CURRENCY EQUIVALENTS

<table>
<thead>
<tr>
<th>Currency Unit</th>
<th>Rial 1</th>
<th>Rials 1,000,000</th>
<th>US$1.00</th>
<th>US$1,000,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>= Rial</td>
<td>US$0.0148</td>
<td>US$14,750</td>
<td>Rials 67.75</td>
<td>Rials 67,750,000</td>
</tr>
</tbody>
</table>

WEIGHTS AND MEASURES

- mm = Millimeter = 0.039 inches
- km = Kilometer = 0.6214 miles
- m = Meter = 3.28 feet
- ha = Hectare = 10,000 square meters or 2.47 acres
- m³ or cm³ = Cubic meter = 264.2 US gallons
- Mg/M or mm³ = Million cubic meters
- m³/sec = Cubic meter per second
- kg = Kilogram = 2.20 pounds
- Kw/H = Kilowatt/Hour
- Mw = Megawatt = 1,000 kilowatts
- Mg/l = Milligrams per liter
- p.p.m. = Parts per Million
- BOD = Biochemical Oxygen Demand

ACRONYMS

- TRWB = Tehran Regional Water Board
- MWP = Ministry of Water and Power
- W.Div. = Water Division of MWP
- PBO = Plan and Budget Organization
- MCRA = Ministry of Cooperative and Rural Affairs
- MHUP = Ministry of Housing and Urban Planning
- KWPA = Khuzestan Water and Power Authority
- D & R = Development Resources Inc.
- RDC = Rural Development Centres
- NIOC = National Iranian Oil Company
- ARWB = Azarbaijan Regional Water Board
- FRWB = Fars Regional Water Board
- ERWB = Esfahan Regional Water Board
- NRWPA = Northern Region Water & Power Authority

FISCAL YEAR

March 21 - March 20
TABLE OF CONTENTS

VOLUME I NATIONAL SECTOR SITUATION AND PLANNING

PREFACE ................................................................................. i-ii

I. SUMMARY OF RECOMMENDATIONS AND SUGGESTED DEVELOPMENT
   STRATEGY ................................................................. 1

   Water Resources and Management ......................................... 1
   Water Supply in Urban Areas .................................................. 2
   Water Supply in Rural Areas ................................................... 3
   Sewerage ............................................................................. 3
   Sector Organization ................................................................ 3
   Suggested Sector Development Program for Iran ...................... 4
   Program Objectives and Targets ............................................ 4
   Consulting Engineers Active in the Sector .............................. 7

II. PRESENT SECTOR SITUATION ................................................ 9

   Background ........................................................................ 9
   Ministry of Water and Power .................................................. 9
   Regional Water Boards .......................................................... 11
   Proposed Legislation to set up regional Water Companies .... 12
   National Water Plan (now Technical Planning Bureau) .......... 15
   Municipal Water Authorities .................................................. 16
   The Plan and Budget Organization (PBO) .............................. 16
   The Ministry of Cooperative and Rural Affairs (MCRA) ......... 17
   The Ministry of Housing and Urban Planning (MHUP) ......... 18
   Ministry of Health ................................................................ 18
   The Ministry of Agriculture and Natural Resources ............. 19

III. PRESENT SOURCES OF SUPPLIES AND FACILITIES ............. 20

   The Ghanats of Iran ............................................................ 22
   The Multipurpose Dams of Iran .............................................. 23
   Existing Sewerage ............................................................... 23
   Existing Water Supply Facilities .......................................... 24

IV. SECTOR GOALS AND POLICY .............................................. 25

   Exploitation of Resources ....................................................... 25
   Water Conservation ............................................................. 27
   Government Goals regarding Inter-sectoral Allocation
     of Water ........................................................................... 28
**TABLE OF CONTENTS (Cont'd)**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals regarding Population to be served in Urban Areas</td>
<td>29</td>
</tr>
<tr>
<td>Investment and Allocations</td>
<td>31</td>
</tr>
<tr>
<td>Targets of Population served in Urban Areas by 1993</td>
<td>31</td>
</tr>
<tr>
<td>Goals regarding Rural Water Supply</td>
<td>31</td>
</tr>
<tr>
<td>Financial and Tariff Policy</td>
<td>33</td>
</tr>
<tr>
<td>Government Subsidies for the Sector</td>
<td>35</td>
</tr>
<tr>
<td><strong>V. SECTOR PLANNING</strong></td>
<td>37</td>
</tr>
<tr>
<td>Resource Development (Multipurpose Dams and Irrigation)</td>
<td>37</td>
</tr>
<tr>
<td>Urban Water Supply</td>
<td>38</td>
</tr>
<tr>
<td>Sewerage</td>
<td>39</td>
</tr>
<tr>
<td>Rural Water Supply</td>
<td>39</td>
</tr>
<tr>
<td><strong>VI. MANPOWER AND TRAINING</strong></td>
<td>41</td>
</tr>
<tr>
<td>Basis for the Assessment and Forecasts</td>
<td>41</td>
</tr>
<tr>
<td>Summary of Forecasts</td>
<td>41</td>
</tr>
<tr>
<td>Training - Existing Facilities</td>
<td>42</td>
</tr>
<tr>
<td>Training Proposals</td>
<td>43</td>
</tr>
<tr>
<td>The Suitability of Isfahan as a Training Centre for Wastewater Works Operatives</td>
<td>46</td>
</tr>
<tr>
<td>Training Requirements</td>
<td>47</td>
</tr>
<tr>
<td><strong>VII. SUMMARY OF REGIONAL SITUATION AND PROJECTS</strong></td>
<td>48</td>
</tr>
<tr>
<td>Introduction</td>
<td>48</td>
</tr>
<tr>
<td>Tehran Region (from Annex 8)</td>
<td>48</td>
</tr>
<tr>
<td>Northern Region (see Vol. II Annex 17)</td>
<td>49</td>
</tr>
<tr>
<td>Azarbaijan (see Annex II)</td>
<td>49</td>
</tr>
<tr>
<td>Esfahan</td>
<td>50</td>
</tr>
<tr>
<td>Fars</td>
<td>50</td>
</tr>
<tr>
<td>Khorasan (Annex 14)</td>
<td>51</td>
</tr>
<tr>
<td>Khuzestan (Annex 15)</td>
<td>52</td>
</tr>
<tr>
<td>Kerman</td>
<td>52</td>
</tr>
<tr>
<td>Other Projects</td>
<td>53</td>
</tr>
<tr>
<td>Role of External Agencies</td>
<td>53</td>
</tr>
</tbody>
</table>

**MAPS**

<table>
<thead>
<tr>
<th>No.</th>
<th>MAP</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11260</td>
<td>No. 11260</td>
<td>Groundwater Resources in Iran</td>
</tr>
<tr>
<td>11261</td>
<td>No. 11261</td>
<td>Population Centers</td>
</tr>
<tr>
<td>11262</td>
<td>No. 11262</td>
<td>River Basins, Dams and Regional Water Boards of Iran</td>
</tr>
<tr>
<td>11263</td>
<td>No. 11263</td>
<td>Rainfall and Climate Divisions</td>
</tr>
<tr>
<td>11300</td>
<td>No. 11300</td>
<td>Water Supply of Northern Cities - Project Area</td>
</tr>
</tbody>
</table>
PREFACE

i. This report presents the findings of a joint IBRD/WHO sector mission that visited Iran from April 14 to May 18, 1974. The mission was intended to obtain general information on the existing situation in the sector, identify the principal problems and constraints on sector development goals and policies and to recommend possible courses of action with respect to a development strategy (including a manpower program), project possibilities and the establishment or modification of existing institutions in the sector.

ii. The report is prepared in two volumes. The general report (Volume I) outlines the "National Situation" with regard to institutions, resource availability, its allocation between sectors, current sector planning, and suggests a development strategy for the sector. It also summarizes regional problems, project possibilities and suggests a role for external agencies.

iii. The second volume is in two parts. Part A (Annexes 1-7) relate to the National situation. Part B (Annexes 8-17) includes the mission's detailed findings in the principal regions of Iran and the major urban centers.

iv. The report puts much emphasis on the analysis of total water resources and their allocation. This is necessary for several reasons. First, Iran is a water scarce country and a discussion of water supply and sewerage problems cannot be meaningfully undertaken except in the context of the country's total available resources and uses. Secondly, the sector is presently organized in such a way that the resource development institutions (such as the Regional Water Board rather than the city water supply authorities) are the dominant ones in the sector. Thirdly, the government's expenditures in the sector has for several years been weighted in favor of resource development projects (dams and irrigation works). Fourthly, a proposal for a development strategy and organizational modifications will be incomplete unless it includes total resource development, goals and policies.

v. Another important feature of the report is the emphasis on the regions. Iran is a large country with wide regional variations in water resource availability. The problems facing the regions are therefore different and require different solutions. Furthermore progress in the sector can only be meaningfully assessed by focussing on the regions. Some generalization can still be made but these have to result from an assessment of individual regional situations.

vi. The focus of the report is on a strategy for developing a sector in a country where human and water resource availability rather than the availability of funds are the principal constraints. Only the outline of the proposed strategy (Chapter I) is presented. Details of the strategy can be developed and implemented as a part of sector program assistance to Iran.

1/ The members of the mission from IBRD were Messrs. V.C. Nwaneri (Mission Chief-Economist), M. Fireman (Agriculture and Rural Development) and from WHO, Messrs. M. Jackson (Engineer), E. Becher (Economist), L. Laugeri (Financial Analyst) and Mr. D. Hughes (IBRD-Consultant on Manpower and Training).
report however tries to present a manpower program in more detail (Chapter VII) as this is considered to be a major factor constraining sector development.

vii. One limitation of the report relates to an analysis of the sector's finances. This is due to the fact that most of the data for a sector financial analysis simply do not exist in most agencies.

viii. Another limitation of the report relates to the analysis of the rural subsector. This reflects the fact that this subsector is only recently being organized as part of Iran's rural development effort. Progress has been slow and the data is not yet available.

ix. A draft of this report was discussed with the Government, municipal, and Regional Board authorities. Their comments have been taken into account in preparing this final version. The mission is grateful to these and other officials, the international agencies and the private consulting firms in Iran. This report would not have been possible without the support and cooperation given to the mission by these officials and agencies.
CHAPTER I
SUMMARY OF RECOMMENDATIONS AND SUGGESTED DEVELOPMENT STRATEGY

Water Resources and Management

1. Iran is a large country with wide variations in climate and topography. The Caspian littoral, with its higher rainfall and generous runoff from the Alborz mountains, varies from the southwest which gets flood waters from the Bactiari and Zagros ranges. The southwest in turn varies from the central basin, which has sparse rainfall and heavy dependence on groundwater. As a result of these different regional resource situations, each region faces different resource problems that require different types of programs to meet its needs. In Volume II of this study, each region is analyzed in detail to highlight (a) the region's total resource situation, management and development; (b) the existing facilities, problems and development programs of the principal cities in the region. A summary of these two aspects of the regional analysis is presented in Chapter VII of this volume.

2. A considerable progress has been made \(^1\) already in the investigation of Iran's total groundwater and surface water resources but some regions have not yet been surveyed to the same degree of detail as others. The Fifth Plan made reference to the need for compiling statistics, conducting research and surveying underground resources as a step towards preparing a national water plan. However progress in the preparation of these studies for the national water plan has been slow. Furthermore, there is a need for a complete inventory of Iran's existing water facilities including wells and gharnats. At present there are varying estimates of their number and yields (Chapter III). At the central level there is inadequate knowledge of the existing facilities for water supply and sewerage and their adequacy to meet the needs of the cities. Without such data, it will be difficult to implement a national strategy for developing the sector.

3. There appears to be a case for a review of the Government's goals in the exploitation of its resources, as recognized in the terms of reference for the National Water Plan. The continuation of the program of constructing large multipurpose dams and their associated networks are behind the targets set in previous plans and likely to be so in the current plan. Causes of the delays in project implementation and cost-overruns need to be explored.

4. Total water resource availability appears to be a constraint for overall agricultural, industrial and urban demand. However, this is still to be firmly established because present information of resource availability and water consumption by various sectors are not sufficiently precise. Domestic and industrial water requirements do not appear to pose a serious constraint at present, as these constitute a small percentage of total demand (see Chapter IV), however, there may be exceptions in certain areas such as Esfahan (Annex 12). Water quality seems to be a greater problem.

\(^1\) See Annex 18 for Bibliography of Studies completed.
than total quantity of available water because of salinity and pollution in some areas (see Chapter IV, para. 12). In this respect agriculture seems to suffer more than other users.

Water Supply Facilities

5. According to the results of the 1966 census (Annex 3) only 13% of Iran's entire population in that year had piped water facilities in their homes, 7.6% depended on piped water facilities outside their homes, 24% on wells, 16% on ghanats, 13% on rivers and 27% on springs and other sources. Thus only 20% of the population in that year had access to modern piped water facilities, and most of it was in urban areas. Until another national census is undertaken it is difficult to be definite on the level of improvement achieved since 1966. However, Annex 3 gives a summary of the number of people served with water in 1972 in the major cities of Iran. This ranges from 25% in Rasht to 75% in Tehran and per capita consumption ranges from 100 to 165 liters/person/day. These cities together comprised nearly 60% of Iran's estimated 1972 urban population and about 25% of its total population. It is apparent from the figures that progress has been made in increasing the percentage of people served with piped water facilities in urban areas. This progress is a result of ambitious programs undertaken in the past decade in these major cities.

