - "Le Plan Directeur des Eaux du Sud" (PDES)/1972-1993

L'étude des ressources en eau du Sahara Septentrional, réalisée en 1972, a identifié 3 réservoirs aquifères importants: le Continental Intercalaire, le Complexe Terminal et la Jeffara. L'ensemble des ressources en eau de ces nappes représente 20 m^3/s en débit fictif continu (soit 600 Mm^3/an). Entre 1972 et 1976, le Ministère de l'Agriculture a réalisé le schéma directeur d'utilisation des ressources en eau et en sol du sud pour satisfaire les besoins des activités socio-économiques de la région jusqu' à l'horizon 2000. Il s'agit en effet des priorités suivantes:

- satisfaction des besoins en eau potable de toute la région, dont particulièrement les besoins de la ville de Gabès et des agglomérations côtières de Jerba et Zarzis;
- sauvegarde des oasis traditionnelles qui souffrent d'un déficit important en eau, et d'une superficie globale de 20,000 ha (129 oasis au total);
- création de nouvelles oasis sur les meilleurs sols dans la limite de 8,000 ha, axées sur les zones du Jérid et de Nefzaoua;
- satisfaction des besoins en eau des activités industrielles, à Gabès particulièrement, et des activités touristiques à Jerba - Zarzis essentiellement.

3.14.4.1 Mise en oeuvre du Plan Directeur des Eaux du Sud: volet agricole

Partant de la capacité de financement du pays et de la participation des bailleurs de fonds étrangers, la mise en oeuvre du PDES s'est effectuée en 4 tranches.

Globalement, il s'agit au niveau de chaque tranche de la sauvegarde d'anciennes et de la création de nouvelles oasis.

Nous entendons ici par sauvegarde ou création un ensemble d'actions à la fois hydrauliques et agricoles. Pour les actions hydrauliques, il s'agit de mobiliser les ressources en eau nécessaires aux besoins des oasis par le remplacement ou la création de forages, leur équipement et la réalisation de réseaux d'irrigation-drainage dans chaque oasis qui remplace les réseaux de séguias en terre ou les vieux réseaux en dur existants. Quant aux actions agricoles, il s'agit de réaliser une reconversion agricole axée sur des plantations à bonne valeur marchande et d'intensifier les cultures intercalaires, essentiellement maraîchères et fourragères.

D'une façon générale, il n'était plus question de procéder à des actions isolées dans les oasis telles que le remplacement de forages uniquement, comme il en a été le cas avant 1980, mais plutôt de réaliser des actions intégrées et complètes, à la fois hydrauliques et agricoles, de nature à permettre un vrai développement agricole.

Nous citons assez rapidement les différentes phases de la mise en oeuvre du PDES:

I Première tranche: Rénovation de 3,200 ha d'oasis anciennes et création de 2,100 ha de nouvelles oasis à Nefzaoua au Jerid et à Gabès, soit 7 oasis d'une superficie totale de 3,200 ha. Par ailleurs, et afin de soulager la densité d'exploitation dans ces anciennes oasis, il a été procédé à la création de nouvelles oasis sur des bons sols au Jérid et à Nefzaoua.

Au total, 12 nouvelles oasis ont été réalisées dont essentiellement la grande palmerais d'Ibn Chabbat (1,000 ha) au Jérid et les palmerais de Réjim Maâtoug à Nefzaoua à la frontière tuniso-algérienne (304 ha/ 3 oasis). Ces nouvelles créations ont permis d'installer 1,715 jeunes agriculteurs sur des lots allant de 0,5 à 2 ha. Le coût total de ce projet s'élève à 37 Millions de Dinars dont 22 MD pour l'infrastructure et 15 MD pour la reconversion agricole. La BIRD a participé au financement de ce projet par un prêt de 25 Millions de Dollars. Il a permis de mobiliser 2,140 l/s (environ 64 millions de m^3/an) par 33 forages.

Le projet a permis une production supplémentaire de 20,000 tonnes de Deglat Ennour et de 30,000 tonnes de fourrages verts. Au niveau de l'emploi, il a permis la création de plus de 300 emplois spécialisés et de l'ordre de 760,000 journées de travail par an,

soit l'équivalent de 3,000 emplois permanents. Au niveau des revenus, ceux-ci ont doublés pour atteindre 2,000 D/ha/an au moins.

II Deuxième tranche: Rénovation de 16,800 ha d'oasis anciennes et création de 700 ha de nouvelles oasis.

Parallèlement au démarrage de la 1ère tranche, le Ministère de l'Agriculture a procédé à la mise en oeuvre d'une seconde tranche qui, contrairement à la première, a identifié des plans directeurs individualisés pour chaque région. C'est ainsi que 4 plans directeurs régionaux ont pu être définis visant la sauvegarde de toutes les oasis anciennes et la création de nouvelles oasis dans la limite des ressources en eau disponibles.

III Troisième tranche: *Le grand projet de Réjim Maâtoug*

Le nombre important de forages réalisés dans la région du Jérid et de Nefzaoua et les données relatives à leur exploitation ont permis d'actualiser les études des ressources en eau du Sahara Septentrional (réalisées en 1970) et de réaliser des modèles mathématiques à partir de mailles plus denses. En plus de la confirmation des données sur la nappe du Complexe Terminal, les modèles ont révélé qu'il est possible de mobiliser des ressources supplémentaires de 2,000 l/s dans les régions très peu exploitées au Sud-Ouest du Chott Jérid, plus particulièrement dans la zone de Réjim Maâtoug. Ces ressources mobilisables par une batterie d'une trentaine de forages, d'une soixantaine de litres par seconde chacun, ont permis de créer sur des sols favorables des nouvelles oasis d'une superficie totale de 2,000 ha au coût total de 50 MD.

Les études réalisées en 1986 ont identifié la possibilité de réaliser 7 unités d'oasis d'une superficie moyenne de 300 ha chacune, irriguée à partir de 3 à 4 forages. Se trouvant sur des terres collectives, l'Etat a procédé à la location de ces terres pour une période de cent ans. Une fois aménagées et mises en valeur, ces terres ont été loties et affectées à des jeunes agriculteurs pour les exploiter.

3.14.4.2 Les structures de mise en oeuvre du Plan Directeur des Eaux du Sud

Ces structures interviennent au niveau de la mise en place des infrastructures, de l'exploitation de ces infrastructures et de l'assistance et la vulgarisation pour atteindre les objectifs du plan au niveau de la production et des revenus.

1. Au niveau de la mise en place des infrastructures: Il s'agit essentiellement de la Direction Générale du Génie Rural opérateur du plan, ainsi que de la Direction Générale des Ressources en Eau pour la mobilisation des eaux.

   Les services centraux et régionaux de ces deux Directions Générales se sont vus dotés de nouveaux cadres techniques de maîtrise et de gestion de projets. Il est à noter ici que les infrastructures hydrauliques sont à la charge totale de l'Etat (128 Millions de Dinars) et exécutées par ses soins.

