THE DEZ MULTI-PURPOSE DAM SCHEME, KHUZESTAN

A SOCIO-ECONOMIC ANALYSIS

by

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## NOTES

1. The Iranian Solar Year starts at the beginning of Spring and can be converted to the Gregorian year by adding 621 to it. Thus, the Iranian year 1355 approximately corresponds to 1976. In most cases the nearest Gregorian year to the Iranian year is used here unless otherwise stated.

2. The unit of currency of Iran is the rial. In March 1977 the official exchange rate was 67.75 rials per U.S. dollar and 120.75 rials per pound sterling. For financial matters, however, a variety of currencies are used. Standardization over a long period of time is virtually impossible in a situation of inflation and rapidly changing exchange rates.

## ABSTRACT

Iran is an arid country, surplus water existing only in small areas in the northern and western parts. Much of the cultivated and potentially arable land of Iran is a considerable distance from the zones of high precipitation. For successful crop production in such areas water has to be transported from regions with excess water. In many cases this can be achieved by tapping rivers which rise in the uplands, or ground water reserves which are replenished in zones of abundant water supply. To overcome the problems associated with water supply, Iran has started one of the most significant developments within the field of water resource management, through the construction of a number of large reservoir dams. This has taken place over the last three decades. Multi-purpose dam construction schemes constitute part of the overall five national development plans of Iran which have been carried out since the Second World War. The early development plans placed emphasis on the provision of water for agricultural use. At a later stage more attention was paid to the provision of water supplies to meet the rapidly increasing demands of water for industrial and domestic use. So far the Mohamad Reza Shah Pahlavi Dam in Khuzestan has been the largest and the most expensive dam Iran has yet commissioned. The Mohamad Reza Shah Pahlavi Dam is part of the integrated regional development plan of Khuzestan which has always been given the highest priority. The master-plan for the Khuzestan region was drawn up by the Development and Resources Corporation of New York in 1959. The plan has aimed at the maximum utilization of the land and water resources of the

five major rivers of the region. The Mohamad Reza Shah Pahlavi Dam has been in operation since 1963. The objectives of the scheme are: the utilization of water from the reservoir to irrigate 124,000 ha of the Khuzestan lowlands. In addition 520,000 Kw of electricity will be produced to meet the industrial and domestic electricity demands of the region. The achievement of these objectives will improve the economic and social status of the local population, who until recently were poor and their standards of living low. The objective of this study is a full appraisal of the Dez scheme, and the establishment of a proper basis for development project evaluation. With the construction of the dam, a new cropping pattern for the area was prepared, providing a diversification of crop types together with changes in the areas of crops already cultivated. Improvement of agricultural methods raised crop yields by large amounts in the Dez Pilot Agricultural Project which constituted 16% of the Dez Irrigation Project. The implementation of the Khuzestan lowlands project was not, however, without its problems. After the supply of regulated water, there was not the necessary incentive for the peasant farmers to use water resources more efficiently and to raise agricultural production under the old system of landlord-peasant share cropping. As a result land reform was carried out in the Dez Irrigation Project area in 1962. By 1965 the Khuzestan Water and Power Authority, which had been established in 1960 to control and distribute the water and power from the dam, found it difficult to develop the DIP. This was because the bulk of the development budget had already been spent for the construction of the dam and its associated hydro-power installations. In addition landlords refused to co-operate in the development programme and the small farmers were incapable of large financial undertakings. The costly water from the dam was used inefficiently by the farmers and they were not able to pay water charges. In order to use water resources more efficiently and to increase agricultural production in order to become largely independent of food imports, a new phase in agrarian reform was introduced in 1968. On the lands downstream of large dams irrational fragmentation of land was prevented through the consolidation of land. As a result agro-business farms and farm corporations are being set up as alternatives to small family farms. Agro-businesses are large mechanized farms run on a commercial basis and capitalized by foreign equity participation. So far five of these companies have been established on 68,000 ha of the Dez Irrigation Project land which were bought from the farmers and leased to companies for a long term of 30 years. In addition four farm corporations were established on a further 12,500 ha of the land of the Dez Irrigation Project. In the long run farm corporations which are backed by free grants from the government will eventually achieve high yields as an inevitable consequence of large scale capitalist farming. Against this advantage stands the disadvantage of the rural unemployment as an unavoidable result of mechanized farming. The performance of agro-businesses has been somewhat unsuccessful. Their cost, which is imposed on the government, is high and their social impacts have been devastating. As a result a number of them have been taken over by the government and the future of the rest is a controversial topic. The only successful project of the Dez scheme is the government sugar cane project of Haft-Tappeh. Although the project is costly, its great advantage is the creation of jobs for thousands of skilled and unskilled local people.

The hydro-power project of the Dez dam scheme has been in operation since 1963 and all the generators were installed by 1971. The social impacts of the project have been considerable. However, the high electricity tariff has discouraged the development programmes to a higher extent than was initially expected. As a result of the lack of an electricity market in Khuzestan, electricity has been transferred to Tehran at a low price. Consequently the hydro-power project has been a losing proposition so far.

A consistent objective evaluation of the Dez scheme through the application of a cost-benefit analysis technique established a proper basis for the appraisal of government investment in the supply of infrastructure for the regional development. This made it possible to determine the objective priorities and to consider alternatives for resource allocation in regional development planning. The water pricing mechanism has been used as one of the most important and immediate means for the modification of the political framework of water resource management in the Dez Irrigation Project. It is very likely that the new price of water will encourage efficiency in water use in the Dez Irrigation Project. The model outlined in this study for water pricing can be tested and applied for other irrigation schemes, yet its application is conditional to reliable statistics and data availability.

Today after almost two decades of operation ot the Mohamad Reza Shah Pahlavi Dam it is well recognised that the operation of the dam has not had the expected beneficial effect on the local agricultural economy. The reasons for this are varied and include environmental, economic and social factors. These factors are defined in an analytical way in this study.

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# SECTION ONE

## INTRODUCTION

# CHAPTER 1

## THE IMPORTANCE OF WATER AND ITS ROLE IN DEVELOPMENT

### 1-1 Water Balance of the World

It is often said that water is the life-blood of our planet. The earth is distinguished from other worlds by the name "The water planet".[1] It is estimated that there are $1.25 \times 10^9$ $Km^3$ of water on the earth, but of this vast total, 97 per cent is in the oceans. Of the remaining $37.5 \times 10^6$ $Km^3$ of fresh water, about 87 per cent is locked up, occurring as ice in the polar regions and in glaciers. All but 10 per cent of this ice is in Antarctica. This leaves about $4.8 \times 10^6$ $Km^3$ of liquid water. Of this quantity about 90 per cent is stored beneath the surface of the earth as ground water. There is still left a very small fraction of the total, about one hundredth of 1 per cent, but it is this water which makes life possible.[2] It is the water which is found in streams, rivers, lakes and the atmosphere.

The small quantity of water, upon which life depends is always moving. The constant change in the location of water is governed by well-recognized natural laws that constitute what is known as the "hydrological cycle".

### 1-2 The Story of Water as the Story of Life

Water is life to man. A man can go usually two months without food, but he can live only three to four days without water. The average human body contains 12 gallons of water weighing about 120 pounds or two thirds of the average weight.[3]

Through the ages, men have tended to build settlements where water was abundant. The history of the use of water by man is recorded in the pottery and implements, found at archaeological sites. Prehistoric man drank directly from streams, springs or ponds. In earliest times communities tended to settle with better watered regions, that is areas of highest or most reliable rainfall, or along the main rivers.[4]

Prior to the urban revolution, the fate of agricultural man was profoundly shaped by what may be called the "hydraulic revolution". The majority of all human beings lived within the orbit of hydraulic civilization[5] in certain parts of the world.

There is evidence that irrigation was practiced from prehistoric times.[6] Man's need to improve the natural resources of water developed first in the warmer latitudes, where evaporation exceeds rainfall for several months of every year.

Egypt claims to have had the world's oldest dam, built some 5,000 years ago to store water for irrigation and drinking. The people of India, Assyria, Babylonia, Israel, Greece, Rome and China enjoyed the benefits of well-designed water supply and drainage systems many centuries ago.[7] In Iran the extraction of water from the foothills by means of underground horizontal canals, known as "Qanat" is well known.[8] The habits of men and the forms of their social organization have been greatly influenced by their close association with water and the need to establish ways of using this water. Ownership of water long outdated ownership of land in the arid lands of antiquity.[9] Property rights were associated primarily with the use of water, first for drinking, and then for irrigation.[10] Mohammad saw water as an object of religious charity as he declared that free access to water is the right of every moslem community and that no moslem should want for it.[11]

The precept of the Holy Koran "no-one can refuse surplus water without sinning against Allah and against man" , also "inform them that the water is to be shared between them"[12], was the cornerstone of a whole body of social traditions and of regulations governing the ownership, use, and protection of water supplies. Natural waterways, oceans and lakes, have greatly facilitated the world wide spread of population and of commerce. Inland transportation, since early times, has been facilitated by canals, first for irrigation and later for transport as among the early Assyrians, Egyptians and Chinese.[13]

The industrial revolution of Europe ushered in a new era of invention, discovery, mechanization and improved communications. There followed a more rapid redistribution of population from rural areas to cities, and from country to country and consequently a sharper realization of differences in living standards. This, with the growth of population, compounded by the great increase in the consumption of water per head by a modern technological society. has caused a vast increase in the rate of water resources development.

Large man-made lakes formed behind dams are one of the great enterprises of man. Dams in Africa, the U.S.A., the U.S.S.R., Australia and India reflect by a series of engineering achievements, the increasing demand for two of the basic requirements of modern man: water and electric power. Major increases in irrigated land are also possible by the construction of these dams. which supply water to areas suitable for crop cultivation. These impressive developments, such as the Aswan High Dam or the Hoover Dam, emphasise the scale of the needs facing mankind with regard to water resource provision.

## 1-3 Trends in Water Utilization and the Problems of Water Resource Development

### 1-3-a Irrigation

A number of developments since 1940 have made man realize that he must take immediate steps to increase the conservation, improve the utilization and expand the administration of water resources. The most significant of these developments is the rapid increase in world population, shifts in industrial location and the growing pollution of streams and lakes in many parts of the world.

The application of advanced scientific and medical knowledge and technology, as well as international aid to all developing countries has meant that the death rate has been halved in many parts of the world. As a result population rates now range from 20 to 35 per thousand per annum in certain countries such as middle America (mainland), Polynesia and Micronesia and tropical South America,[14] (1965-73). As a result the total population of the world will double in 18 to 35 years. The general estimation of the average rate of population increase is 21 per thousand per annum, thus producing a doubling in 33 years. The U.N. Food and Agricultural Organization estimated the world population at 2,142 million in 1937, 2,407 million in 1950, and 2,800 million in 1966.[15] In 1973 it reached 3,500 million[16] and in 1976 it passed

4,000 million. It may well reach 6,700 million by the year 2000 and 13,000 million by 2033.[17]

The increasing demand for agricultural production has resulted in large increases in the area under irrigation and the rapid introduction of supplemental irrigation in the countries of both the developed and the developing world. This has produced a much greater consumption of water for agricultural purposes.

The area under irrigation in the world was estimated at 8 million ha in 1800 and 40 million ha in 1900.[18]

In 1949 probably over 83 million ha were irrigated throughout the world.[19] By the early 1960s this area was thought to have increased to 162 million hectares which is almost 12% of the cultivated land of the world.[20] By 1970 it was estimated that the twenty-four leading countries for irrigation possessed about 183.3 million ha out of a world total of 196 million hectares. It is estimated that 80% of all irrigable lands are in non-Soviet Asia, about 7.5% in the U.S.A. and 5% in the U.S.S.R.[21]

By far the leading country for irrigation is the Chinese People's Republic, where large river control schemes have been and still are being undertaken. In China 70% (77.5 million ha) of her 110.8 million cultivated hectares, were irrigated in the early 1960s. At this time it was announced that a new programme would be launched to bring 80% of the farmland under irrigation.[22]

The Indian Sub-continent contained 24.16 million ha irrigated land in 1959. This had increased to 41.66 million ha in 1969. The long-term objective of Indian planners is to bring about 75 million ha under irrigation which is 44% of the total gross cropland area of 130 million ha.[23]

In the U.S., the third leading country for irrigation, the irrigation projects are mostly situated in the seventeen western states, the chief being California with about 3.13 million ha.[24] In 1939 when about 7.5 million ha were irrigated, the water abstraction was about 77,710.5 million $m^3$ of which 83% came from surface streams. In 1959 the 14.2 million ha irrigated area used 127,050 million $m^3$ of water of which only about 56% was derived from surface flow. In 1965 to irrigate 18.33 million ha, 419.57 million $m^3$/d were abstracted.[25]

The great modern interbasin water exchanges which have been planned, especially on the Columbia and in California, have resulted in a wider and greater use of river water. The planned irrigation water supply for 1980, 2000 and 2020 A.D. are (145,852 mgd) 552,050 mld, (149,824 mgd) 567,084 mld and (160,978 mgd) 609,302 mld respectively. The upper limit of irrigated lands in the U.S. is estimated to be about 29 - 31 million ha of which approximately 21 million ha will be under cultivation by the turn of the century.

The amount of irrigation in southern Europe is relatively small, about 10% of the cultivated land. Statistics of irrigable land and available water development potential indicate that 24% of the farmlands could be brought under irrigation. In the

Mediterranean countries of Europe the importance of irrigation is small for winter crops and large for spring crops. Italy, France and Spain are placed amongst the top twenty-four countries in terms of their areas of irrigated lands. In Italy, the irrigated area was 2.87 million ha in the early 1960s and it was estimated to have increased to 3.2 million ha in the early 1970s. The corresponding figures for France have been estimated at 2.58 million ha and 3.1 million ha respectively.[26]

In northern Europe further expansion of irrigation will not be so great as in southern Europe, mainly because irrigation is less important. Irrigation in the northern regions is a safeguard against crop damage during occasional dry periods. A good example of this is the summer of 1976 in England and Wales. Water abstraction for agricultural purposes often forms only a small fraction of the total in some of these countries. For instance the Water Resources Board has reported that from a total of 37,918,000 $m^3$/d of water abstracted in England and Wales, agricultural use was only 113,000 $m^3$/d or 0.29% of the total in 1967.[27]

The U.S.S.R. is the fourth country in terms of the area of irrigated land. Here large developments have progressed in the last thirty-five years, particularly in Soviet Central Asia, the Ukraine and in the Caspian trans-volga areas.[28] By the construction of a number of dam schemes and irrigation projects on the Amu daria, Syr-daria, Dneper, Volga and the development of the Don River, a total area of over 2.1 million hectares are to be irrigated. It is said that in the Soviet Union the areas suitable for irrigation and which possess adequate water resources cover more than 30 million ha. With water diverted from the northern and Siberian rivers this figure may reach about 80 million ha.[29]

Amongst the twenty-four countries with large irrigated areas many with less than 8.3 million hectares under irrigation have made considerable extensions to these areas since 1950. These include a number of Middle East countries, some of the southern and south-east Asian countries. To these the arid countries of South America such as Argentina, Peru and Chile and also Mexico in Central America must be added. In addition to these Japan and Australia which are considered as developed countries fall into the category of the twenty-four leading countries for irrigation.

In the Middle East, perennial water resources have played a crucial role in the siting of settlements and the growth of economic activities. In the past, water resources development has tended to take place at a local level, with the aim of supplying immediate agricultural and domestic needs from either surface or ground water resources. With increasing population and in particular the rapid growth of large cities, local water resources have often been totally inadequate to supply the new demand. As a result, individual cities have had to resort to the implementation of a number of large water resource projects. Among all the major water resource projects currently under construction or being planned, nothing comparable in size to the Aswan High Dam is being contemplated. Finance for the Aswan High Dam, which represents the biggest dam project in the Middle East, was arranged between Egypt and the U.S.S.R. in the late 1950s and the project was officially inaugurated by President Nasser in 1960.[30] The High Dam provides a controlled mean annual discharge of 84,000 million $m^3$ downstream from Aswan, which is considered to represent the mean flow of the Nile over a 60 year period.[31] Water stored in the reservoir will enable an expansion of the cultivated area by 1.3 million feddans (546,000 ha) and a conversion of 700,000 feddans (294,000 ha) from basin to perennial irrigation.[32]

1-1-b Domestic and Industrial Uses of Water

The consumption of water both for domestic and industrial purposes increases as living standards improve. As a result in countries that are both highly populated and heavily industrialized, a shortage of water and serious pollution problems are to be expected in the near future. Already parts of the U.S. and western Europe face severe water problems.[33] In the developing world the growth of the large cities has imposed a tremendous burden on the water supply facilities of the urban centres for domestic and industrial use. In the past, drinking water has been obtained from local resources such as wells and streams. The increase in population numbers of the last thirty years or so has meant that such supplies have now become totally inadequate and the water catchment regions have had to be continuously enlarged in an attempt to cope with water demands especially in the arid regions. Even with these tremendous efforts, it is true to say that almost every large city in the arid zone has water supply problems and that these are likely to increase before the end of the century.

In the Middle East, Tehran the capital of Iran, has experienced growing problems with both domestic water supply and sewage disposal.[34] Full details on Tehran's water supply projects and the associated problems are discussed in Chapter 3. Istanbul is another large city in the Middle East which has envisaged similar problems such as those of Tehran in both water supply and sewage disposal.[35]

In the developed countries such as in western Europe domestic use of water varies at present between 116 l/c/d for Brussels and 273 l/c/d for Munich.[36] In England and Wales per capita water consumption, which was 100 litres per person in 1900 increased to 290 litres per person in 1971. Official forecasts have estimated a figure of 425-490 l/c/d for 2001 A.D.[37] Domestic water use in industrial towns has tended to be higher than that in non-industrial areas. In 1962 the total average per capita consumption of water for industrial towns in the British Isles was of the order of 171 to 208 litres per day.[38] The corresponding figure for non-industrial towns was of the order of 130 to 170 litres per day. Over a five year period the increase in per capita consumption of water in industrial towns was of the order of 33.6% and 63.5%.[39] There are in the U.S. about 150 cities with a population of over 100,000. The total urban population (in communities of over 2,500) is about 170 million.

In the U.S.A. the demand of cities for water has grown much more rapidly than their growth of population, because cities use water in ever more lavish ways and also for the creation of new industries. The demand of American and Canadian cities for water has risen steadily, from about 68 to 75 litres per person per day in 1790 to about 620 litres in 1972.[40] A fair estimate is that American cities now abstract 300 times as much water from surface and underground sources as the whole nation needed in 1790.

