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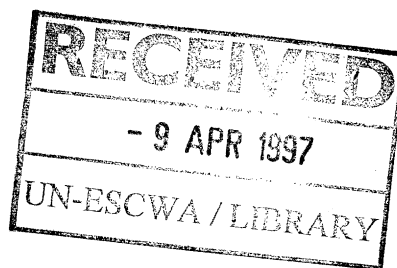


**UNITED NATIONS**  
**ECONOMIC AND SOCIAL COUNCIL**

Distr.  
LIMITED  
E/ESCWA/NR/89/WG.3/WP.5  
9 November 1989  
ORIGINAL: ENGLISH

**ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA**

Ad Hoc Expert Group Meeting  
On Water Security in the ESCWA Region  
13-16 November 1989  
Damascus



**WORKING PAPER ON  
TOWARDS ESTABLISHMENT OF WATER SECURITY  
IN WESTERN ASIA**

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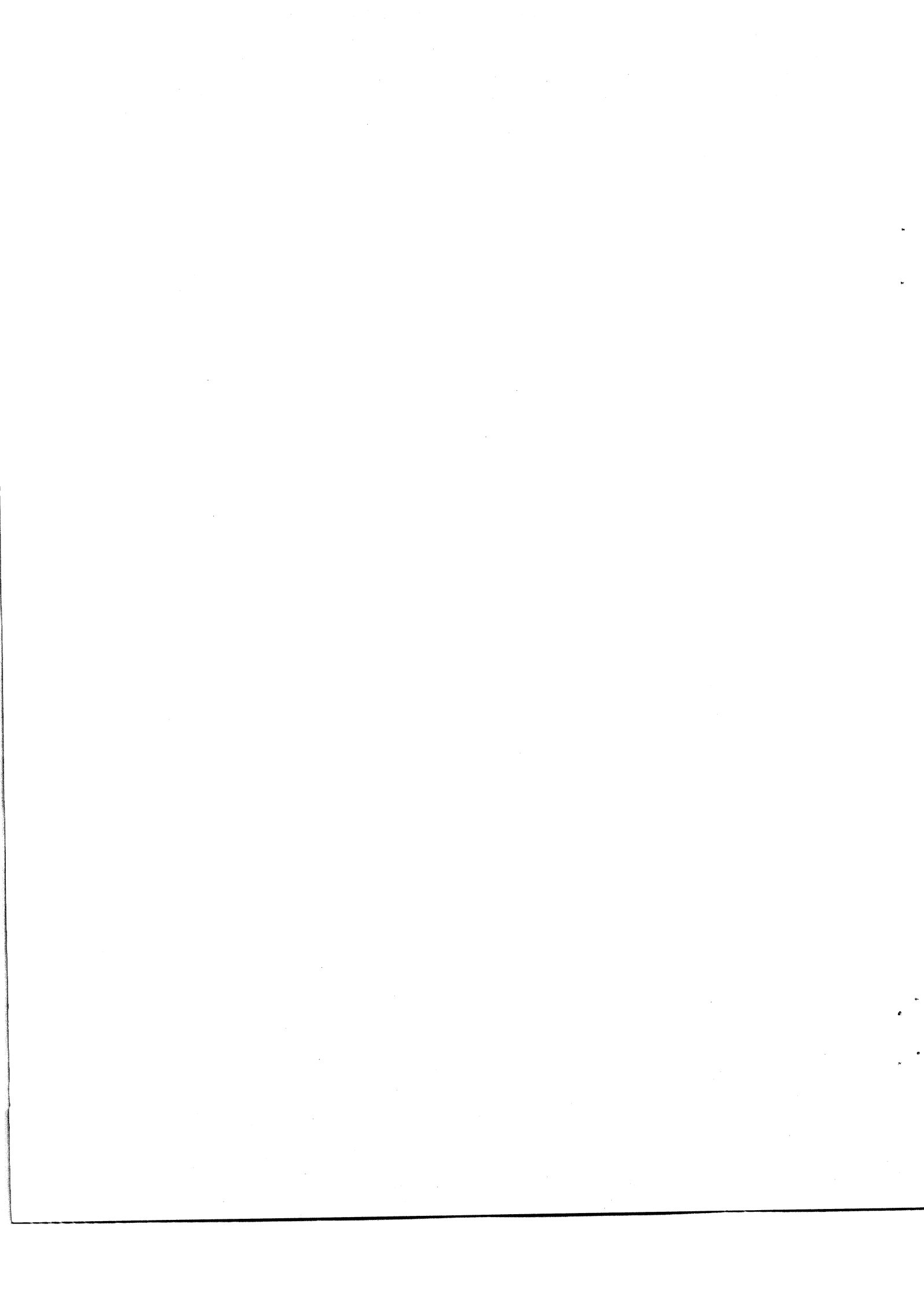
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## INTRODUCTION

### A. General:

The development, conservation and management of the limited water resources all over the ESCWA region in recent decades have been marked by an increase, together with diversification of growing water demands for various uses. The competition in the use of the scarce water resources has become intense, while the interdependencies between the various uses and the other sectors of the social and economic systems have called for further comprehensive planning development and allocation of water resources.