2. Au niveau de l'exploitation des infrastructures: L'exploitation des réseaux de distribution des eaux et le pompage de l'eau sont confiés aux Associations d'Intérêt Collectif (A.I.C.). Le bilan financier de l'exploitation agricole (charges/recettes) fait apparaître un résultat d'exploitation positif, de quoi permettre aux AIC de prendre en

charge les frais d'exploitation directe du pompage des eaux et de maintenance des réseaux hydrauliques.

A cet effet, et en vue de permettre à ces AIC d'assumer pleinement les missions qui leurs sont assignées, l'Etat a jugé utile de leur octroyer la personnalité civile afin qu'elles puissent avoir une capacité juridique leur permettant d'assurer une bonne gestion de leur patrimoine et de garantir une meilleure administration de leurs structures.

Dans le même sens, les procédures administratives de gestion des AIC ont été bien assouplies pour les rendre plus efficaces. (cf. loi ní87-35 du 06 juillet 1987 modifiant certains articles du Code des Eaux et décret ní87-1261 du 27 octobre 1987 relatif à l'organisation et au mode de constitution des AIC).

3. Au niveau de la vulgarisation et l'encadrement: S'agissant de pompage d'eau qui remplace les sources, de réseaux en dur qui remplacent les séguias et s'agissant de nouvelles techniques de production et d'exploitation agricole, l'Etat a créé depuis 1980 deux Offices de mise en valeur des périmètres irrigués:
   - Gafsa - Jérid à Tozeur pour les oasis de Gafsa et du Jérid;
   - Gabès - Mednine à Gabès pour les oasis de Kébili, Gabès, Mednine et Tataouine.

   Ces Offices ont pour mission d'encadrer les agriculteurs pour une meilleure production agricole et une meilleure gestion de leur exploitation, et d'assister techniquement les AIC dans la gestion de l'eau et l'exploitation des équipements hydrauliques à l'intérieur des oasis.

   Par ailleurs, les Offices ont la charge d'assurer la maintenance et l'entretien des grands ouvrages hydrauliques et des réseaux d'adduction d'eau vers les oasis. Aussi et afin de contribuer à assurer des revenus meilleurs aux agriculteurs, les Offices assistent les AIC et les Coopératives de services dans l'écoulement de leur production.

3.14.5 Problèmes rencontrés

3.14.5.1 Implication des bénéficiaires

Les plans directeurs étant élaborés par l'Administration centrale, les bénéficiaires et les organismes de gestion concernés (SONEDE, ONAS, CRDA, AIC...) n'ont pas préparé leurs plans d'exploitation des ressources mises à leur disposition.

Ils se sont généralement trouvés dans une situation telle que des plans d'exploitation et de gestion des ressources nouvellement mis à disposition ont été préparés à la hâte, laissant en veilleuse des programmes déjà entamés.

Actuellement, et grâce à la décentralisation, ce genre de situation est de moins en moins fréquent. Au sein même du Ministère de l'Agriculture, la préparation des plans directeurs est confiée, selon la nature des activités, soit à la Direction Générale des Etudes des Grands Travaux Hydrauliques (Plan Directeur des Eaux du Nord et de l'Extrême Nord), soit à la Direction Générale du Génie Rural lorsque la composante sociale est prépondérante (Plan Directeur des Eaux du Sud).

La Direction Générale des Ressources en Eau s'occupe du recensement des ressources en quantité et qualité.

3.14.5.2 Evaluation globale des Plans Directeurs

Il est évident aujourd'hui que c'est grâce aux Plans Directeurs des Eaux (PDE) que la Tunisie ne souffre pas de pénurie d'eau. Néanmoins, la conception des plans directeurs et leur exécution mérite une évaluation globale.

Pour le PDE Sud, cette évaluation va démarrer dans un proche avenir mais risque être longue et pénible. En effet, la conception et l'exécution du plan ont nécessité plus de 20 ans.

L'évaluation du PDE Nord n'a pas également eu lieu car les travaux de la dernière tranche se poursuivent jusqu' à l'horizon 2000. Il est à signaler que l'absence d'une base de données au moment de l'élaboration des plans directeurs a conduit à une série de révisions de leur contenu et une augmentation de l'enveloppe financière des projets.

3.14.5.3 Mise à jour des textes juridiques

Le Code des Eaux et quelques textes relatifs aux eaux usées constituent l'essentiel de textes juridiques réglementant le domaine de la gestion de l'eau en Tunisie.

Le code des eaux nécessite une mise à jour pour traiter des aspects suivants:

- La notion économique de l'eau: l'eau est de plus en plus considérée comme un bien marchand. La responsabilisation des opérateurs et la participation du secteur privé ne seront guère efficaces en dehors de cette mesure: l'eau a un coût et les bénéficiaires doivent payer ce coût.
- Le rôle de l'état: ce rôle doit être relativisé. Il est opportun de passer le relais aux organismes et aux opérateurs concernés. L'Etat doit renforcer son rôle régulateur.

3.14.5.4 L'organisation administrative et institutionnelle

Au début de l'exécution des plans directeurs, l'Etat a créé des offices de mise en valeur. Leur spécialisation a permis dans une certaine mesure à bien exploiter les ressources en eau mises à leur disposition. La gestion de ces offices a été entachée de certaines défaillances notamment par la dilapidation du patrimoine foncier, la faiblesse des recettes et les sureffectifs.

L'Etat a décidé de dissoudre ces offices et de confier leurs tâches au CRDA.

Cette décision de recentralisation semble actuellement aboutir à l'échec. Les CRDA, structures administratives déjà surchargées, ne peuvent pas s'occuper convenablement de la gestion des domaines agricoles confiés auparavant aux offices. Une révision de ce choix est plus qu'urgente.

Un autre aspect non négligeable est la coordination et la concertation entre l'administration, les opérateurs et les bénéficiaires concernés. L'absence de cette coordination dans le passé a eu des retombées négatives telle que la réalisation des barrages sans le traitement au préalable du bassin versant, l'envasement rapide des retenues ou la réalisation des forages sans la préparation des périmètres à irriguer, ou encore l'aménagement des barrages collinaires inaccessibles à la population bénéficiaire.

3.14.5.5 L'aspect "Environnement"

En Tunisie, l'aspect préservation de l'environnement devient une composante fondamentale dans la planification et la réalisation des projets pour la gestion des

ressources naturelles. Cet aspect a été renforcé par la pression exercé par les bailleurs de fonds. La Tunisie est actuellement bien placé en matière de lutte contre la pollution d'origine hydrique, notamment les eaux usées urbaines.

L'exécution d'une partie des ouvrages de retenue et de transfert des eaux du nord a été remise en cause afin de tenir compte de la sauvegarde de l'équilibre écologique d'un parc naturel (Ichkeul).