Domestic use of water in the U.S.A. has doubled over 20 years in the East Bay Municipality Utility District of California from 364 l/c/d in 1940 to over 728 l/c/d in 1960. At the national level per capita water consumption which was 327 l/d in 1962 increased to 714 l/d in 1965.[41] Official forecasts predict a water use of 741 litres per day by 1980, 764 litres per day by 2000 and 773 litres per day by 2020 A.D., whereas Pereira (1972) quoted a figure of 1000 litres for 2000 A.D.[42]

As has happened in the past, the course of development will be dictated by the amount of water available. An important change is developing in the pattern of demand, as industry calls for an ever-increasing proportion. In 1965 the total abstracted water in the U.S. was 1,227,420 million litres per day (mld) of which 48.54% was used for industry and 41.75% for agricultural purposes. In 2000 A.D. the industrial demand is expected to be 74.29% of the total supply of 3,657,712 mld whereas the use of water for agricultural purposes will be only 19.4% of the total supply[43]. In England and Wales the use of water for agricultural purposes is small compared with the domestic and industrial water uses. By 30th September 1970 the Water Resources Board reported that out of the total abstracted water of 16,823,000 $m^3/d$, 69.17% was for industry, 30.2% for public use and only 0.61% for agricultural purposes.[44] The corresponding figures for 1971 were 65.8%, 33.6% and 0.6%[45] respectively.

1-1-c <u>Water Pollution and Water-born Diseases</u>

Priorities for the most developed countries of Europe, North America, Japan and elsewhere are to develop supplies of fresh water and to reduce the pollution of existing resources. As cities have grown, it has proved easier to supplement water supplies by piping water from a greater distance, than to solve the disposal problem for urban sewage and industrial effluent. Major rivers have thus been degraded to open sewers, even though they flow through the centres of wealthy cities. Examples of this include the Hudson through New York, the Thames through London, the Seine through Paris and the Rhine through Cologne and the Netherlands.

In 1972 a government survey of all the rivers of England and Wales showed that 3.7% of the total non-tidal river lengths and

13.3% of the tidal river lengths were grossly polluted. The corresponding figures for rivers which needed action for improvement were 4.2% and 19.2% respectively.[46] Today about 180 mgd (860 mld) of sewage effluent and about 42 mgd (200 mld) of treated effluent are discharged into the non-tidal Thames.[47]

Disposal of sewage is a problem that has confronted mankind ever since people started to concentrate in towns and cities. In western nations the problem of sewage disposal in large cities became acute during the 1900's. In England and Wales a Royal Commission was appointed in 1898 to enquire into the methods of treating and disposing of sewage and liquids from factories and manufacturing processes.[48] By 1972 from 4,371 sewage effluent discharges to rivers and canals, 67% were considered to be satisfactory by the quality standards of the water authorities. Out of the total 4,371 sewage effluent outlets, 3,385 were considered as discharges of industrial effluent and cooling water.[49]

However, with increasing population it became apparent that rivers could no longer cope with the quantities of sewage supplied to them. As a result some rivers have become highly contaminated, and ocean beaches have become lined with sewage where currents failed to carry sewer discharges off-shore.[50] Some of the lakes such as Lake Erie are so polluted that many of their edible fish species have perished.[51]

So far much progress has been made in waste disposal. Sewage disposal plants have now been installed in many cities. In 1965 in addition to 11,655 municipal sewage treatment plants in the U.S.

which served a population of approximately 118 million, 6,584 factories had been supplied with sewage treatment plants.[52] Throughout history, water-born diseases have been an important restraint on population growth. It is nevertheless probable that the great cities of the ancient Mediterranean world, with their admirable aqueducts, had safer water supplies than most rural areas in their own or later times. The ancients, although they knew nothing of bacterial disease, were well aware that polluted water supplies were dangerous, and they had strict laws to protect water against pollution.

The chief water-borne diseases are cholera, dysentery and typhoid. Sudden and widespread epidemics usually come from infected water supplies, although these diseases are not exclusively water-borne. Personal contact plays a part, and so does transmission through soiled clothing and the lack of personal cleanliness. Cholera strains of recent times (Asiatic cholera) are different from those of the sixteenth century. There were six or more great epidemics of Asiatic cholera in Europe and America during the nineteenth century. There were tens of thousands of cases of illness in every western country, with mortality sometimes as high as 60 per cent. These great pestilences were all traced back to India, and especially to Bengal, where lack of sanitation was universal, the rivers were all polluted, and poorly drained soil near the river mouths remained polluted from year to year.

Cholera shows very clear evidence of being water-borne. An outbreak in Hamburg in 1895 caused more than 8,600 deaths in the part of the city supplied with unfiltered river water. There were at least a half-million deaths from cholera in India in 1918 and 1919, but it has only seldom been a threat to western Europe or America during the twentieth century[53].

Dysentery includes at least five distinct diseases. There are some countries in which the natives seem to have a degree of immunity, so that those who become ill are chiefly tourists.

Typhoid, although a water-borne disease, is less sudden and terrifying in its onset than that of the other water-borne diseases. However, mortality may be considerable. Typhoid, in some wars, has produced more casualties than enemy bullets have. During the Russo-Japanese war of 1904-5, it was reduced in intensity in the Japanese army by sanitary measures. Drinking water was boiled, privies were disinfected with "choride of lime", flues were controlled, wells were inspected and marked "safe" or "unsafe" and pills were provided that gave some protection if a soldier had to fill his canteen with water of unknown quality. Anti-typhoid inoculation has since become an important means of control.

In the absence of modern sewage disposal, typhoid passes from typhoid carriers into septic tanks and from these through gravel beds into the soil. There it lingers to be picked up on the feet of those who walk on the soil and it is thus carried into the home.

This by no means completes the list of water-borre diseases. Among those that rarely appear outside the tropics is bilharzia, which is endemic in Africa, the West Indies, tropical South America, the Near East, tropical Asia, China, Japan, the Philippines and elsewhere. Bilharzia is spreading, and today probably affects 150 million people.[54] It increases in frequency near irrigation projects, especially where seasonal water supplies are replaced by perennial sources. In parts of Egypt its incidence rose from 5 to 75% of the adult population between 1948 and 1963.

Today polluted water and contaminated food joins with malnutrition to account for the high infant mortality rate of the lands where sanitation is not widely used.

Half the children born in Vietnam die before they reach the age of five. The average age attained there by peasants is about 36 years, just half of what may be expected for anyone born in the United States.

Water-borne diseases are not controlled completely in the most advanced country of the U.S.A. either. The U.S. Water Resources Council has reported that between 1946 and 1960 there were 228 outbreaks of water-borne diseases, with 25,984 individual cases stemming from public and private water supplies[55]. Out of 228 outbreaks, 70 were observed in the rural areas of the U.S., with 19,928 individual cases which were traced to public utility water systems[56]. Another study found that in the Mississippi River Delta region in 1966, 45% of the rural houses had neither a public sewer nor a septic tank or cesspool. Some 33,000 communities contain fewer than 1,000 residents but a few with populations of more than 5,500 are without public water facilities. 43,000 communities lack public sewers and of them more than 100 have populations over 5,500.

With increasing population new problems will develop. In modern farming systems the introduction of heavy fertilizers on both cropland and pastures has caused groundwater pollution. Nitrogen is very soluable and is leaked in large quantities into the drainage waters. Recently the State Health Department of California reported concentrations of nitrate of 176 mg/l in ground waters in California's San Joaquin Valley and moved against its use for babies[57].

The development of nuclear energy as a new power resource and a weapon of war has brought a new source of pollution - radioactive contamination of water and air[58].

1-3-d <u>Water Problems in the Arid Countries and the Management Measures</u>

In the arid developing countries, water problems are somewhat different. Where supplies are abundant they must be purified to make them suitable for human consumption, or clarified for industrial processes. Where supplies are scarce every possible economy must be made and they must be used whatever their natural composition.

It is well known that advanced civilizations formerly occupied what are arid regions today. The disappearance of these civilizations may have been brought about by the action of man[59].

In arid regions the quantity of fresh water is one of the major controlling variables in the planning of projects. Owing to the development of water-extraction and conservation techniques over the last decades water supply limitations in many countries have been reduced. One of the most comprehensive schemes for water resource management is undoubtedly found within the small state of Israel. During less than three decades (1948-76) Israel, through an integrated water resource development programme and as the result of the construction of the National Water Carrier in 1958, has gained extra supplies of approximately 1,400 million $m^3$/yr or about 90% of all its fresh and easily available water resources. This allows more than 116,000 ha of land to be irrigated compared with a figure of 28,000 ha when Israel was established in 1948[60]. By the use of all known resources of water a total of about 265,000 ha can be irrigated after meeting higher priority demands that would be one half of all potentially irrigable land - 530,000 ha[61]. For countries such as Israel, which have developed and used most of their easily available water resources, it is essential that new ways of water resources management are developed for future economic growth[62].

For the arid countries a model consisting of six strategies of water resources management has been introduced to fit their requirements. These strategies, which were outlined by Wiener (1972) are as follows[63]:

a) To increase the conservation of run-off.

b) Weather modification.

c) Modification of space and time patterns of the application of water, which is the most important improvement.

d) The reduction of the salinity of water through dilution, by the "kidney effect" of salt extraction methods such as electrodialysis and reverse osmosis, as well as the reclamation and re-use of domestic and industrial waters.

e) Manipulation of pollution at source (e.g. by selection of a "soft" pollutant) disposal of waste or extraction of pollutants before they reach the water resource (e.g. sewage treatment and disposal of residual wastes) or by dilution.

f) Modification of the political framework related to changes in the pricing of water. Reliance on the water price mechanism would be the straightforward way to change prevailing decision patterns.

1-3-e <u>Water Resources</u>

<u>Surface Water Resources</u>

The total amount of water available in the arid and the developing world is still not known with any degree of certainty. At the world scale the total mean annual run-off of 243 mm/yr is quoted by The Open University Course Team (1975, p.30) (Table 1-1). Also Clark has estimated that river flow alone provides 8,000 $m^3$ per capita of population per year[64], but the water resources of the earth are inequitably distributed and the arid zone countries have only a small fraction of the total water supply.

For the Middle Eastern Countries, an attempt has been made only recently to tabulate existing data on the total amounts of river water which are available (Table 1-2). The most favourable positions are confined to Egypt, Turkey and Iraq.

Table 1-1

Water Balance of the World's Continents

| Region | Precipitation mm/yr | Evapotranspiration mm/yr | Run-off mm/yr |
|---|---|---|---|
| Africa | 670 | 510 | 160 |
| Asia | 610 | 390 | 220 |
| Eurpoe | 600 | 360 | 240 |
| North America | 670 | 400 | 270 |
| South America | 1,350 | 860 | 490 |
| Australia and New Zealand | 470 | 410 | 60 |
| Mean values derived after weighting according to area | 725 | 482 | 243 |
| Great Britain | 1,050 | 400 | 650 |

Table 1-2

River Water Available in Middle Eastern Countries

| Country | Estimated total mean annual flow of major rivers | |
|---|---|---|
| U.A.R. | 84.0 | 18.5 x $10^9 m^3$ of this can be used by Sudan. |
| Turkey | 80.0 | About 40 x $10^9 m^3$ of this is in Euphrates and Tigris. |
| Iraq | 76.0 | Of which only 20 - 30 x $10^9 m^3$ originates in Iraq. |
| Syria | 28.0 | Of which 24 x $10^9 m^3$ is in Euphrates. |
| Iran | 42.0 | 22 x $10^9 m^3$ in Karoon and Dez systems in Khuzestan. |
| Israel | 1.0 | Includes Jordan flow. |
| Jordan | 0.5 | Excludes main Jordan. |
| Lebanon | 1.0 | Excludes the upper Orontes (0.5 x $10^9 m^3$) |

Source: Smith, C.G., "Water Resources and Irrigation Development in the Middle East", Geography 55, p.424, (1970).

Also the U.S. President's advisory committee (1970) has estimated the annual run-off of a number of rivers in Asia, Africa and South America (Table 1-3). These estimates also give figures on the arable lands and potentially irrigable lands in these countries. The great bulk of the irrigation water in the arid zone comes from the exotic streams whose head waters lie in humid regions and are large enough to sustain a course across the arid zone, either to the sea, as does the Nile, or to inland basins as does the Helmand river in Afghanestan. Although the large river basins in Asia, Africa and South America have a substantial annual run-off, the potential area of irrigable land in these basins is confined to only 259.11 million ha out of a total arable area of 1,305.6 million ha (Table 1-3). In India, the second leading country in the world for irrigation, of the total annual run-off of 1,665,201 million $m^3$, only one third is considered utilizable for irrigation[65]. In 1950 only 93,744.6 million $m^3$ were utilized[66]. At that time India had a total irrigated area of 20.8 million ha. By the end of the second Indian Development Plan (1960-61), the area had been increased to 28.34 million ha. By the end of the Third Plan (1965-66) India had hoped to irrigate an area of 36.44 million ha . In the Fourth Plan (1966-71) it was hoped to increase the irrigated area on a further 10.53 million ha[67]. However it seems unlikely that these targets would have been achieved

Table 1-3

Irrigation Potential in Parts of Asia, Africa and South America

| Region | Major River Basins | Annual Run-off (million $m^3$) million acf | Arable Land Area ($10^6$ ha) $10^6$ acre | Potential Irrigation ($10^6$ ha) $10^6$ acre |
|---|---|---|---|---|
| India (327.9 million ha) | Indus Brahmaputra Ganges Godaveri Kristna | (1,520,881.00) 1,233 | (163.20) 403 | (75.70) 187 |
| Pakistan (95 million ha) | Indus Brahmaputra Ganges | (1,390,134.20) 1,127 | (34.80) 86 | (17.40) 43 |
| South-western Asia (689.8 million ha) | Tigris Euphrates | (61,674.10) 50 | N.A. | (32.38) 80 |
| Continental South-east Asia (220 million ha) | Irrawaddy Mekong Salween | (851,102.58) 690 | | (10.12) 25 |
| Brazil (851 million ha) | Amazon Sanfrancisco Parana | (3,304,498.20) 2,679 | (388.66) 960 | (4.04) 10 |
| Tropical South America less Brazil (382 million ha) | Orinoco Magdalena | (677,181.60) 549 | (126.32) 312 | (4.04) 10 |
| Southern South America (369.6 million ha) | Parana, Uruguay Buneno Valderia· Bio Bio Nego | (708,018.66) 574 | (107.69) 266 | (52.08) 125 |
| Tropical Africa (955 million ha) | Congo Niger Zambezi | (1,874,892.60) 1,520 | (391.49) 967 | (60.73) 150 |
| Total | | (9,464,507.30) 7,673 | (1,305.66) 3,225 | (259.11) 640 |

Source: U.S. President's Advisory Committee, The Food Problems, Volume 11, 1967, cited in Todd, 1970, p.284.

since in 1968 India had only an estimated 27.52 million ha irrigated land[68]. This area excludes Kashmir-Jammu which was still in dispute between India and Pakistan.

In the U.S.A., the total average precipitation is 5,859,039.5 million $m^3$ per annum. Of this total, 1,702,205.1 million $m^3$ run-off accounts for stream flow. A total of 425,551.3 million $m^3$ or 25% is abstracted from the streams and the rivers of the country for beneficial uses. 195,123.6 million $m^3$ is used for irrigation, a further 195,123.6 million $m^3$ for industries and only 33,304 million $m^3$ for municipal water supply in 1962[69]. With 15.83 million ha already irrigated (1968), estimates of the additional irrigable area, which can be brought into production amounted to some 4.85 million ha by 2000 A.D.[70] Another estimation is the irrigation of a total area of 24 million ha by 2000 A.D. Based on the latter estimation the water abstraction for irrigation which was 153,143.05 million $m^3$ in 1965, will be increased to 222,101 million $m^3$ by the turn of the century.[71] The scaling down of the estimates which has been necessary over the past seventy or eighty years is the result of the fact that irrigation is not a panacea for all the ills of a dry region, but a specialized technique of limited usefulness and application.

Australia as a developed and arid country, and the twenty-first leading country for irrigation, has a total annual average run-off of 345,374.96 million $m^3$. The annual surface run-off from tropical Australia is 213,392.4 million $m^3$ and from the southern part 131,982.6 million $m^3$. Of this latter figure, 46,872.32 million $m^3$ occurs in Tasmania. It is significant for the country's development that the surface water resources of the mainland south of the tropics (85,110.3 million $m^3$) have, from a practical view-point, been substantially committed for use, whereas the northern and greater part of Australia's water resources are practically unused[72].

Australia lacks the extensive inland river systems of the mountainous continents. Its largest system is the Murray river and its tributaries which drain 1,056,312 $km^2$ and have an estimated average annual discharge of 23,436.2 million $m^3$ (not including diversions from the Snowy River catchment). Australia has practiced small scale irrigation since 1870. In 1958-59 Australia had only 368,000 ha under irrigation. Between 1910 and 1920 with the construction of large dams on the Murray and Murrumbidgee rivers, the irrigated area expanded. By 1970 Australia irrigated 1.05 million ha of which 0.93 million ha was located in the system of Murray-Goulburn-Murrumbidgee and Darling rivers[73].

The total water storage capacity of the dams which were constructed during the last 20 years are estimated at 54,273.21 million $m^3$. With the supply of these waters, the irrigated area of Australia expanded to 1,342,800 ha. With the completion of the Snowy Mountains Hydro-electric scheme in 1974, and the diversion of 986.8 million $m^3$ of water to the Murray and 1,356.83 million $m^3$ to the Murrumbidgee systems a further 2,589 $Km^2$ is planned to be irrigated.[74]

In 1960 Japan, as the eighth leading country for irrigation, had approximately 3.44 million ha under irrigation. This was more than half her cultivated land and it was almost entirely devoted to the cultivation of rice. As most of Japan's cultivable land is already being used, no greater extension of irrigation is possible. With the implementation of new river development projects, 67,846.2 ha of new land will be irrigated.[75]

Ground Water Resources

Ground water supplies made up not only a large proportion of the potential supply but also are already of considerable importance in many countries. 95% of the population of Tunisia rely upon ground water for their water supplies. The Arabian peninsula is quite without streams except in the mountainous periphery of the south-west. In Saudi Arabia 70% of all water used is ground water and in Morocco 75%[76]. In Iran at least one third of the irrigation water is abstracted from this source. (See Chapter 2) In the western U.S.A., the interior of Australia, South Africa and Kazakhestan the livestock industry is dependent upon ground water. A quarter of India's irrigation water comes from wells and so does an unknown, but substantial proportion of China's irrigation water. In the U.S.A. the number of wells drilled by 1960 was 381,000 and it had increased to 435,700 in 1964. In California, Texas and Arizona, several million hectares are under perennial irrigation from ground water sources. In Australia, artesian and sub-artesian water occurs under about 60% of the continent. Of the extensive sedimentary basins in Australia, the largest and most important is the Great Artesian Basin. Its area of about 1,734,630 $Km^2$ covers nearly two-thirds of Queensland and extends into New South Wales, South Australia, and the Northern Territory. It is estimated that this basin alone has 18,000 recorded bores of which 12,000 are in Queensland[77].