The climatic conditions, characterized by low rainfall and high evaporation rates of surface water partly explain the scarcity and limited availability of water, which has become a major development constraint in the fast growing ESCWA region.

During the last two decades, ESCWA developing countries have fully appreciated the importance of water for economic and social development purposes. Their efforts to develop systems of water were considerable but piecemeal, and the lack of comprehensive approach to planning, development and conservation of water resources rendered the water situation in the region more critical. It is becoming increasingly evident that surface and ground water potentialities of a country constitute national assets vital to almost every phase of economy. Neglect or misuse of these assets can prejudice the health and prosperity of the inhabitants and can prevent or retard the economic development of a nation.

At the same time an increasing by technical knowledge is becoming available and when properly applied, will enable more accurate assessment to be made of water potentialities, more efficient methods to be introduced and a wider variety of benefit to be obtained towards achievement of water security in the ESCWA region.

### B. Nature of the Water Problem and Objectives

Western Asia is a semi-arid to arid region characterized by a limited availability of water resources, and a growing demand for their various uses. Its population was estimated in 1985 to be about 58.2 million inhabitants (Except Egypt) and is expected to increase to some 88.9 million by the year 2,000 and to double before the end of the following decade.

Recent studies have indicated that several countries are now, or are expected to be by the year 2000 at a point where total demand for water will be about equal to, or exceeds the estimated available resources. The threat of water shortages is not something that merely looms into the future. In some areas, water shortages are already a reality. Depletion of groundwater resources due to overpumping and degradation of water quality due to increased salinity and return flows from irrigation are known to be taking place in a number of places. Likewise, surface water resources are increasingly vulnerable to pollution from agricultural chemicals, sewage from large cities and other wastes. To overcome these shortages many countries of the region have been engaged in active water resources development projects over the past decade.

The situation in the Region is sometimes rendered more complex by the international nature of a great part of its water resources. In the long run, increasing demand for water is likely to bring about conflicting development plans and programmes among the riparian countries.

A comparison between present and projected water requirements with the known availability of water resources poses serious questions about the long-term economic, environmental and political sustainability of existing water resources development and use patterns. It is not likely that the expansion of irrigated agriculture under existing patterns of cultivation and water use can proceed without encountering water shortage problems.

As far as drinking water supply and sanitation is concerned, there is every indication that most countries in the Region will have achieved full service coverage in urban areas by the end of the International Drinking Water Supply and Sanitation Decade. The main task for the future would therefore, consist in upgrading the quality of services, and expanding them at a rate commensurate with the rate of urban population growth. The increasing scarcity of water could, however, impose a significant constraint in that the amounts of water needed to supply the growing urban population would be obtained through the use of increasingly high cost technologies. In fact desalination is already being used extensively in some countries as a means of supplying water for domestic and industrial uses. Although some progress has been achieved with regard to the provision of drinking water supply to the rural population of the Region (from an estimated 48 percent of the rural population in 1980, to a projected 56 percent in 1990), the current rate of expansion would not be sufficient to yield significant improvements in the foreseeable future. The level of service coverage for rural dwellers varies considerably from country to country, and is closely related to the current availability of and knowledge about the existing resources.

In as much as agriculture is still the main consumer of water in the ESCWA region, its problems are thus more important and more urgent. Agriculture in some ESCWA countries is largely based on dry land farming, nevertheless irrigation from surface water is practiced in many parts of the area, whereas in other countries such as Saudi Arabia, and the other the Gulf States, groundwater constitutes the main source. Thus ways and means are to be studied and evaluated for more efficient water use and management starting from the water source of supply down to the plant root zone in the soil.

Finally, the demand for water for industrial purposes is also expected to increase significantly in a number of countries, and is likely to generate additional pressures on the overall availability of water resources and on the related environmental aspects. To a large degree, however, the demands for water for industrial purposes in some countries can be satisfied from more expensive sources such as desalinated water.

While the above considerations give cause for concern, there are a number of measures that are available in order to ensure a safe and orderly development of the water resources of the Region commensurate with the economic and social development needs of the Region. Some of these measures are technological in nature, while others are in the domain of policy formulation and implementation, and institutional development. Accordingly, measures should be taken to provide the basic ingredients for a regional strategy to be followed by the governments of the Region in the near future, and by the international community in support of their efforts.

Hence, determined efforts should be focussed at the sub-regional and regional levels to explore and develop the water resources, on the one hand, and to utilize efficiently these resources in various sectors in an integrated manner, on the other hand.