6. The importance attached to water resources by the Government can be gauged from the size of funds allocated in previous development plans for its development - 1.85 billion Rials in the first development plan, 17.7 billion in the second, 21.7 billion in the third, 53.1 billion in the fourth, and 110.7 billion in the original Fifth Plan (which is being revised (Annex 5)). It is projected (Annex 3) that at the end of the current Fifth Plan, urban population would increase by 30.7% (from the level at end of Fourth Plan) while total annual consumption of water by cities and industries would increase by 39%. The amounts of water supplied to these cities and industries from public facilities would increase by 63%, and population served will increase by 89%. Some projections of water consumption in the major cities of Iran by the year 1993 have been made (see Annex 3). It is therefore evident that considerable progress has been made and plans are being prepared by MPW, PBO and MHUP (Annex 5) to supply water to Iran's urban population. Similarly considerable progress has been made with regard to water controlled by reservoir dams, the annual amount of which is expected to increase by 61% from 16,360 mcm achieved at the end of the fourth plan to 26,280 mcm at end of the Fifth Plan (Annex 3 and 4).

7. Despite the progress that has been made in the past in the urban areas, problems regarding sector organization and policy remain to be tackled. There is evidence to suggest that water charges throughout Iran are too low and too rigid (see p. 33). This is the principal cause of poor financial performance of many urban water supply and sewerage authorities in Iran. Their inability to raise sufficient revenue to cover basic operation and maintenance expenses makes them unable to offer attractive conditions for their staff. This, in turn, has aggravated manpower problems. Rigid and low water charges have compelled most municipal agencies to rely on high
consumer contributions to obtain connections to the system. In certain areas these are so high that poor residents are discouraged from seeking house connections. Because water charges in some places do not reflect quantity consumed and because of the practice of giving discounts to some large users, there is a tendency for wastage of water in a country in which water is one of its scarcest resources. Considering its social policies it might be appropriate for Iran to extend its social measures by adopting a policy of assisting poor residents to obtain house connections while encouraging large consumers to pay economic prices for water in the interest of water conservation. Funds for capital expenditures are readily provided by PBO once projects have been prepared.

Water Supply In Rural Areas

8. Until quite recently most rural residents in Iran have relied on traditional sources of supplies - qanats and springs. While considerable progress seems to have been made in providing modern piped water systems to the major cities of Iran, the rural areas deserve to be given greater attention in future programs. The Government recognizes this need, and is currently embarked on an ambitious program of rural development. The problem is that villages in Iran are usually too scattered to justify many facilities that require experienced operators. Hence the Government has adopted a strategy of creating rural development centers (Chapter V) and satellite villages. An expanded program for rural areas can also be justified on social grounds since about 58% of Iran's 1974 population still lives in the rural areas.

Sewerage

9. Lack of sewerage facilities in most major cities in Iran is causing problems of pollution and in some areas creating health hazards. Only Esfahan has a modern sewerage system. The Government is giving attention to this problem and plans are being set up for other major cities. Allocations for water and sewerage facilities in the original Fifth Plan constitutes 45.5% of total urban development credits (Chapter IV). These allocations may have been substantially revised in the current revision of the Fifth Plan but detailed figures are not yet available.

Sector Organization

10. The responsibility for the water and sewerage sector in Iran is at present spread over a number of organizations at the national and local levels. The management of urban water and sewerage systems has remained the responsibility of municipalities and their agencies. In Tehran and recently in Northern and Fars regions, the Regional Water Boards have taken up some responsibility for urban facilities, but their major responsibility is the exploitation of water resources and construction of dams and irrigation systems. The oldest urban water supply system in Iran is in Shiraz and this is still operated by a private foundation. Planning for the sector is scattered among various ministries. Rural water supply and sanitation are being undertaken as part of the overall rural development effort. This fragmentation of
sector operations and management is further aggravated by inadequate coordination between responsible organizations. These two factors constitute a major constraint on sector development.

11. In view of the above, there are clear advantages in integrating the functions of water resource development and major water uses such as irrigation, urban water supply, and sewerage under one Government department. Such an arrangement would ensure maximum use of manpower within a unified administration, and facilitate standardization of services throughout the country, so that sector resources can be moved more easily to areas where the need is urgent. For these reasons, the proposed bill to establish regional water companies that will be attached to the existing Regional Water Boards is a step in the right direction. These companies would be responsible for urban and, to some extent, rural water supplies. The bill, however, appears to provide only the foundation for an improved organization of the sector. Additional measures will be required before a full organizational improvement can be achieved (see para. 32). However it would be necessary to maintain the executive responsibility for the whole sector under the Ministry of Water and Power.

With regard to the area to be covered by the proposed regional companies, a single company for each of the existing Water Board areas seems to offer greater advantages than an arrangement where several companies would be responsible for various towns or cities. The latter arrangement could apply in exceptional cases where urban centers are widely scattered and communication links between them poor. Government intends to leave rural water supply and sanitation as part of rural development effort by MCRA rather than give the responsibility to the new companies (para 31).

Suggested Sector Development Program for Iran

12. In view of the need to consolidate the considerable progress that has been made in certain areas, a water and sewerage sector development program with clearly defined targets, objectives, policies and organizational arrangements needs to be undertaken at the national level as a matter of priority. In this regard the following suggestions could be considered as providing a basis for future sector development program.

Program Objectives and Targets 1/

13. The principal objectives of a national development program need to be clearly defined in terms of targets such as the proportion of:

(i) the urban population of each region in Iran to be served by public water supply systems;

(ii) those to be connected to public sewerage systems;

---

1/ See Chapter IV for a discussion of the government's current goals for the sector.
(iii) the proportion of rural population to be supplied with water and sanitation facilities; and

(iv) a series of target years by which the above aims should be achieved and thereafter maintained. This should be translated into the number of people to be served in the region or city by these years, for example 1980, 1985, 1990.

14. In order to define the principal objective, the first step is to assess the existing situation. This involves first an assessment of the existing resources and the demand on these resources from major users at both the national, regional and local levels. The aim of such an assessment is to find out the principal resource problems and constraints that may inhibit the achievement of the stated objectives.

15. An assessment of the organizational arrangements required to implement the program is necessary. The aim of such an assessment is to determine what measures are required to meet the shortcomings in the existing structure. One of the problems constraining sector development frequently relates to the inadequacy of existing sector policies which often do not clearly reflect the degree of water scarcity in the country. Irrespective of the availability of funds, most countries including Iran need to adopt allocation and pricing policies to discourage wastage of water. An improved tariff structure for the sector is needed not only to discourage wastage of scarce water but also to enable operating agencies to meet eventually their full cost and above all offer attractive conditions for employment. Therefore, one of the principal objectives of the program could be to design policies that will ensure that Iran's capital and human resources allocated to the sector are utilized most efficiently and that these resources are being put to best use. This economic objective needs to be made compatible with the Government's social objectives and provision made to give low income consumers access to improved services. Introduction of progressive water and connection charges that enable poor residents in urban areas to have house connections will facilitate such an objective.

16. A continuous review of the progress of the sector program is necessary in order to determine whether the objectives of the sector development will be achieved by the target years. If there are reasons to believe that this is unlikely, then specific adjustments will be required. This process of re-evaluation and adjustments involves assessing current sector investment programs, manpower programs and financial plans, and suggesting improvements to be made in these areas. In this regard there are a number of options for Iran. These are:

(i) **Investment Objectives**

(a) Once the regional water companies are established, each needs to have an integrated investment program for its respective area. These programs may incorporate the current investments of existing municipal and other entities to which could be added other investment required in these areas to achieve the targets in (iv) above.
(b) A financing plan for these investment programs could then be prepared which will show the requirements and sources of funds for each year (including contributions by the regional water companies themselves, Government grants, loans, etc.). The Government may consider a policy that will enable regional water companies when established to eventually become financially viable by a target year.

(ii) Manpower and Training Objectives

At present there is a serious shortage of qualified staff of all categories throughout the sector. Training facilities and a program to meet this shortage are non-existent in most areas and inadequate in others. An assessment of the shortage and ways of resolving it is presented in Chapter VI. Government might therefore consider the setting up of a central training and advisory unit in Tehran or Esfahan supported by regional residential training centers for all levels of staff in the water and sewerage services. An experienced Director of Training needs to be appointed who would proceed to recruit a nucleus of about 35 technically qualified persons to form the upper level of training staff for the central unit. The new Director should have authority to recruit such additional staff as will be required to man the central and regional training center. A further 24 instructors would also need to be trained to run the regional centers. Initially, a program of seminars aimed at orienting appropriate officials on the objectives and arrangements for the training activities could be considered.

(iii) Project Preparation and Implementation

Project preparation in the sector needs to be strengthened in the operating agencies and coordinated within the Ministry of Water and Power. Project preparation is slow in the sector but this problem is more serious in sewerage subsector where the experience in Iran is rather limited to a few consulting engineers and contractors. The problem is aggravated by the general shortage of qualified staff in both public and private sector. However, the increasing activities of consulting and contracting firms have so improved their conditions of employment that they are attracting qualified people away from the Government services. Project preparation capability is the constraint for most areas especially for medium and small towns.

At the project implementation stage, there is a problem of cost-overruns for most public projects. This problem is common in other sectors and remedial measures need to be considered in a wider national context. The suggested manpower program (Chapter VI) is a way of dealing with this problem.
17. The strategy outlined above is not altogether new in Iran's current planning. PBO has proposed a set of targets for 1990 1/ and the MPW has created a technical planning bureau to prepare a long-term national water plan. The MPW has also set up an active unit for its manpower development and administrative reform programs. However, these units are not effectively coordinated nor conceived as integral parts of long-term sector development strategy.

Consulting Engineers Activities in the Sector

18. A great deal of sector information has been collected by a number of consulting engineering firms now operating in the country. A list of the principal firms is given in Annex 7. Not all of these firms are exclusively in the water supply and sewerage activities. Some firms are specialized in areas such as regional development or irrigation projects but have become involved in the drinking water component as part of multipurpose schemes. Others are more active in specific areas such as power production rather than in water projects proper, and still others do most of their business on the international scale. The mission's observations regarding the activities of the Consulting Engineering Firms in Iran can be summarized as follows:

(i) It is the Government's policy to give preference to local Consulting Engineers and encourage international or foreign firms to set up partnerships with local firms. In view of the growing demand for consulting services in the sector, particularly for urban projects and for management aspects of operations, existing firms will continue to depend heavily on much foreign technical support. At present, many local firms are attracting qualified staff from the Government Departments.

(ii) It was not possible to assess fully the potential and present capabilities of consulting engineers active in the sector in Iran. However, it appears from past records that the present capability of most firms in executing urban water supply projects is satisfactory. Some smaller firms have more recently entered the market and are taking over urban extension and modernization projects in small and medium sized towns. The capability of most firms, however, is not so strong in the preparation of sewerage projects, both urban and industrial. In this area, the demand for foreign consulting expertise is likely to increase rapidly in future.

1/ Annex 3 gives the targets which the PBO has projected for most of the urban centers of Iran, though the methods of forecasting are open to certain criticisms (see Chapter V).
(iii) Consulting firms, other government departments and the universities could participate in the training program outlined in Chapter VI of this report in two respects:

(a) Participation as guest lecturers and discussion leaders by their senior staff.

(b) Participation as students in the course program by their junior staff.

19. It was not possible to obtain information on the capability and potential of local contractors in project execution. It appears that much of the more sophisticated work such as installing treatment plants, big pumps, electrical equipment is done by foreign contractors and that these are readily available.
CHAPTER II
PRESENT SECTOR SITUATION
Organization and Legal Aspects

Background

20. In Iran, water has been recognized as a scarce resource. However, until the 1960's, the rules and institutions governing water supply and sewerage remained almost unchanged from the early times of application of the Moslem Law which stressed the rights and obligations of the individual with respect to water. As water resource development gained more recognition in the national development plans, the need was felt to centralize the control of this activity. As a result, the Ministry of Water and Power (MWP) 1/, was established in 1964. This first step was followed by the promulgation of the Water Nationalization Act in 1968 2/. Under this new legislation, water resources were considered to be national wealth and as such belong to the public. The Act further vested the MWP with the management, development and control of all water resources. These duties were to be exercised in close association with the Ministry of Agriculture, other technical Ministries, and special water resource development agencies. The Department of Water Resources of the Plan and Budget Organization (PBO) was responsible for overall economic planning and allocation of development funds for the sector.

Ministry of Water and Power

21. The Ministry of Water and Power was entrusted with the control of all water resource development activities. This Ministry was established by a Legal Decree on April 5! 1964 to ensure the maximum use of national water resources, the production of sufficient electric power for use in cities and villages and that agricultural and industrial water requirements are met. It functions are to:

(i) draw up and carry out plans and projects concerning the provision of water and its transfer to main consumption centers;
(ii) manage establishments to be created to develop water resources in various regions;
(iii) supervise the manner of utilization of water resources;
(iv) supervise the construction of town and industrial sewers;

1/ See Annex I for Organisation chart of MWP's Water Division.

(v) draw up and carry out plans and projects concerning the generation and transmission of electric power, the establishment of regional power stations and the building of a high-tension electrical network throughout the country;

(vi) manage and operate electrical establishments;

(vii) supervise the manner of using electric power by enacting necessary regulations and by-laws.

22. The MWP was also made responsible for the coordination and control of all institutions and of other ministries, government agencies and municipalities interested in water resources development. Furthermore, provision was made for such ministries, government agencies and municipalities to gradually transfer their prerogatives, as concerns water to MWP in accordance with cabinet decrees. The MWP may propose, (for the cabinet to approve) all the necessary corresponding changes in the charters of these authorities and organizations.