3.14.6 Axes possibles d'une coopération régionale méditerranéenne

3.14.6.1 La maîtrise des techniques et procédés de traitement des eaux usées en vue de leur réutilisation en irrigation

La Tunisie dispose d'une bonne expérience en matière de collecte et de traitement biologique des eaux usées. A nos jours, 40 stations d'épuration traitent 100 millions de m^3/an à travers tout le pays. Seulement 20% de ce potentiel est réutilisé pour l'irrigation. Le traitement tertiaire n'est pas encore introduit en Tunisie pour des problèmes de coût d'exploitation. L'élimination totale des germes pathogènes, des oeufs de parasite et la réduction à moins de 30 mg/l des matières en suspension représentent les conditions minimes pour vulgariser la réutilisation de ces eaux.

3.14.6.2 Le dessalement des eaux saumâtres et marines

Plusieurs zones du pays souffrent de la qualité des eaux potables desservies par le réseau public. La salinité de ces eaux dépasse dans les régions de Gabès et Jerba 3.5 g/l. Le techniques de dessalement à grande échelle ne sont pas encore maîtrisées en Tunisie. Des recherches technologiques sont effectuées actuellement pour identifier des procédés, économiquement viables, de dessalement des eaux géothermiques au sud. Le développement de petites unités mobiles et fiables pour le milieu rural est plus que souhaité.

3.14.6.3 L'économie de l'eau

Qu'il s'agisse du milieu urbain ou du monde rural, le gaspillage des ressources en eau est loin être maîtrisé. Le taux de perte dans le réseau public de distribution de l'eau potable atteint 30%. Les casses, soit par vétusté du réseau soit par accident, sont fréquentes et génératrices de grandes pertes d'eau.

Dans les foyers domestiques, la qualité de la robinetterie, la qualité chimique des eaux potables et le comportement de certains consommateurs sont les raisons essentielles du gaspillage qui est néanmoins durement sanctionné par le système de facturation.

En milieu rural, l'agriculture utilise 85% des ressources en eau. L'irrigation gravitaire et l'irrigation individuelle par puits de surface sont à un taux d'efficience ne dépassant guère 50%.

En conclusion, les problèmes décrits ci-haut sont à notre avis les sujets essentiels d'une éventuelle coopération entre les pays méditerranéens. Des visites mutuelles peuvent être organisées afin d'arrêter les lignes directrices d'une telle coopération. L'échange d'experts, la définition d'actions prioritaires, la réalisation de projets pilotes de démonstration, ainsi que l'identification de nouveaux mécanismes de financement devraient constituter le couronnement des travaux de notre atelier.

3.15 INTEGRATED WATER RESOURCES MANAGEMENT IN TURKEY

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3.15.1 Summary

Turkey's development strategy envisages significant investment in the hydraulic sector with the aim of increasing the country's capacity in irrigation, energy, and domestic and industrial water supply.

In Turkey, most of the decisions related to investments are taken at the national level. There are several governmental and municipal institutions in the water sector, operating under specific laws and regulations. Turkey has so far developed roughly 26 percent of the economically usable surface and groundwater potential.

As a leading, multiple-function institution, the State Hydraulic Works (DSI) carries out most of all sub-sector activities at all stages of water resources development in Turkey.

Comprehensive water resources management should aim at realizing the integration of economic, social and environmental dimensions in a long-term perspective.

The development of EIA helps to take better decisions that balance the use of water resources with the environmental protection concerns. Environmental aspects should be considered from initial planning and design of a project, but also through construction and operation of the projects.

Problems faced in the development of EIA in developing countries are, *inter alia*, lack of trained human resources, lack of financial resources, lack of data, reliability of data, lack of appropriate legal and institutional arrangements, lack of coordination between agencies, limited public knowledge and public participation, lack of political will, and lack of appropriate technology transfer from developed countries.

Integration of environmental considerations into feasibility studies of water resources development projects is being introduced in Turkey.

In accordance with the recent regulation on environmental impact assessment, which came into force in February 1993, most of the water resources development projects are subject to EIA with the aim of providing sustainability.

Enhancing cooperation within the Mediterranean region on this subject is recommended.

Training programmes can be organised for the exchange of knowledge and experience on the integrated approach to the development, management and use of water resources.

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3.15.2 Legal measures and administrative structure

3.15.2.1 General legislative frameworks

Legislation and organization are two components of institutional framework, and these two components are very much interrelated. Organizations could only be successful if they are properly empowered by legislation, while legislation could only be effective if it is properly administered.

3.15.2.2 Laws in the water wector in Turkey

In relation to water resources management, there are several codes in the Turkish Legislation. The list given below states the most significant ones:

6200 Coded Establishment Law of General Directorate of the State Hydraulic Works (DSI)

6200 Coded Law entered into force in 1954. The law defines duties and authorities of the State Hydraulic Works (DSI).

Water resources management and nation-wide responsibility for water sector planning is centralized within the General Directorate of State Hydraulic Works (DSI) under the Ministry of Public Works and Settlement.

According to the law, DSI acts towards the water sectors integration to some extent, although this is not systematically established in the legislation.

167 Coded Ground Water Law

The law came into force in 1968, and according to it, groundwater is the sole property of the State, and DSI is the only legal authority responsible for investigation, use, and allocation of ground waters.

1053 Coded Drinking Waters Supply Law

The law entered into force in 1968, and authorized DSI to provide drinking water to the cities with population of more than 100,000, provided that the Government authorizes DSI, and the concerned city council approves it.

4759 Coded the Bank of Provinces Law

The Bank of Provinces was established with a mandate to assist all municipalities, irrespective of size, in financing and construction of the most of their infrastructure works including water supply and sewerage. The law came into force in 1975.

7428 Coded Rural Area Water Supply Law

According to this law, the responsibility for supplying drinking water to the villages was given to the "State Hydraulic Works". Later on, the duty was transferred from State Hydraulic Works to the General Directorate of Rural Affairs.

2872 Coded the Law of Environment

The law came into force in 1983. It starts from "the polluter pays principle", and handles the environmental issues of board scope. The aim of the law, which considers the environmental pollution, is also to allow for the management of natural and historical values and land in such a way as to utilize and preserve them with concern for future generations as well.

3.15.2.3 Organizations in the water sector

Presently, the organizational structure for water resources management in Turkey is not so complex, as there are a restricted number of authorities involved. Nevertheless, water related problems can be anticipated if efficient water management with a systematic approach is not initiated.

Most of the decisions related to investments are made at the national level. There are several governmental and municipal institutions in the water sector operating whiten specific laws and regulations. These institutions and the related laws are tabulated in appendix - A.

With regard to legislation, all groundwater and common surface waters are vested in the Government by the Constitution, except for some privately owned springs and small waters.

The State Hydraulic Works (DSI)

As a leading, multiple-function institution, the State Hydraulic Works carries out most of all sub-sector activities at all stages of water resources development.