In connection to the development of water supply, ESCWA's Secretariat is always aiming at strengthen the sub-regional and regional co-operation in the water sector as some of the major surface and ground water basins in the region extend beyond the national level. Mutual co-operation and co-ordination for developing and managing the shared watersheds and river basins is important to formulate and implement comprehensive plans dealing with all measures to ensure rational development, utilization and conservation of the water resources taking into account the socio-economic factors prevailing in the concerned member countries. Such co-operation and co-ordination might be achieved through establishment of regional bodies or joint shared water-shed commissions. As regards the management and efficient utilization of the resources in various development sectors, these plans should aim at assessment of water resources and the optimum and efficient use of the available resources (water, funds, manpower, and other relevant means).

Previous water issues have been emphasized in meetings and conferences at regional and International levels. ESCWA first regional water meeting held in Baghdad in 1976 indicated the importance of optimum use and rational development of water resources giving special attention to the techniques used in the region. The Second Regional Water Meeting held in Riyadh in 1979, working papers discussed different issues in water sector particularly, water assessment, management and conservation of water resources.

At the International level, Mar del Plata Action plan recommendations and resolutions focussed on the rational development and conservation of water resources for different uses. In Section III, Resolution 1981/80 of ECOSOC called on the regional commissions and other United Nations organizations to implement regional and sub-regional programmes for the optimum use, development, and conservation of water resources.

Hence, ESCWA secretariat, being conscious of the importance of the subject matter, has organized this Expert Group Meeting on Water security to develop a strategy action plan to sustain water resources development in the region.

The Meeting is primarily aiming at working out ways and means to achieve water security in the region, to provide water strategy action plan for policy makers, experts from within and outside the ESCWA region and representatives of national, regional and international organizations involved in various water sector related activities through:

1. Exchanging views and experience on the application of new and appropriate technologies designed to augment water supply, and increase the efficiency in the use of the available limited water resources and achieve optimum use;
2. Reviewing institutional and legislative organization of governments, to formulate and implement policies and programmes for the management development and conservation of water resources in the region;
3. Debating and identifying means of co-operation and co-ordination among governments for the development and utilization of shared water basins;
4. Assessing methodologies and techniques used in the ESCWA countries in water policy making, planning, managing and conserving of conventional and non-conventional water resources;
5. Developing a water strategy action plan and formulating appropriate recommendations and proposals for the consideration of the national and regional organizations concerned.



## I Planning of Water Resources

Planning of water-related activities is one of the most important requirements to meet increasing demands from competing interests. When the system is put into operation after planning, apportionment of water should be allocated between conflicting interests and demands for considerable periods of time, thereby determining the future water consumption characteristics of the country. However, it is not possible to forecast correctly the interaction of all the factors taken into account in planning, although new techniques, such as system analysis approach and mathematical models simulation, are available,

### A. Towards adequate planning of water resources in the ESCWA region:

A water resources project may be small or large, simple or complex, serving one or several purposes, but it should provide the facilities to accomplish the optimum development of related physical resources, with the main objectives of:- the national income development, regional development, environmental quality control and social well-being. These aims may be obtained through long-term planning of water development projects which include achieving the following results:

- Provide reliable and adequate water supplies for the entire population;
- Provide adequate supplies to meet agricultural water requirements with a view to continuous expansion;
- Provide sufficient water for expanding industry;
- protect the environment and conserve water quality;

To achieve above results, the following criteria should be taken into consideration: 1/

- Availability of reliable data bases (hydrologic demographic, economic) upon which the availability and demand for water resources can be assessed;
- Generation of alternative water resources development strategies, each of which should be evaluated with the same degree of accuracy, with respect to costs and benefits, advantages and disadvantages, secondary effects and other implications;
- Local, regional, and national priorities should be taken into account in selection of the water development strategy and co-ordination among all levels during the planning process;
- Implementation of the selected strategy should proceed expeditiously following its acceptance by the concerned authorities;
- The preferred strategy should be flexible and capable of being pursued on a phased basis, keeping in mind national policies and priorities among competing parts of the plan;
- A mechanism should be set-up to monitor the performance of the plan, with provision of modifying it if circumstances, needs and/or priorities change.

Table 1 present, the major considerations in water resources planning.

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1/ United Nations, "Water Resources Planning Experiences in a National and Regional Context", Report TCD/SEM. 80/1, New York, 1980, P.2

TABLE 1 - Major Factors To Be Considered For  
Water Resources Project Planning and Development

Project Area

- a. Physical geography: location and size; physiography; climate; soils;
- b. Settlement: history; population; cultural background ;
- c. Development: industry; transportation; communication; commerce; power; land uses; water uses; minerals; undeveloped resources;
- d. Economic conditions: general; relief problems; community needs; national needs;
- e. Investigations and reports: previous investigations; history; scope;

Hydrologic Data

- a. Hydrologic records and networks: gauging and observation stations; data-collecting agencies
- b. Hydrometeorological data: precipitation; evaporation; and evapotranspiration;
- c. Surface water: low flows; normal flows; maximum floods; "design flood"; drought; quality;
- d. Groundwater: aquifers; recharge; quality.