23. The water division of the MWP was primarily concerned with implementing water resource development projects such as dams. As a result it lacked four important sub-divisions: a) a central unit for collection and evaluation of data on water supply and sewerage activities and needs; b) a planning unit which would be of service to the municipal water agencies. This unit would be essentially concerned with the overall picture of water supply and uses, and should be advised by an inter-agency committee of water users. This responsibility was until now assumed by the Plan and Budget Organization but the tendency has been to relieve this organization from the responsibility of sector planning, which could be carried out by the technical Ministries concerned; c) a financial sub-division which could monitor the financing of various projects in the sector. At present, the Plan and Budget Organization provides funds to the final beneficiary of each project (usually the municipality or its water agency). The MWP does not actually handle these funds and thus it does not control their economical use; d) a sub-division concerned with community water supply and sewerage, which could be further sub-divided between rural and urban. These units would be staffed with competent sanitary engineers in charge of the sector; e) a special unit could be created in MWP for the purpose of licensing and controlling water reuse. Recent projects, particularly in Esfahan and Tehran, have stressed the importance of the reuse of treated effluent as a possible source to compensate for the general scarcity of water for agriculture, afforestation and other purposes. This raises such problems as pollution control (currently the responsibility of Regional Pollution Control Boards related to the MWP), allocation of treated effluent, and charges for such services. In this new field little progress has been accomplished. In the absence of the first four divisions, the MWP was not adequately staffed and structured to supervise the activities of its Regional Water Boards and of the Water and Power Authorities in the field of urban and rural water supply and sewerage. Units such as (a) to (d) exist in other Ministries.
24. The Ministry of Water and Power is responsible for the creation of irrigation and water conservation boards and committees at the regional and district level. Furthermore, the Water Nationalization Act provides for the Ministry of Water and Power, through its subsidiary organizations and companies, to take over the technical and financial responsibilities formerly assumed by Independent Irrigation Foundations as regards small irrigation and works.

25. Until the promulgation, in 1964, of the legal decree establishing the Ministry of Water and Power, all major administrative, legal and technical control over the construction and operation of water resources development projects and works for municipal, agriculture and industrial purposes were exercised by autonomous and semi-autonomous institutions or authorities. Municipal water supply systems were dealt with by autonomous municipal or village water boards, committees or companies; agricultural water undertakings were the responsibility of the Independent Irrigation Foundation, and hydropower production and distribution, as it still is to a certain extent, was the responsibility of autonomous power agencies and companies. After 1964, the Ministry of Water and Power assumed overall control of these agencies. Their former statutes or charters were officially amended and, while their basic original functions have been maintained, they are now governed by a unified standard constitution. This constitution further provides for the functioning of these agencies as companies and for their observance of business-like principles. These organizations have been reconstituted under the name of Regional Water Boards 1/. The Regional Water Boards are linked directly to the Ministry. However, according to common specifications of their articles of association, they are separate legal and financial entities, with full responsibility for water resource development within well-defined boundaries. They are responsible for the construction, management, operation, maintenance and extension of water resource and agricultural development installations including, (in most cases) irrigation systems and dams within their regional boundaries. In some cases these Regional Boards operate electric power generating systems in conjunction with their services. They have authority for the management and control of rivers and their basins, and the abstraction of underground waters. Consequently, they exercise a licensing authority with respect to any user. 2/

1/ See Annexes 8, 15, 17 Articles of Association and Organization charts of TRWB, KWPA, NRWB Vol. II describes the activities of these Boards in detail.

2/ At the level of each district, the MWP appoints a three-member committee which is responsible for the evaluation of beneficial uses of water and which recommends the issue of permits to the Regional Water Boards. One of their experts is appointed on the recommendation of the Ministry of Agriculture. For each basin, a five-member committee is responsible for considering appeals of the decisions of the district committee. The basin committee is staffed with representatives of the province (where the river basin is situated) and the MWP.
They can delegate any one of their responsibilities to other Governmental agencies or institutions related to the Government subject to the approval of the MWP. Their Managing Director can propose changes in water rates, which are subject to the approval of the MWP. The MWP (through the Regional Boards) has until this year concentrated its efforts on the realization of large multi-purpose projects, and the strengthening of the irrigation and the power sectors. With the exception of the Tehran Region, the MWP’s Regional Boards have so far played a minor role in the development of urban and rural potable water supply and sewerage. 1/

26. The factors that could be considered in order to improve the organization of the Regional Water Boards are:

(a) At present the Regional Water Boards are not adequately staffed to be able to cope with the responsibility of creating and controlling public water supply and sewerage companies even if they have the financial and legal power to do it. Until now the main task of the Regional Boards in the sector has been in most cases to convey water to the perimeters of communities. They do not have the expertise in sanitary engineering which is needed for the design and operation of water supply and sewerage facilities.

(b) At present, the General Assembly supervising and guiding the Boards serve as the link between the agency and the responsible government department such as the Ministries of Water and Power, Health and Finance. In the future it may be considered that Ministries of Health, Mines and Industry may also have a voice in the issues affecting their departments when such issues are decided upon by the General Assembly.

Proposed Legislation to set up Regional Water Companies

27. The MWP as indicated above, played a limited role (except in Tehran) in the development of urban and rural potable water supply and sewerage. As a result, responsibility for this subsector has remained scattered among several Ministries and agencies of the municipalities, which have continued to play a large role in its development. Currently, the rapid growth of population and industry and the problem of competing demands, essentially from agriculture, is a cause of official concern. Drinking water demand is given first priority, but progress in its development necessitates significant improvements, particularly in organization and manpower. Consequently, a major objective of the fifth plan was to provide the basis for the organizational

1/ This position is now changing in certain regions such as the Northern Region, Fars, etc. (see Vol. II, Annexes 13 and 17).
change that is necessary for further development of the sector. The concepts underlying the decisions in the Plan can be summarized as follows:

(a) All urban water supply and sewerage activities would be merged under the responsibility of the MWP; this responsibility would be delegated to the Regional Water Companies attached to the Regional Water Boards and affiliated to the MWP; these companies would construct and operate the water supply and sewerage works.

(b) The initial investment would be funded by grants, to enable the agencies use internal funds for operation, maintenance and extension of water supply and sewerage works.

(c) The supervisory role of the village council in the operation of rural systems and overall responsibility of MCRA were recognized.

(d) The magnitude of the operations to be taken over by the end of the Fifth Plan is considerably greater than that of previous Plans, and consequently changes in the institutional set-up would be required.

28. An enabling bill has been prepared for submission to the Parliament. The purpose of the bill is to introduce the constitution of companies that would supply and distribute water and install sewerage systems in the cities. 1/ The text generally follows the intentions of the Plan, with minor changes. The decision to create Regional Water Companies attached to the Regional Boards also follows a general policy of the Government of Iran to decentralize its activities. 2/

29. A major weakness of the MWP is the weak link with the other ministries and municipal agencies active in the subsector of urban and rural potable water and sewerage. This is being remedied by the proposed legislation to set up Regional Water Companies. The proposed bill however, is essentially a first step (albeit in the right direction) and further measures will have to be taken to ensure the necessary institutional improvements required to facilitate further sector development. The principal issues that need to be considered include the Ministry's weak coordinating role, inadequate staff who do not have the necessary expertise, insufficient data on the sector, inadequate standardization of organizations and equipment and little encouragement for agencies to operate financially independent and viable systems.

1/ The mission's translation of relevant parts of the text is given in Annex 1).

2/ The essential features of this policy include increasing the numbers of Ostans, enlarging the powers of the Ostan Governors to embrace technical activities, and setting up of regional offices of the PBO.
30. The institutional arrangements under the bill provide for two levels of delegation namely, from the MWP to the Regional Water Boards and from the Regional Water Boards to water companies. This is consistent with a general division of tasks between the overall water resources allocation and control (Water Division of the MWP), the construction of large multi-purpose works with conveyance to various users (Regional Water Boards) and the distribution of potable water to communities (water supply and sewerage companies). Such an arrangement will be an improvement on the existing structure.

31. Alternative organisational arrangements for the rural sector include:

(a) Extending the responsibility of the Regional Water Companies (when these are established) to include provision of rural water facilities.

(b) Extending the role of the Ministry of Cooperative and Rural Affairs to include all rural areas.

(c) Giving the Ministry of Health the responsibility for rural water supply and sanitation.

Each of the three organizational arrangements for rural water supply and sanitation ensures that the manpower, expertise and equipments of the agencies would be available for use in rural areas. Each arrangement also provides a more closely unified administration. The Government however prefers to retain within MCRA the ultimate responsibilities for providing rural water facilities. It is recommended that until MCRA covers all rural areas, there should be greater utilization of existing resources within the Ministry of Health and MFW. Lastly the proposed manpower program (ch. VII) will be open to participation by MCRA.

32. The essential features to be considered in a new sector organization can be summarised as follows:

1) The major responsibilities for both the resource development and uses should come under one Government Department.

2) Strong co-ordination with other Ministries.

3) The Regional Water Companies should be linked to the existing Regional Water Boards but with some degree of independence. This can be achieved through the chairmanship of the Water Companies being given to the Director of the Regional Water Boards while the Managing Director of these companies retain only executive functions.

4) The Regional Companies should be run as financially viable entities.
5) The companies should be given some degree of flexibility in fixing water and sewer charges to ensure that their operations are financially viable. Initially they will need government subsidies to enable them to survive.

6) The number of companies in each Water Board area should be chosen to ensure that they cover enough urban areas to operate viable systems. In most regions, there would be one company covering the whole area but the number may be increased in the very large regions.

7) The operation of rural facilities could be retained in MCRA as part of rural development program to ensure maximum use of resources and that rural residents have access to the larger capital available to MCRA. However, strong co-ordination with the Ministry of Health is desirable.

National Water Plan (now Technical Planning Bureau)

33. The Ministry of Water and Power is empowered to "draw up and carry out plans and projects concerning the provision of water and its transfer to main consumption centers". On the basis of this Authority, the Ministry contracted with Development and Resources Corporation on September 22, 1973, to assist the Ministry in preparing "Iran's water resources program", a national water plan and project possibilities. The aim is to set forth the objectives and scope of the planning program as well as the fundamental concept and methodology to be employed in the planning process which was to be a continuing process within the ministry itself. The objectives of the planning program is to develop a comprehensive water resources plan which will contribute effectively to the attainment of Iran's total national goals with regard to the water supply needs of its present and future population. Other objectives were (a) to identify programs and projects needed to meet water use demands in ten years' time and prepare a schedule for the implementation of these projects. (b) For the long-term (30 years) to develop a concept for a national water plan and prepare a strategy to meet such a concept. (c) Other principal issues to be considered in the plan include: definition of national goals, determination of quantity, quality and sources of water in Iran, as well as their future need and uses, and identification of potential means of exploiting water resources.

34. The progress in preparing the National Water Plan has been slow. The consultants have not progressed beyond a desk study of already published materials. The unit needs some guidance in order to be successful, the unit requires a high degree of inter-ministerial cooperation considering that much of the responsibility for the sector is fragmented. However, it is evident that the unit is hardly coordinating its work with other important departments. In particular strong coordination is needed with other units within the Ministry such as the unit responsible for manpower development and administrative reforms which has development extensive programs intended to embrace all Regional Water Boards in Iran.
Municipal Water Authorities

35. All urban areas with populations greater than 5,000 are constituted as municipalities and there are about 440 of these in Iran. Those with populations greater than 10,000 have elected Town Councils. These are supervised by the Ministry of Interior. 1/ Urban water supply and sewerage responsibility in Iran falls under one of the following four organizational arrangements:

(a) An independent city water supply and sewerage authority owned jointly by the municipality and the PBO or other government ministry.

(b) A water supply and sewerage unit of the municipal administration operated directly from the local mayor's office.

(c) A division of the Regional Water Board for the area.

(d) A privately owned agency such as the Shiraz system which is operated as a private foundation.

A description of these organisational arrangements as they apply in the major cities of Iran is given in Volume II. Most municipal water supply and sewerage organizations in Iran have the following important features.

(a) finance and administration are merged;

(b) there is a special department for technical services, including laboratory, treatment, technical inspection, maintenance, etc.;

(c) all systems are grouped under one Department of Operations, which takes care of all distribution problems;

(d) there is a technical bureau in charge of design, project planning, topography, drawing and contracts;

(e) inventories and procurement of spare parts are under the responsibility of the finance section of the Division of Finance and Administration;

Other institutions active in the sector

The Plan and Budget Organization (PBO)

36. The planning and implementation of specific projects such as dams and irrigation works, which were principal function of the Plan and Budget

Organization during the first two national plans, are being gradually transferred to the technical ministries. This should enable the PBO to concentrate on national and sector planning and policies. At present, the Urban Development and Housing Division of the Plan and Budget Organization is concerned with the water supply and sewerage sector. In the past most of its projects were initiated when it received requests from the provinces, the MWP, the Ministry of Housing and Urban Development or the individual consultants employed by the Plan and Budget Organization for evaluation of the needs. The PBO is setting up Regional Planning offices in various provincial capitals of Iran. These offices will in future be responsible for processing requests for projects and this is expected to lead to an improved screening process. It will ensure that projects are selected according to their wider regional usefulness, comparative social need, complementary industrial or commercial requirements, and local capabilities of operation. The budget allocations by the PBO are made according to various priority criteria, the most important being related to population and economic growth. Priority is also granted to areas with serious problems (e.g. sewerage facilities in cities where the water table is high) or strategic importance. Social considerations have not figured prominently in PBO's decisions because social criteria are difficult to apply in the selection of priority projects and often the necessary data are not available.

37. The PBO has also a Rural Development Division which is responsible for rural water supply planning as part of its overall planning effort for the Rural Development Centers. The executive responsibility, however, lies with the Ministry of Cooperative and Rural Affairs.