The ground water resources of the world constitute a major source of potential water for supply. It has been estimated that the ground-water in the area up to 800 metres below the earth's surface has 30 times the water in all lakes and 3,000 times the water in all the rivers of the world[78]. Not all of this ground water can be tapped for irrigation. Ten metres is the present economic limit for wells in India and in Australia artesian wells for drinking water average 150 metres in depth. Therefore at the moment only a small proportion of the total available groundwater is being used. More importantly, there is relatively little ground water available in the arid zone. Ground water is derived from rainfall and seepage from lakes and rivers. In this zone, precipitation is meagre, and the lack of vegetation cover means a high run-off ratio and so smaller amounts infiltrate. Evapotranspiration rates are also high, so water that has penetrated to the root zone may be brought back to the surface by capillary action and evaporation.

1-3-f The Future Water Supply Prospects

For world population, water supply may prove to be the ultimate limiting factor. Synthetic food is a possibility, even a probability for the future feeding of the masses, but the manufacture of new water by chemical means, though technically possible, can hardly be contemplated on a scale sufficient to make any substantial difference to the main problem. If all known sources of fresh water were fully used, about ($4.5 \times 10^{15}$ g) $2 \times 10^{13}$ $m^3$ would be available.

This would imply a world population of 20,000 million at roughly the present per capita rate of consumption[79]. Some estimates suggest that by 2100 A.D. world population will have reached or passed this figure if the food problem can be solved. After that, water must come from the sea. So any scarcity is not absolute, but related to cost. Potable water is still comparatively plentiful and, though costs are increasing, it is likely to be many years before they reach such a level that desalination of sea water would be competitive except in the world's arid and semi-arid areas. Even water is, of course, inexpensive in relation to its almost supreme importance to life.

A recent study of the global picture suggests that by the end of this century, Europe, South and East Asia and Africa will need a total water intake corresponding to more than 20% of their total annual run-off[80]. This will mean that advanced water management measures must be employed with an unknown impact on climate. It will be necessary to:-

1) Develop techniques for the efficient cycling of waters on a massive scale.

2) Abstract deep stagnant ground water.

3) Improve the efficiency of irrigation.

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# CHAPTER 2

## THE AGRICULTURAL ECONOMY OF IRAN

Iran has benefited from a steady stream of oil revenues since 1908. But it is only since the Second World War that Iran has been transformed from an under-developed country to a country with a dynamic and increasing modern economy. The most important factor in the development of Iran is the increase of oil revenues especially since 1971. About 60 - 70% of the oil revenues are allocated for economic development.

Since the 1950's five development plans have been carried out. Agriculture, as the major sector for employment, has been affected by the planning policies. An extremely important milestone in Iran's agricultural strategies was reached with the implementation of the land reform programme, which began in 1950 and its main phases were undertaken in 1962-66. To complete this strategy two further policies were carried out in the field of water management. These are the creation of the Ministry of Water and Power in 1964 and the nationalization of water resources in 1968. Iran's agricultural economy has been affected by two major factors. These are:

a) The environmental factors

b) The economic and social measures

### 2-a The Environment

#### 2-a-1 The land

Iran covers an area of 1,648,000 $Km^2$. It includes desert lands, high plateau and extremely rugged mountain ranges. There are four main topographic areas, namely: the Khuzestan lowlands, the Caspian littoral, the Zagros-Elburz mountains and the central plateau.

The Khuzestan lowlands are a vast area of about 30,000 $Km^2$[1] in the south-west of Iran. These are situated on the south-western flanks of the central Zagros mountains. In physical terms, they are a natural continuation of the Mesopotamian plain, bordered in the south by the head of the Persian Gulf, in the west by the Iraqi frontier and in the north and east by the Zagros mountains. While the Zagros mountains are a massive and complex upland, the lowlands immediately on their western flank are a geosyncline that has been partly infilled by sediments[2]. These sediments were brought down mostly from the Zagros by the Karoon-Karkheh river systems, and also from the plateaus of Asia Minor by the Tigris and Euphrates rivers. The widest part of the plain is not more than approximately 193 to 241 Km across .

The Caspian littoral has been formed by alluvial deposition, carried by the numerous rivers. The rivers rise in the Elburz ranges, which border the south of the lowlands. Along most of the Caspian littoral the Elburz mountains are close to the coast, except in Gilan and Mazandaran where plains occur. The former is formed by the deposition of the Sefid river and the latter by deposition from the Tajan, Talar, Babol and Haraz rivers.

Each plain extends over an area of more than 5,180 $Km^2$ and slopes from 91.44 m above sea level to 27.43 m below sea level[3].

The Elburz range is about 1,300 Km long and forms a linear barrier between the central plateau and the lowlands of the Caspian sea. Its peaks usually rise to heights of about 4,500 metres. The width does not exceed 100 Km. Zagros range consists of a series of parallel fold ranges trending north-west to south-east in western Iran. Their highest peaks range from 1,500 to 3000metres and their width is more than 500 Km. In this mountain range, Mezozoic and Tertiary sediments form inter-mountain valleys[4]. The deep transverse canyons and gorges have broken through the fold ranges[5]. In several regions of the country volcanoes are prominent, the highest being Mount Damavand with a peak of 5,670 m in the central Elburz[6].

The Central plateau of Iran is located between these two mountain ranges. Its elevation ranges between 500 and 1,000 metres. The Great Kavir and the Southern Lut are the largest interior drainage basins, found in the central plateau, but a number of local basins also occur.

2-a-2 <u>Pressures and winds</u>

2-a-2-a <u>Pressures</u>

Iran is the meeting point of air masses of varying characteristics. Winters are marked by cold air streams from Siberia. The interior of the Iranian plateau too is usually covered with a local centre of high pressure during the winter months. In contrast to these centres of high pressure, low pressure centres also are found over the warm waters of the Caspian Sea in the north, the Persian Gulf in the south and the Eastern Mediterranean. Lying within this Middle Eastern pattern of pressure systems, Iran may be said to have a pressure field in winter that declines in intensity from north to south. With the onset of Spring in the northern hemisphere, the interior of Iran warms up rapidly and by May the Summer pressure pattern is fairly well established.

2-a-2-b Winds

Because of the winter pressure pattern over much of Iran the winds tend to blow consistently from the east or north-east. This is not necessarily a dominant pattern of wind since masses of relatively warm and humid air from the Mediterranean frequently break through to cover the plateau of Iran. These masses not only raise the temperature but also bring precipitation[7].

During the Summer months the winds of Iran are dominated by the Indian monsoon system. Summer wind directions over most of Iran are almost always from the north or north-west, but topography and the nature of the terrain modify this general picture.

Local winds are in almost all cases influenced by local topographical features such as extensive flat deserts, complex mountain systems, closed basins, long valleys, coastal lowlands, lakes and the sea.

Over the mountainous regions, winds are extremely variable and influenced by topography. In the narrow valleys "up and down" flows are a common feature. Along the northern shores of the Persian Gulf and especially in Khuzestan a south-westerly warm wind that has its origin in Saudi Arabia blows occasionally during the cold months with storm force. Unlike the sirocco of the southern Mediterranean region it brings a good deal of moisture because of its passing over the Persian Gulf[8].

Of all the local winds that blow over Iran during the Summer months, two are very well-known. These are the Shamal (north) of the Persian Gulf which is a north-westerly wind that blows down the valley of the Tigris and Euphrates and affects the coastal areas of the Persian Gulf from February to October, though its greatest intensity and steadiness is during the hottest Summer months. The other is the wind of 120 days, which blows during May to September from the north-east with great regularity, steadiness and sometimes violence[9]. This occurs in Sistan and Baluchestan.

2-a-3 Temperature

Iran's climate is characterized by hot summers, (except in the north-west, along the Elburz mountains and the Caspian Sea) and cold winters. The Elburz Mountains, just north of Tehran form a great climatic divide, producing the most significant contrasts in Iranian climate[10]. To the north of the mountains, there is year-round warmth with abundant moisture. To the south. there is a desert with frigid winters and hot summers. In July and August, the mean monthly temperature in the north can rise to 26°C along the Caspian Sea[11] and it is between 26°C and 29°C on the northern part of the plateau. In Tehran, the temperature sometimes reaches 43°C. In Abadan, on the Persian Gulf, temperatures as high as 53°C have been recorded, but the mean temperature there, for the month of July is under 40°C. Hot summer temperatures occur in the foothills of the Elburz and the Zagros mountains and as a consequence, evapotranspiration rates are extremely high. For instance, in Tehran (35°41' Lat.N. 51°19' Long.E, 1,191 m above sea level) where the average annual precipitation is 233.5 mm, potential evapotranspiration is about 2,700 mm or approximately 12 times the actual precipitation[12]. As a result water demand for plant growth during the summer season is high. These high evapotranspiration rates, coupled with high ground water levels as the result of over-irrigation and poor drainage, have often resulted in soil salinity. The example for this is the Varamin Plain which begins 30 Km south east of Tehran and covers roughly 130.000 ha[13]. The downstream water resources of certain rivers, which flow through these salty lands, especially in the central plateau and southern regions, cannot be used either because of high salinities[14]. By the application of some water treatment techniques, these water resources can be used. At least for the present time the application of such techniques are not economically justified for Iran.

In winter, frosts produce the most harsh conditions for the growth of plants in Iran. Mean monthly temperatures in January vary from 20°C in South Eastern Iran to less than -10°C in some of the higher stations in Azarbaijan. Absolute minima are recorded at many stations, even at Haft-Tappeh (-10°C in 1964 and -8°C in 1966).[15] Early in 1964 when a very cold, stagnant air mass covered most of the country for a few days, Bijar (Lat. 35°52'N, Long. 47°36'E.) at an elevation of 1,938.5 m above sea level, reported the lowest minimum temperature of -36°C.[16] Frosts occur in Iran even as late as April.[17]

2-a-4 Water resources

2-a-4-a Precipitation

The most important adverse factor for the development of Iran's water resources is the low rainfall. The annual amount of precipitation for the country as a whole averages from 300 to 350 mm.[18] A mean annual precipitation total for the country of 400 mm is quoted by Gangi (1968), while Vahidi (1968) gives an annual precipitation depth over the whole country of 275 mm.[19] This would suggest a total annual volume of freshwater of $450 \times 10^9 m^3$. The highest annual precipitation is recorded on the lowlands to the south-west of the Caspian Sea (Fig. 2-1). This part of Iran has an annual precipitation of around 1,800 mm.[20] The Caspian lowlands which accounted for only 10% of the total area of Iran receive one third of all the precipitation falling on Iran In contrast the interior deserts receive less than 100 mm as their average annual precipitation. Two belts of high precipitation exist in Iran. First, the higher totals are found along the Caspian Sea coast and the northern flanks of the Elburz mountains. The second belt follows the western flanks of the Zagros mountains, whose precipitation amounts exceed 820 mm on some of the highest peaks. Between the two belts of high precipitation, in the north-western highlands, precipitation reaches values of between 215 and 418 mm.[21] Over Iran as a whole, precipitation decreases from north to south and from west to east, except where the relief of land alters this regularity. Referring to both areas of high precipitation, namely the Caspian lowlands and the Elburz and Zagros mountains, MEAN ANNUAL PRECIPITATION IN IRAN mm

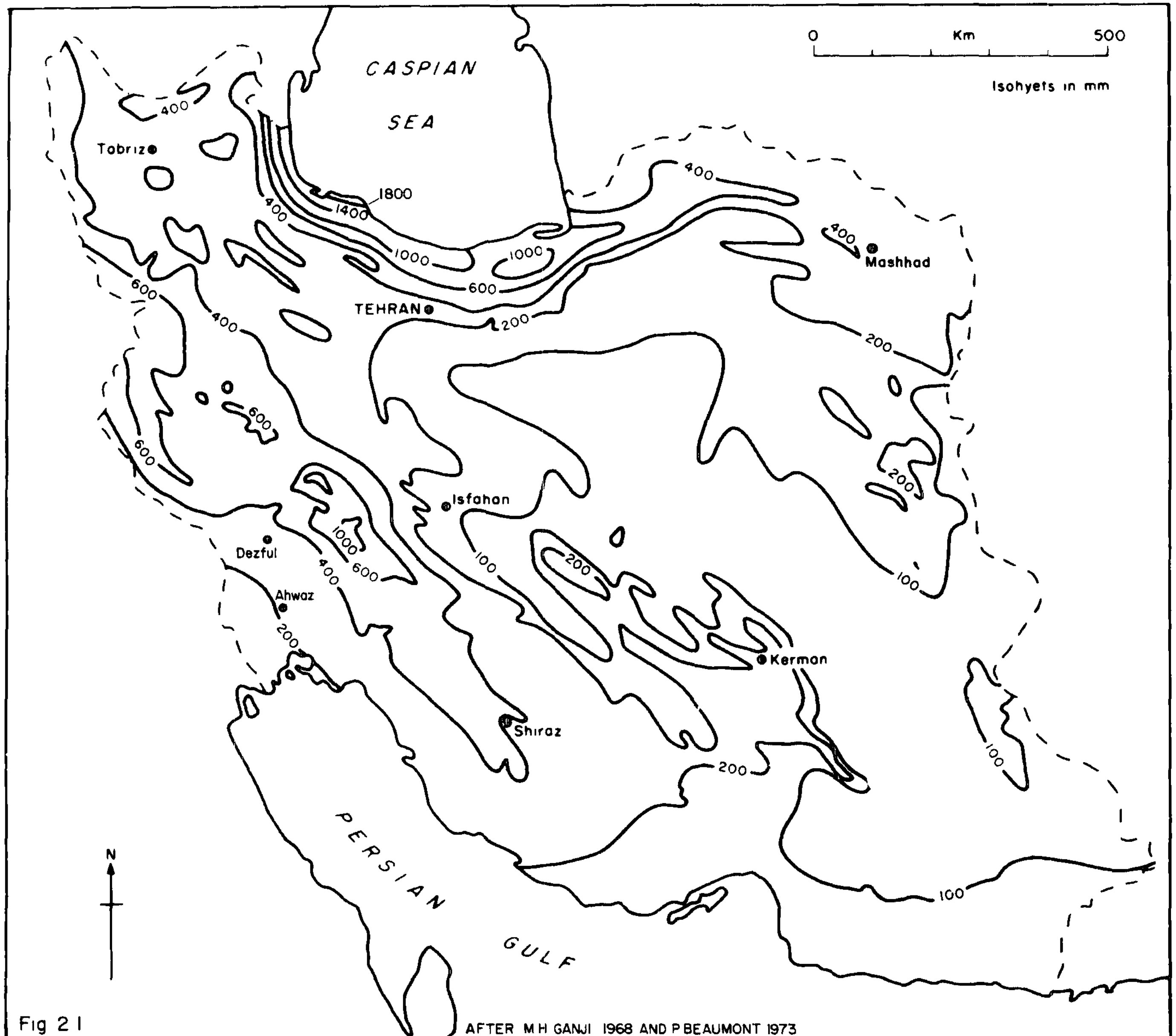


Fig 2 1

AFTER M H GANJI 1968 AND P BEAUMONT 1973

52% of the total precipitation of the country falls in these regions, which cover about 25% of the country's area. The central plateau covering an area of 50% receives only 28% of the annual precipitation. The remaining 20% of the average precipitation of the country occurs in the eastern and southern regions.[22] Successful agriculture without irrigation requires at least 250 mm annual precipitation at an inter-annual variability of 37%.[23] Since about half of the total area of the country receives annual totals of less than this amount, agricultural activities in these arid regions are therefore impossible without the availability of surface or ground water resources.

The period of maximum precipitation over most of the country is between October and March. Winter is considered as the rainy season nearly everywhere in Iran. During this period about two thirds of the country receives over half of its annual precipitation.[24] The percentage of precipitation falling in winter decreases from south to north. Parts of Southern Iran may receive as much as 75% of their annual precipitation in the three winter months.

In Spring, the rising temperatures produce atmospheric instability which creates convectional rainfall, especially over the highlands of the west and north.

Summer is the dry season throughout Iran, except along the Caspian Coast. In this region orographic rains occur, with some stations receiving more than 25% of their annual precipitation during this period.[25] In Autumn high precipitation occurs in the Zagros and Azarbaijan highlands, and along the Persian Gulf Coast due to the active Mediterranean depressions moving over Iran.