Supply of Water

- a. Sources of supply: surface-water supply; groundwater supply; reservoirs,
- b. Variation of supply: variability; consumptive use; regulation, diversion requirements; return flow; evapotranspiration losses; seepage losses or gains;
- c. Quality of water: physical, chemical, biological, and radioactive qualities; quality requirements; pollution;
- d. Legal rights: water rights; development of project rights; operation rights.

General Considerations For Design And Planning

- a. Geology: explorations; geological formations; foundation problems ;
- b. Design problems: design criteria; methods of analysis; project operation and maintenance;
- c. Construction problems: accessibility to project site; rights of way and relocation; construction materials; construction period; flow diversion; manpower; equipment; accessibility
- d. Alternative plans: comparison of alternative plans; supplementary plans; possible alternative plans; relationships to areas to be served;
- e. Estimates of costs,
- f. State, interstate, and international problems;
- g. Organizations involved: public and/or private; technical, social, and political.

Economic Aspects

- a. Benefits and damages: identification and evaluation;
- b. Costs: identification and estimation;
- c. Financial feasibility;
- d. Allocation of costs;
- e. Reimbursement requirements and sharing of allocated costs;
- f. Methods and costs of financing the project, bringing all benefits and all costs to an annual basis and recognizing interest on the investment not only during construction, but throughout the entire proposed "life of the project";
- g. Benefit-cost-ratio analysis: alternative plans.

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Source: Chow, V.T. "Handbook of Applied Hydrology" McGraw-Hill, 1964,  
pp. 26-4 to 26-6.

TABLE 2 - Major Water Development Activities,  
Related Concerns and Components

Agricultural Use Of Water (Irrigation And Related Drainage)

- a. Factors for land classification: soil texture; depth to sand, gravel, shale, raw soil, or penetrable lime zone; alkalinity; salinity; slopes; surface cover and profile; drainage; waterlogging;
- b. Present and anticipated development: crops, livestock; financial resources; improvements; organizations; development period;
- c. Water requirements, if any: total crop requirement; irrigation-water demand; farm-delivery losses; diversion amounts;
- d. Available water: sources; quality; quantity; distribution;
- e. Irrigation methods: flooding; furrow irrigation; sprinkling; subirrigation; supplemental irrigation;
- f. Structural works: storage reservoirs; dams; spillways; diversion works; canals and distribution systems, boreholes, wells; pumping plants; drainage systems; land preparation; treatment systems for wastewater re-use.

Domestic, Municipal And Industrial Water Supply

- a. Sources of supply: surface and/or groundwater; location and capacity; desalination;
- b. Water demand: climate; population characteristics; industry and commerce; water rates and metering; size of project area, fluctuation;
- c. Water requirements: quantity; pressure; quality (tastes, odours, colour, turbidity, bacteria content, chemicals, temperature, etc.
- d. Methods of purification: plain sedimentation; chemical sedimentation or coagulation; filtration; disinfection; aeration, water softening;
- e. Treatment plant: location, design; purposes;
- f. Distribution systems: reservoirs; pumping stations; elevated storage; layout and size of pipe systems; location of fire hydrants;
- g. Waterworks organizations: maintenance and operation of supply, distribution and treatment facilities;
- h. Structural works: storage reservoirs, dams; boreholes, wells; desalination plants.

### Hydroelectric Power

- a. Development: sources; present potential and future capacities;
- b. Alternative sources of power: stream; oil; gas nuclear power;
- c. Types of power plants: run-of -river; storage, pumped storage;
- e. Power problems: load demand and distribution; interties (inter connections with other power transmission systems);
- f. Markets; revenues; costs.

### Flood Control

- a. Flood characteristics of the project area: historical floods; flood magnitude and frequency;
- b. Design criteria: project design storms and floods; degree of protection;
- c. Damage: survey of flooding areas and things affected by floods, nearby or quite a distance away, including commerce, good will, dates of delivery of goods, etc.
- d. Measure of control: reduction of peak flow by reservoirs; confinement of flow by levees, floodwalls, or closed conduit; reduction of peak stage by channel improvement; diversion of floodwater through by-passes or flodways; floodplain zoning and evacuation; floodproofing and flood insurance of specific properties; reduction of flood runoff by watershed management.

### Drainage

- a. Existing projects
- b. Drainage conditions: rainfall excess; soil condition; topography disposal of water;
- c. Drainage system: urban; farmland;
- d. Structural components: ditches, tile drains; levees; pumping stations.

### Water Quality Control

- a. Problems involved: sources; nature and degree of pollution; sediment; salinity; temperature; oxygen content; radioactive contamination;
- b. Hydrologic information and measurement;
- c. Methods of control (depending upon source and type of contamination).

Recreational Use of Water

- a. Population tributary (population near enough to the project area to use it for recreational purposes);
- b. Facilities: boating; fishing; swimming; etc.
- c. Water requirements: Depth of water; area of water surface; sanitation.