The Ministry of Cooperative and Rural Affairs (MCRA)

38. The MCRA took over the responsibility for rural water supply and sanitation from the Ministry of Housing and Development during the Fourth Plan. At present, the MCRA has a total of 24 local offices in the provinces and about three engineers and eight technicians in each local office. These are responsible for designing and supervising construction works undertaken by contractors. The Ministry usually channels its funds to the provincial governorate which allocates it to the Ministry's local office for the needs of the province. The village Council (assisted by MCRA's local officials) carries out the operation and maintenance of local water and sanitation schemes. The village Council staff receive short period training locally or in the Public Works Department in Tehran for the purpose of maintaining and operating all rural development schemes (electricity and water facilities and public baths). For the water supply facilities, the MCRA receives guidelines from the Ministry of Health on the level of treatment required. The organization chart of the MCRA is given in Annex I and its progress in achieving the Fifth Plan objectives for the rural development centers is discussed in Chapter V. The MCRA should consider setting up mobile maintenance units to assist village councils in emergencies and for repair of rural water facilities.
The Ministry of Housing and Urban Planning (MHUP)

39. The City Water Supply and Waste Disposal Department of MHUP is responsible for water supply and sewage facilities in small and medium size cities especially in those relying on underground sources rather than rivers and dams. The MHUP generally relies on the city to take the initiative by requesting (through its local offices) for a project to solve its problems. On the basis of the reports of the Ministry's engineers or consultants, a decision to undertake a project is made. The ministry usually prepares small scale projects (usually up to 60 million Rls.) by its own staff and subcontracts the rest to consulting firm 1/ MHUP does not have regional organizations such as the Regional Water and Power Boards but its local offices undertake all functions relating to the province or the city. The Ministry obtains funds for its projects from the PBO but does not consult or coordinate with other Ministries when processing requests for projects. It also acts independently in preparing feasibility studies and approving consultants' reports. On completion of each project, it is handed over to the municipal agency or municipality itself and there is no effective supervision or monitoring of future performance. Since the majority of medium and small size cities do not have independent water supply agencies these projects are usually mismanaged by municipalities because they are ill-equipped with staff and equipment. The MHUP does not have any legal responsibility to continue supervision of its projects once they are completed so that proper operation and maintenance can be ensured. Furthermore, the Ministry does not have the legal power to effect important organizational and policy changes such as tariffs and connection charges by municipalities. Considering the large number of these medium and small size cities and large number of projects the proposal to introduce regional water companies to take over responsibility for these municipal facilities is a step in the right direction. One of the major problems facing the MHUP itself is the shortage of staff to undertake its own work. When the bill to create Regional Water Companies becomes effective it will result in the phasing out of water supply and sewerage functions carried out by MHUP.

Ministry of Health

40. This Ministry has been active in the sector of urban and rural water supply and sanitation. It provides hygienic inspection and the general monitoring of water quality. It also provides statistics on water borne diseases. These statistics indicate a prevalence of these diseases in rural areas. However, because the law requiring compulsory reporting of communicable diseases is not enforced, the Ministry does not have reliable statistics on morbidity, which are essential for the identification of problem areas. A recent decree providing for strengthening of the public health services makes provisions for the enforcement of compulsory reporting of communicable diseases. Ten years

1/ The list of MHUP's ongoing and completed projects and MHUP's future program are given in Annex 5.
ago, the former Plan Organization approved a program and budget for the Ministry of Health for rural water supply. Due mostly to shortage of personnel in the starting phase, disbursement on rural water supply projects did not exceed US$2 million per year (plus US$0.5 million equivalent in self-help). In two years 670 systems were completed, together with latrines and slaughterhouses. In the subsequent plans, the budgets for rural water supplies were considerably increased, and the responsibility for rural water supplies was transferred to the Ministry of Housing and subsequently to MCRA. The Government plans to retain responsibility for rural water and sanitation with MCRA as part of its rural development effort. It is recommended that MCRA coordinate with Ministry of Health which already have sanitary engineers, officers and training schools all over the country. Coordination between MCRA and the Regional Water Companies (when these are established) is also recommended to ensure full use of resources in the sector (para 31).

The Ministry of Agriculture and Natural Resources

41. In the past the Ministry of Agriculture and Natural Resources had shared with MWP important responsibilities in water resource allocation especially with regard to irrigation. The Water Nationalization Act 1968 had prescribed such coordination between both Ministries. This coordination has been successful in the past largely due to the responsibility of the Regional Water Boards in providing irrigation water and other facilities. Though it has been recommended that the responsibility for water resources should continue to remain within MWP (para 11), it is important to continue the present coordination between MWP and the Ministry of Agriculture, especially in the allocation of resources and determination of water charges.
CHAPTER III

PRESENT SOURCES OF SUPPLIES AND FACILITIES

42. Iran is largely an arid or semi-arid region, characterized by an unfavorable geographic and seasonal distribution of rainfall and a high rate of evaporation. Mean annual precipitation is only about 223 mm. with a range of less than 100-1,500 mm. The heavy rainfall in the North and West of Iran is prevented from reaching the central plateau by the Alborz and Zagross mountain ranges. According to a study of Iran's water resources by Plan Organization in 1968, one third of total precipitation occurs in the Caspian Sea area which comprises only 10% of Iran's land area. Another third of the precipitation occurs in the central plateau, the area with most of Iran's population and agricultural land. Over 95% of the country's land gets on average less than 200 mm. of rainfall a year, the rest receiving more than 500 mm. Over 60% of the rainfall is lost to the atmosphere through evaporation and evapotranspiration. Furthermore, most of the rainfall occurs in the winter and the beginning of spring, reaching its minimum level in summer, when most plants and crops have their maximum period of growth and need for water.

43. A significant amount of surface water flows into Iran from Turkey, Russia and Afghanistan but almost as much flows out into Iraq. With few exceptions, the fresh waters of Iran are intranational. The streams that do cross international boundaries are mostly water-exporting. That is, their flow is out of Iran and, therefore, the portions of the drainage basins within Iranian borders would still be available for development. For all practical purposes, therefore, the total water supply of Iran is the precipitation that takes place over its own territory in the form of rain, snow, hail and dew. Barring scientific developments that will make feasible the large scale conversion of saline water, precipitation will be the main source of fresh water available to Iran that can be developed for long range dependable use.

44. The average quantities of annual water supplies and use in Iran is summarized in Annex 2. This is based on a fairly recent (March 1974) desk study by the PBO assisted by other government agencies. The Ministry of Power and Water (MPW) assisted by various agencies had also made some estimates of the ground water situation in the major regions of the country. These estimates are summarized also in Annex 2 and regional breakdown of the figures are included at the end of the regional Annexes (Vol. II, Annexes 8-17). 1/

45. A summary of the MPW's previous and latest groundwater estimates is as follows:

1/ An assessment of the Ministry's estimates is included in Annex 2.
<table>
<thead>
<tr>
<th></th>
<th>Previous Estimates /1</th>
<th>Latest Estimates /1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of wells</td>
<td>42,000</td>
<td>37,000</td>
</tr>
<tr>
<td>Total number of ghanats /2</td>
<td>18,000</td>
<td>14,000</td>
</tr>
<tr>
<td>Total number of springs</td>
<td>4,500</td>
<td>4,000</td>
</tr>
<tr>
<td>Total discharges per year</td>
<td>20-21 billion m³</td>
<td>17 billion m³</td>
</tr>
</tbody>
</table>

/1 Source: MWP  
/2 Sloping tunnels dug manually to lead water to the point of use from distant aquifers (see paragraph 49 below).

**Sectoral Allocation**

46. According to a 1968 publication 3/ by PBO, non-agricultural use of water was as follows:

<table>
<thead>
<tr>
<th></th>
<th>Billion m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Households</td>
<td>0.45</td>
</tr>
<tr>
<td>(b) Livestock</td>
<td>0.1</td>
</tr>
<tr>
<td>(c) Industry, etc.</td>
<td>0.45</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.0</strong></td>
</tr>
</tbody>
</table>

These figures were obtained by assuming that household water consumption ranged from 60 m³ per capita per year (44 gallons per day) in Tehran to 10 m³ in "third class towns" (presumably the smaller rural centers) with a country wide average 18 m³ (13 gallons) per capita per day for 25 million people. For livestock, it was assumed that the average daily consumption was 1.5 gal for each of 50 million of sheep and larger animals.

47. More recent estimates by various Government Ministries for non-agricultural use of water vary but approximate the following:

<table>
<thead>
<tr>
<th></th>
<th>Billion m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Households</td>
<td>0.80</td>
</tr>
<tr>
<td>(b) Livestock</td>
<td>0.2</td>
</tr>
<tr>
<td>(c) Industry, etc.</td>
<td>0.8 - 1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.8 - 2.0</strong></td>
</tr>
</tbody>
</table>

These figures are based on an average of 25 m³ per capita per year for 32 million people; about 3 gallons per day for 50 million livestock and only rough estimates for industry, parks, etc.

3/ "Water and Irrigation in Iran" by M. Vahidi, 1968.
48. The methods employed in Iran for the utilization of its water resources range from the most primitive to the ultra-modern. Water is diverted from streams by the simplest brush dams. Recently placed in operation or still under construction are such huge multi-purpose structures as the Karaj, Sefid Rud and Dez Dams. Some towns are supplied with water from unprotected open ditches called "jubes" running through their streets while others have modern distribution systems with the largest in treatment works such as exists in Tehran. Groundwater is extracted by various means including hand-dug wells with animal drawn lifts, an ancient but ingenious system of tunnels called ghanats. Some rely on power pumped wells of poor design and low efficiency while others have superior types of wells with properly designed screens and turbine pumps.

The Ghanats of Iran

49. Because of the tremendous investment that they represent and the unique influence that they have on the cultural pattern of the country, the ghanats deserve special consideration in any survey of the water resource sector in Iran. A ghanat is essentially a well dug horizontally instead of vertically. A site is chosen where the elevation of the groundwater table is known to be higher than the area to be irrigated or the community to be served. At the consumption or lower end, if the topography is steep, an oval shape tunnel is started and drifted into the earth toward the water source. If the topography is flat, the tunnel section may be preceded by some distance of open channel. The ghanat excavation is given just sufficient slope to reach the groundwater source, location of which has been predetermined. The water thus intercepted is discharged by gravity through the tunnel (and open channel, if any) to the point of use. The usual size of the ghanat excavation is just enough for a man to work in a crouching position. Unstable sections of the ghanat are supported by pottery ovals about four feet high and two feet wide. About every 30 or 40 meters along the route of the ghanat, shafts are sunk for ventilation and the removal of excavated material. There are ghanats in Iran reported to have the astonishing length of 48 kilometers and to have taken several generations to complete.

50. An exact inventory of the number of ghanats in Iran has apparently never been made, but various estimates put them at 14,000 to 18,000 (see para. 3). The discharge of an average ghanat is said to be between 2 and 3 cubic feet (about 70 liters) per second. This figure appears much too high in relation to the total annual groundwater recharge and probably refers to a maximum discharge rather than an average yearly discharge. In fact, some recent estimates would indicate average ghanat flows will vary from about 7 to 30 liters per second.

51. The advantages of the ghanats, particularly for a time preceding the mechanical age, are obvious. The principal construction ingredient was human labor, and the water flowed by gravity to the areas of use. A relatively small amount of annual maintenance assured the continuity of this flow. There was no dependence on machinery, fuel or imported materials. The only manufactured article that entered the construction was the pottery liners for soft ground, and the Persians were well versed in the arts of burnt clay manufacture.
The disadvantages of the ghanats are equally obvious. By their very nature they must in most cases tap only a limited part of the available groundwater resource. The flow from the ghanats is a continuous drain on the water table, which cannot be closed off when not needed. Therefore, the operation may be accompanied by a considerable wastage of groundwater. The ghanat is unable to irrigate lands at a higher elevation than its outlet without pumping. Since the ghanats also supply drinking water requirements as well as irrigation, the case with which water can be polluted through the open shafts is a serious health hazard. The sudden collapse of a ghanat roof may shut off the supply of water at a critical crop period. The accident and health hazards for ghanat diggers is exceptionally high. The understandable necessity to protect the investment of ghanat owners has led to the enactment of laws which inhibit the full development of groundwater resources and also are the cause of considerable controversy. Ghanats are usually constructed by a single large landowner and the later fractionalization of ownership through inheritance has resulted in loss of responsibility for maintenance, and the deterioration beyond the point of usefulness of over half the estimated number of installations. From a modern point of view, however, the greatest disadvantage of the ghanat is its high initial cost for a very limited yield. The construction of a ghanat requires the employment of a number of specialists known as "moghanies," and though the bulk of the labor in ancient times may have been exceedingly cheap or even conscripted serf labor, the cost in human effort was enormous. In view of the large investment in these ghanats, it is recommended that public funds be used to rehabilitate the abandoned inoperative ghanats where these prove more economical sources of supply.

The Multipurpose Dams of Iran

Since the start of the first seven year development plan in 1949 the major efforts in water resource development and the greatest allocations of available funds have gone to big dam projects. These are multipurpose structures, designed in most cases to provide benefits in flood control, irrigation, power generation and community water supply. The huge storage reservoirs created by these dams and the vast acreages of land for which they provide irrigation water make them conservation and development projects of the first order but the government needs to reappraise its dam construction programs (paras. 3 and 58).

Existing Sewerage Facilities

The only one modern conventional sewerage system in Iran is located in the City of Esfahan (see Vol. II Annex 12). Another one is being planned

---

1/ See Annex 4 for the list of dams in Iran and their specifications. Map No. 11262 shows their locations. The planning of these dams from the first to the fifth national plans are discussed in Vol. I, Chapters III and V, "Sector Planning." The management of the dams are under the Regional Water Boards and these are discussed in Annexes 8-17.
for Tehran (Vol. II Annex 8). In Abadan there is a simple public collection system for pumping sewage and waste into the river through open canal (see Vol. II Annex 15). On account of its significance in the country and in view of the need for planning sewerage systems in other cities, a detailed description of Esfahan's system is given in Annex XII.