Water surplus (precipitation minus evapotranspiration) estimations for Iran have been made as part of the detailed work of Thornthwaite, Mather and Carter in their production of three water balance maps of south-west Asia (Fig. 2-2). The highest water surpluses of more than 1,600 mm per annum occur in short linear belts along the northern slopes of the Elburz mountains bordering the Caspian Sea lowlands. Disconnected belts of 800 to 1,600 mm per annum water surplus also extend throughout the Elburz mountains and to a lesser extent through the northern parts of the Zagros mountains. A small amount of the country, about one third of the total receives more than 100 mm per annum water surplus, all of this is concentrated in the northern and western parts of Iran. This emphasises the fact that the central, southern and eastern parts are extremely arid.[26]

In contrast, for the regions of water surpluses which usually occur in the highlands region, the

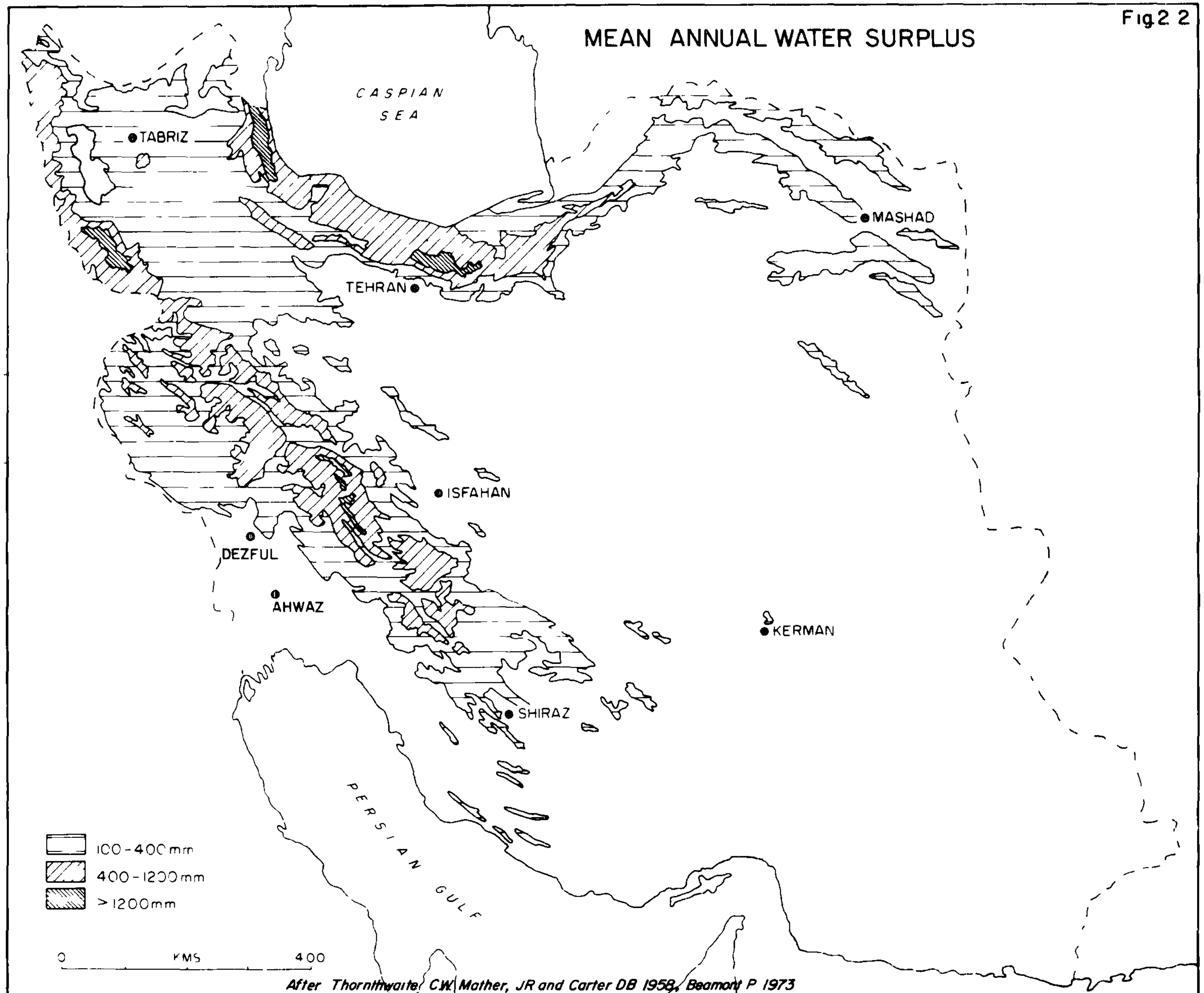


Fig 2 2

MEAN ANNUAL WATER SURPLUS

*After Thornthwaite, C.W. Mather, J.R and Carter DB 1958, Beamont P 1973* growing seasons tend to be shorter, whereas the arid areas possess a much longer growing period (Fig. 2-3). The restriction of the growing season in the highland areas, coupled with the shallow soils and the scarcity of flat land, make farming difficult. A compromise, therefore, has to be reached in which water is transported from the uplands of water surplus to the dry fringing basins and alluvial plains, which possess a longer growing season and more fertile soils. In many cases this can be achieved by merely tapping rivers which rise in the uplands, or ground-water reserves recharged in zones of abundant water supply.[27]

Droughts are not uncommon in Iran. For instance, following a four-year absolute drought between April 1958 and April 1962, thousands of Baluchi tribesmen were forced away from their mountains and reduced to begging in Zahedan and Zabol and spread as migrant casual labourers throughout eastern Iran.[28] The last drought occurred in 1971.[29]

2-a-4-b <u>Drainage systems and stream discharge</u>

The drainage basins of Iran correspond to the topographic areas with four principal watersheds. These are the Persian Gulf, the Great Desert Basin, the Caspian Sea Basin and the Lake Rezaieh Basin. Within the great basin there are six smaller basins.

# LENGTH OF GROWING SEASON IN IRAN

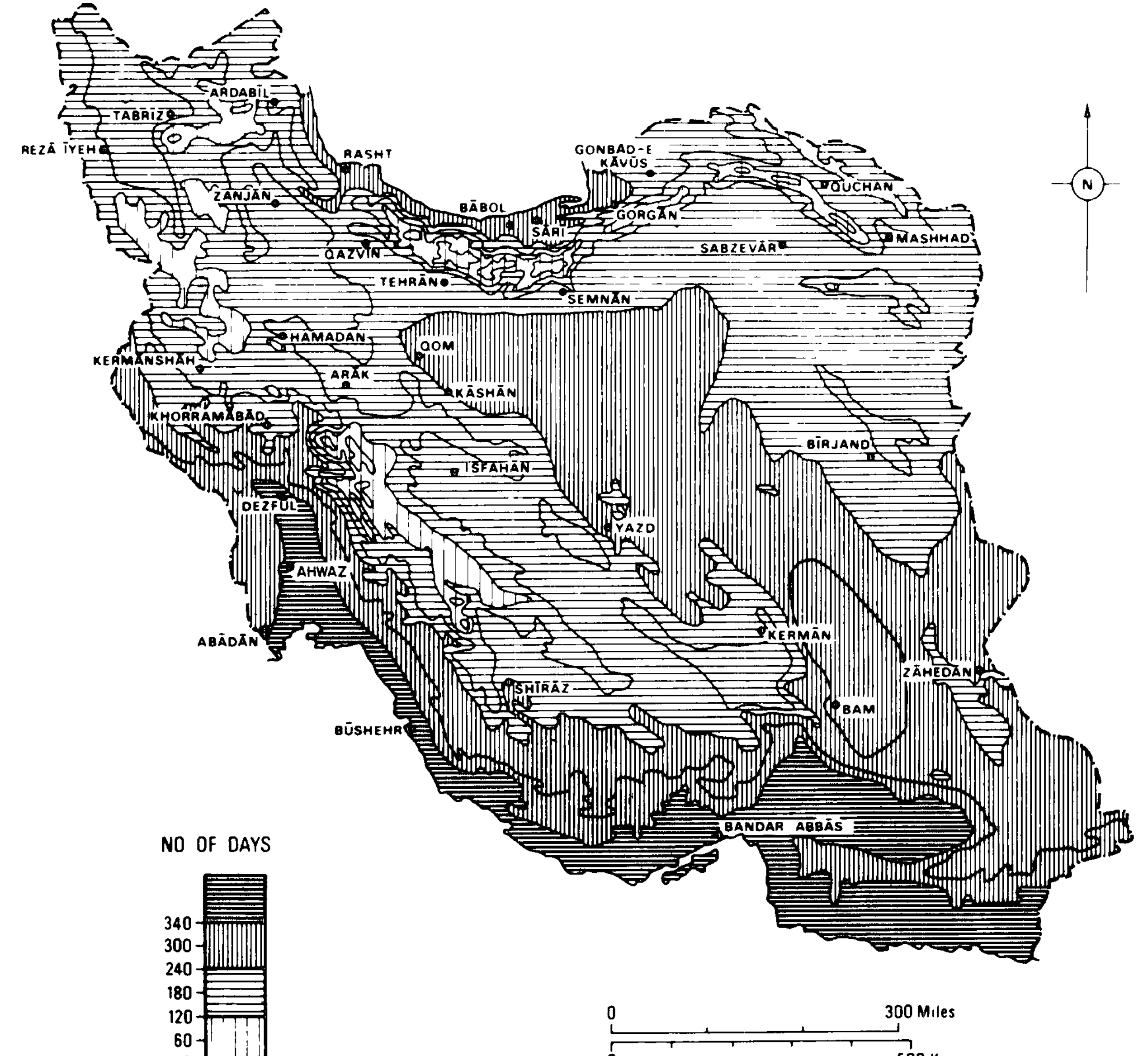


Fig 2 3

AFTER, CLIMATIC ATLAS OF IRAN 1965 PLAN ORGANISATION OF TEHRAN AND P BEAUMONT 1976

They are Masileh, Zayandeh, Jazmurian, Dasht-i-Lut, Nairize and the Great Kavir.

The most important rivers of Iran are the Karoon, the Karkheh and the Dez which flow into the Persian Gulf, and the Aras, the Sefid Rud, the Chalus, the Lar, the Gorgan and the Atrak which discharge to the Caspian Sea. The other large rivers are the Zayandeh, the Karaj, the Qum and the Kor. These flow into one or other of the desert basins. Table 2-1 lists the hydrological data of the most important rivers of Iran. (Period of river gauging, October 1955 to September 1965).

From the above table two important points should be noted: first, the ratio of monthly variations of flow which varied from 129.73 in the case of the River Qezel Ozan to 2.79 for the Hableh river. Secondly, months of maximum discharge which are almost always in the early Spring and those of minimum flow which often occur in Summer months or in early Autumn. Both point to the serious problems facing irrigated agriculture in Iran. While there is a great need for more water for irrigation, i.e. during the Summer and early Autumn, there is relatively little water in the streams. In contrast when there is little need

Table 2-1

Rivers of Iran

| River | | Basin area ($Km^2$) | Annual discharge (mcm) | Ratio of max. to min. mean monthly discharge | Month of max. mean discharge | Month of min. mean discharge |
|---|---|---|---|---|---|---|
| Chalus at Pol-e-Zoghal | | 1,555 | 141.47 | 3.37 | Ordibehesht | Day |
| Lar at Poloor | | 1,250 | 347.31 | 10.72 | " | Esfand |
| Gheselozan at Ostoor | Sefid River | 41,590 | 2,110.49 | 129.73 | " | Amordad |
| Shah at Looshan | Sefid River | 5,070 | 397.78 | 9.47 | " | Shahrivar |
| Gorgan at Gonbad Ghaboos | | 5,310 | 123.00 | 32.61 | Farvardin | Shahrivar |
| Gorgan at Pahlavideg | | 10,200 | 89.49 | 66.21 | Farvardin | Shahrivar |
| Karkheh at Hamidieh | | 45,882 | 3,822.82 | 17.08 | Ordibehesht | " |
| Marboreh at Dorood | Dez | 2,680 | 238.98 | 5.40 | Farvardin | Mehr |
| Ab-e-Tireh at Dorood | Dez | 3,340 | 423.15 | 24.89 | Farvardin | Shahrivar |
| Karoon at Gotvand | | 31,899 | 9,651.65 | 4.29 | Farvardin | Mehr |
| Karoon at Ahwaz | | 60,709 | 15,502.13 | 5.37 | " | " |
| Maroon at Behbanan | | 3,650 | 949.14 | 8.22 | " | " |
| Zohreh at Dehmolla | | 12,600 | 1,694.76 | 6.32 | Bahman | Shahrivar |
| Zarrineh at Sar Gav Mish | | 7,200 | 1,392.85 | 58.46 | Farvardin | Shahrivar |

cont...

Table 2-1 (cont..)

| River | Basin area ($Km^2$) | Annual discharge (mcm) | Ratio of max. to min. mean monthly discharge | Month of max. mean discharge | Month of min. mean discharge |
|---|---|---|---|---|---|
| Hableh at Bonekooh | 3,145 | 197.92 | 2.79 | Farvardin | Shahrivar |
| Jaj at Latian | 710 | 256.10 | 9.90 | Ordibehesht | " |
| Karaj at Pol-e-Khab | 725 | 384.78 | 8.47 | " | Day |
| Kordan at Deh-e-Sormeh | 380 | 107.91 | 39.27 | " | Shahrivar |
| Qum at Abasabad | 10,230 | 147.05 | 9.37 | Farvardin | " |
| Zayandeh at Pol-e-Zaman Khan | 4,850 | 881.94 | 4.41 | " | Mehr |
| Kor at Doroodzan | 5,100 | 667.50 | 4.28 | Esfand | " |

Source: Beaumont, P. 1973, "River regimes in Iran", pp.10-12.

for irrigation water, tremendous volumes of water are available. This runs to waste to the sea or the interior basins. This regime hydrograph of Iran is produced through the following process:

Most of the precipitation which occurs during the period from October to March is in the form of snow, owing to the altitude of the crescent high mountain ranges of Iran. The snow does not melt immediately, but rather remains as deep snow packs. Snow-melt begins in the Spring because of rising temperatures in late Spring and early Summer. The amount of water produced by this melting is often considerably increased by warm frontal rain from Atlantic or Mediterranean depressions falling onto a ripe snow pack.[30] The result is to produce the maximum discharge of many rivers in early Spring. This maximum discharge coincides with the beginning of the growing season. Water supply is, therefore, not as much out of phase with the season of maximum crop growth as precipitation data alone at first suggest.[31] However, because of close correlation between the month of maximum precipitation and maximum river discharges, many rivers during the Summer months are reduced to a mere trickle or even dry up completely. Unfortunately, this is at a time when water demand for the growing crops is reaching maximum. Where water can not be supplied from alternative sources during this period, irrigated farming is impossible.

In many parts of regions, where over-grazing has diminished or even demolished the vegetation cover, rapid run off of precipitation makes it difficult to utilize the streams' water for agricultural purposes. This, in turn, has resulted in considerable flood damage in the adjacent lowlands as well as heavy siltation in water storage reservoirs. Examples of these siltations are those of the Mohamad Reza Shah Pahlavi reservoir of the Dez River[32], the Shahbanoo Farah reservoir of the Sefid River[33] and the Farahnaz Pahlavi (Latian) reservoir on the Jaj River[34].

2-a-5 Water balance of Iran

Numerous figures have been quoted in various works on the water balance of Iran[35].

Perhaps the main difficulty in establishing an accurate water balance for Iran is the fact that the country has such a vast size and a scarcity of climatic and hydrological recording stations. The length of records of most stations is also short, usually less than 15 years. Beaumont (1974) quoted an average figure of $450 \times 10^9$ $m^3$/annum as the total amount of water with extremes ranging from 300 590 $\times 10^9$ $m^3$ in the ten year period of gauging records, 1956 - 65 (1335-44)[36]. Out of the total $450 \times 10^9$ $m^3$/a, 70% is accounted for by water losses through evapotranspiration. Therefore, the available water supply is estimated at $130 \times 10^9$ $m^3$/a. From this total $20 \times 10^9$ $m^3$/a is considered as ground-water recharge.

In 1968, for the irrigation of an area of $1,800 \times 10^3$ ha a total of $16 \times 10^9$ $m^3$/a of the surface water of the country was used. This result has been obtained through the application of a consumptive use of water of 9,450 $m^3$ per hectare[37]. Since it is estimated that also about 35% of the water, which is applied is actually used by the crops, this means that about $45 \times 10^9$ $m^3$/a have to be abstracted from river sources. In addition to that a total of $20 \times 10^9$ $m^3$/a was extracted from ground water sources ($15 \times 10^9$ $m^3$/a by Qanats and $5 \times 10^9$ $m^3$/a by wells). Of this total $13 \times 10^9$ $m^3$/a is actually used for crop growth. For the irrigation of a total area of $3,068 \times 10^3$ hectares in 1968 a total of $65 \times 10^9$ $m^3$/a of water was abstracted from surface and ground-water sources (Table 2-2).

Table 2-2

Distribution of Sources of Water, Area under Irrigation and the Volume of Actually Used and Abstracted Water

| Source of water | Irrigated area (1000 ha) | Abstracted water ($10^9$ $m^3$) | Water actually used for plant growth and percolation ($10^9$ $m^3$) |
|---|---|---|---|
| Rivers | 1,800 | 45 | 16 |
| Qanats | 1 281 | 15 | 9 |
| Wells | | 5 | 4 |
| Total | 3,081 | 65 | 29 |

Source: Vahidi, M. 1968, p.13-14.

To obtain the total amount of water consumed, a figure of $1 \times 10^9$ $m^3/a$ which represents the urban and industrial loss, should be added to the total of $65 \times 10^9$ $m^3/a$. This makes a total annual consumption of $66 \times 10^9$ $m^3$ of this $7 \times 10^9$ $m^3$ is regarded as the irrigation drainage water, so that only $59 \times 10^9$ $m^3$ is available for beneficial uses. Therefore a total $71 \times 10^9$ $m^3$ flows out of the country as river discharges to make the balance of $130 \times 10^9$ $m^3/a$ of available water supply.

During the period of the five National Development Plans of Iran (1949-78) water resource development has concentrated mostly on surface water resources by the construction of a number of large multi-purpose dams (Chapter 3). The amount of surface water used by agricultural activities has steadily increased but the use of ground-water, especially by qanats has declined. It seems that current trends will go on, although since the fourth Development Plan the extraction of ground-water by means of deep and semi-deep wells has tended to increase slightly (Table 2-3).

From the table over a ten year period (1968-78) the total amount of $71 \times 10^9$ $m^3/a$ of water which left Iran as river discharges is to be reduced to $61.22 \times 10^9$ $m^3/a$. As a result of the major dam projects, an extra 880,000 hectares have been irrigated or will be irrigated in the near future[38].

Table 2-3

Distribution of Water Resources, Water Supply and the Irrigated Area by the end of the 2nd, 3rd, 4th and the Projection for the 5th Plan

(water in $10^9$ $m^3/a$)
(area in 1,000.000 ha)

| | 1962 | | 1968 | | 1973 | | 1978 | |
|---|---|---|---|---|---|---|---|---|
| | Available water (1) | Irrigated area | Available water (2) | Irrigated area | Available water (3) | Irrigated area | Available water (4) | Irrigated area |
| Rivers | 11 | | 16 | | 20.5 | | 26.28 | |
| Qanat | 12 | 2.3 | 9 | | 6.0 | 3.45 | 12.52 | 3.88 |
| Wells | 2 | | 4 | | 5.0 | | | |
| Total | 25 | 2.3 | 29 | 3.0 | 31.5 | 3.45 | 38.80 | 3.88 |

Source: (1) Rochani, M., 1963, "Iran's Water Resources Development Problems and Recommendations, p.67.

(2) Vahidi, M., 1968.

(3) Echo of Iran, 1973, Iran Almanac, Teheran, Iran, pp.215-220.