Fish And Wildlife

- a. Biological data: species; habits;
- b. Facilities: reservoirs; fish ladders;
- c. Water requirements: temperature; current velocity; biological qualities.

Navigation

- a. Water traffic: present and future needs and savings in shipping costs, if any, on the basis of which the justifications are primarily judged at the present time;
- b. Alternative means of transportation: air; land;
- c. Navigation requirements: depth, width, and alignment of channels; locking time; current velocity; terminal facilities;
- d. Methods of improving navigation: channel improvement by reservoir regulation; contraction works; bank stabilization, straightening and sand removal; lock-and-dam construction, canalization; dredging.

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Adopted from: Chow, V.T., "Handbook of Applied Hydrology:", McGraw-Hill, 1964, pp. 26-5 to 26-6.

Each water resources has its own essential and particular characteristics and will therefore, have to be planned and developed in a specific manner. However most of the major water development activities can be grouped as presented in table 2, where the major concerns and components that need to be considered for each sector are listed. In planning for each field, a different methodology needs to be followed to determine their purposes and objectives. For instance, in a single purpose water resources project, an optimum combination of investments to increase the fresh water supply for the system and more efficient use of water in the system should be pursued. In a multi-purpose water planning project, conflicting interests and interconnected problems related to the allocation of the actual or potential available fresh water resource among different types of uses must be handled.

If such conditions are interlinked to problems of a hydrological regions, they lead to the establishment of organizations such as river commissions or other adequate authorities. The interaction of such regions and over all possibilities of development of different water resources aspects over a span of time is usually handled by a national master water plan, which should be an integral part of the over all national socio-economic plan.

B. Necessity of master water plan:

Few countries in the ESCWA region had established their master water plans. Preparation of the national master water plan starts with the survey of the existing demands and prevailing conditions as listed in tables 1 and 2, followed by the prediction of the socio-economic development and the investigation of the activities required to meet future demands evaluated according to a certain role of development. The main purpose of a master plan is to provide a framework of future water resources development and to provide guidelines for any type of planning pertaining to water activities in the country. In master plans it is preferable to establish a flexible schedule based on the interrelation between the economic development forecasted and water resources activities which have been requested instead of setting a rigid time-schedule for realization of various water projects. Nations development plans should normally include a national water master plan, and each development option would have a place assigned relative to its importance to meet the total needs of the population. It should be reiterated here that only a plan which is based on accurate information and be realistic. A water master plan should take into account the following elements: available water and land resources to meet the total demand of all various users, measures required to forecast and minimize adverse effects of water (floods, droughts, salinization, soil erosion etc.); and measures should be taken to prevent pollution and protect water quality and health. On the basis of the national water policy and the water master plan, the water administration should approve execution of projects to meet demand and conserve water.

In formulating a national water plan, priority should be given to the available water projects consecutively on the basis of indices for future alternatives. The project generating process should meet the following requirements to ensure proper development of the water resources planning:

-It must ensure that water-related studies respond directly and specifically to the needs in terms of economic, social and environmental aspects at the national sub-regional and regional levels, and allow for a broad range of alternatives;

-It must make the best use of available resources in preparing studies, and in training new staff;

-It must draw upon international experience whenever necessary to ensure the transfer of knowledge.

C. Policy-options to water resources development in the ESCWA region



Long-term planning of the water development projects is included in the integrated planning system for the national economy, and development programmes for various sectors are prepared based on major decisions aimed at satisfying social needs and furthering economic and technical progress. In water development, overall policies are usually directed towards achieving the following:

- to ensure a continuing balance between the demand and supply of water for all uses, and when necessary to direct economic and social activities towards the optimum use of water and other resources;
- to co-ordinate utilization of surface and groundwaters in order to make optimum use of the water resources of every region of the country;
- to seek possibilities of augmentation of conventional water supplies by utilization of the latest techniques in desalination, cloud seeding, wastewater recycling for various uses;
- to prevent wastage of water flowing into the seas, lakes, deserts and sumps by constructing suitable structures;
- to provide adequate water supplies for urban and rural populations and for domestic, municipal and industrial uses;
- to rehabilitate old irrigation schemes, to increase water use efficiency and to construct new systems;
- to divert water from surplus areas to areas in need;
- to construct flood control, hydropower, drainage schemes for social and economic betterment;
- to maintain water quality and protect the environment, prevent salinity;
- to conduct research in fields related to water resources development, utilization, conservation and management.

Information on water resources is a necessity in the formulation of a water policy, and collection of data should be integral part of such a policy. In particular, data on rainfall, surface water, quantitatively and qualitatively, are the most important. In many ESCWA countries, there is not much information on dry periods although availability of such data is essential for forecasting wet and dry seasons, where demand for irrigation is high, policies are introduced to solve the problems of sharing-out inadequate quantities of water for various uses, increasing water availability by storage and securing adequate supplies to different users. In most of these countries, large scale irrigation can be sustained only by massive storage. Overall water policies may also include establishment of priorities among various users; setting up measures to prevent and remedy adverse water effects; control and maintenance of water quality for protection of health and environment; adoption of guidelines for economic and financial purposes; the education of the public and ensuring their participation in developing awareness; and regional co-operation on shared water basins.