**Existing Water Supply Facilities**

55. A detailed description of the existing water supply facilities in the major cities of Iran is given in Vol. II, Annexes 8-17. The development of urban water systems has remained the responsibility of municipalities and their agencies except in Tehran. Recently some Regional Water Boards - The Northern Region and Fars - have taken up the responsibility for certain important cities (see Annexes 17 and 13). The oldest urban piped system in the country began operating in Shiraz about 1952 and is still being operated as a private foundation at the initiative of a wealthy local philanthropist. Until then ghanats and shallow wells were the traditional sources. The development of most urban systems in the country was an important objective in Iran's Second National Development Plan (1955-1962) and since then construction of municipal systems has begun in all major cities. Most medium and small towns have been provided with piped systems largely through the effort of the Ministry of Housing and Urban Planning. Water quality in most urban systems is generally good and most agencies in major cities have daily tests in their laboratories and regular checks are made by local officials of the Ministry of Health. Annex 3 shows that annual water consumption by cities and industries will grow from an estimated 690 mcm at the end of the fourth plan (1968-1973) to 958 mcm at the end of the current Fifth Plan in 1978. In the same period water supplied by the public sector is estimated to grow from 768 mcm to 1,255 mcm. The population served by these public systems is estimated to be 9 million to 17 million respectively for the period. The same Annex 3 gives a breakdown of sources of household water supplies in Iran according to the results of the 1966 census. By that year only 13% of the entire country had piped water facilities in their homes (39% urban and 0.7% rural), 7.6% depended on piped water outside the house (19.6% urban and 1.6% rural), 24% on wells, 16% on ghanats, 13% on rivers, 27% on springs and other sources.
CHAPTER IV
SECTOR GOALS AND POLICY

Exploitation of Resources

56. In the light of Iran's geographic and climatic conditions that inhibit uniform distribution of water supplies over time and space, the government's long-term objective emphasized in several previous plans was to expand water control, storage, diversion and distribution facilities throughout the country.

57. During the Fifth Plan 1/ the following objectives for resource development were stated in order to meet both agricultural and other needs:

(i) completion of reservoir dams started during the Fourth Plan (these dams control about 9.5 million m³ of water per year);

(ii) construction of new reservoir dams of moderate size that would control about 0.4 billion m³ of water;

(iii) diversion of 0.1 billion m³ of water from one water basin to another;

(iv) installation of facilities to utilize 1.12 billion m³ of groundwater (the private sector was expected to invest capital for developing another 1.01 billion m³ of groundwater);

(v) where economic and technical feasibility studies show the possibility of underground water utilization, water users will be encouraged to invest in it through their cooperatives and farm corporations, but in all cases such use will be under government control and supervision;

(vi) the Government itself will invest in the development of underground water resources under the following circumstances:

(a) under exceptional circumstances when development of underground resources is technically difficult or financially heavy beyond the capability of the private users (i.e. cooperatives or farm corporations);

---

1/ References on the Fifth Plan in this report are based on the English summary published by PBO June 1973.
(b) when the underground water is intended for use in conjunction with a modern surface water network under the jurisdiction of a single authority;

(c) in each case, the price of water will be determined on the basis of all costs, including depreciation, and in the light of various socio-economic conditions.

(vii) Research and Studies

(a) the necessary standards and rules will be developed for the compilation of statistics, conduct of research and establishment of water installations;

(b) special attention will be paid during the Fifth Plan to the survey of subterranean water resources and the preparation of a national water plan.

(viii) Supervision – Nationalization of the water resources in the country will be carried out as a matter of priority.

59. These goals raise the following issues. First, most of Iran's existing dams and facilities are still under-utilized. It appears that the dams started during the Fourth Plan will be completed by the end of the current plan period. Only one (Marun) of the proposed medium size reservoir dams has been started but none will be completed and in use during this plan period. Also the third goal is behind schedule and probably will not be completed during the fifth plan period. Government should therefore reappraise its programs to take into account under-utilization of existing dams and the problems of delays and cost overruns.

59. Groundwater development (item iv) has been slow. This is partly due to the fact that the Government has adopted a conservative "safe - yield" policy in exploiting underground sources even in areas where it has reasonable information on the groundwater status. Completion of a country-wide groundwater survey by the Groundwater Division of the Ministry of Water and Power is progressing rather slowly and the Government is loath to permit well construction where its studies are incomplete. Furthermore, the Government requires certificates of ownership of land before granting licenses to private owners. This requirement limits tubewells largely to former landlords and entrepreneurs and makes it impossible for most of the beneficiaries of land reform, i.e. the new small "landowners" to develop groundwater sources since they cannot obtain such certificates until they have paid for their land - this usually requires 15 years. Lack of credit is a significant but far less important constraint to groundwater development. This problem is being alleviated through rural cooperative funds being made available to small farmers.
According to Government plans, over the next 20 years the "surface water supply" is expected to increase from the present 32.6 to 52.6 billion m³ per year, and the "groundwater" supply from the present 20.7 to 37.7 billion m³ per year. Thus, from the same total supply now available for use (105.6 billion m³), the increase in the total amount used for irrigation would be 37 billion m³ per year (about 70%). These increases are expected to be accomplished by constructing more dams, reservoirs and diversion structures; installing more tubewells; increasing trans-basin diversions of water; and by improving overall irrigation efficiencies by lining canals and irrigation ditches, levelling land, decreasing the number of ghanats, and by instructing farmers in modern water management practices. If these plans materialize, then one can conclude that there certainly will be considerable increase in both surface and groundwater supplies and perhaps in irrigation efficiency in the future.

Water Conservation

In Iran the flow of many streams is completely lost in the vast evaporation basins of its deserts. The diversion and utilization of some of these waters may provide additional opportunity for conservation. The experiments of recent years in the reduction of evaporation losses from reservoirs by using mono-molecular films are attempts by man to control the evaporation. Extensive experiments have also been conducted on increasing precipitation by cloud seeding techniques. As yet, however, these efforts have produced only localized effects.

Conservation measures are at present of even greater importance to the future of Iran than precise knowledge about the extent of its water resources. Precipitation in Iran, as in most parts of the world, is not uniform. It is poorly distributed both geographically and chronologically. Quantitatively it varies from well over 1,000 millimeters per year on the Caspian slope of the Alborz Mountains to almost zero in some parts of the Kabir desert. The larger part of the seasonal flood runoff is wasted to salt water or the deserts of the great inland basin. Annually the unchecked flood waters erode away millions of tons of the country's unprotected precious top soil. Some measures need to be taken to impede this wasteful and destructive runoff.

The conservation of flood water by the creation of large storage reservoirs and diversions to crop lands are well known practices in Iran. The remains of ancient hydraulic structures in various parts of the country attest to the ability, energy and wisdom of old Persia. In recent times a number of medium size river control structures have been erected (see Annex 4). However, other conservation practices, less spectacular in character than the big dams, but with potential benefits, need to be considered in the government's policy making. In Iran centuries of unrestricted wood cutting and grazing malpractice have changed areas once covered with forest

1/ See Annex 2, page 1.
and grass lands to barren mountainsides and desert plateaus. These depreda-
tions have reached such an extreme state that vast areas are unable to absorb
any significant portion of the precipitation and thereby contribute to the
heavy runoffs that cause soil erosion and floods. In addition to the con-
struction of big dams, additional conservation measures that should be con-
sidered, include reforestation, development of grasslands, improved cultivat-
ing methods, erection of check-dams and water spreading. These measures will
bring such benefits as increasing domestic water supplies from wells and
ghanats, continuous supply of wood, good grazing land for livestock, increased
agricultural yields, avoidance of soil erosion and siltation.

Government Goals Regarding Allocation of Water Within the Sector

64. It has not been possible to obtain or to develop reliable figures
for future use of water by the non-agricultural sector, but some "educated
guesses" can be made from current PBO estimates. According to these estimates,
non-agricultural sector will require 6% to 7% of the available water, or 5 to
6 billion m$^3$ per year in 20 years or so. Over the shorter period, it is planned
to greatly increase livestock numbers, as much as 50% and their water require-
ment should increase proportionately, or from about 0.2 to 0.3 billion m$^3$ per
year. With regard to industrial development, though indefinite future plans
(in some cases), lack of clear policies regarding allocations in water-scarce
areas, and military secrecy make any near-term prediction hazardous, it is
most likely that water requirements for industry will double, or amount to
at least 2 billion m$^3$ per year in 10 years' time. Estimating the amount of
water that will be developed for household use in the next 10 years is also
difficult. Such an estimate will depend on priorities set by Government and
operating agencies, increases in implementation capacity, relevant training
capacity, kinds of water supply systems that already exists or will be set
up in the cities and rural areas. However, increases both in population
(about 3% per year) and in water use would raise the household water require-
ment to about 1.3 billion m$^3$ per year. Thus, the total requirement for this
sector in about 10 years will be about 3.6 billion m$^3$ per year.

65. An average summer crop uses about 9,000 m$^3$ of water per hectare in
a growing period of about 150 days, or about 60 m$^3$ of water per ha per day.
In an average village without a water distribution system, use of water for
domestic purposes is perhaps 15 to 20 liters per capita per day; with con-
struction of a reasonably convenient water distribution system, average water
use would increase, it is estimated, to about 80 litres per capita per day.
In an average Iranian village of 1,000 people, one would expect to find 170
or more families of which 130 would be farm families cultivating a total of
more than 100 ha of irrigated cropland. A modern village water distribution
system in such a water-scarce area would reduce the amount of water available
for irrigation by 1% or less. In other places, the percentage reduction in
water available for cropland would be even less. In this connection, it
should be noted that irrigation water management practices are so poor in
most plates in Iran that a reduction in irrigation supply in the range of
1 to 3% would make no measurable difference in the area that could be irri-
gated or in crop production.
66. It can therefore be concluded that over most of the country, development and distribution of water supplies for domestic use would not significantly reduce the amount of water available for agriculture and industry. That is, domestic water supplies are not in competition with water for industry or agriculture nor are they likely to be in the foreseeable future. Domestic requirements will not exceed 2% of available supplies, and the planned increases in water supplies during the next 20 years are several times greater than all non-agricultural requirements are likely to be. However, in some exceptional areas (especially southern coastal cities), there are quality or quantity problems. In these cases priority goes to domestic use but even in these areas, domestic demand does not as yet impose severe pressure on overall resources.

67. In approximately 60% of the area of Iran (see Map No. 11260) containing only 25% of the population, there are serious water quantity and/or quality problems (except in small isolated areas) whereas over the remaining 40% of Iran containing 75% of the population, there are few water quantity problems of consequence but salinity and pollution hazards are common. As regards insufficient quantity, this relates almost entirely to water for irrigation because centers of population are established originally only where there is sufficient water for domestic use. However, this situation may be altered if industrial or other requirements inadvertently become excessive. In many areas, particularly in the south and east, the water supply is slowly deteriorating in quality, i.e., become more saline. When this is the case, agriculture suffers first and most (i.e. is the least tolerant of salinity). Domestic use is the next most sensitive and livestock are least sensitive to salinity in water. Little can be done to improve quality of water for agriculture owing to the high cost involved, but deionization of saline supplies by exchange resins, or desalination by evaporation or other methods (all quite costly) are economical for household and for many industrial uses, and the Government is currently considering plans to establish a number of desalinization plants for southern coastal cities in particular.

68. Industrial demand has not yet become critical in the country as a whole though problems are appearing in some areas. Until future industrial plans are clear the situation will be difficult to assess. In some areas, however, conflicts between industry and other sectors are becoming evident. The situation in Esfahan (see details in Annex 12) is a case in point. The problem there is that present planning indicates clearly that water available for irrigation agriculture will have decreased by at least 28% in 1985 yet the irrigation requirements per unit area are being planned to increase (owing to changes in cropping patterns). Similarly total area under irrigation is planned to increase by 17 to 30%. Resolution of this planning conflict is being hampered by inadequate coordination between Government and other agencies now operating in the region.

Goals regarding Population to be served in Urban Areas

69. The Government's basic goal as stated in the Fifth Plan is
"to provide reliable water supply for an additional 8 million urban population, so that by the end of the Fifth Plan the entire 17 million urban population will have reliable water supply. By the end of the Fifth Plan, some 483 million m$^3$ of water a year will be supplied by urban water supply networks which will include water processing plants, pump stations, etc."

70. The means of achieving this goal include:

(i) prevention of wastage of water flowing into the seas, lakes, swamps and deserts by building suitable water installations;

(ii) utilization of frontier river waters, underground sources and the water rights of the country;

(iii) diversion of water from surplus areas to arid but fertile areas;

(iv) prevention of water salination;

(v) utilization of the latest scientific, technological advances in such fields as sea water desalination, cloud impregnation, sewage water recycling and water recovery from nature;

(vi) construction of modern irrigation and water supply networks where traditional methods fail to ensure efficient supply;

(vii) construction of proper drainage systems;

(viii) conducting research in hydrology, hydrography, irrigation, etc;

(ix) carrying out measures to protect water quality, preserve resources, and carry out water nationalization; and

(x) increasing water desalination capacity from present 3 million m$^3$ a year to about 16 million m$^3$/year.

71. With regard to institutions, financial and economic policies, the plan states that regional water boards will be responsible for handling water supply affairs of each region, including the cities, towns and villages in their area. In cities and towns, local water companies will be formed under the regional water board management for water supply and sewage systems. In the villages, the regional water board will train local personnel to operate under the supervision of the village council. 1/

1/ The government needs to revise these proposals along the lines suggested in paragraph 32 above.
(i) initial capital investment in the water and sewerage systems of cities and towns will be according to specific rules and out of development funds, provided that all income from the water supply is devoted to the system's maintenance and expansion;

(ii) in cities like Tehran facing water shortage, the price of water will be determined at a scale to encourage water saving. In places where the cost price of water is too high, the Government will subsidize it for social considerations; though in any case the rate will be fixed at a level which will ensure the income is sufficient for operation and maintenance of the supply system.

Investment and Allocations

72. Total allocations for the development of water resources will increase from 46.8 billion rials under the Fourth Plan (consisting of 45.3 billion rials out of the development budget and 1.5 billion rials out of the normal budget) to 110.7 billion rials under the Fifth Plan which is being revised. The table on page 32 shows development allocations and fixed investment for the development of water resources under the Fifth Plan.