(4) Plan and budget organization statistical centre of Iran, March, 1975.
Statistical Yearbook of Iran. 1973-74, p.326.

2-a-6 Social and institutional aspects of water resources

Since the beginning of the second seven year Development Plan (1956) a great effort has been made with regard to water supply, water regulation and the modernization of irrigation and drainage systems. In spite of these efforts, water use in the fields is still somewhat inefficient. Some officials involved in water management believe that lack of co-operation by the peasants in the modernization of irrigation systems has caused delays in the implementation of irrigation projects.

In the past, Iran's farmers have benefitted from the extraction of ground water for irrigation purposes by the implementation of an ingenious method for tapping ground-water. This has been achieved by the construction of horizontal galleries known as Qanats[39] or Kariz. These are especially common in eastern Iran[40].

Until recently, primitive irrigation methods using temporary diversion structures, made of wood, sand or gravel and hand-dug unlined channels, which were often highly complex in pattern, were or still are common in Iran. Their essential characteristics are high evaporation and percolation losses which are usually over 50%[41]. These increase when numerous irrigation canals are used to irrigate an individual village. In many cases the length of the canal network is much longer than is necessary for the efficient distribution of available water. This is considered one of the major problems of irrigated agriculture in Iran.

Until 1962 qanats were considered as the major supplier of irrigation water. The advantages and disadvantages of this irrigation technique have been stated by a number of authors. Among the advantages the following stand out. Once a qanat is constructed it continues to supply water for many years with only relatively little annual maintenance[42]. Also these annual cleaning and maintenance operations are facilitated by a few locally available and skilled labourers[43]. Disadvantages usually outweigh the advantages. The most important one is that the qanat can not be regarded as a reliable source of water supply, as during drought conditions the flows will decline in association with falls in the water-table. In addition, the qanat's discharge can not be controlled. Therefore, water runs to waste during the winter seasons and during the summer nights when irrigation water is not required .

So far, complex customs and traditions have tended to control irrigation amounts rather than actual calculations of the water needs of the growing plants. As a result, water efficiency tends to be low and the coordination between the development of water resources and agricultural projects is lacking[44].

The rules, regulating water supplies, canals and qanats, have remained almost unchanged for many centuries. The importance of proper water control and management which is reflected in Moslem law, is now part of the customs and the legislation of Iran[45]. Until the late 1960's, apart from a number of written laws, a complex body of Islamic laws and local customs governed water resource management[46]. Two major events have profoundly influenced water resource development in Iran since that time. The first was the foundation of the Ministry of Water and Power by a legal decree No.20,392 dated 5 April 1964. This gave the Ministry the task of supervising, coordinating and implementing policies dealing with water resource development. The second was the enactment of the nationalization of water resources on 29 July 1968. With the implementation of this act all water within the country was defined as belonging to the nation and was considered as national wealth[47]. With the enactment of this law, only the Ministry of Water and Power has the authority to supervise and control all future development of water resources. All future water users will now have to obtain a permit. As a result it was hoped that in a few years time, a more rational policy of water management would be implemented throughout the country.

Since Iran has a great contrast in geographical and climatic conditions, large-scale water resource development requires both enormous investments and the application of advanced technologies. The private sector is not capable of supporting such programmes. This means that government finance is essential for such schemes.

In the early years of the Third Plan the implementation of the Government's land reform programme had considerable effect on water resource developments. Many landlords were unwilling to invest in water resource projects, because of uncertainty felt about the future[48]. This continued until early 1970's. Since the beginning of the fifth Development Plan (March 1973) the Government has begun to encourage private sector investment in ground water resources. Indeed there is a major part of the Fifth Plan in which the functions of the private sector in water resource development are defined[49].

Planning for domestic and industrial water supply has not followed long-term programmes. Currently, overcoming the problems of water shortages in the towns and cities of Iran has required immediate solutions. Projects of this nature are usually more costly than those which could have been planned over a longer time period.

Water pricing for domestic, industrial and agricultural uses has not been undertaken in terms of a coordinated policy[50]. Water supply projects have usually been costly, but have indicated an indefinite contribution of the private sector in investment.

So far water resource development schemes have required both the employment of expensive foreign specialists and the importation of high technologies. These have been claimed, by a number of Iranian scholars, as the major reasons for the high cost of water development projects in Iran[51].

As every water resource development project requires a long, regular and accurate knowledge of recorded data, there is a great need for Iran to develop her meteorological organization. In 1965 there were only 44 synoptic stations, 140 climatological stations and 200 rain gauging stations[52]. Taking into account both the vast area of Iran and its great climatic contrasts, there is an urgent need to expand the meteorological networks. During recent years the Iranian Meteorological Department has developed its observational stations. In 1974 there were 50 synoptic stations, 1,000 rain gauges and 500 climatological stations[53]. The Ministry of Water and Power has also expanded its own network of stations. However, water resource planning projects in Iran are still not well equipped as far as the availability of climatological and hydrological data are concerned. There was only one synoptic station for every 32,960 $Km^2$ in 1974. The corresponding figures for rain gauging and climatological stations were one for 1,648 $Km^2$ and 3,296 $Km^2$ respectively.

## 2-b The Economic and Social Measures

### 2-b-1 Land use and the place of agriculture in the economy of Iran

In Iran, as in many developing countries, cadastral surveys often present conflicting or questionable data. The amount of land lying fallow and the amount under permanent pasture is debatable. Table 2-4 reveals the pattern of land utilization in Iran in the early 1960's and at the end of the Third and the Fourth Plans.

Of the total 18.0 million hectares of cropland officially reported in 1960, 6 million hectares were under cultivation and the remaining (75%) were temporary fallow due to the lack of

Table 2-4

Land Use, 1960, 1967 and 1972

| Land Use | 1960[1] | | 1967[2] | | 1972[2] | |
|---|---|---|---|---|---|---|
| | Area 1,000 ha | Total land area of country Per cent | Area 1,000 ha | Total land area of country Per cent | Area 1,000 ha | Total land area of country Per cent |
| Total cultivated land including fallow | 18,000 | 11.00 | 19,000 | 11.5 | 19,000 | 11.5 |
| Area under annual and permanent cultivation | 6,000 | - | 7,100 | - | 7,650 | - |
| Irrigated | 2,300 | - | 3,150 | - | 3,450 | - |
| Prepared for cultivation beneath dams | - | - | - | - | 100 | - |
| Dry farmed | 3,700 | - | 3,950 | - | 4,100 | - |
| Area temporarily fallow | 12,000 | - | 11,900 | - | 11,350 | - |
| Permanent pastures and meadows | 10,000 | 6.10 | 10,000 | 6.1 | 10,000 | 6.1 |
| Forests and woods | 18,000 | 11.00 | 19,000 | 11.5 | 19,000 | 11.5 |
| Uncultivated land capable of reclamation and development | 31,500 | 19.26 | 31,000 | 18.8 | 31,000 | 18.8 |
| Uncultivable land including mountains, deserts, lakes, cities, roads. etc. | 86,100 | 52.64 | 86,000 | 52.1 | 86,000 | 52.1 |
| Total | 163,600 | 100.00 | 165,000 | 100.0 | 165,000 | 100.0 |

Source: 1. Plan organization of Iran, 1962, "Review of the second seven year plan programme of Iran", 1960.

2. Imperial Government of Iran, 1968. Plan organization, fourth National Development Plan, 1968-72, pp.89-114.

water, low level of agricultural technology and the lack of transportation facilities for marketing crops. Approximately 2.5 million hectares (41.7%) of land received irrigation. In the main dry farming areas of the country, i.e. Azarbaijan, Kurdestan and Kirmanshah, crop failures due to insufficient rainfall are of frequent occurrence[54]. It is estimated that Iran has a potential for expanding its croplands by 30 to 50 million hectares[55]. FAO projections show Iran's planted cropland could be 9.5 million hectares by 1985.

One of the major physical factors limiting the extension of the cultivable lands is water, although in many parts of the country, the restraints are associated with its distribution and management rather than with its supply.

The amount of capital including land investment per man in Iran is far from sufficient. Population pressure on cultivated land is one of the most serious problems in Iranian agriculture. According to the calculations made in 1343 (1964) by the Plan Organization of Iran, 71.8% of rural people resided in 10,241 villages and the remaining 28.2% lived in 38,586 villages[56].

In 1966 the total population of Iran was given as 25,778,000. 15,994,000 of these people lived in rural areas. Most of these people, were directly or indirectly engaged in agriculture.

According to Plan Organization's report of 1966 the number of villages belonging to the relatively modern sector of Iranian agriculture was 1,277 villages, with a total area of about 700,000 hectares. In the same year, the total land under cultivation in the whole of Iran was 6,842,000 hectares. Therefore, the total land farmed traditionally was about 6,142,000 hectares. By dividing the amount of land among the rural families, the per family unit of land area is about 2.5 hectares. The figure for each American family is 125 hectares, for an Australian farmer it is 140 hectares, for a Canadian farmer 185 hectares and for an Indian farmer 2.5 hectares in 1964[57].

In 1960, there were 1,877,299 farmers and of this total 60% had less than 5 hectares. Farm units of more than 50 hectares made up only 13.68% of the total area under cultivation[58].

The first phase of the government's land reform programme was implemented in 1962. Land was distributed among the peasants, but there was little change in the size of the farm units, as each peasant received the plot of land that he was farming on. However, after the land reform there was a change of management, and as a result the number of farm managers and decision-makers increased. Hence, the problem of farm size started to reach a more critical point in Iran's agriculture. An F.A.O. observer in 1962 recommended that farm units averaging about 25 hectares were the optimum size for Iranian conditions[59]. The mutual commission of the agriculture and natural resources of the National and Senate assemblies of Iran has recommended farm units of an average size of 20 hectares in 1975[60] whereas an optimum farm size of 50 hectares was suggested by the Ministry of Cooperation and Rural Affairs of Iran (R. Sadaqiani) one year later in 1976[61].

Yields of all crops were extremely low in the late 1950s. Although approximately one third of all cultivated land is irrigated, wheat yields were on average less than one tonne per hectare[62]. Lambton gives a detailed list of yield-to-seed ratios from 45 locations, of which 16 are as low as 4 to 5 to 1 and only 6 are above 20 to 1 on irrigated lands[63].

Comparative figures from the U.S.A. provide yields from 7 on dry farms and 75-150 to 1 under irrigation.

This low yield per hectare resulted in a very low per capita income for the peasants in Iran. Roohani (1963, currently the Minister of Agriculture and Natural Resources of Iran) has estimated a per capita farm income at about 16,500 rials per year, or a per capita income of 3,300 rials per annum[64].

A low subsistence diet is a consequence of this low gross income. Bowen-Jones (1968) quoted a figure of 1,700 calories as an average per capita daily intake. This low calorie diet is 50 to 60% of that normal in Western Europe and North America. A F.A.O. technical research team in Iran has reported figures of 1,217 to 2,000 calories as an average per capita daily intake for the provinces of Kerman, Fars and Khuzestan[65]. These figures still range between 34 to 60% of that normal in Western Europe and North America.

The population of Iran, which was estimated to be 19.4 million at the General Census of 1956, had increased to 26.5 million by 1967. A figure of 57.7 is anticipated by 1990. A larger proportion of the population consists of rural dwellers:- 70% of the total population in 1956, 66.3% in 1960 and 61% in 1967[66]. The anticipated figure for 1991 is around 49.4%[67]. The proportion of the labour force engaged in agriculture was put by the manpower section of the Plan Organization at 56% in 1958. (It declined to 47.6% in 1966, 40.1% in 1971 and it is expected to decrease further to 34.1% by the end of the Fifth Development Plan[68].

Since 1962 agricultural production has not been sufficient to meet domestic consumption needs. In the case of wheat in the year 1962-63

Iran imported more than 70,000 tonnes. For rice also extra imports of 933 tonnes were required[69]. Currently the wheat importation increased to 3 million tonnes[70] and that of rice to 510,000 tonnes[71].

Among the imported food items, tea, sugar and vegetable oil constitute the bulk of agricultural imports. Vegetable oil importation accounts for 60% of the domestic consumption[72].

The fact that only small amounts of capital have been invested in the agricultural sector of the economy is considered one of the reasons for the failure of agricultural production to grow at higher rates. According to estimates by the Agricultural Bank of Iran, total expenditure for the provision of improved seeds, fertilizers and other expenses is at least 7,000 rials for every hectare of land[73]. If we assume that every year the total land under cultivation is 7.5 million hectares, the total amount necessary to satisfy this minimum need by the farmers would be 52.5 billion rials per annum. But in fact the total expenditure allocated to agricultural credit in the Third Plan (1962-67) was only 6.8 billion rials[74]. The Fourth Development Plan (1968-73) has followed a strategy for agricultural development similar to that of the preceding plan, aimed at increasing farm incomes and producing as much of the domestic requirements of food and fibres as possible. The overall objective was to increase agricultural productivity, but in fact, only 14 billion rials were allocated to agricultural credit in the Fourth Plan[75]. In the Fifth Plan the allocated credit rose to 25.2 billion rials per year which is still only half the estimated minimum need of 52.5 billion rials per annum but the revised figure of 47.92 billion rials[76] is closer to the minimum required credit. The Fifth Plan primarily aimed at a 5.5% annual growth rate for agriculture, but the revised Plan has a goal of a 7% growth[77]. How far the planned objective has been achieved is not yet definite.

The contribution of agriculture and related activities to the G.N.P. was estimated at 80-90 per cent at the turn of the century, whereas from 1926 to 1950 it was about 50%[78]. By 1959 the contribution had fallen to 32.1[79] followed by further falls to 30.5% in 1961[80], to 29.4% in 1962 and to 25.0% in 1967[81]. A further decrease to 16.6% was recorded in 1972 and a figure of 12.5% is anticipated for 1978[82]. The decline of the agricultural sector in terms of its contribution to the G.N.P. is mainly due to the rise in the production of oil, and the emergence of an industrial sector in the overall structure of economy.

Agriculture's contribution to the country's balance of trade and overall balance of payments is small. The share of agricultural products in the total value of exports and imports had declined considerably in the past several years, even though the absolute value of both has increased

In the 1971/72 Iranian trade year, agricultural exports accounted for slightly less than 50% of the value of all exports (excluding oil) and agricultural imports for almost 12% of the value of all imports (Tables 2-5 and 2-6). Total exports in 1971/72 amounted to $2.7 billion, of which $2.3 billion were from oil and $170 million were from agriculture[83]. Leading agricultural exports are cotton, fruits and nuts, and hides and skins. Carpets, an important export, depend on the livestock sector for raw materials.

Agricultural imports averaged 14.5% of total imports during 1958/59 - 1964/65. The percentage dropped to only 6.7% in 1969/70,

Table 2-5

Iran's Exports : 1962/63 - 1971/72

(U.S. $1,000)

| | 1960/61 - 1962/63 | 1969/70 | 1971/72 |
|---|---|---|---|
| Total exports | 885,589 | 2,193,336 | 2,676,607 |
| Oil exports | 748,565 | 1,939,006 | 2,227,128 |
| Agricultural exports | 79,224 | 134,603 | 169,546 |

Source: Ministry of Finance: Foreign trade statistics of Iran. Cited in the U.S.D.A. E.R.S. April 1974, pp.42-43.

Table 2-6

Iran's Imports : 1962/63 - 1971/72

(U.S. $1,000)

| | 1960/61 - 1962/63 | 1969/70 | 1971/72 |
|---|---|---|---|
| Total imports | 621,596 | 1,525,637 | 2,086,295 |
| Agricultural imports | 89,799 | 103,090 | 246,017 |
| Other imports | 531,797 | 1,422,547 | 1,835,278 |
| Net Balance of Agricultural Imports and Exports | -10,575 | -31,513 | -76,471 |

Source: Ministry of Finance. Foreign trade statistics of Iran. Cited in the U.S.D.A. E.R.S. April 1974, pp.44-45.

the lowest level since 1963/64. This percentage increased to 15% in 1974/75 with a total value of $1,000 million[84]. Iran's main agricultural imports as discussed before, are wheat and vegetable oils. Imports of these items are now larger in value than traditional imports such as sugar and tea. The value of wheat importation which was $10.7 million in 1960/61 - 1962/63 increased to $75.9 million in 1971/72. The corresponding figures for sugar imports were $30.3 million and $11.5 million respectively. Wheat imports depend on the amount of local crop production and have at times been substantial, such as in 1971/72 and 1973/74, when yearly imports totalled about 1 million tonnes. There has been a substantial increase in the import of live animals, meat and meat preparations, dairy products and eggs, animal feed and natural fibres. The import of live animals which was 500 tonnes in 1960/61 - 1962/63 increased to 12,100 tonnes in 1971/72. In terms of value the corresponding figures range between $483,000 and $8,034,000 respectively. For meat and meat preparations the figures of volume ranged between 800 tonnes and 6,800 tonnes and that of value between $699,000 and $5,260,000. Dairy products and eggs rank even higher in amount in 1971/72 this was 13,800 tonnes (it was only 4,600 tonnes during 1960-63) but always with higher values of $3,603,000 in 1960-63 and $15,580,000 in 1971/72[85].

The growth in demand for agricultural products can be approximated by a well-known equation, D = N + ey, where D is the demand for agricultural products, N is population, y stands for per capita income, and e is the income elasticity of demand for agricultural products[86].

It is estimated that the average income elasticity for less developed countries is 0.6[87], therefore, food shortages could cause higher prices for food. A study carried out by the Central Bank of Iran puts the income elasticity of demand for food at 0.513 in Teheran, 0.554 for nine large cities in Iran and 0.613 for twenty-two small cities. The average for all the urban areas of the country is 0.58[88].

Of course a country could import food supplies from abroad, but there then arises the problem of foreign exchange and the balance of payments. Furthermore, with the acceleration of industrialization, a surge in demand for many agricultural products, such as cotton, oil seeds, sugarbeet, tea flax and jute, is to be anticipated.

In 1972, 87.71% of the area under the cultivation of annual field crops was planted with wheat and barley, (Table 2-7). In this year the value of wheat products was estimated at 28 billion rials. Rice and cotton take up about the same amount of land but rice is a much higher value crop. It also costs more to grow[89]. The total value of agricultural products was 201.8 billion rials in 1972. In 1971 field crops accounted for 70% of all agricultural crop values[90].

2-b-2 The rural structure and the organization of agricultural production

The general descriptions presented so far to some extent obscure the real patterns of Iranian rural life and the chronic problems which confront the cultivators. Nothing has yet been said on the organization of agriculture, the status of Iranian cultivators, the return they receive for their labour and their share in the expanding economy.