## II. CONSTRAINTS

The main constraints that are usually confronted in the development of water resources aiming at establishing water security in most countries of the ESCWA region are summarized in the following main items:

- (a) The time and budget allocations for water resources development are often limited. Some countries suffer from lack of foreign currency. Others depend largely on foreign aids.
- (b) Various regulations and legislative requirements narrow the range of feasible water resources development alternatives. Laws and regulations aiming at water resources conservation and good management are already issued in most countries of the ESCWA region. Nevertheless, their application in some countries is not yet fully honoured.
- (c) The administrative and hydrologic boundaries of the watersheds do not usually coincide. The absence of regional cooperation among some interested riparian states in the Region could cause a serious obstacle for the best development and uses of water resources.
- (e) In most ESCWA countries, water resources development and management are not handled by one single administration. This causes the dispersion of the scientific, technical and operational personnel together with the technical documents and reports.
- (f) Adequate number of trained personnel in water resources development and management is not yet available in most ESCWA countries.

Moreover, there is, generally, no system to reward staff, at any level, on the basis of their effectiveness and achievement. This creates, in many cases, inertia among the staff and encourage neglect of the required field services.

### III. PROPOSED WATER STRATEGY IN THE ESCWA REGION

#### A. General

Water is a major resource factor that is normally considered and assessed when decisions among possible development alternatives are made. In most ESCWA countries, projecting water demands and planning of the development of water supplies are the responsibility of a national authority. Techniques of developing water resources and the technology for water use are generally related to availability of water resources and alternative water resources policies. They are also largely affected by the marginal cost of water and the required quantity and quality.

In the past, water resources management strategies were generally based on the principle of "Supply Management" But, with increasing scarcity of water related to the growing population in ESCWA countries, there is a general tendency towards "Demand Management" . To outline a strategy to a decision - maker at national and regional level for more effective use of existing water resources, such as:

- (i) Water conservation measures
- (ii) Reallocation and augmentation of available water resources.

There should be water pricing policies to reduce water demands together with water restriction to reduce water supplies.

Prerequisite to a water strategy needed for a satisfactory solution to water shortage problem, are the integrated assessment of present water potentials and reexamination of its optimum use. Proper allocation of water use among different economic sectors, the importance of industrial water needs against agricultural ones ...etc have to be reexamined. Slowness in translating scientific findings into action at the level of operation, and lack of comprehensive surveys and political and social attitudes towards the effective management of the limited water resources should have serious consideration.

#### B. Technologies

It is evident that future success in increasing the quantitative and qualitative utility of water hinges to a great extent on ingenuity in finding new and improved methods and technologies. The need for technology varies from country to country and should be assessed according to specific features of each country and local situation, some cases may justify large capital intensive projects while more often simple technological improvements in water exploitation or conservation may have immediate local results. It should be noted, however, that technology alone is not the magic solution which will solve all the water problems faced by most countries in the ESCWA region, but application of advanced technology calls for over-whelming support from the indigenous population and social institutions, and will also depend on the economic conditions. For further development of applied technology, concrete supporting public policies with specific objectives are needed.

Technologies required to offering effective tools for improving the water situation in the ESCWA region might be described as follows:

- (i) Technologies for the conservation of water.
- (ii) Technologies for exploration of water resources.
- (iii) Technologies for increasing water supply.

C Proposed Water Strategy Action Plan:

The situation of water resources development in the ESCWA region is not sensibly different in (1990) from that in (1980). Thus, the recommendations contained in the Mar del Plata Action-Plan are still valid with slight modifications. Most countries of the Region are moving slowly to initiate policies geared to conserve available resources and use them more efficiently. Towards achieving water security and formulation of a "water strategy action plan" in the ESCWA region, the following important guidelines should be considered:

C-1 Water Policy And Planning:

The following measures should be considered towards achieving water policy and planning:

- C-1-1 Formulate and reviews national water policies regarding: water resources exploration, utilization and conservation.
- C-1-2 Ensure optimum use and conservation of available water resources considering the supplies and present and projected future demands.
- C-1-3 Establish priorities among various users.
- C-1-4 Formulate water master plan
- C-1-5 Evaluate water tariff policies and direct any necessary restructuring or adjustment.
- C-1-6 Contain planning and management activities based upon assessment of the water resources, projection of demands and efficient water use, environmental control and natural hazards.
- C-1-7 Improve institutional and legislative set-up .
- C-1-8 Adopt best available techniques for planning, implementation, operation and maintenance of water resources projects.