Targets of Population served in Urban Areas by 1993

73. According to the information provided to the mission by PBO, the government is attempting to establish targets for population to be served in the major cities of Iran by the year 1993. These targets are established by starting from existing population and consumption requirements which reflect existing facilities and standards of living. With this information the PBO is able to estimate present per capita water consumption in these cities. In order to project to the year 1993, the PBO made estimates of population of major cities by that year and assumptions that standards of living in these cities will approximate those in cities of similar size in the advanced countries of Europe and America. It is then assumed that per capita consumption in the major Iranian cities by 1993 will approximate per capita consumption in these advanced cities of today. The results of PBO's per capita projections on the above assumptions are summarized in Annex 3.

74. The projections however have certain limitations. First population data and population projections at the level of individual towns and cities are open to questions as the last census was taken about eight years ago. Secondly, estimates of water consumption in major towns and cities are poor since measurement of existing water facilities and services at the national level are inadequate. Thirdly, the assumption that conditions in these Iranian cities in 1993 will approximate those in the advanced cities of similar size is open to questioning. However these projections are indicative of the government's expectations regarding the per capita consumption of these cities by the year 1993.
### Fifth Plan Allocation of Water Supply and Sewerage Expenditure (Billion Rls)

<table>
<thead>
<tr>
<th></th>
<th>Fixed Dev. Credits</th>
<th>Resources of Public Enterprises</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Urban Sector</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Supply</td>
<td>7.5</td>
<td>6.5</td>
<td>14.0</td>
</tr>
<tr>
<td>Sewerage</td>
<td>7.3</td>
<td>2.0</td>
<td>9.3</td>
</tr>
<tr>
<td>Total Credits</td>
<td>14.8</td>
<td>8.5</td>
<td>23.3</td>
</tr>
<tr>
<td>Total Urban Program</td>
<td>32.5</td>
<td>28.5</td>
<td>61.0</td>
</tr>
<tr>
<td>Water Sewerage as % of Urban Program</td>
<td>45.5</td>
<td>30.0</td>
<td>38.0</td>
</tr>
<tr>
<td><strong>II. Rural Sector</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Supply</td>
<td>18.0</td>
<td>1.3</td>
<td>19.3</td>
</tr>
<tr>
<td>Sanitation/1</td>
<td>1.0</td>
<td>0.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Total Rural Program</td>
<td>36.0</td>
<td>2.5</td>
<td>38.5</td>
</tr>
<tr>
<td>Water and Sanitation as % of Total Rural Program</td>
<td>53.0</td>
<td>56.0</td>
<td>53.0</td>
</tr>
<tr>
<td><strong>III. Fifth Plan Credits for Water Resources</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Supply</td>
<td>0.8</td>
<td>26.5</td>
<td>27.3</td>
</tr>
<tr>
<td>Urban Water Supply</td>
<td>-</td>
<td>14.6</td>
<td>14.6</td>
</tr>
<tr>
<td>Total Credits for Water Resources</td>
<td>2.7</td>
<td>106.0</td>
<td>110.7/2</td>
</tr>
<tr>
<td><strong>IV. Fixed Investment during Fifth Plan in Water Resource Development</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Supply</td>
<td>24.5</td>
<td>3.4</td>
<td>27.9</td>
</tr>
<tr>
<td>Urban Water Supply</td>
<td>14.6</td>
<td>-</td>
<td>14.6</td>
</tr>
<tr>
<td>Total Fixed Investment in Water Resource Development</td>
<td>109.0</td>
<td>4.0</td>
<td>113.0</td>
</tr>
</tbody>
</table>

/1 Public baths, mortuaries and slaughter houses.
/2 Includes 2.0 billion Rls, for Nonfixed Dev. Credits.

Source: Compiled from PBO's English version "Iran's 5th Plan '73-78" (June 1973). The 5th Plan is now being revised.
Goals regarding Rural Water Supply

75. Chapter XVI of the Fifth Plan on Rural Development, relates entirely to the establishment of Rural Development Centers (RDC's) and indicates that about half of the total allocation for RDC's is for "Drinking Water Supplies." Thus, it appears that only 1,180 RDC's and the approximately 12,000 villages regarded as their satellites have had funds budgeted for development of domestic water supplies, and no provision has been made for the remaining 50,000 or more villages. Furthermore, progress with the RDC's has been slow despite a determined effort by the Ministry of Cooperative and Rural Affairs.

Financial and Tariff Policy

76. The Government's policy regarding water supply and sewerage charges is indicated in the Water Nationalization Act 1968 (Article 53).

"The Ministry of Water and Power is empowered to establish the cost of water on an average per cubic meter basis, due consideration to be given to current expenses for water management, maintenance and operation of works, financial interest and amortization." (Annex 1)

77. Again in the Fifth National Plan it is stated that:

"the cost price of each cubic metric of water will be calculated on the basis of the current and amortized costs including interest on investment, with due regard for the investments made in the various water resources development projects, as well as the relative maintenance and operating costs. This will form the basis of a coordinated tariff policy for agricultural and industrial consumers, with due regard for social and economic factors, which will gradually be introduced on a regional basis."

78. In the Chapter on Greater Tehran, the Plan lists two important limitations on Tehran's supplies. "The first is that the utilization of distant water is inevitably more expensive. The second is that diverting such resources from regions that are situated some distance away from Tehran will put an end to agricultural and industrial activities and adversely affect life in those regions while at the same time aggravating the problem of migration to Tehran." In formulating a water supply policy for Tehran, particular attention will therefore be paid to the long-term effects and to the social and economic aspects of measures taken in this field.

79. The articles of Association of most urban water supply and sewerage authorities specifically require these authorities to operate as financially independent organizations. For example, Article 7 of the Northern Region Water Board's articles of Association states (Annex 17):

"The company has lawful character and financial independence and is running according to commercial principles." Similar requirements are stated in Article 2 of the TRWB's articles of Association (Annex 8) and Article 2 of KWPA's Charter (Annex 15).
80. It appears therefore that Water Authorities in Iran are legally required to conduct their operations in accordance with accepted financial and economic principles. In practice however, water charges throughout the country are rigid and generally low. As a result urban water agencies rely on substantial initial consumer contributions towards connections and Government subsidies to meet their operational and capital expansion needs. The experience of Tehran Regional Water Board (which is discussed extensively in Annex 8) illustrates the common financial problems facing urban water authorities throughout Iran. Briefly, these authorities do not have clearly stated financial strategy or objectives and no reliable financial data to enable a reasonable judgment to be made on the viability of their water supply operations (Esfahan City Authority is probably an exception in this regard).

81. The principal aims of water and sewerage charges are not met by most authorities in Iran. These functions include (a) to raise some target level of total revenue of the agency so that it can operate and maintain its system effectively as well as service its debts and maintain the degree of financial independence necessary for it to be an efficient organization; (b) to distribute the burden of water and sewerage charges equitably amongst users; (c) to ensure administrative simplicity and efficiency; and (d) to influence consumer behaviour.

82. With regard to the first of these functions most of the municipal agencies clearly admitted that they could not raise sufficient revenue to service their debts or maintain a reasonable degree of financial independence. Most of their debts are however owed to the PBO and these agencies simply do not repay the PBO's loans and in general the PBO does not put much pressure on them to repay. Their debts do not significantly affect their ability to raise further loans from the PBO or other Government Departments. The agencies therefore do not have much problem raising loans from the Government for capital expenditure once the project has been identified and prepared. Their greatest problem however relates to raising sufficient revenue from their charges to meet their operation and maintenance needs. This problem was emphasized by most agencies as being the single most important cause of the staff and manpower shortages since they cannot offer attractive employment conditions compared with the private sector.

83. The distribution of the burden of water charges between users in the same city, between the regions and between the urban and rural areas is hardly a factor in the fixing of water charges in Iran despite the reference made to this factor in the Fifth Plan (see para 57 above). Here again the experience in Tehran (as discussed in Annex 8) is quite common throughout the country. Briefly, the problems facing Iran are as follows:

(i) The poor residents in most cities rely on few public standpipes and other inadequate sources of supplies (springs, rivers, wells etc.) because of the high connection charges. However, most water agencies have no incentive to increase the number of standpipes because water from these standpipes is not adequately paid for.
(ii) As the water charges do not fully reflect financial and economic costs of providing them, most poor residents may suffer additional inequity when the cost of supplying these poor residents are low (see Annex 8 for the example of South Tehran).

(iii) The criteria for selecting water supply projects in the urban areas do not adequately reflect priorities in these areas. Political pressure from provincial governors, ability of municipal agencies to identify and prepare their own projects etc. are the strongest factors influencing the selection of urban projects. As a result, medium and small towns with no independent water agencies or influential governors tend to get less attention and to suffer most from the inadequacy of qualified staff and equipment to maintain their systems (see Chapter II para 35).

84. The fourth function of water charges - influencing consumer behavior - is similarly negated throughout Iran due to the common policy of granting generous discounts to large consumers including public and religious establishments. This policy applies equally in water scarce cities. This policy tends to encourage wastage of water in a country where water is one of its scarcest resources.

Government Subsidies for the Sector

85. Sector development planning in Iran needs to be accompanied with a thorough review of water and sewerage financial policies with a view to ensuring that water charges meet the basic aims stated above. The issues to consider in such a review include a continuation of subsidy for the sector. The Government policy tends to regard development projects in this sector as non-profit-making in the sense of the National Plan and Budget Act (see Annex 5) and therefore to be subsidized at least in part with public grants. The present increase in national revenue no doubt strengthens the case of subsidizing its infrastructure expansion throughout the country. This may well be the best outlet for employing such increases in revenues especially in the light of galloping worldwide inflation. However, the Government needs to ensure that its subsidy to the sector does not perpetuate financial indiscipline by the operating agencies. Even if the aim of raising revenues for meeting their debts with the Government is made unimportant because of increased revenues, there will still be a strong case for flexibility in water charges to cover full costs and ensure equitable distribution of water burden and conservation of one of the country's scarcest resources.

86. The Ministry of Power and Water (MPW) was reviewing its policies on the pricing of water throughout Iran with a view to using pricing as an instrument in achieving a more efficient utilization of the country's scarce water resources. To this end, the MPW asked the Industrial Management Institute in Tehran to undertake a study of the present situation (existing
laws and policies relating to water pricing in all sectors) and to make recommendations for future policy by the Government. The following suggestions made by a recent study by the Industrial Management Institute of Iran should be considered in a review of pricing policies. Water pricing could become a strong instrument for allocating scarce water resources amongst competing users. In determining water charges considerations of economic efficiency as well as other social factors (e.g. income distribution) could be taken into account. An upper limit water price should be the amount consumers are willing to pay for water use and the lower limit the water authority's short run marginal cost. Within these limits, price could vary according to type of user, type of use, cost of supplying that user, his geographic location and similar economic efficiency considerations. The water price structure which is so determined could be submitted to the government to set the final structure of tariffs taking non-economic considerations especially income distribution into account. However, any deficits in the operations of the water authority resulting from the later considerations could be made good from direct government subsidies or by charging higher prices to users who are willing and capable of bearing higher than average charges. Water charging however is only one (albeit an insignificant one) of the measures to achieve more equitable income distribution in a big country such as Iran. Though the government's statements on water tariffs (see paragraphs 57 iv(c) and 71 (ii)) are reasonable, in practice these policy statements are not adhered to. It is evident that the divergence between sector policy statements and actual practice is one of the factors adversely affecting sector development because it creates financial problems for the agencies.
87. Sector planning in Iran has proceeded separately for resource development and for urban and rural potable water supply and sewerage. Considerable progress has been achieved in the resource development planning largely due to the determined efforts of the Central Government and the existence of the Regional Water Boards or Regional Irrigation Departments of the former Ministry of Water and Power. In contrast, there has been much slower progress in planning urban and rural water supply and sewerage facilities. The principal factor accounting for this slow progress is the fragmentation of urban and rural water and sewerage responsibilities (Annexes 8-17 and Chapter II on organization and legal aspects).

Resource Development (Multipurpose Dams and Irrigation)

88. During the First Plan, about 1.85 billion rials was allocated for the development of water resources of which about 1.4 billion rials was used. Kohrang tunnel was built to diver water from one of the branches of the Karun river to the Zayandeh Rud which supplies the water requirement of the Esfahan Region. Construction of two diversion dams on Sistan rivers and irrigation network for four thousand hectares in Moghan Plain were carried out (see Map 2 and Annex 4).

89. For the Second Plan (1957-1961), the fund allocated for water resource development was increased more than ten times to 17.7 billion rials. During this plan a high priority was given to the construction of large scale multipurpose storage dams and the concept of regional development through construction of large water resources projects was the accepted strategy. Therefore, the construction of storage dams on Sefid Rud, Dez, Golpaykan, Karaj, and Latian Rivers started. Furthermore, studies of future water resource projects in many river basins began. Attention was also paid for the increased utilization of groundwater and about 0.8 billion rials was made available as long term credit through the Agricultural Credit Bank.

90. During the Third Plan (1961-1967), 21.7 billion rials was invested by the Government for the development of water resources. The construction of the five large storage dams started during the previous plans was completed. New construction of storage dams on Zayandeh Rud, Kor, Mahabad and Zarineh Rud, Aras and Gorgan Rivers started. The significant portion of the development budget, therefore, was used for the construction of dams. The Agricultural Credit Bank made available about 2.8 billion rials for the development of new wells, ghanats and their renovation.

91. For the Fourth Plan (1968-1972) which ended (March 1973) the original budget allocated for the water resources sector was 53.1 billion rials including 4.6 billion rials from the resources available from the Regional Water and Power Authorities. However, the actual investment during the Fourth Plan was
about 48 billion rials. Taking into consideration the performance during the 1957-67 plans and the fact that unbalanced priorities were given to the construction of large scale storage dams, the following two important policies were incorporated in the Fourth Plan:

(a) Priority to be given to the construction of irrigation networks as to obtain the maximum benefits from the storage dams already built.