The State Hydraulic Works ensures the long-term supply of drinking, utility and industrial waters. DSI, furthermore, plans, executes and, in most cases operates the works for flood protection, irrigation and drainage, and hydroelectric power generation.

Further responsibilities of DSI include performing basic investigations (streamflow gauging, soil classification, etc.), mapping activities, etc., related to the project areas.

Administrative chart of DSI is given in the appendices (Appendix - B).

General Directorate of Rural Services (KHGM)

The water related activities of KHGM can be summarized as follows:

- to develop small water resources (up to 500 l/s) for irrigation purposes;
- to carry out on-farm works for irrigation schemes;
- to supply drinking water to rural settlements.

General Directorate of the Bank of Provinces

The principal development functions of the Bank of Provinces for municipalities are to provide infra-structure projects on a turn-key basis; to provide credits to finance such projects; to prepare urban development plans; to provide technical assistance in construction, construction control, and mapping; to sell or rent materials and equipment; to insure property; and to train personnel of municipalities.

General Directorate of Electrical Power Resources Survey (EIE)

EIE has the responsibility for carrying out hydrological studies; geotechnical investigations and mapping activities in order to evaluate the national hydroelectric potential and subsequently prepare reconnaissance, prefeasibility, feasibility and final design studies of identified projects. These identifications are set out in protocols made with DSI.

State Planning Organization (DPT)

The principal function of the State Planning Organization is to prepare for submission to the Government the annual and five-year investment program for the various sectors of economy.

In line with the national policies, aims and targets, the State Planning Organization reviews the related ministries' requests for national funds on a sub-sectorial basis, namely agriculture, energy and social services.

In Turkey, there is a fragmentation of responsibilities, and all tasks related to conservation, protection and allocation of water resources are not carried out by a single independent agency. There are several ministries and organizations dealing with water resources and their protection. These are the Ministry of Environment, Ministry of Interior, Ministry of Public Works and Settlement, Ministry of Health, Ministry of Agriculture and Rural Affairs, Ministry of Tourism, Ministry of Energy and Natural Resources, and the Ministry of Industries and Technology, as well as several directorates under these ministries.

Agencies concerned with water pollution and protection, and the related laws can be summarized as stated below:

In Turkey, the first institutional arrangement for environmental management was made in 1978 with the establishment of the Prime Ministry Undersecretariat for the Environment whose status has been promoted to that of a Ministry in 1991. There are 3 General Directorates attached to this ministry. Those are:

- Environmental Pollution Prevention and Control;
- Environmental Impact Assessment and Planning; and
- Environmental Protection.

The Article 56 of the Turkish Constitution states that "Everyone has the right to live in a healthy and balanced environment. It is the duty of the state and citizens to develop the environment, to protect the environmental health and to prevent environmental pollution." As an result of the requirement in the Constitution, the Environmental Act was promulgated in 1983. This frame law sets the general policy for a coordinated management of the environment, but this has to be regulated in detail by the subsidiary legislation, i.e by regulations. One of these regulations concerning water pollution (Regulation for Water Pollution Control) was promulgated in 1988.

According to this regulation, all inland waters are classified into four quality classes. The utilization purpose of each class, together with the standards for water quality parameters and industrial discharge criteria are specified in the regulation.

Being the oldest law covering environmental subjects, the General Public Health Law has articles on public health and pollution control.

The Fisheries Law, which came into force in 1971, also has an article related to pollution control.

The Istanbul Water Supply and Sewerage Administration (ISKI), and the Izmir Water Supply and Sewerage Administration (IZSU) have prepared some regulations concerning protection of water resources used by the cities.

The Construction Act dated 1985, has two articles related to environmental protection. In accordance with one of the articles, Regional Planning Systems' integration with the economic and social planning systems has been improved in terms of land-use and location decisions. And according to another article, local governments have been authorized for prepermitting and permitting the activity locations.

In accordance with the recent regulation on environmental impact assessment, which came into force in February 1993, most of the water resources development projects are subject to EIA with the aim of providing sustainability.

3.15.3 Experience of Turkey

3.15.3.1 Water resources in Turkey

Turkey has been divided into 26 drainage basins. A map showing the drainage basins of Turkey is given in the appendices (Appendix - C). Nine main river basins out of 26 drainage basins cover 50% of the whole area of the country. The longest river, Kizilirmak, originates from Turkey and goes into the Black Sea, and the largest river, Firat (Euphrates), originates from Turkey and goes to Syria, Iraq and, then the Gulf.

The rivers of Turkey have generally irregular regimes, depending on the climate. Reservoirs for the regulation of regimes are needed for effective use of waters of the rivers.

There are approximately 200 lakes in Turkey. The largest is the lake Van with 3,713 sqkm surface area, the deepest are the Lake Nemrut and the Lake Hazar with 150 m in depth, and the shallowest is the Lake Tuz.

The average annual runoff is 186 cukm, and the total annual safe yield of groundwater is determined as 12 cukm. Contrary to what is believed, Turkey is not a water rich country.

Only 95 cukm of annual runoff can be technically and economically developed, since the regimes of the rivers are irregular and distribution of water resources is uneven. 6 cukm groundwater resources have already been developed.

There are many problems relative to the use of the available water resources, since those are not evenly distributed in time and place. Increase in costs of water resources development projects, and degradation of water quality are among other important problems in utilizing the available water resources.

3.15.3.2 Land resources in Turkey

The total land area suitable for some form of agricultural production is estimated at 28 million hectares. This represents 36 percent of the total land area of the country. According to available comprehensive studies, approximately 8.5 million hectares can be technically and economically irrigated.

At present, about 2.7 million hectares of land are irrigated by small-scale, privately owned irrigation schemes. The total of 4.2 million hectares of land, 49 percent of the potential, is under irrigation.

3.15.3.3 Hydroelectric energy potential of Turkey

The total hydroelectrical energy potential of Turkey is 122,400 GWh annual energy production with HEPP's 34,750 MW installed capacity; HEPPs with 9,800 MW installed capacity are under operation, producing 35,800 GWh annual energy.

HEPPs with 1,850 MW installed capacity (to produce 5,500 GWh/y energy) are under construction, while the others are at planning stage.

3.15.3.4 Integrated Water Resources Development and Management

Comprehensive water resources management should aim at realizing the integration of economic, social and environmental dimensions in a long-term perspective.

The concept of using water on a national level and its interrelationship with environmental protection and sustainable economic development should be the main policy for the water resources development projects.

Water resources development projects, like any other resource development projects, will affect the nature and have both positive and negative impacts on it. The most important task of the project planners and managers is to maximize the positive impacts and to minimize the negative ones. Development projects whith the significantly more positive then negative impacts should be executed. In many water development projects, adverse environmental impacts can be reduced significantly through careful design, construction, and operation of the projects by introducing EIA.