C-2 Assessment of Water Resources:

Actions towards improving the assessment of water resources in the ESCWA region should include:

- C-2-1 Improvement of hydrometeorological, hydrological and hydrogeological data in terms of data gathering network and processing.

- C-2-2 Standardization of measurement techniques and equipment.
- C-2-3 Preparation of inventory of country's water resources.
- C-2-4 Projection for future demand based on factual and realistic data to be revised and updated periodically.
- C-2-5 Assessment of water quality of different water resources.

C-3 Legislation for Water Resources Conservation, Development and Management:

Legislation actions should be taken to conserve, develop and manage water resources, such actions should contain:

- C-3-1 Reviewing and assessing of the existing legislation and its ability to cover all subjects related to water development and management including: licensing, abstraction, ownership, prevention of pollution, penaltics for undesirable effluent discharge, protection of quality, etc.
- C-3-2 Facilitating implentation of adopted water policy.
- C-3-3 Defining rules and regulations for public ownership.
- C-3-4 Ensuring water rational use, water conservation and optimum management in order to satisfy the present and future demand.
- C-3-5 Encouraging saving of water reflected in differential water tarrif system.
- C-3-6 A basic water act or code which could include provisions with respect to : availablity of water resources in the country of the region; Knowledge of existing uses and amounts of water utilized by whom and what purpose; ownership of water; right to use water ; present and future water requirements; water right administration and water authorities; water conservation; water rates and charges; water quality and pollution control; health preservation; groundwater discipline measures; permits and metering of abstraction; and special measures for water-related natural hazards.

C-4 Institutional Framework for Water Resources Development, Conservation and Management

Institutional arrangement should be made towards ensuring real co-ordination between all bodies responsible for water resources development, conservation and management in line with overall national policies and planning. These arrangements may include: a central body or co-ordinating mechanisme to co-ordinate water-related activities. The most important activities of such a centralized authority should include, but not be limited to:

- C-4-1 Planning, conservation, utilization and management of water resources;

- C-4-2 Following activities if there is a master plan;
- C-4-3 Preparing proposals for water legislation;
- C-4-4 Co-ordination of activities of attached bodies;
- C-4-5 Establishing a central national information centre;
- C-4-6 Management of education and training activities;
- C-4-7 Strengthening regional and sub-regional co-operation.

C-5 Efficiency and appropriate technology in water development, conservation and management:

Measures should be taken in almost all of the ESCWA region to increase efficiency in the fields of municipal, industrial and agricultural water use by.

- C-5-1 Strict application of municipal water metering, scale of charges and proper maintenance of conveyance and distribution system to control leakage and prevent losses.
- C-5-2 Application water tariff system to water users in industry to improve their technologies to use lesser amounts of water or to recycle it.
- C-5-3 Increasing efficiency in agriculture by minimizing evaporation and seepage losses in reservoirs and leakage in delivery systems through well designed and maintained conveyance systems as well as adopting improved water application techniques in irrigation.
- C-5-4 Developing local and appropriate technologies related to water resources conservation, development and management and supporting them financially and institutionally.
- C-5-5 Developing adequate facilities for servicing and maintenance of installed equipment and for manufacturing of some of the spare parts.
- C-5-6 Standardization of equipment, specifications, designs and plans of hydraulic works to increase efficiency in application.
- C-5-7 Adopting various techniques which are under consideration or already have been applied, in the region. These include:
  - C-5-7-1 Technologies for water conservation; evaporation control, and seepage and percolation control;
  - C-5-7-2 Technologies for exploration of water resources: remote sensing, isotope techniques etc;
  - C-5-7-3 Technologies for increasing water supply: desalination, rainfall harvesting, reuse of water, artificial recharge of groundwater, brackish water, weather modification, water transportation, interbasin transfers.

## C-6 Manpower Training

Rapid increase in improvement and modernization of various aspects of the development, conservation and management of water resources resulted in unexpected demand for trained manpower at all levels (professional and technical) which must be provided by countries involved. Recent studies conducted by ESCWA secretariat have shown that in all ESCWA countries there is a serious shortage of skilled manpower in water resources development, conservation, planning and management. This shortage of scientific and technical personnel is one of the major constraints on progress in this field.

In order to strengthen and expand facilities of existing institution, universities, colleges and training centres so that quantity and quality of their output can be increased, the Expert Group Meeting held between 5 to 8 June 1989 in Amman has recommended the establishment of a regional training network for water resources. The functions of such a network are:

- C-6-1 Training in various fields of water resources, both at professional and technical levels.
- C-6-2 The strengthening of regional training capabilities.
- C-6-3 The dissemination of relevant information on training in water sector.
- C-6-4 The introduction of other components that ESCWA member countries consider to be important.