Table 2-7

Area under cultivation and the Gross Value of Agricultural Products

| Crop | Area under field crops (1,000 ha) | % of the total | Gross value of products ($10^9$ rials) |
|---|---|---|---|
| | (1) | | (2) |
| Wheat | 5,469 | 64.72 | 27.99 |
| Barley | 1,519 | 18.00 | 5.4 |
| Rice | 377 | 4.46 | 12.32 |
| Cotton | 309 | 3.70 | 8.03 |
| Sugarbeet | 146 | 0.20 | 4.05 |
| Others | 630 | 7.50 | |
| Total | 8,450 | 99.31 | |
| Total agricultural products. (Crops and animals) | | | 201.8 (3) |

Source: (1) Plan and budget organization, August 1974, Statistical Centre of Iran. Agricultural Census of 1351 (1972). p.IX.

(2) Ibid. pp.28-40.

(3) B.M.I. August 1974, "Annual report and balance sheet by March 1973", p.63.

The need to supply cheap food and fibre for the urban areas, the high proportion of the population employed in farming, and the decline in rural incomes are the main political problems with regard to agriculture. Because of rising population numbers and general lowering of rural incomes, the life of the Iranian peasant has undergone little change in the past thousand or more years. Their existence has been about or just above starvation level[91]. The condition of this situation could result in human suffering and political instability.

The village with its cultivated and fallow land is a long-established agrarian unit in the agricultural sector. Traditionally, each village is divided into six parts or dangs, regardless of size. The population of villages varies considerably. If a village population exceeds 5,000 it is then considered to be a municipality. (Table 2-8 - the distribution of villages in relation to their population.)

Table 2-8

Distribution of Villages on the basis of their Population

| Population | No. of Villages |
|---|---|
| Less than 100 | 23,625 |
| 101 - 250 | 15,496 |
| 251 - 2,500 | 14,627 |
| 2,501 - 5,000 | 256 |

Source: Dadgar, M. and Sarkhnian, G. 1971, "Teamwork for World Health". Gordon Wolstenholm and Maeve O'Connor (ed) J.&A. Churchill, London, p.38.

The land area of each village is often very difficult to define. The unit of cultivation has numerous terms, namely, the Joft, the Kharvar, the Khish, the Jarib and the Gin. The most common term used is Joft, which refers to the amount of land that can be ploughed and cultivated by a pair of oxen. According to the physical characteristics of the land and the strength of the oxen, the area of the Joft differs from one area to another. In Jofts, holding tends to be between one and three hectares [92].

Khish is the cultivation unit employed in Khuzestan. This is approximately 6 hectares [93]. This represents the area which a farmer with traditional plough and a team of two oxen can cultivate.

In the Caspian provinces the unit of cultivation is known as the Jarib. This is 1.1 ha in extent [94]. In different parts of the country, the Jarib can be of different size.

Where water is in short supply for agricultural practices, the irrigated land is frequently discussed in terms of minutes or hours of water application. The terms used in this case are the Sang, the Jurreh, the Ghefis, the Abdang, the Joft, the Jarib, the Taq, the Nim Taq, the Finjan, and the Habbeh. For example a Jurreh is between $8\frac{1}{2}$ minutes and $11\frac{1}{2}$ minutes in length [95].

A possible link to a collective method of cultivation on a small scale in Persian agriculture is illustrated by the boneh[96] or bonkoo in Khuzestan[97]. The term boneh refers to a team or a group of farmers, relatives, or friends working with a number of teams of oxen to carry out cultivation. It owed its existence to water-shortage, and its size was also determined by the amount of water available for irrigation. The land allocated to each boneh in one village was almost equal in area, while the water rights were certainly equal [98]. The area cultivated by one boneh usually consisted of scattered plots in order to ensure that each boneh got a fair share of the sown area, in terms of quality as well as quantity. The hierarchy of a boneh consisted of the landlord (and/or his representative called a sarboneh), the village headman, the Abyar (irrigators), assistant irrigators, and the ordinary cultivators. The landlord was the chief decision-maker. He chose the range of crops grown, and the time of cultivation. The boneh was almost entirely dependent on him for finance. The boneh also encouraged close co-operation amongst its members.

The landownership and tenure systems, especially the landlord-tenant relationship, are the most important subject in the agrarian system of Iran. These have to be studied to achieve a full understanding of Iran's agrarian problems. The rural land falls into five major categories of ownership. These are:- Crown land, Public domain (Khaleseh), religious endowment (waqf), large private estates and peasant proprietorship.

Before the land reform law of January 1962, available statistics indicate that 56% of the cultivated land of Iran was owned by 1% of the population[99]. Small-holders and peasant owners are estimated to have had between 10 and 12% of the total cultivated land. Table 2-9 shows the overall situation of land ownership before the 1962 law. The table shows a wide range of land ownership and holding sizes, with relatively few private owners. State and religious endowments owned large estates, a large number, (sometimes close to 40 of single villages) and also part ownership of other villages. A larger number of individual farms were owned by small cultivators. This, then, was the pattern of land tenure in Iran, before land reform.

Table 2-9

Estimates of the Distribution of Land Ownership before Land Reform

| Type of ownership | % of all land owned | No. of villages | % of all villages |
|---|---|---|---|
| Large proprietors | 56.0 | 13,569 | 34.43 |
| Small proprietors | 10-12 | 16,522 | 41.93 |
| Crown domain | 10-13 | 812 | 2.06 |
| Religious endowment | 1–2 | 713 | 1.81 |
| Tribal holding | 13.0 | — | — |
| Public domain | 3-4 | 1,444 | 3 67 |
| Other holdings | | 6,346 | 16.10 |

Source: McLachlan, K.S., 1968, p.687.

In pre-land reform Iran, the landed aristocrats sought political power influence by use of their wealth.

The Iranian land-owning system was different from the feudal system practised in Europe. Lambton views the Iranian land system as being bureaucratic and not feudal[100]. Keddie has referred to the whole land tenure system of the Middle East and much of Asia as "city feudalism"[101].

Patches of land belonging to peasants and the lands of owner-occupiers are on the whole confined to the less fertile and remote parts of the country. Vadiie (1969) illustrates the pyramid of power in pre-reform Iranian villages. The landlord is at the top of the pyramid and the peasants and Khoshneshines at its base. In between these extremes are the Mobasher, Mirab, Motoveli, Gavband and Pilevar[102].

Absenteeism by the landlords was the rule rather than the exception. An overseer (Mobasher) would normally represent the landlord in the village. Some of the overseers might become small landowners in the course of time. The Mirab (water distributor) is another important key functionary in village life, who was nominated by the landlord and who may not necessarily be an inhabitant of the village. Sometimes a Mobasher's function was to act as a Mobasher and a Mirab. The establishment of the Independent Irrigation Institution in 1943 gave the state a wider control over irrigation, which extended also to privately owned Qanats. Of course, the primary intention of the law was to facilitate the undertaking of irrigation works. The Institute was authorized to form boards for the purposes of ensuring the regular division and distribution of the water and the maintenance of water works. These boards were composed of landlords and persons receiving water supplies. Even today, more than a decade after the implementation of the land reform laws which were aimed at the abolition of the power of the landlords, it is the Sar Mirabs or Mirabs who oversee the division of water. They are now empowered by the Regional Water Authorities. This was the case with the Sefid River irrigation project, visited during the field work period in July 1975. In a country like Iran, where water is so scarce a resource that people kill each other to obtain it, the high social status of the water distributor in rural areas is easily appreciated[103]. This is especially the case, because his close relationship with the landlords and now with the water authorities.

The ownership of water was not in all cases in the same hands as the ownership of the land. For example in Khu zestan and in some parts of Yazd, the ownership of the two could be distinguished. In the latter case the peasant proprietors used to pay water dues to an absentee owner[104].

The division of the crop between the landowner and the peasant was mainly based on the five elements of production - land, water, draught animals, labour and seed. Theoretically one fifth of the crop would go to the provider of each of these elements, land, water and, in some instances, seed were supplied by the landlord. Share cropping was exercised on 54.8% of the cultivated land and a fixed rental arrangement on only 7%, which was more common in the northern Iran. Cash payments or payments in kind, or often a mixture of the two, satisfied the terms of contract. This relationship remained unchanged for many years prior to land reform. Pasian (1962) has supported this proposition in the last section of his article on the peasant and farming activity in Iran[105]. This view is corroborated by Lambton's comment in "Landlord and Peasant in Persia" that "very little attention is paid by the Civil Code (or any other body of legislation) to the regulation of the relation of landlord and tenant. In general the scales are weighted in favour of the former, and little or no protection is afforded to the latter."

Although owner-operators utilised 26.2% of the cultivated land areas 63% of them had less than 1.1 hectares, 25% had between 1.1 and 2.83 ha and only 12% had more than 2.83 ha[106]. Even this largest category is too small to support a farming family. Labour dues in the form of cleaning the qanats belonging to the landowner, or ploughing his private garden for so many days a year were also imposed on the peasant.

Recognition of the type of village organization is of great value as a frame of reference in analysing the social and economic relations of rural society with regard to formulating rural development plans.

The village headman (Kadkhada), in privately owned villages, would be selected by the landlord. The selection of headman on the <u>Khaleseh</u> lands and religious endowments (Waqf) was carried out by the local branch office of the Ministry of Finance and the <u>Motevalli</u>, the trustee of the religious lands. It was only owner-operators, who decided on the appointment of their headman. One of the most important jobs of a <u>Kadkhada</u> was the implementation of Government regulations and decrees concerning village affairs. Persons involved in the process of cultivation were known as gavband (oxen-owner or tenant farmer), zari or peasant (formerly called rayat which literally means serf), barzigar (a share-cropper) and agricultural labourers.

The <u>gavband</u> normally did not own land but benefited from the return on his capital (oxen, ploughs and sometimes seed, as well as his labour). He also benefited from the lending of his oxen to peasants who lacked draught animals themselves. The landlords welcomed the existence of gavbands because they relieved landlords from supplying oxen or providing credit for oxen purchase to the cultivators.

The zari and barzigar did not own the land they worked. The former provided, usually, seed or oxen as well as his labour input, but the latter only participated in farming by offering his labour to the landlord or the a gavband. Both rendered a share of crop produced (in cash, kind or both) to the landlord.

Receiving a fixed wage is the only difference between agricultural labourer and barzigar. Involvement of most of the people in the average village are either zari or barzigar.

The unsolved problems of unemployment, disguised unemployment and rural-urban migration are made even worse by the existence of khoshneshins. There are a group of village dwellers, who, though not directly involved in agricultural production, are considered as a part of the village community. Essentially their role is to act as migrant workers.

Shopkeepers are considered as parasites, imposed on the cultivators, and charging high interest rates on their transactions.

Khoshneshines were usually made to emigrate by landlords, since they had no stake in land and were thought to be interested in intrigue, and to cause friction among cultivators for the purposes of self-interest. Finally, the Pilevars (pedlars) who are a kind of link between the retail commerce of the town and the village, sell cloth and consumer goods to villagers at high interest charges. This selling is usually by credit or by the purchase of standing crops before they reach maturity. These people do not necessarily reside in the village.

The backwardness of agriculture, besides the defects in the existing institutions of land tenure and the absenteeism of landlords, is due to traditional methods of farming. These are low consumption of fertilizers, very little consumption of improved seeds, lack of weed, pest and plant disease control, insufficient water, ill-managed irrigation and field crop losses sustained in harvesting.

The use of tractors and other types of powered machinery in agriculture advanced at a very slow pace during the period 1900 - 1955. By 1960 there were a total of 10 - 12,000 tractors and combines in use all over the country, operating on 10% of the total land holdings (i.e. 176,000 out of 1,877,300 holdings)[107]. By 1969 at the eastern end of the Caspian plain, 85 to 90% of the land was cultivated by tractors and wheat was harvested primarily by combines[108]. Japanese made power tillers are used on about 70% of all land devoted to rice cultivation, primarily in the Caspian area. During almost 16 years (1960 - 76) the number of tractors and combines increased to 35,000 (33,000 tractors and 2,000 combines) operated on an area under cultivation of 8,837,000 hectares[109]. The modest expansion of mechanization meant in some places encroachment of the plots of the small cultivators. Over most of the country, the vast majority of farmers continue to use traditional animal-drawn or hand operated tools which are unchanged since ancient Persian times. At the beginning of the 1960's about 75% of all land holdings used animal power, while 15% used human power alone. Farmers on about 40% of all land-holdings possessed their own draft animals. On other holdings farmers rented or borrowed animals and 75% of these animals were used on holdings of under 5 hectares.

Application of chemical fertilizers, presently on an increasing scale, was almost unknown two decades ago. During three Development Plans 1949-1968, fertilizer consumption developed to 47,000 tonnes/annum. The Fourth Development Plan projected a fertilizer use of more than 130,000 tonnes in 1972/73[110], and a further use of 800,000 tonnes is anticipated for 1977/78[111]. However increases of such magnitude are not easily achieved. Inadequate credit and poor distribution facilities have been two of the major obstacles retarding the use of fertilizers.

Under the division of the produce, based on the accepted five elements, introduction of any innovation by either landlord or peasant would seem improbable. Since rent is a function of output a farmer would only undertake additional cost up to the point where it did not exceed his portion of the extra revenue gained. On the whole, the owner operators and fixed rental farmers were more concerned with the fertility of land than were share croppers, and their land also had a better agricultural performance. The agricultural census of 1339 (1960) clearly showed this fact. Also Ajami's comparison of the economic productivity of the two systems of land ownership in Iran, i.e. peasant-farmers and owner-operators emphasises the disability of the landlord-peasant system in the improvement of land productivity[112], (Table 2-10).

In addition to the great difference of per capita income between the rural and urban areas, lack of social services, in both cases, health and education made the urban-rural gap larger. In 1960 out of a total 10,115,501 peasants over 10 years in age, 8,583,230, or 84% were illiterate[113]

Table 2-10

Economic Productivity in two systems of Land Ownership

(Pre land reform period)

| Criteria | Owner operators | Peasant farmers without land |
|---|---|---|
| Capital investment - rial/ha | 3,800 | - |
| Wheat yield - Kg/ha | 1,625 | 1,438 |
| Barley yield - Kg/ha | 1,474 | 1,280 |
| Ratio of the crop value to cost (regardless of the cost of labour) | 2.8 | 1.9 |

Source: Ajami, I., 1969, "Shesh Dangi".
Cited in Poorafzal, H. and Najafi, B., Nov.1972.
"Land reform and collective units of farm production",
University of Pahlavi, Iran, Pub. No.37, p.28.

Yet without educational training the peasantry cannot successfully overcome the usually harsh environment, let alone develop sophisticated approaches to economic organization such as those envisaged in the land reform proposals for village co-operatives.

It was general belief in the pre-land reform period that the landlords, in order to safeguard their interests, thought it necessary to keep the peasants in ignorance and poverty by opposing the establishment of schools and medical services.

### 2-b-3 Implementation of Land Reform and the redistribution of the land

In the last two decades, steps were taken to reform the agrarian order and rural backwardness by removing the traditional institutions governing village life. In short, land reforms were designed to meet two major purposes. These are:

1) To establish social justice, so that 75 percent of the rural population of the country can enjoy decent living standards and be free to handle their own affairs.
2) To increase the nation's agricultural output. The idea behind this was that, when a farmer works on the land which belongs to him, he will work harder and this will naturally tend to increase production.

In 1950, the Shah took the first step in land reform by divesting himself of more than 2,000 villages. About 200,000 hectares of this land have been sold to about 25,000 former tenants. In 1958 under the programme of public domain land division, 100,000 families became owners of land plots of about 10 hectares each of irrigated or 15 hectares of non-irrigated land[114].

The first serious effort to redistribute private land occurred in 1960, but much protest from the land-owners impeded progress. This was due to the deep-rootedness of the problems and the resistance of vested interests who regarded the reforms as a direct challenge to their authority.

In 1962 a new law referred to as: "The Original Law" limited land ownership to one village of six "Dang". Mechanized farms, plantations, tea gardens, and orchards were exempted from this decree, but all other land had to be sold to the Government. The Government then resold the land to the farmers who were actually working the land, on the condition that they would supply their own draught animals, ploughs and seeds, and would become members of the farm co-operatives organized as part of the reform[115]. It is difficult to assess the effectiveness of the first phase of land reform. Official statistics, regarding the implementation of land reform of January, 1962, to 21 March 1971, are given in Tables 2-11, 2-12 and 2-13. The tables do not show the actual area distributed, or the number of people who became new landowners. U.S.D.A. (1974) gives an estimated figure of 600,000 farmers who became owners of the land they had previously held as tenants[116]. However, an agricultural sample survey undertaken by the Iranian authorities and the F.A.O. in 1960 estimated the rural population of Iran as 15.4 million and the cultivated areas as 11.4 million hectares, of which 39.9% was left fallow. 1.9 million rural families had regular positions on holdings averaging about 6 hectares in size (including fallow), but another 1.3 million rural

### Table 2-11 First Phase

| | | |
|---|---|---|
| 1. | Number of villages purchased | 16,325 |
| 2. | Number of farms purchased | 1,019 |
| 3. | Cost of properties purchased | 9,857,036,000 rials |
| 4. | Payment of first instalment to landlords | 3,104,901,000 " |
| 5. | Cost of the state lands | 1,340,641,000 " |
| 6. | Number of farming families who have received land | 774,108 |
| 7. | Number of family members who have received land | 3,830,517 |

### Table 2-12 Second Phase

| | | |
|---|---|---|
| 1. | Number of villages leased | 54,727 |
| 2. | Number of farms leased | 21,677 |
| 3. | Number of farmer families benefiting from the second phase | 2,518,079 |
| 4. | Number of family members in above | 12,473,379 |

### Table 2-13 Third Phase

| | | |
|---|---|---|
| 1. | Number of small holders who asked for the sale of their farms | 26,191 |
| 2. | Number of small holders in whose case sales have to take place | 224,770 |
| 3. | Number of small holders whose lands have been transferred to cultivators | 92,617 |
| 4. | Number of remaining small holders | 132,153 |
| 5. | Number of buyer farmers | 323,765 |

Source: Ministry of Co-operation and Rural Affairs.
Cited in the Plan Organization, Statistical Centre, Annual statistical yearbook, 1350: Esfand 1351 (March 1972). pp.284-285.

families had no such regular positions and most had to live off the same holdings[117]. The survey also found that 13.3% of the employed rural population were wage labourers and 33.8% were family workers[118].