Turkey has a good experience in planning, construction and operation of exploitation projects. Consideration of environmental impacts in developing Water Resources Projects is also being introduced in Turkey.

3.15.3.5 Environmental Impact Assessment

Regulation for Environmental Impact Assessment has been published in February 1994. According to this regulation, all water resources development projects are subject to EIA.

All development projects have both negative and positive impacts on the environment. Actually, any activity undertaken by human beings has impacts on the environment. Environmental impact assessment studies should define positive and negative impacts on environment and show how to maximize the positive, and minimize the negative impacts.

Water resources development projects are environmentally interlinked through their potential impacts on surface water hydrology, river transported sediment loads, and surface and groundwater quality. But, it is clear that agricultural development, especially in the developing countries which could not have developed water resources yet, is an important goal.

There is a consensus today, that given certain preconditions, both economic development and environmental management can be pursued simultaneously. Increasing awareness of environmental issues during past decades, and growing concern about the adverse environmental impacts of water resources development projects in many developed countries are reasons for such a consensus.

The development of EIA helps to take better decisions that balance the use of water resources with the environmental protection concerns. Environmental aspects should be considered from initial planning and design of a project, but also through construction and operation of the projects. Such a phenomenon requires interdisciplinary and interagency team study. A wide range of expertise, *inter alia* engineering, hydrology, economics, environment, and sociology, is needed. In developed countries, attention in the evaluation of water resources projects has been shifted from technical considerations to economic and, especially, environmental factors, and even to social and cultural impacts.

It is clear that measures taken to minimize adverse environmental impacts of a project may make it less efficient, or mitigation measures may increase the total cost of the project. Since this is inevitable, the measures taken for minimizing adverse impacts should be accepted as a part of the project, thus increasing the success of the project.

Environmental costs of water resources development projects will be minimized when decisions related to the project are incorporated in the planning process and guided by ample knowledge and information. The environmental conflicts can be identified and solved early, before the project is approved for construction, by incorporation of EIA into the planing process. Otherwise it is very difficult to resolve environmental conflicts as construction is proceeding, and it is very costly to delay construction while discussing resolution of the problems. This is a positive effect of EIA on the project.

Since decisions-makers were not fully aware of long-term environmental impacts of projects as they are today, decades later, adverse impacts of those projects are seen today, and it is too costly, and in some cases impossible, to minimize them. We must learn from our mistakes, draw lesson from the past, and avoid making the same errors again. So, the same mistakes will not be repeated in the future projects. Environmental considerations need to be integrated rationally and efficiently in water resources planning, to minimize depletion of the natural resources as a whole.

While making EIA studies for projects, river basin-wide development plans must also be considered. The relations between the projects, environmental impacts of one project on another in a basin-wide context, will be made clear to determine if the plans should be evaluated again, and some projects will be eliminated, if necessary, to minimize adverse environmental impacts.

EIA process has been defined in different ways in different countries. The most important are cost-effective and efficient means of implementing EIA as a part of approaches to achieving sustainable development. The purpose of EIA is to ensure environmentally sound and sustainable development through timely incorporation of environmental issues into project design.

EIA studies for each country should be specifically based on available land and water resources, as well as climate and cultural characteristics. The study must be able to reflect the impact on the environment in quantitative terms, and should enable a long-term forecasting of the environmental changes before the commencement of the project.

EIA studies have been based on analyses of the effect of projects on a number of issues, such as, socio-economic conditions, education, income, health conditions, housing, land ownership, land values and its use patterns, agriculture, water resource, natural disasters (like floods), employment, fisheries, environmental quality.

Comprehensive water resources management plays an important role in the mitigation of adverse impacts of water resources projects. For comprehensive water resources management, integration of water resources allocation, demand management through appropriate water pricing and cost recovery policies, environmental impact assessment, appropriate legal and institutional arrangements, and technical means such as data bank, research, modeling and technology transfer, are very important.

Environmental impact assessments in developed countries are complex, expensive, lengthy and time consuming. EIA reports are too academic, bureaucratic, mechanistic and voluminous. The methodology used in developed countries may not be a right tool for developing countries. Multi-objective decision-making framework, and development of an operationally sound, flexible methodology might be more convenient for developing countries.

Problems in the development of EIA in developing countries are, *inter alia*, lack of trained human resources, lack of financial resources, lack of data, reliability of data, lack of appropriate legal and institutional arrangements, lack of coordination between agencies, limited public knowledge and public participation, lack of political will and lack of appropriate technology transfer from developed countries.

Public awareness and participation play a very important role in the implementation of EIA reports. EIA report should be circulated and submitted for comments to interested agencies, NGOs, and also to members of the affected public. In this way, the affected people will have the right to make comments on water resources project before they are implemented. This will also help beneficiaries of the projects and others to know each other's comments, and to discuss these comments. NGOs may be empowered for mobilization of public opinion and participation.

The above paragraphs try to explain the significance of EIA of water resources projects for economically and environmentally sound development. It should not be forgotten that EIAs are not a panacea that will magically allow development to proceed while preserving environmental values. There may be an occasional project which meets this, but it is much more likely that EIA process will only highlight the difficult trade-offs between economic development and environmental protection. Ultimately, it may be decided to proceed with some projects, notwithstanding their unfavorable environmental impacts. Such decisions do not simply result from ignorance, but rather from a careful consideration of environmental losses, economic benefits, and alternatives. The purpose of EIA process is to help decision makers by giving information on positive and negative environmental impacts of a project.

There is a mechanism within the ecosystem for self-regulation and self-maintenance, and this makes the ecosystem stable. This mechanism develops after a long period. Once the system collapses, it may take very long time to recover, if at all possible.

The main question is how to avoid problems related in our ecosystem which is so complex and still largely not understood, and to maintain sustainable economic development.

Conservation and rational development of water, land and associated natural resources are essential for sustainable development. Amount of land and water may be considered to be finite. Therefore there are some constraints to development.

For the purpose of ensuring environmentally sound and sustainable development, environmental issues should be incorporated into project design.

In Turkey, rapid growth and structural changes in the national economy, coupled with fast urbanization, generate a variety of significant environmental problems that are now receiving considerable attention by the Government and the general public. The most important aspects of Turkey's structural characteristics is the transition to a modern structure from its traditional structure, and the observation of a fast transformation process from the economic sectors. It is obvious that every transformation process brings along certain distress, and that the environment is also affected in such a structural transformation process.

Environmental issues have gained some consideration in Turkey during 1970s, in parallel to the activities throughout the world.

The Turkish Constitution gives the responsibilities of protecting and developing the environment to the citizens. Thus, the environment right is being guaranteed by the Constitution.

The main principle of the policy concerning the environment has been defnied as "management of natural resources enabling continuous economic development through protection of human health and natural balance; and leaving a natural, physical and social environment to the future generations which they deserve". Within this frame, the position, to take environment fully into account in all economic policies has been adopted.