(b) At the outset of the Third Plan, water was declared a national asset and was nationalized. The implementation of the law governing nationalization was to be undertaken during the Fourth Plan, though it was recognized that it would take many years for its full implementation.

92. In the original allocations for the Fifth Plan (1972-1977) total allocations for the development of water resources will increase to 110.7 billion rials. These allocations are now being revised upwards.

93. With regard to the past achievements of the water resources programs the following data may be of some interest. By the end of the Fourth Plan about 70% of urban-population was served 690 million cubic meters of water per year by public water supply systems. The amount of water supply for irrigation available by means of new public projects was about 10.8 billion cubic meters per year. The average annual surface run-off controlled by storage dams is around 16.4 billion cubic meters. In summary, the construction of large multipurpose water resources projects in Iran has provided firm water supply sources for several large cities, irrigation water for more than 600 thousand hectares of land and hydroelectric power for a significant portion of the total electricity needs.

Urban Water Supply

94. Regarding water supply for cities and industries in the current Five-Year Plan, a total of 14,800 million rials has been allocated to be invested by public sector. Of this, 7,500 million rials will be for water supply and 7,300 million rials for sewerage. Under this plan the total urban population of 17 million people will be served with water supply by the end of the Fifth Five-Year Plan. At present all cities have been provided with some degree of water supply facilities. The breakdown of the amount of water which will be supplied for domestic use and industry by provinces is as follows: (The figures of the Fourth Five-Year Plan are also included for comparison):
Water Supply for Domestic and Industrial Use by Public Sector
(In Million m³/year)

<table>
<thead>
<tr>
<th>Provinces</th>
<th>4th Plan</th>
<th>5th Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azerbaijan</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>W. Azerbaijan</td>
<td>-</td>
<td>19</td>
</tr>
<tr>
<td>Khuzestan</td>
<td>35</td>
<td>120</td>
</tr>
<tr>
<td>Fars</td>
<td>45</td>
<td>56</td>
</tr>
<tr>
<td>Bandar Abbas &amp; Kerman</td>
<td>4</td>
<td>39</td>
</tr>
<tr>
<td>Sistan</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Khorasan</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>Northern Province</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td>Tehran</td>
<td>306</td>
<td>498</td>
</tr>
<tr>
<td>Esfahan</td>
<td>210</td>
<td>213</td>
</tr>
<tr>
<td>Total</td>
<td>627</td>
<td>1,047</td>
</tr>
<tr>
<td>Urban areas</td>
<td>138</td>
<td>192</td>
</tr>
<tr>
<td>Desalination Water</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Grand Total</td>
<td>768</td>
<td>1,255 million/ m³/year</td>
</tr>
</tbody>
</table>

Sewerage

There is no specific target in the Plan for development of sewerage except a general guideline that all the cities and towns in Iran will be served with sewerage systems within the next 30 years. For Tehran Sewerage, there is no special allocation and funds have been included within the overall allocation for sewerage. There are plans underway to provide sewerage to Mashad, Rezaieh, Esfahan (extension), Kermanshah, Sanandaj and Rasht and also to other small towns, but no specific details are available at present. All these works will be executed by the Ministry of Housing and Development for small towns or cities and by the Regional Boards for larger communities. Technical assistance for design and planning of water supplies and sewerage and for training of specialized personnel for water works and sewerage will be sought from international agencies such as UNDP, IBRD and WHO.

Rural Water Supply

The following are the principal elements in planning rural water supply as identified by the Rural Water Supply Division of PBO, (The Ministry of Cooperative and Rural Affairs is the executing department (see Chapter II).

(a) Study of the water resources available in the village or environs (such as underground water, natural springs, "Channats", etc.).
(b) Study of the topography of the village to determine the type of the reservoir and the construction materials needed.

c) Determine the level of demand for water.

d) Collection of other relevant data and information needed for planning specific projects.

In the past for most rural development projects, the villagers or the Village Council submitted an application to the Government and guaranteed to pay their share. In the Fourth Development Plan, villagers, i.e., Village Councils paid as much as 20% of the total expenditure of the project and the rest i.e. 80% was paid by the Government before the plans and the actual project were prepared and executed. Village participation on such a scale, however, is being phased out in the Fifth Plan. Usually, each drinking water supply project consists of a well (or natural spring or Ghanat), a pump house, a motor pump, a water reservoir and public water taps installed at different points in the village. If the villagers wish to have water piped inside their houses, they can do so through the Village Council without material help from the Government.

97. In the first three years of the Fourth Development Plan, 7,332 different projects were completed in different villages of Iran, out of which 1,453 projects were for drinking water supply. The total budget allocated for rural water supply in the Fourth Development Plan was 3,344,000,000 Rials. At the end of the Fourth Plan about 2,156 water projects were executed or under construction. In 1972-73, there are 703 water supply projects under performance and in the same year, 154 water supply projects have been completed in addition to 197 projects carried over from the previous year. The total budget allocated for drinking water supply in 1972-73 for rural areas was 1 billion Rials. In the Fifth Development Plan, taking into consideration the fact that most villages in Iran are isolated and that many of them have less than 250 inhabitants, the strategy of rural development was changed. Villages having better and more suitable conditions are chosen as the "Center for the Rural Development Region". In such Centers, all services will be provided and these centers in turn will provide necessary services to related satellite villages. The satellite villages are divided into 2 different classes:

1. Villages with more than 250 inhabitants.
2. Villages with less than 250 inhabitants.

Water supply projects will be given to about 16,000 villages including only the "Service Centers" and the "satellite villages" with more than 250 inhabitants. For the villages with less than 250 inhabitants, only safe water will be provided. Some of these will be gradually eliminated and incorporated into the "Centers". In the Fifth Development Plan, a budget of 18 billion Rials was allocated to be spent gradually within five years, according to the projects and programs prepared.
CHAPTER VI

MANPOWER AND TRAINING

98. The prospects for further development of the Water Supply and Sewerage Sector in Iran will be constrained by various factors including availability of total water resources, manpower and financial resources, organizational and institutional arrangements. Of these, manpower is undoubtedly one of the most serious constraints. A realistic sector development program must therefore include an assessment of the present manpower situation in the sector, a forecast of the future manpower requirements and a program of training needed to meet these requirements.

Basis for the Assessment and Forecasts

99. An assessment and forecast of the number of personnel required to plan, design, construct, operate, control and maintain all the functions of the water supply and sewerage sector in Iran is given below separately for the periods up to 1984 and 1994. The assessment and forecasts are based on information about the present sector conditions, planned development projects and population projections obtained from visits to selected cities and regions. These data are supplemented by those obtained from Government sources and private consulting firms working in the sector.

100. The estimates of manpower required have been divided into the three broad groups, professional, technician and skilled labor. These have been further divided into a series of categories which become marginally more detailed as the technical level of the work decreases from that of the professional through the technician to that of the skilled laborer. The assumptions used in the forecasts and definitions of various manpower categories are discussed in detail in Annex VI. These forecasts are by necessity imprecise due to the inadequacy of existing data and the figures for 1994 are no better than guesstimates.

Summary of Forecasts

101. On the basis of these definitions and assumptions, a forecast of the manpower requirements was made (see tables in Annex 6 for details). These are summarized in the table below:
<table>
<thead>
<tr>
<th>Existing Category</th>
<th>Professional</th>
<th>Technician</th>
<th>Skilled Labor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water 1974</td>
<td>1,004</td>
<td>3,107</td>
<td>5,680</td>
<td>9,791</td>
</tr>
<tr>
<td>Sewage</td>
<td>42</td>
<td>55</td>
<td>166</td>
<td>263</td>
</tr>
<tr>
<td>Total</td>
<td>1,046</td>
<td>3,162</td>
<td>5,846</td>
<td>10,054</td>
</tr>
</tbody>
</table>

| By 1984          |              |            |               |       |
| Water            | 1,986        | 5,695      | 12,550        | 20,231|
| Sewage           | 677          | 1,074      | 4,172         | 5,923 |
| Total            | 2,663        | 6,769      | 16,722        | 26,154|

| By 1994          |              |            |               |       |
| Water            | 3,321        | 8,617      | 18,464        | 30,402|
| Sewage           | 1,473        | 2,847      | 7,523         | 11,843|
| Total            | 4,794        | 11,464     | 25,987        | 42,245|

Training - Existing Facilities

102. The problem in Iran, as in most other countries, is the absence of a central training organization. By the nature of their work, personnel in the water supply and sewerage sector are scattered. Most water units make use of whatever training is available and marginally applicable in schools and colleges or in large commercial firms and water authorities. Frequently experience is the substitute for training, and where organized programs exist they are often the work of a dedicated and enthusiastic individual. Iran, however, has several organizations presently operating in the sector with varying degrees of emphasis on training for the water industry. These organizations are described in Annexes 8-17.

103. An assessment of the existing manpower and training facilities leads to the following conclusions:

(i) There is a shortage of trained and experienced personnel at both professional and technician levels in work associated with water resources and supply.

(ii) Although there is less immediate demand for trained personnel for work connected with sewage disposal, nevertheless that demand will grow rapidly over the next ten years or so.
(iii) In the water industry in Iran there is little evidence of systematic managerial or supervisory training except for the individual programs of a select few who have been largely self-motivated rather than encouraged by their employers.

(iv) Technical training is presently largely a matter of sending personnel to foreign countries generally for long periods, or the Institute for Hydro-Sciences and Water Resources Technology in Tehran. Most of this training is restricted to the area of water resources, neglecting distribution and treatment. The expansion of sewage disposal schemes which seems imminent will reveal another important technical area on which to concentrate.

(v) There is virtually no organized training in the manual skills. The on-the-job training which is carried out by individual authorities is of varying success and less than high class practice may well be handed down with the inherent dilution of standards. It naturally follows that no national standards exist.

(vi) The general attitude towards training in the water industry varies widely among the water organizations in Iran. In general, there is a commitment to the need for training of personnel but the degree of the commitment varies considerably.

Training Proposals

104. On the basis of the above findings, the principal recommendation is that a central training organization for the water and sewerage industry should be set up as a matter of urgency with the aims of:

(i) promulgating the principles of systematic training throughout the industry;

(ii) providing national and regional residential training centres for all levels of staff; and

(iii) offering a training and manpower advisory and information service to all operational units.

105. In order to meet the aims of these principal recommendations, a series of supporting proposals is necessary. These are set out below indicating the major steps which might be followed. These steps might be modified once the training requirements have been surveyed more thoroughly and the program gets underway.
(i) Establish a central training organization under a full time professional Director of Training with experience of the industry. The organization should cover all aspects of water industry training required by all government or private agencies in the sector.

The Director's task is not just to master-mind the setting up of physical facilities, but to develop a technique and system of consultation with the industry and with other organizations, commercial and educational, to establish a steady flow of worthwhile recruits for whom training is guaranteed.

It is likely that assistance from overseas would be sought to help the Director to set up his organization.

(ii) Recruit a nucleus of about 15 technically well qualified young university graduates with six or seven years' experience of the industry, to be developed as the upper level of training staff of the organization. Most of this team will need to be basically civil engineers, but all of the major disciplines of the industry such as chemistry, mechanical engineering, electrical engineering, accountancy and law should be represented.

Although each man has his basic discipline, it should be the overall aim to make him as multi-purpose as possible. This affords flexibility in the advisory role of the training staff.

Assuming that the level of recruitment is sufficiently high, the members of this team would probably need a crash programme of technical training and experience lasting about three months in order to fill in the gaps in their previous experience. This would be followed by a period again of about three months in which the officer would receive a training in training, covering such topics as instructional techniques, job analysis, manpower planning, consultation, manual writing, and the development and measurement of training schemes and courses.

If recruitment were started in the very near future, this team could be ready to begin to make its impact by about mid-1975.

(iii) Establish residential training centres at least to meet the initial minimum demand (described in Annex VI) of 194 and 327 training places by 1984 and 1994 respectively.

(iv) Recruit a team of instructors technically skilled in their own fields to instruct between them technicians, supervisors and skilled labor in the training centres. Initially a total of 24 instructors will be needed if the minimum permanent training place target is to be met (on the assumption that
most courses have about ten persons under instruction). The training period for these instructors should last about three months during which time they should learn the skills of instruction, job analysis, lesson planning, and manual writing.

This team should be recruited and trained as far ahead of the establishment of training centres as possible in order to have the maximum time available for preparation before courses need to be operated. A target date could therefore well be mid-1975 for the completion of recruitment and training.

The Industrial Training Board of Iran and certain experienced overseas agencies should be able to afford considerable help in recruiting and training the instructor team.

(v) Before being able to mount a successful training programme, all of the staff described above will need to assist in carrying through an exhaustive series of seminars both in the new centres and in the operating units. These seminars will aim to explain the philosophy and benefits of organized training and so persuade managers and supervisors at all levels of the importance of being committed to the planned and systematic training of the staff for whom they are responsible.

Such seminars could therefore begin from about September 1975. These should produce for each operational unit of the industry a member of the training staff with whom they can identify, and who amongst his other duties will be the training advisor for that unit.

(vi) The higher the level of training course offered, the less the frequency that course will be needed. Therefore for a range of special technical and administrative courses and for the majority of management courses, it will be uneconomic for the training organization to retain its own specialist staff for instructing purposes. A select cadre of experts from the industry should be encouraged to commit a short period in every year to the training organization. Initially this period could total about three weeks. They would need the guidance of the new professional training staff in delivering their material.

This team will be augmented by people from outside the industry, particularly from such organizations as the Industrial Management Institute and from universities.

These part-time contributors to off-the-job training should be recruited from about early 1976.