This 47.1% of the employed rural population with nothing to offer but their labour, generally received no land in either phase of the land reform. They remain dependent on the farmers or on the new land owning peasants for their employment, or they must continue to migrate to the cities, where unemployment and under-employment are still prevalent.

About ten million out of the 15.4 million rural population of Iran belongs to the poorer class who have either no land at their disposal or have less than 4 hectares to cultivate[119].

At the beginning of the land reform, the number of villages was estimated at over 48,500 (Research Group. 1964, 139). As the reform proceeded it grew to 54,000, and in the most recent official statistics, it appears as approximately 70,000 plus 22,750 farms or hamlets[120].

At the first stage, the total number of villages considered to be eligible for reform was estimated to be 15,830, of which only 3,967 (25%) were whole (six-dang) villages, the rest being only partially eligible. Bank Markazi of Iran refers to the distribution of over 16,300 whole or part villages through the first stage of land reform. This is almost close to the quoted figure of 15,830 villages by the Ministry of Co-operation and Rural Affairs. Assuming the rest of 11,863 partially eligible villages as 5,431 whole villages, it follows that about the equivalent of 9,398 whole villages or about 13.5% of the total number of 70,000 villages have been affected by the first stage. The number of households receiving land are numerated at 707,000[121] out of 3.2 million households or 22% of the total. This stage implemented by more articles, which were added to the land reform law on the 17th January 1963. These articles affected the landlord-peasant relationships not previously covered by the original law. It offered the landlords three ways of reducing the area of the land they cultivated. These were by lease, by sale or by land division. The lease was to be for 30 years, payable in cash, based on average returns over the preceding three years, and subject to revision every five years. The division of the land is in the same ratio as the customary sharing arrangements, while sales to tenants are by mutual agreement. Land holdings were restricted to a minimum of 20 to 2,000 hectares, depending on the location and productivity of the land. As in phase one, however, certain land holdings were exempted from the total amount of land allowed to one owner. Data on the number of villages affected by different procedures of the supplementary articles are not publicly available. For example, Shadman (1972), as the result of negotiations between the National and Senate Assemblies, made public on the 5th of Bahman 1351 (February 1972) declared that up to the 1st of Azar 1351 (December 1972), the application of the law governing the second stage of land reform in 54,827 villages and 21,811 hamlets was completed, and that the legal position of 2,522,372 peasants' households, composed of 12,459,773 persons was clearly defined[122]. About 1.2 million households became lease-holders and 200,000 to 400,000 were affected in other ways. Only 57,000 households managed to buy land privately from landlords.

In 1969 the Act of the distribution and/or sale of rental farms to farmers was passed, initiating the final phase of the land reform programme, under which, areas previously rented, had to be sold to the peasants on the basis of 12 years rent or else the land could be divided between the landlord and peasants on the basis of the customary ratio of landlord/peasant shares[123].

In both stages, of the 3.2 million households, less than one-third received or privately bought land, or acquired shares in agricultural corporations[124]. About 40% were given tenancies, and around 28% still cultivated under the old system. Furthermore, about one million households of Khoshneshines still wandering between villages and towns, are excluded from the above figures[125].

In addition to the land distribution aspects, the land reform programme sought to stimulate agricultural growth by increasing productivity and to replace all subsistence farms with new, market-oriented enterprises. A joint stock farm Corporation bill passed by parliament in January 1967[126], sought to merge small-farmer groups under government supervision with government finance. This legislation provided that such operations might be formed wherever 51% of the landowners in a given area vote in favour of them. Up to March 1974, sixty-five agricultural corporations were established on a total area of 285,162 hectares and had a total number of 22,778 share holders.

The strategy for the establishment of "Agro-industrial Companies" which was put forward in the law enacted in June 1967, is based on the formation of "agro-businesses". These are large economic complexes covering over 5,000 hectares of agricultural land, and are run along commercial industrial lines. They can both be set up by the public sector and by foreign and domestic private capital. The law authorised the Ministry of Water and Power ( now the Ministry of Energy) to promote such industries in order to allow for the maximum exploitation of the country's land and water resources[127] (manab-i-ab-va-khak). So far these companies have been established on the most fertile lands. These "fertile regions" are usually to be found around the more recent hydro-electric dams. During the Fourth and the Fifth Development Plans (1968-78) a number of such companies has been established on lands below dams, especially below the Mohamad Reza Shah Pahlavi dam in Khuzestan, the Aras dam in Azarbaijan and the Shahbanoo-Farah dam in Gilan. By the end of the Fifth Plan the area leased to such companies will be extended to 300,000 hectares[128]. But this is only an initial step in the implementation of this policy. The bill for the extension of advanced agricultural industries on the country's land and water resources has been presented to the Iranian parliament for enactment. When this bill is passed the agro-industrial policy will apply in over twenty regions of Iran. Most of these regions are located below the dams on irrigation networks fed by the major rivers of Iran[129].

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# CHAPTER 3

## WATER RESOURCE DEVELOPMENT IN IRAN

### 3-1 Development of Water Resources until 1960

It is generally recognized that the agricultural production of a nation depends on meteorological conditions, the land and its inherent fertility, the application of agricultural technology and the cost-income relationship of products therefrom.

Due to the arid nature of Iran's climate, numerous irrigation projects through the years have been constructed in different parts of the country. In the dry upland basins of Iran, ground-water was sometimes the only water resource which was available to the inhabitants[1]. Over the years a number of ingenious methods have been evolved to extract this water and to supply it for irrigation purposes.

The Persian wheel was popular in Iran[2]. It consisted of a series of buckets usually made from skins attached to an endless belt and driven by animal power (camel, ox or horse). It served as a pump that lifted water from the stream or well to supply irrigated lands but was used more frequently to provide drinking water for the villages. Perhaps the most unusual way of tapping ground-water has been by use of a qanat[3] (in Eastern Iran, Kariz[4]). The qanat is an underground tunnel, usually constructed through alluvial material, which transmits water from beneath the water table to the ground surface. The exact number of qanats constructed in Iran is not known though it has been estimated that perhaps 50,000[5] were at once in operation. In 1961 the number of existing qanats was quoted at 35,000[6], but Beaumont (1973) gives a figure of between 10,000 to 40,000 and Vahidi 20,000[7].

The supply of water by qanats was estimated on average at 20 l/S making a total supply of about 700,000 l/S. Most qanats seem to have discharges between 0 to 100 cubic metres per hour[8].

The largest known qanat in Iran has a length of 120 Kilometres and is located in Yazd[9]. However the majority would seem to be between 0.5 to 5.0 Kilometres in length. Similarly, although mother well depths of more than 250 metres are known in the Gonabad region of Eastern Iran, most qanats have mother well depths of only 10 to 50 metres In 1961, the total value of all qanats was estimated at 40 billion rials. These qanats supplied 12 x $10^9$ $m^3$ of water during the growing season to irrigate some 1,250,000 hectares of land .

Wherever surface water supplies have been available, they have been used for irrigation. Water is usually directed from a river by means of a temporary structure, made of wood, sand, or gravel, into a hand-dug irrigation channel network, which transports the water to the fields. Such networks are often highly complex in pattern and require careful control to ensure their successful operation.

It is estimated that 11 x $10^9$ $m^3$ of water were supplied by traditional irrigation systems to irrigate 1,140,000 hectares of land in 1961 .

The old surface water development works have been famous since antiquity in Iran. Some of the works have remained in useful service, and evidence of many others can still be seen. The Khuzestan region in south western Iran was, twenty-five centuries ago, a wealthy centre of a notable civilization. Many thousands of hectares were under extensive cultivation, irrigated by the five large rivers of this region. Subsequentl this land has been reduced to a huge desert[10].

To-day there is ample evidence of these works all through Iran. Table 3-1 shows the ancient barrages on the rivers of the country. The first four barrages date back 2,000 to 2,500 years ago, i.e. the Achaemenian era. The second group numbered from 5 to 24 date back 1,300 to 1,700 years ago to the Sassanian period. The third group, numbered 25 to 32, dates back 1,000 years to the Al-e-Booyeh reign. The fourth, numbered from 33 to 34 are about 900 years old from Ghaznavian period. The fifth group from 35 to 37 dates back 700 years to the Ilkhanian period. The sixth, ranging from 38 to 49, were 300 to 400 years old and belong to the Safavid monarchy. And finally the seventh group, numbered from 50 to 59, are 100 to 200 years old.

Owing to water shortage in some irrigated lands, fed from surface water could be cultivated only once in three years. For the remaining two years, the land remained fallow[11]. Because of the limited supply of surface water in central Iran many wells have been constructed. Deep well construction has not a long history in Iran. It was only after the second World War, that Water supply by means of deep wells became important. The initial objective was to supply water for domestic demands, then it developed in the suburbs of the major cities to supply irrigation water for orchards and gardens. It is a new device in the villages for irrigation purposes dating from the 1950's. The delay is due to shortages of reliable and cheap electricity in the villages, although early ones were powered by internal combustion engines. In 1961 it was estimated that approximately 2,000 wells throughout Iran supplied 2 x $10^9$ $m^3$ of water for irrigation purposes[12]. By 1976 the number of deep wells had increased to 9,000, the number of semi-deep wells to 31,000 and the number of artesian wells to 2,000[13].

Table 3-1

The Old Surface Water Works in Iran (2500 - 100 yrs old)

| No. | Achaemenian Period (2000-2500 yrs old) | No. | Sassanian Period (1300-1700 yrs old | No. | Al-e-Booyeh Period (1000 yrs old) | No. | Ghaznavian Period (900 yrs old) | No. | Ilkhanian Period (700 yrs old) | No. | Safavid Period (300-400 yrs old) | No | (100-200 yrs old) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | The Koorosh Kabir (D) | 5 | Aghili (W) | 25 | Amir (W) | 33 | Toos (BB) | 35 | Saveh (D) | 38 | Qohrood (W) | 50 | Darreh (W) |
| 2 | The River Kor (3Ds) | 6 | Dokhtar (W) | 26 | Faiz Abad (W) | 34 | Shesh Taraz (D) | 36 | Kebar (D) | 39 | Qamsar (W) | 51 | Omar Shah (W) |
| 3 | Bahman (W) | 7 | Mizan (W) | 27 | Tilakan (W) | | | 37 | Tabas (D) | 40 | Khajoo (BB) | 52 | Allahverdi-Khan (B) |
| 4 | Dariush Kabir (W) | 8 | Gar Gar (W) | 28 | Mowan (W) | | | | | 41 | Akhlemad (W) | 53 | Abshar (W) |
| | | 9 | Aiiar (W) | 29 | Hasanabad (W) | | | | | 42 | Fariman (W) | 54 | Sarvan (W) |
| | | 10 | Mahibazan (W) | 30 | Jahanabad (W) | | | | | 43 | Kalat (W) | 55 | Gely (W) |
| | | 11 | Dara and Qir (Ws) | 31 | Darvazeh qoran (W) | | | | | 44 | Karit (W) | 56 | Shanzdah Deh (W) |
| | | 12 | Lashgar (BB) | 32 | Dokhtar (W) | | | | | 45 | Salami (W) | 57 | Qati-qeshah (W) |
| | | 13 | Shah Ali (BB) | | | | | | | 46 | Golestan (W) | 58 | Shadervan (BB) |
| | | 14 | Shushtar (BB) | | | | | | | 47 | Tarq (W) | 59 | Khalafabad (W) |
| | | 15 | Dezful (BB) | | | | | | | 48 | Ashraf (W) | | |
| | | 16 | Pai-e-Pol (BB) | | | | | | | 49 | Qazvin (W) | | |
| | | 17 | Karkheh (W) | | | | | | | | | | |
| | | 18 | Khak (W) | | | | | | | | | | |
| | | 19 | Khoda Afarid (BB) | | | | | | | | | | |
| | | 20 | Argan (W) | | | | | | | | | | |
| | | 21 | Shahr-i-lut (W) | | | | | | | | | | |
| | | 22 | Darvazeh (W) | | | | | | | | | | |
| | | 23 | Persian Gulf Island (Ws) | | | | | | | | | | |
| | | 24 | Mond (D) | | | | | | | | | | |

Structures:- D = Dam
W = Weir
B = Barrage
BB = Barrage-bridge

Source: Reza, A., Kooros, G., Emamshushtari, M.A. and Entezami, A.A. 1971. "Water and Irrigation Technique in Old Iran", Ministry of Water and Power, Iran, p.224. Fig.137.

## 3-2 The Development Plans of Iran and Multi-purpose Dam Schemes

After the Second World War, Iran started her development plans. Water resource development in Iran dates back to 1930 when the legislation relating to qanats and the establishment of the Agricultural Bank was enacted. The Bank was given the authority to supply loans for a ten year term to landowners for the establishment of new qanats, and the reclamation and clearing of others. The Bank could also establish companies for the construction of dams and for the supply of agricultural water. These acts favoured the landowners rather than the peasant farmers, as the loans went directly to the landowners. In 1936 the Department of Irrigation and Dam Building of the Ministry of Agriculture was established. A year later, in 1937, the enactment of the rural development scheme law focused on the reclamation and development of qanats and irrigation works.

It was in 1943 that the law on the establishment of the Independent Irrigation Bongah (Corporation) was passed. The corporation was involved with the investigation and planning of surface and ground-water supplies through the construction of single-purpose dams and irrigation and drainage works.

Until the end of the first Seven Year Plan (1949-1956), despite the fact that there were neither accurate long term hydrological data nor reliable data on the resource potentials throughout Iran, the Shavoor dam in Khuzestan, the Kahak and Zehak dams in Seistan, the irrigation networks of Moghan, the Koohrang tunnel in Isfahan province and some other structures were built[14].

The Plan Organization Act of 1948 gave powers to the newly formed organization to undertake many projects concerning economic and social improvements of the country.

Agricultural development, under the Plan Organization Act, has followed two principles. The first is to supervise agricultural activities on arable lands created by new irrigation schemes and to increase the production on existing farm lands through the use of more effective techniques of farming[15]. During the First Development Plan (1948-55) a fund of $5.7 \times 10^9$ rials was spent on agriculture and irrigation . Of this total, $1.4 \times 10^9$ rials were for water resource development projects[16].

The allotted funds for agriculture and irrigation were $7.3 \times 10^9$ rials out of a development budget total of $26 \times 10^9$ rials[17].

In the second Seven year Development Plan (1955-62) $13.7 \times 10^9$ rials was allocated for the investigation of irrigation possibilities and for the construction of irrigation schemes. Of this 89% ($12{,}237 \times 10^6$ rials) was used for dam construction, 7% for irrigation development, 3% for repair of qanats and for the drilling of deep wells and 1% for irrigation operations[18].

It was, however, during the second Plan that the first large dams were built. These included the Mohamad Reza Shah Pablavi Dam on the Dez river in Khuzestan, the Shahbanoo Farah Dam on the Sefid river at Manjil in Gilan, the Amir Kabir Dam on the Karaj river to the north west of Tehran and the Shahnaz Dam near Hamadan. Meanwhile, Plan Organization was vested with the authority to carry out regional development schemes involving multiple-purpose undertakings. Four large regional development projects had reached the stage of construction during the plan. These were, the Khuzestan development plan for south west Iran, the Sefid river dam project in the Caspian littoral, the Karaj dam project, north west of Tehran and the Sistan-Baluchestan development project of south eastern Iran. These projects had aimed at the maximum utilization of the resource potentials of the different regions with the focus on the development of the water and land resources. The Khuzestan regional development plan has always been given the highest priority since 1955 owing to its high potential with regard to water, land, and abundant oil and natural gas resources[19]. During the third Five Year Development Plan (1963-68) $21,997 \times 10^6$ rials was allocated to irrigation projects. Of this $17,873 \times 10^6$ rials was allotted to the completion of projects started in the Second Plan. The overall objective of the Third Plan was to supply water for an additional 140,000 hectares of land and to regulate and to improve supply to a further 240,000 hectares[20].

In both the Second and the Third Plans, there was a heavy concentration of Government spending on dams with 35 billion rials being spent on 12 multi-purpose reservoir dams projects[21].

The Fourth Development Plan, covering the years 1968 to 1973 included a programme for the continued construction of the eight multi-purpose dams already being built. The allocated credits for the development of water resources in the Fourth Plan was estimated at 53.15 billion rials[22]. Of this 46.8 billion rials were allotted to surface water development schemes. The major objectives of the Fourth Plan were as follows:

a) To increase irrigation water supply by 3.32 billion $m^3$.

b) To regulate 1.63 billion $m^3$ of water for irrigation by the construction of diversion dams.

c) To irrigate a further 275,000 hectares of arable land

d) To improve the existing irrigated lands, amounting to 280,000 hectares[23].

As in the Third Plan, priority was given to the completion of irrigation networks below the dams already constructed and to the development of eixsting irrigation networks.

In March 1973 (the beginning of the Fifth Plan) 12 reservoir dams had been built, (Table 3-2 and Fig. 3-1). They supplied water totalling 10,050 million $m^3$ per annum. The increased area of arable land was estimated to be 400,000 hectares and the improvement of already existing irrigation networks affected some 500,000 hectares[24].

During the Fifth Development Plan (1973-78) total allotments for the development of water resources have been increased from 53.15 billion rials under the Fourth Plan to 110.7 billion rials[25]. More water for irrigation will be made available to increase the area of irrigated farmland to 3.9 million hectares compared with the 3.5 million hectares cultivated in 1973[26]. Considerable emphasis has been placed on the more efficient use of irrigation water and the management of the irrigation networks below the large reservoirs. The sub-allocation of the irrigation sector was 51.9 billion rials or 46.8% for the irrigation networks, 27.9 billion rials or 25.2% for water supply, 14.6 billion rials or 13.2% for the urban water development, 2 billion rials for hydro-power supply and the rest for research and water resource supervision[27].