The "polluter pays" principle has been stated in the legislation concerning environment as a policy. The aim of environmental legislation is not only to prevent and eliminate environmental pollution, but also to allow the management of natural and historical resources utilizing and preserving them at the same time.

Although different approaches can be adopted in the water resources planning, one of the initial stages of the planning process is regionalization, with the water basin as the basic unit of study. A river basin is a logical geographic unit and has distinct regional hydrological and socio-economic characteristics. Anything done in it affects some development elsewhere along the stream. With different and independent organizations pursuing unintegrated and separate plans on one river, conflicts and duplication of effort are inevitable. In this respect, experience points to the need for water planning to be based on hydrological boundaries (river basins).

Water resources plans must balance and propose measures in the basin for all user interests.

Generally speaking, water resources planning and river-basin oriented project generation includes:

(i) survey of land and water resources and their present utilization;

(ii) determination of various requirements, such as irrigation, hydroelectric power generation, flood control, municipal and industrial water supply, etc.;

(iii) alternative solutions based on certain economic criteria;

(iv) final formulation and plan of implementation.

Development stages to realize the above mentioned studies are reconnaissance, master plan, feasibility, and final design. The whole river basin is studied at the reconnaissance and master plan levels, while feasibility studies are generally carried out for the separable project areas within the basin. Therefore, the plans are generally justified on the basis of a favorable ratio between the total cost and total benefit of the scheme.

It is obvious that water project planning always takes place in large settings in which plans are made for different sectors at different levels. Hence, water-development must be consistent with the development plans of other sectors, and with the availability of capital at national level. One of the most important stages in the whole planning process is the integration of programmes at the national level, which calls for a complete evaluation of river basin-oriented projects from the national standpoint. Generally speaking, this evaluation is made with reference to the established national policies, aims and targets, and provides information on the quantity and location of financial resources needed to carry out the projects. According to the Turkish Constitution, this task is given to the State Planning Organization (SPO), which is attached to the office of the Prime Minister.

Economic Planning in Turkey at present comprises a Five-Year Development Plan and annual programs of public investment, both mandated by Law and prepared by the State Planning Office (SPO).

The prevention of pollution and protection of environment have been considered by the Five Year Development Plans of Turkey. The 4th Five-Year Development Plan, prepared in 1979, adopted the basic principle of "solving the environmental problems concurrently with the social transformation process". The basic principle of the 5th Five-year Development Plan (1985-1989) was not only the elimination of existing and prevention of potential pollution, but also the preservation and development of resources for future generations.

The concepts of prevention of pollution and protection of environment have been strongly considered in the 6th Five-Year Development Plan (1990-1994). The objectives of these policies and strategies can be summarized as follows:

- The basic principle is to ensure the management of the environment in such a way as to protect human health and natural equilibrium.
- It is essential to take into consideration the factor of environment in all economic policies.
- Probable environmental deterioration will be forecasted in advance and preventive measures will be taken against pollution.
- Awareness of the environment will be disseminated, and at all stages of planning, the environment factor will be taken into account.
- Management of water basins will be developed.
- A national program will be developed to make soil studies and soil mapping aimed at a planned and balanced utilization of land in conformity with its potential. First, second and third grade agricultural lands will not be exploited for the purposes of earth industry, infrastructure, settlement and tourism activities.

- Chemicals will be used rationally in order to minimize their harmful effects on the environment.
- Joint waste treatment plants will be encouraged.
- Economic evaluations will be made, taking into account the environmental factors in the production, transmission, conversion and utilization of power.

All of the above strategies aim at finding national solutions, and using national resources more rationally on a sustainable basis.

3.15.4 Problems

3.15.4.1 Key issues and actions on legislation

- Existing water-sector laws do not include provisions to meet specific problems. New legal codification on water-use is considered necessary, with special stress on water ownership, water rights, registration of right of use, permit system, penalty against misuse of water resources, etc.

  The draft law on water use, which was prepared in detail some years ago, will be updated and legitimized.

- Legislation does not lay special emphasis on public participation.

  Public participation is realized in a rather conventional way in the democratic political process, but not in clearly stated concrete procedures.

  Desires and complaints are directed to the authorities individually, or through political initiatives. There is no regulated process, such as public inquiry based on legislation.

3.15.4.2 Key issues and actions on education and training

- Education and training are not sufficient for the development of work force. Flexible human resources planning, and policies based on reliable forecasts of future manpower needs should be developed.
- Each water-sector agency also has to have its own manpower training policy and programme, integrated with the national policies. These two frontiers of policies are very much interrelated, because of shortage of personnel at some posts, too much work has affected adversely the performance of some agencies while excessive work-force in some areas creates lack of job satisfaction.
- On-the-job training should be emphasized.
- As long as water agencies depend on their Government for the personnel emoluments, they will be forced to pay public service rates, which are not attractive.

As a consequence of this policy, the Government agencies in the water sector will loose competent engineers to private enterprises. However, this change could be beneficial for the creation of national consulting firms if such accuracies are managed and encouraged properly. Their contribution to the elaboration of water development projects has been very attractive. This will also help to remove the back-log on the Government agencies, and with fewer people, it will be possible to remunerate them adequately. Moreover the quality of the services is increased to a large extent.

3.15.4.3 Key issues and actions on environmental aspects

The following actions need to be taken concerning the environmental aspects of water resources planning.