## IV REGIONAL CO-OPERATION

The surface and ground water occurrence in western Asia is independent of the artificial political boundaries among the states of this area. Euphrates and Tigris rivers are shared among Turkey, Syria and Iraq, Orontes river between Lebanon and Syria, Yarmouk river between Jordan and Syria, Jordan river between Jordan and Palestine, Decal ground water basin between Jordan and Saudi Arabia, Dammam, Almat, and Khobar ground water basins among Saudi Arabia, Kuwait, Bahrain, United Arab Emirates and Oman, Taiz and Ibb Basin Between North and South Yemen ....etc

The Helsinki Rules (1966) of the International Law Association define the international drainage basin as "a geographical area extending over two or more states determined by the watershed limits of the system of waters, including surface and under ground waters flowing into a common terminus". The basin state is "the state the territory of which includes a portion of an international drainage basin". According to these definitions, almost every state in the ESCWA region is sharing surface or ground waters with the neighboring states. Thus regional cooperation for water resources development is rather a must. For better use of the limited water resources in the Region, either in quantity or quality wise, the ESCWA states have no choice but cooperation among each other. There are many recognized situations that, on evaluation, call for interstate co-operation. Measuring stations, for instance on Euphrates or Tigris rivers, to produce the desired new data must be located, monitored and serviced at the hydrologically appropriate sites.

Works to accomplish the control purposes must also be situated where the technical data indicate, regardless of which states have sovereignty over the sites. A determination must be made of the number and location of peoples and properties to be affected. In short, compilation of data and coordination of projects and operation programmes of water storage, water diversion and power generation necessitate regional cooperation and even collaboration.

Each basin state should recognize the legitimacy of the interest that its co-basin states have in the use of the waters of their international surface or ground water basin or water resources system, and should be disposed to co-operate to optimize the uses of the water resources, and to seek management of the system on a system-wide long term basis.

The state or states experiencing harmful effects will be inclined to protest to the state originating these effects when surface or ground water resources are depleting or when water quality is deteriorating (e.g. increase in water salinity). The result may well be an unpleasant and lengthy international dispute unless the basin or system states are successful in organizing themselves to deal with such issues in a rational manner on the basis of technical information and careful integrated basin or system cooperation and planning.

A basin state is under a generally recognized obligation, in the spirit of regional cooperation, to give formal notice to any state that might be substantially affected of any proposed surface water impounding or diversion, or ground water pumping if the contemplated action might infringe the rights of that state in the waters of the basin. The notice should be accompanied by all informations needed by the other interested states or states to assess the probable impact of the water storage or diversion or ground water pumping on the states rights in the system of waters. Thus regional arrangements for periodic consultations to include notice, exchange of information and discussion are regarded as minimal institutional requirements in any water resources regional cooperation for the development, conservation and uses of the waters of shared basins.

A major opportunity towards water security in countries with shared water basins often results when interested states implement and agreed regime of water allocation or regulation. The riparian countries in the ESCWA region should agree on:

(a) dividing the common water resources in an equitable fashion (Helsinki Rules).

(b) Regulating the use of these resources so as to maximize benefits and minimize harm from existing or potential uses.

The interested states are free to determine, by agreement, percentage or volume shares of any size, based upon a total assessment of the relevant factors except that no state may be deprived of its fundamental right to its equitable share of the beneficial uses of the available resource.



The establishment of the "Regional Water Resources Council" proposed by ESCWA in the ESCWA Seventh Regional Session held in Baghdad on April 1980 was, as a matter of fact, a proposed institutional arrangement for the promotion of regional/sub-regional cooperation among the water resources governmental authorities in the field of water resources development in the ESCWA region.

The objectives of the Council are to initiate, launch and coordinates activities for the implementation of short and long term regional plans for water resources conservation, management and development with a view to ensure the optimum, comprehensive and co-ordinated utilization of the scarce water resources at regional level, and bearing in mind the overall regional and subregional socio-economic development plans. Three alternatives concerning the establishment of Regional Water Resources Council were proposed. The first alternative proposes that the Council shall not be an executing agency, but shall function as a coordinating body for water resources matters at regional level. It will be an independent functional body with ESCWA serving as its secretariat during initial tak-off stage after which the Council will develop into a fully independent and autonomous inter-governmental mechanism with its own secretariat support. The second alternative authorizes the Council to act as a co-ordinator for water resources matters at regional level. The Council in this alternative shall be an independent functional body with ESCWA serving as its secretariat and shall be composed of a Board of Representatives and a Supporting Technical Staff.

Finally, the third alternative authorizes the proposed Regional Water Resources Council to focus on co-operation and co-ordination in all aspects relating to water resources development in the ESCWA region. The Council shall be then viewed as a vehicle for mobilizing regional co-operative efforts in the water resources field.

It is to be mentioned that the establishment of the Regional Water Resources Council is still open for reconsideration among the ESCWA Countries.

Moreover, ESCWA is always aiming to strengthen and promote regional co-operation WMO, WHO with different United Nations Agencies and organizations such as FAO, UNESCO, UNEP and Arab League Agencies such as ACSAD and others in matters related to water resources development in Western Asia