(vii) There should be some coordination and review of the total number of Iranian trainees and students being trained for the
water industry in foreign countries. A national plan for the use of overseas facilities should be considered, and it may well be found that many of the extended courses could well be handled in shorter periods of intensive training within the new training centres. In the short-term this might well necessitate importing foreign technical help for periods of two or three weeks of concentrated instruction.

(viii) Review the content of education programmes to determine whether in such institutions as universities, agricultural schools and vocational training schools additions or amendments to the syllabi might well open up the water and sewage industry as an attractive career. Not only might future employees of the industry be better prepared for their training, but recruitment might also be stimulated.

(ix) Determine the cost of operating a national training programme 1/ for the industry, and the means of meeting this cost. It could well be that the Government might bear the initial capital cost of supplying facilities. In training situations such as the above in other countries a levy on the payroll of the industry is commonly made. An average operating cost is about 1.5% - 2% of the payroll of each unit within the industry.

Within Iran, the Industrial Training Board has some experience of operating costs of training centres, but of a non-residential kind.

(x) Explore the prospects for overseas assistance in training for the water and sewage industry and executing all aspects of the work needed to set up, staff and operate a training organization, (from recruiting and training staff through writing manuals and preparing teaching materials to monitoring the success of the training). Most of the foregoing proposals have been practiced to some extent in some countries especially USA, France, Germany, Holland and Britain. There is, for example, a national training organization specifically for the water sector in Britain.

The Suitability of Esfahan as a Training Centre for Wastewater Works Operatives

106. The Esfahan sewage system is of modern design and comprises a range of treatment processes including trickling filters and chlorination which the effluent utilized on site for agricultural purposes. The extensions are to incorporate activated sludge treatment. The works could therefore be used as a base for training operators for plants of this type built elsewhere. How-

---

1/ Annex 6 gives the cost estimates for the training program.
ever, with the limited need for sewer operators for the next five years, it would be desirable to postpone this training program until after all elements of the water training are taken care of.

107. Professional staff required for the design and construction of sewer system should be given the opportunity of training overseas or at least of visiting appropriate wastewater treatment works elsewhere. Even at the senior level however there would be advantage in acquiring familiarity with treatment under Iranian conditions at Esfahan.
CHAPTER VII
SUMMARY OF REGIONAL SITUATION AND PROJECTS

Introduction

112. Because Iran is a very large country with wide variations in climate and resource situations, each region faces different problems that require different types of programs. This chapter presents a summary of the regional analysis in Volume II of the report and outlines the existing development projects in the regions.

Tehran Region (from Annex 8)

113. In the Tehran region the problem is largely to provide adequate water supply and sewerage facilities to meet the demand of a rapidly expanding urban population and deteriorating waste disposal standards. The institutional structure to deal with the problem has been created - TRWB - but it is being constrained by organizational and financial problems.

114. To solve its water supply problem the TRWB's long term program consists of:

(a) Groundwater exploitation to meet demand in 1974-1980.

(b) Lar-multipurpose project which is expected to bring water to Tehran by 1981. The total cost of the project is estimated at 26,238 million Rls. ($387.3 million).

(c) Beyond 1984, TRWB plans to exploit other sources of supplies not yet identified. These will probably include Talegan river.

115. Consultants studying Tehran's sewerage and surface water drainage system have concluded that a sewerage and surface water drainage program is needed for the city of Tehran. They proposed two projects:

(a) Surface water drainage project to be constructed in two stages both estimated to cost 14,310 million Rls. ($211.2 million) with foreign exchange component estimated at $35.0 million.

(b) A sewerage project for Tehran was also proposed by the same Consultants to be constructed in three stages (1975-2000) at an estimated total cost of 46,300 million Rls. ($683.4 million) with a foreign exchange component estimated at $260.5 million. These two projects were prepared with UNDP assistance and WHO as executing agency.
Northern Region (see Vol. II Annex 17)

116. Though the Northern region has a favorable rainfall and climate it has some water supply problems. This is due to unfavorable distribution of rainfall over the year, high salinity of the Caspian Sea, which restricts the underground resources available to areas far from the sea and lastly the absence of conventional sewage. In the Mazandaran province fourteen cities have been designated as areas facing the most serious water supply problems in the region because they do not have good water facilities. The NRWPA for the first time in its history has assumed responsibility for supplying these cities and expects to gradually take over urban water supply in the region.

117. The NRWPA's development program should offer scope for participation by international institutions for the following reasons:

(i) It provides an excellent opportunity for organizational, manpower training, financial and other forms of technical assistance badly needed by Iran.

(ii) The NRWPA has itself expressed interest in assistance from international organization.

(iii) The program itself is certain to prove of high technical interest to foreign lenders.

(iv) The preparation of the program is already advanced and should be ready for appraisal by the lending institutions.

118. The NRWPA's programs are in the two provinces of Gilan and Mazandaran. The Gilan sub-project to provide water supply for the provincial capital city of Rasht and Pahlavi was prepared by Kuros Consulting Engineers to meet the needs of the two cities up to 1992. This subproject is proposed in two stages - the first stage (1974-80) is estimated to cost 309 million Rls. ($4.56 million) and the second stage (1980-1995) is estimated to cost 920 million Rls. ($13.58 million). Other investments (e.g. in distribution system) were suggested bringing total cost of the Gilan subproject at 2,571.8 million Rls. ($38 million).

119. The Mazandaran subproject for fourteen cities was prepared by a consortium of consulting engineers in Iran and proposed to cover two groups of towns. The first group consist of six cities with the greatest priority needs. Total program cost (in two stages) for the first group is estimated at 867.0 million Rls. and the estimate for the second group is 748.1 million Rls.

Azarbaijan (see Annex II)

120. Though this region has plentiful underground water, abundant rainfall, snow rivers and lakes, it faces some water supply problems. First it has an unfavorable distribution of precipitation, threats of flooding during heavy rains, in summer most of its rivers are dry and lastly the high salinity
of its waters. As a result of these problems the region's development programs focus on the control of its rivers and the supply of Tabriz city with water from less saline but more distant sources because the city lies on an aquifer which makes well drilling difficult. The ARWB had undertaken several big dams mostly in conjunction with the Soviet Union.

121. The project that is likely to be of greatest interest to foreign lenders is that designed to supply the long term needs of Tabriz. This project was prepared by Kuros Consulting Engineers and has been approved by both municipal and central authorities. The first stage is estimated to cost $14 million and will result in 85% of the city's population being served by 1980. The second program will meet the city's needs in 25 years and is expected to cost about $42 million. The Tabriz project should appeal to foreign lenders for the same reasons as stated above for ERMFA. In addition the city of Tabriz Authority appears to be fairly efficient and well organized and could be a model for the country.

Esfahan

122. The problems in this region include the high dependence on groundwater resources, and the competition between agriculture and other water uses. Around the city of Tabriz the poor geological structure of the soil makes sewage disposal a serious problem. Most of the cesspits in the city used to fill up rapidly and they had to be emptied very regularly with buckets. For this reason Esfahan was the first city in the country to install a modern sewerage system.

123. The ERWB has a program of developing its main river sources by constructing multipurpose dams and irrigation networks. The Esfahan city water supply Authority itself has its own development program consisting largely of expanding the city's sewerage system. The extension is being proposed in two stages. The design of the first is nearly completed and expected to cost $17.7 million. Construction is scheduled to start in 1975 and be completed by 1980. The second stage of the extension is estimated to cost $14.8 million.

124. This project is of much interest in view of its being the biggest sewerage system in the country and a potential training place for staff in this field. As other regions, the ERWB could benefit from technical assistance in manpower training, organizational and financial management.

Fars

125. This region derives an estimated 75% of its groundwater from wells and ghanats. The groundwater level is believed to be declining in some areas especially the Northern part of the province where licenses for digging more private wells are no longer being issued. Salinity problem have limited the use of major rivers and underground water (e.g. Shiraz). As a result more distant sources of supplying the expanding needs of Shiraz has to be explored. Urban water supply to other major towns such as Bushier, Kazerun and Boraygan has become a serious problem because of the expanding population and industrial
needs. The FRWB has decided to take over responsibility for these towns. Rural water supply presents the most serious problem in the region but its solution is hampered by the fact that villages are scattered so widely that few people use existing facilities. Furthermore these schemes are expensive because the rural wells have to be drilled to greater depths due to the declining groundwater table.

Thus the principal projects by FRWB aim at exploiting sources further away from Shiraz and supplying other urban and rural areas. The Dariosh dam meets the first aim. The current development program prepared by Tehran Boston Consulting Engineers aims at supplying from existing Dariosh dam the growing demand in the city of Shiraz, industry (fertilizer plant near Shiraz) and the needs of a nearby air force base. The project designed in two phases is estimated to cost 4,194 million Rls. ($32.4 million). The project may be premature if current underground water investigations uncover sufficient and cheaper groundwater sources for Shiraz.

Shiraz will soon need sewerage facilities. At present the city's water supply system is operated by a private foundation and tied to a local hospital by the same founder. There is a need for the government to fully assess the adequacy of this organization in meeting the expanding needs of the city for both water supply and waste disposal and decide on the future organizational arrangement for the city's needs. The FRWB is inclined to take over responsibility for the city but is legally powerless to do so because the organization is a private foundation.

The expanding industrial and military needs of Bushier has resulted in rapid increase in the town's population. Development of water supply for the city is constrained by its long distance from the sources of supply and salinity problems. Future projects therefore include construction of desalination plant. The feasibility has been investigated but detailed design is still to be made. This project is to be supplemented by the drilling of more deep wells and extension of the distribution network.

KHORASAN (Annex 14)

The principal problem in Khorasan is the declining groundwater table in a region with heavy reliance on groundwater sources for both irrigation and supplying the growing needs of Mashad city. The rate of extraction from groundwater is believed to have reached its limit. The city of Mashad accounts for 60% of the provincial population and is the country's leading religious city. As such it attracts considerable number of pilgrims every year and the resulting upsurge in the city's population during these times of the year creates a problem of designing facilities that may be under-utilized during some times of the year. The diversion of water from agriculture to urban needs will increase in the future and though this is not serious at present, continued diversion may jeopardize agriculture on which the region's economy depends.

The Water Authority of Mashad appears to be very well managed but constrained by the same factors as in other municipal authorities - low and rigid water charges. The authority's current development program to meet the
immediate needs of the city aims at expanding existing underground sources, storage and distribution system. This program is estimated to cost about 600 mil. Rls. ($8.9 mil.).

131. A development program to meet Mashad's long term needs was prepared by the French consulting firm SCETIRAN which proposed three subprojects with total estimated cost of 1,625 million Rls. ($24 million). The first sub-project should be operational between 1975-1979, the second by 1979-1981 and the third by 1981-1992 (See Annex 14, p. 8). A sewerage project has also been proposed for the city of Mashad and estimated to cost 2.5 billion Rls. ($37 million).

132. A Regional Water Board should be set up in place of the present Irrigation Department. Also a water resources master plan is recommended as a basis for future planning in the region. Such a master plan should incorporate existing resource studies undertaken by SCETIRAN. The need for sewerage in Mashad also has yet to be established. The rural areas in this region probably face more serious problems than in urban centers.

KHUZESTAN (Annex 15)

133. One of the World Bank's major involvements in this sector outside Tehran includes the establishment of the KWPA through the participation in the Dez dam project. KWPA has since remained a model institution in Iran. The success of KWPA is yet to be repeated in other regions. The principal problems in Khuzestan includes pollution of rivers and salinity. One of the principal aims of KWPA is to launch a project in the Abadan area for increasing the river flow and reduce pollution and salinity.

134. A development program for the capital city of Ahwaz (whose population has been growing rapidly), was prepared for Ahwaz City Water Authority by Kuros Consulting Engineers. It is aimed at expanding the capacity of the existing system. The extension of the system is estimated to cost 1,260 million Rls. ($18.6 million). A sewerage plant is being planned for the city. A public sewage collection system exists for Abadan.

135. A development program for supplying water to the Ahwaz Khormanshor and Abadan area has been prepared by Tehran Boston Consultants who estimated the cost of such a program at 8,817 mil. Rls. ($132 million).

KERMAN

136. This desert region relies heavily on groundwater (90% from wells and ghanats). Most other sources (mainly flood rivers) are dry for most of the year due to high rate of evaporation and low precipitation. There are no dams in the region. The high rate of abstraction from groundwater in the Kerman city area is believed to have resulted in rapidly falling groundwater level.

137. The development program for the region therefore focuses on improving the city's existing facilities, controlling the water in the flood rivers and exploiting groundwater further afield from Kerman city. The program
prepared by Pars Consultants is estimated to cost about 820 million Rls. ($12 million) for the water supply and 1,530 million Rls. ($22.6 million) for the provision of sewerage facilities for the city of Kerman.

OTHER PROJECTS

138. There are additional projects in both the major urban centers and smaller towns that are justified and should be developed as soon as possible. These are summarized in Annex 5 of Vol. II.

ROLE OF EXTERNAL AGENCIES

139. The Iranian officials expressed interest in widening external assistance in the sector such as that provided by the international organizations in the Tehran Region. Furthermore, such assistance, it was suggested, should emphasize institutional improvements, manpower planning, the design and implementation of a development strategy for the sector and other technical assistance. This could be the basis for participation by these organizations in the funding of some of the major projects in the sector outlined above. This role is in line with the areas of concentration agreed in recent discussions between the World Bank and Iran. The UNDP will soon start a project to assist the Ministry of Water and Power to strengthen its manpower and technical capability. Three of the eight staff for the project have already started work.

140. On February 20, 1974, the Government submitted a request to the UNDP for US$15,000 in assistance for a study to "assess the manpower needs for water and sewerage works in urban areas, design a training program and assess the resources required for such a program to meet the qualitative as well as quantitative needs for technical personnel, particularly technicians". This request has been approved by the UNDP which has indicated its intention to engage a consultant for about six months to undertake such a study. A total of $180,000 has been allocated to this program. The possibility of including this as part of or wider technical assistance program to loan is being studied.