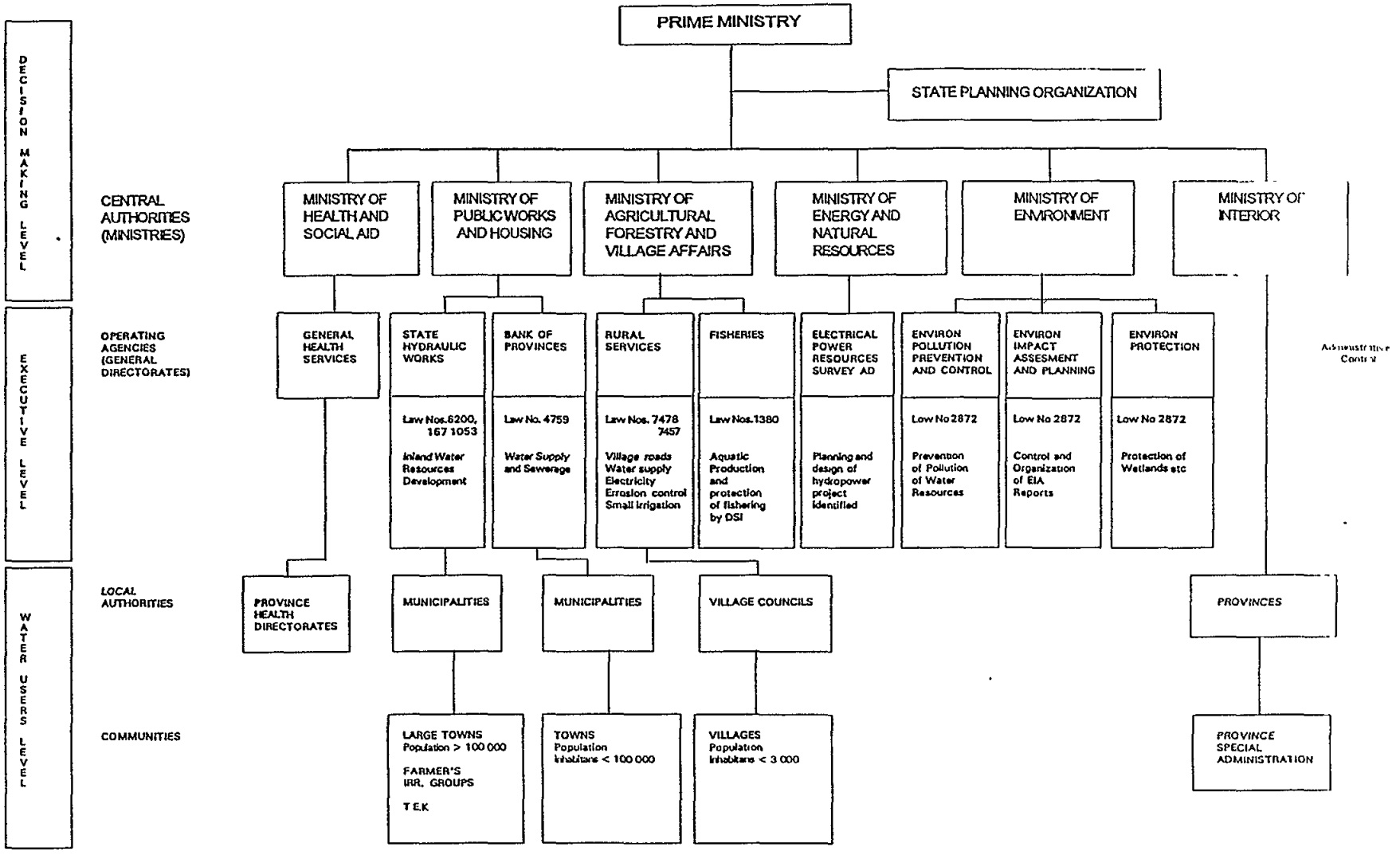
- Water quality control network should be expanded gradually starting from the areas already exposed to severe pollution, to cover the whole country. Financing is to be made available to back up the institutions for monitoring, research and implementation.
- Accurate inventory of polluted sources is to be made urgently in order to monitor and assess different pollution discharges.
- Technical and financial support to different water uses, particularly water uses in industry, should be provided to have suitable water treatment facilities.
- Since the efforts started in late 1970s to control pollution have not yet significantly materialized, environmental legislation, including the various types of penalties, has to be enforced more strictly.
- There are several agencies which are responsible for different aspects of water quality management. Presently, there appears to be an understanding that various activities should be handled by the Ministry of Environment. Arrangements are made as to open offices of the Ministry of Environment in the provinces.
- Last but not least, public education is the most important element in environmental considerations. Some work has already been started in this field, and should be encouraged through the mass media.

3.15.5 Proposals

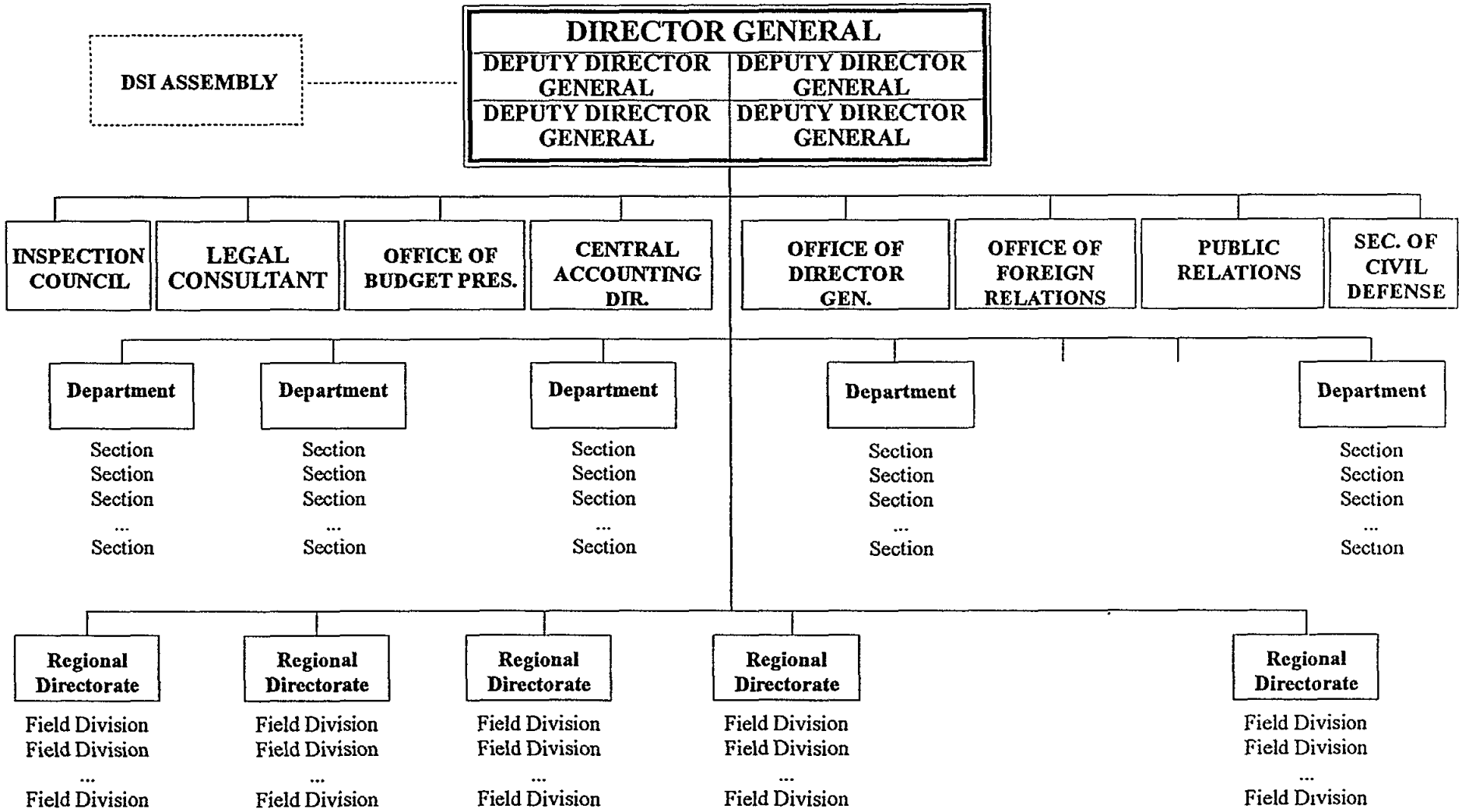
Activities to be implemented in the future, in order to protect the quality and supply of fresh water, will be appreciated.

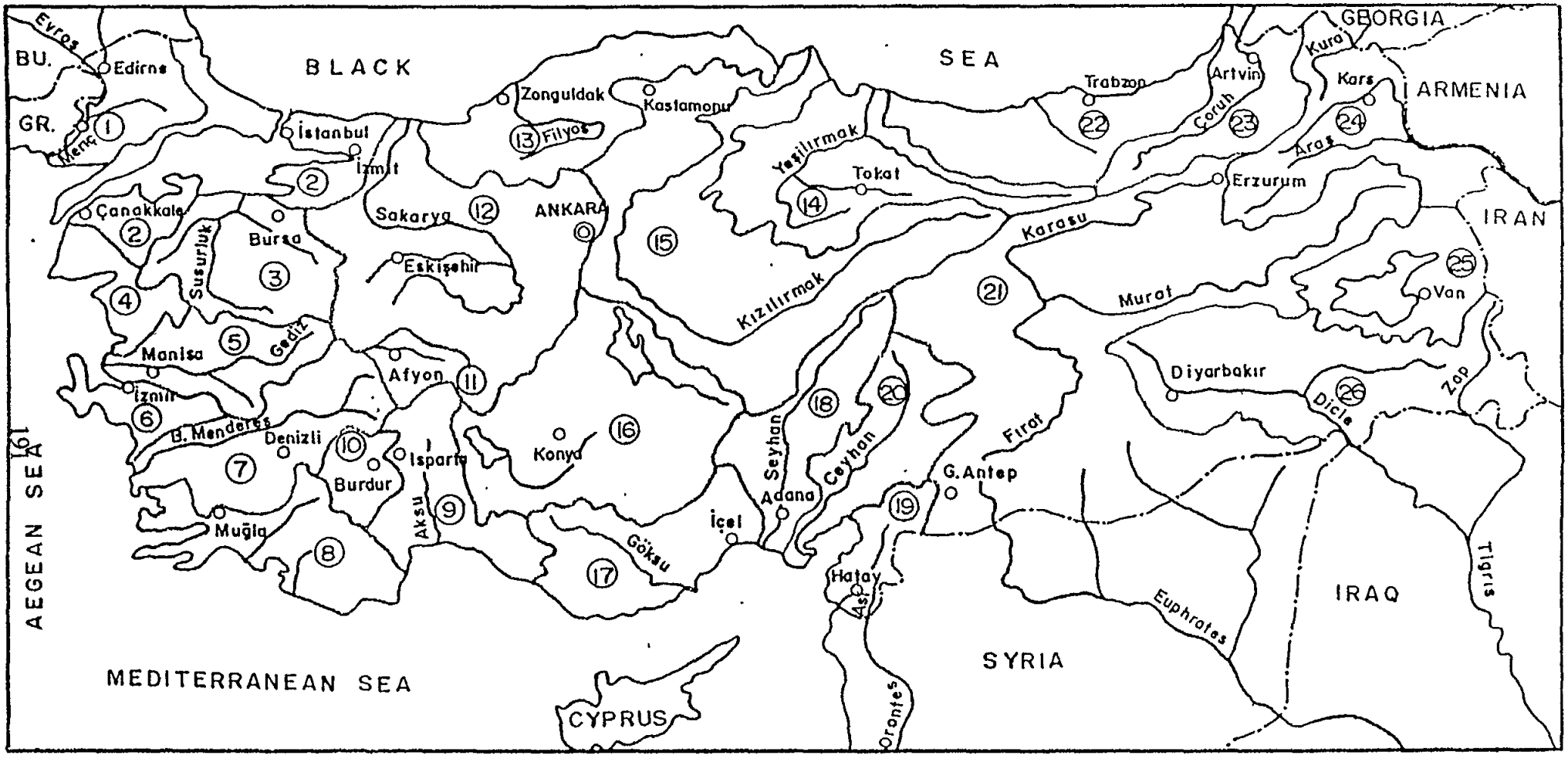
Enhancing cooperation within the Mediterranean region on environment and development, and especially on integrated water resources development and management, is strongly recommended.

Training programmes can be organised for the exchange of knowledge and experience within the Mediterranean region in the field of integrated approach to development, management and use of water resources.


DECISION MAKING LEVEL
EXECUTIVE LEVEL
WATER USERS LEVEL
CENTRAL AUTHORITIES (MINISTRIES)
OPERATING AGENCIES (GENERAL DIRECTORATES)
LOCAL AUTHORITIES
COMMUNITIES
PRIME MINISTRY
STATE PLANNING ORGANIZATION
MINISTRY OF HEALTH AND SOCIAL AID
MINISTRY OF PUBLIC WORKS AND HOUSING
MINISTRY OF AGRICULTURAL FORESTRY AND VILLAGE AFFAIRS
MINISTRY OF ENERGY AND NATURAL RESOURCES
MINISTRY OF ENVIRONMENT
MINISTRY OF INTERIOR
GENERAL HEALTH SERVICES
STATE HYDRAULIC WORKS
BANK OF PROVINCES
RURAL SERVICES
FISHERIES
ELECTRICAL POWER RESOURCES SURVEY AD
ENVIRON POLLUTION PREVENTION AND CONTROL
ENVIRON IMPACT ASSESMENT AND PLANNING
ENVIRON PROTECTION
Law Nos.6200, 167 1053
Inland Water Resources Development
Law No. 4759
Water Supply and Sewerage
Law Nos. 7478 7457
Village roads Water supply Electricity Errosion control Small irrigation
Law Nos.1380
Aquatic Production and protection of fishering by DSI
Planning and design of hydropower project identified
Low No 2872
Prevention of Pollution of Water Resources
Low No 2872
Control and Organization of EIA Reports
Low No 2872
Protection of Wetlands etc
PROVINCE HEALTH DIRECTORATES
MUNICIPALITIES
MUNICIPALITIES
VILLAGE COUNCILS
PROVINCES
LARGE TOWNS Population > 100 000
FARMER'S IRR. GROUPS
T.E.K
TOWNS Population Inhabitans < 100 000
VILLAGES Population Inhabitans < 3 000
PROVINCE SPECIAL ADMINISTRATION

ORGANIZATION CHART OF THE GENERAL DIRECTORATE OF STATE HYDRAULIC WORKS





RIVER BASINS IN TÜRKİYE

ANNEX I /ANNEXE I LIST OF PARTICIPANTS/LISTE DES PARTICIPANTS

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Publié et imprimé par:

Plan d'action pour la Méditerranée
Programme des Nations Unies pour l'Environnement

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