New reservoir dams will be built only where the control of water resources is an essential prerequisite for urban water supply, for regional economic development or for power production which is economically feasible[28]. With the expansion of the oil revenues in 1973 the development

Table 3-2 Dams in Iran

| Name | River | Capacity million $m^3$ | Area Irrigated Development 1,000 ha | Area Irrigated Improvement 1,000 ha | Power Generated 1,000 k |
|---|---|---|---|---|---|
| **Already Constructed** | | | | | |
| Shahesmail | Golpaiegan | 50 | 2.3 | 2.7 | Nil |
| Amir Kabir | Karaj | 205* | 0 | 2.1 | 75 |
| Shahbanoo Farah | Sefid | 1,800 | 11.0 | 130.0 | 87.5 |
| Mohamad Reza Shah Pahlavi | Dez | 3,340 | 37.8 | 58.5 | 520.0 |
| Shahnaz Pahlavi | Abshineh | 8 | 0.2 Water for Hamadan | | Nil |
| Farahnaz Pahlavi (Latian) | Jaj | 95 | Water for Tehran | 20.0 | 22.0 |
| Shah Abbas Kabir | Zayandeh | 1,250 | 30.0 | 65.0 | 55.0 |
| Shapoor Aval | Mahabad | 230 | 40.0 | 10.0 | 5.76 |
| Aras | Aras | 1,350 | 72.0 | 18.0 | 22.0 |
| Voshmgir | Gorgan | 79 | 10.0 | 10.0 | Nil |
| Kourosh Kabir | Zarrineh | 650 | 65.0 | 20.0 | 10.0 |
| Darush Kabir | Kor | 993 | 21.0 | 21.0 Water for Shiraz | Nil |
| **Under Construction** | | | | | |
| Reza Shah Kabir | Karoon | 2,900 | 31.8 | 62.0 | 1,000 |
| Minab | Minab | 344 | 7.0 | 7.0 | Nil |
| Jiroft | Halil | 430 | 8.0 | 2.0 | 15 |
| Lar | Lar | 960 | 35.0 | 30.0 Water for Tehran | 140 |
| Qeshlaq | Qeshlaq | 224 | 7.0 | Water for Sanandaj | 3 |
| Pishin | Sarbaz | 130 | 2.8 | - | 150 |
| **Under Study** | | | | | |
| Nader Shah | Maroon | 1,620 | 5.9 | 49.6 | Nil |
| Saveh | Vaforqan | 290 | 14.0 | 11.0 | 2 |
| Taleqan | Shah | 208 | 56.0 | - | 76 |
| Bahoo Kalat | Bahoo | 60 | 0.5 | - | Nil |
| Khoda Afarin | Aras | 1,700 | 70.0 | 30-40 | 150 |

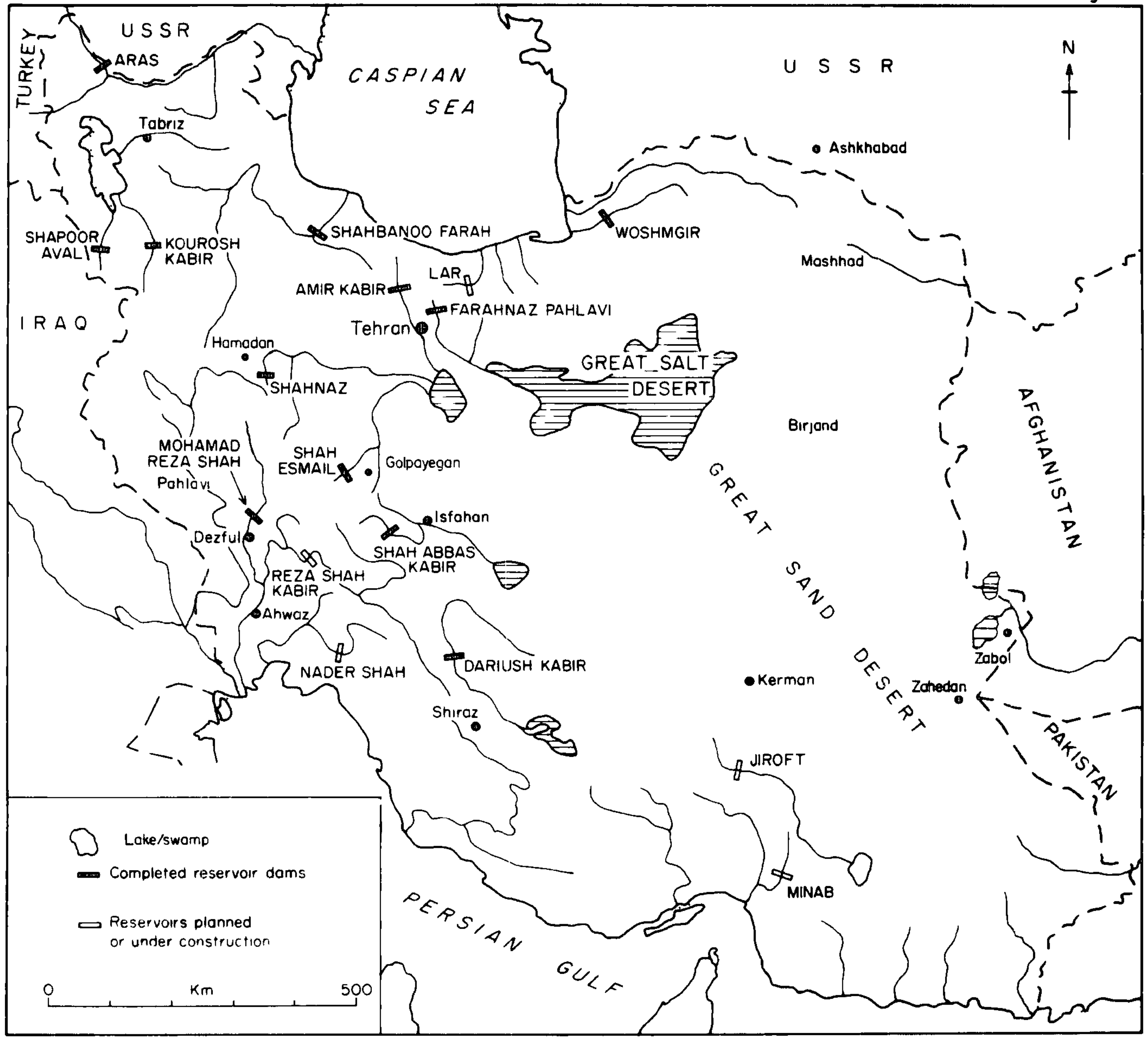
Source: (a) Echo of Iran. Iran Almanac, 1976, pp.186-187.

(b) Plan and budget organization, Statistical Centre of Iran. Statistical Yearbook 1352. (March 1973 - March 1974) March 1974, pp.308-309.

(c) Iran Economic News, May 1975, p.4.

* Water supply for Tehran.

THE MAJOR DAMS OF IRAN Fig 3 1



budget was revised and the allocated funds for the irrigation sector increased to 159 billion rials.[29]

The quantitative objectives of water supply during the Fifth Plan will be:-

a) The completion of the reservoir dams started during the Fourth Plan to control some 9,490 million cubic metres of water a year.

b) To build new reservoir dams studied during the Fourth Plan. Some of these will be completed during subsequent plans. The amount of water to be controlled by those dams which are to be completed during the Fifth Plan amounts to 430 million $m^3$ per year and those under subsequent plans to 2,470 million $m^3$/yr.

c) To transfer 430 million $m^3$ of water from water surplus areas to semi-arid fertile areas. Work on these undertakings was commenced during the Fourth Plan. New measures will be taken for the subsequent diversion of a further 195 million $m^3$. Of this total the diversion of 95 million $m^3$ is hoped to be achieved during the Fifth Plan[30].

Irrigation and drainage networks development projects will have the major objectives of:-

a) Completion of the major irrigation and drainage networks studied in the Fourth Plan. These will affect 387,000 ha.

b) Building of new major irrigation and drainage networks. This has started for 744,000 ha, of which 455,000 ha will be completed by the end of the Fifth Plan.

c) Completion of the lateral and sub-lateral irrigation and drainage networks started under the Fourth Plan for 140,000 ha. This will be followed on the new networks covering 998,000 ha. 455,000 of this total will be completed during the Fifth Plan.

d) Improvement of traditional irrigation networks which has been started on 165,000 ha, and will be completed on 110,000 ha by the end of the Plan.

Sea water desalination, cloud seeding and recycling of waste waters are the adapted new technological advances forming part of the Plan. The policy of desalination of water in the Fifth Plan has focused on the production of 23 million $m^3$ of water every year by 1978 in addition to some 3 million $m^3$ of desalinated water already in production every year[31].

During three development plans (1955-73) three major developments occurred in Iran, which have had significant impact on water resource developments. The first was the implementation of the Land Reform Programme. The second was the formation of the Ministry of Water and Power in March 1964 and the third was the nationalization of water resources in Iran on 29th July 1968.

Following the Land Reform Law, and the associated uncertainty about the future felt by landlords, private investment in water resource projects fell significantly below what had been foreseen when the plan was being prepared[32]. Thus it has been the public sector which has undertaken the major water resources development projects with a marked increase in allocated funds from 5.7 billion rials in the First Plan to 159 billion rials in the Fifth Plan. On the other hand, the water dues payers are mainly poor peasants who could not afford to buy the expensive water. As a result the return on capital investment in water development schemes fell much below what had been anticipated. This major factor together with others such as the small size of farms and the low productivity resulted in the introduction of new farming institutions such as farm corporations and agro-industrial companies. It is hoped that these new farming organisations can use water resources more efficiently and increase land productivity. With the creation of the Ministry of Water and Power in 1964, the Independent Irrigation Corporation was abolished and its various responsibilities were divided between the Ministry of Agriculture and the newly created water unit of the Ministry of Water and Power. The Ministry of Water and Power now undertakes the tasks of supervising, coordinating and implementing policies dealing with water resource development. In addition, authorities were created to complete major water and power facilities. Notable among these were the Khuzestan Water and Power Authority, the Teheran Regional Water Board, and the separate authorities for water and power in Gilan, Azarbaijan, Fars and Isfahan. These authorities replaced many of the local water users' cooperatives, which had been operating under the supervision of the I.I.C.

The nationalization of water resources is an extremely important event in the history of Iran's water resources development. The act reiterated concepts similar to those introduced in Islamic law by which all waters within the country were considered natural wealth and also to belong to the public[33]. The Ministry of Water and Power has been given the full authority for the supervision and control of water. It also issues permits for water use. The newly created water authorities are trying hard to implement the new laws and legislations and to replace the traditional ones which were governed by local customs and Islamic laws. They hope to increase the efficiency of water use and to end the mis-management of scarce water resources. When it is remembered that even in an advanced nation, like the United States of America, irrigation efficiencies are only 30 to 40 percent[34], then it is hard to believe the Iranian targets of up to 75 to 80 percent will be achieved[35].

3-3 Dams and Water Supply for Domestic and Industrial Uses

Prior to 1950, most domestic water demands were supplied largely from untreated ground-water transmitted by gravity flow through qanats and distributed within the communities via "jubes" (open ditches), a system dating back to early historic times. It was estimated that some 18,000 villages throughout Iran obtained water by this method[36]. Even in Tehran , the Capital of Iran with no perennial streams close by, they have until recently been dependent on 34 qanats with a total discharge of 1.3 $m^3$/sec.[37]

Within communities, most streets were bordered with jubes which were usually lined, but often included many unlined sections, from which consumers obtained their domestic supplies either by diverting water into small storage reservoirs, called "unbars" located beneath their houses or by taking water directly with pails or buckets. Supply was intermittent with water carried along these jobes to various sections of the community on specified days. Drinking water was usually bought from a street vendor, who went from door to door peddling a reportedly, but questionably safe product. In the early years of the second Seven Year Plan, practically all the towns and cities of Iran were without treated water supplies. Even in the capital of Iran, there was no piped water system before 1955.

Since 1955, Plan Organization has assumed the responsibility for undertaking projects of domestic and industrial water supply. During the Second Plan (1955-62), 207 domestic water supply projects were started. The development of deep wells has become widespread and over 1,300 wells have been drilled mostly for domestic use. The largest installation was a 12 inch well at the Shahnaz Square in Tehran. It is 155 metres deep and has a flow of 56 litres per second[38].

At the beginning of the Second Development Plan (1955) a population of 2,286,100 was served by the municipal water systems of Tehran, Tabrize, Shiraz and Kermanshah. By the end of the Second Plan a further 3,144,130 urban population were served through 159 additional systems[39]. The Third Plan programme of domestic water supply was to construct 146 new systems to serve a population of 1,075,920[40]. The goal of the Third Plan schemes was the development of water supplies, capable of initially supplying an average of 75 l/cap/d with provision for future expansion to 150 l/Cap/d.[41] To carry out domestic water supply projects, Plan Organization allocated half of the urban development funds for water development schemes[42].

The most serious problem involved with domestic and industrial water supply was the lack of available water resources. In most cases sources such as rivers, springs and qanats either did not exist or were used for agriculture and therefore could not be used on a large scale for domestic supply. On the other hand because of the rapid increase of population and the increasing demand for industrial and domestic water, a large and more dependable water supply became urgently necessary. The population of Iran increased from 18.9 million in 1956 to 25.8 million in 1966, and according to a Plan Organization projection, Iran's population will increase from 36,025 million in 1977 to 45.0 million in 1985[43].

Urbanization trends are important for urban development planning, and in particular for water supply. The growth of industry and the service sectors has resulted in increased employment opportunities in cities and a parallel growth in the rate of urbanization. Furthermore the rapid growth of population in the rural communities and the rise in the numbers of population in these regions has meant that many centres have now been classified as urban centres. Urban centres are defined as those with populations of more than 5,000. Whereas in 1956 about 31% of the population lived in urban areas, this proportion has increased to 38% in 1966 and the projected figures for 1972 and 1977 are 42 and 47% respectively . The increase in urbanization is associated with an increase in the general standards of living of the population. All these current trends in Iran have resulted in increased per capita demands for water[44].

Tehran has faced a very serious situation with rapid increase of population and associated water and sewage system problems. The population of Greater Tehran reached 4.6 million in 1975[45], and it is estimated to become more than 5.5 million by 1983[46], compared with a figure of only 210,000 in 1922. Also the per capita water consumption which was 88 l/Cap/d in 1960[47] increased to 150 l/Cap/d in 1966[48]. The total water supply at source was 28.5 million $m^3$ in 1959 and this increased to 288.4 million $m^3$/annum in 1971, A figure of 887.1 million $m^3$ is quoted by Sir Alexander Gibb and Partners for 1991/92[49].

The major objective of multi-purpose dam schemes in Iran has usually been the supply of water for agricultural needs. However, among dams built during the Second to the Fourth Plans (1955-73) a number of them designed with the objective of supplying water for urban and industrial needs. The Amir Kabir (Karaj) Dam on the Karaj river, 63 Km north west of Tehran, and the Farahnaz Pahlavi (Latian) Dam on the Jaj river, 30 Km north east of Tehran are the most important ones. The two together supply a total of $264 \times 10^6$ $m^3$ of water per annum, ($184 \times 10^6$ $m^3$ from the Amir Kabir dam and $80 \times 10^6$ $m^3$ from the Farahnaz Pahlavi Dam), at a cost of $8,381 \times 10^6$ rials for Tehran. The Karaj Dam was opened in 1961 and the Latian Dam in 1967[50].

Since the Fourth Development Plan the objective in water supply policy has slightly shifted. Some attention has been placed on industrial and domestic water supply which in many cases was in direct competition with agricultural needs. The most important case example is the Shah Abbas Dam on the Zayandeh river to the west of Isfahan. The mean annual flow of the river has been estimated at about 1,208 million $m^3$/annum of which 892 million $m^3$ is diverted water from the upper part of the River Karoon[51]. For centuries, the oasis of Isfahan has been furnished with water from the Zayandeh river. All available water resources were utilized for agricultural purposes. Since 1960's, with the building of a large steel works 30 Km west of Isfahan, the industrial demands for water from the river have increased greatly. The problem of water shortages will be met by diverting some 260[52] to 285 million[53] $m^3$/annum of water from the headstreams of the Karoon system into the Zayandeh river. The problem will become especially serious within the next decade when the steel works reaches its full production capacity in the 1980's. At that time the Zayandeh river should supply the expected industrial demand of 180 million $m^3$/a as well as the agricultural needs[54]. The agricultural water needs were estimated at 1,365.4 million $m^3$/a for the irrigation of 132,216 ha in 1970/71[55].

In the Fifth Five Year Development Plan, emphasis has been placed on providing a reliable water supply for a further 8 million urban inhabitants. Table 3-3 presents the overall situation of domestic and industrial water supply by the end of the Fourth Plan and the planned programme for the Fifth Plan.

Table 3-3

Domestic and Industrial Water Supply by the end of the Fourth (1973) and the Fifth (1978) Development Plans

| | Unit | 1973 | During the Fifth Plan | 1978 |
|---|---|---|---|---|
| Urban population | million | 13.2 | 3.8 | 17 |
| Annual water consumption by domestic and industrial consumers | million cubic metre | 690 | 268 | 958 |
| Water supply by the public sector | million cubic metre | 768 | 487 | 1,255 |
| Urban water consumers | million | 8.9 | 8.1 | 17 |

Source: Imperial Government of Iran. Plan Organization. "The Fifth Development Plan", 1352-56, January 1972. pp.251-300.

The figures indicate that at the end of the Fourth Plan the total water supply increased to 768 million $m^3$ and this water served a population of 8.9 million. By the end of the Third Plan an urban population of 6.5 million had assured water supplies. The supply of water for an extra 2.3 million urban inhabitants was achieved in the Fourth Plan. It is hoped that by the end of the Fifth Plan the total projected urban population of 17 million will have an assured water supply by the making available of an additional 487 million $m^3$/annum.

Among dams currently under construction, the Lar Dam on the Lar river to the north east of Tehran, has been given priority amongst all urban water supply schemes. Given the fact that even the total water supply from the Amir Kabir dam and the Farahnaz dam is insufficient to meet the rising needs for water in Tehran, great emphasis has been put on the completion of the Lar project by 1977-78. This scheme provides Tehran with 100 million $m^3$ of water per year at an estimated cost of 75 million U.S. dollars[56]. The later data on the Lar scheme indicate higher values in both water supply for Tehran and its cost. These values are 178 million $m^3$ per annum of water at a total cost of £128 million[57].

The dam had been scheduled to be completed by 1977/78, but according to the later data it will not be completed before September 1980. This water will be delivered to Tehran via the Talou Tunnel which is designed for the delivery of a total 180 million $m^3$ of water a year of which 100 million $m^3$ flow from the Lar river[58] and the remaining 80 million $m^3$ from the Jaj river[59].

This is the first project in Iran, which transfers water over long distances. In the Zayandeh river basin, near Isfahan an attempt was made to divert water from the head waters of the river Karoon into the Zayandeh river during the Safavid era, but this project was never completed.

In addition to the Lar project, the Minab scheme of the Minab river in Bandar Abbas and the Gheshlagh dam on the Gheshlagh river in Sanandaj (governing centre of the province of Kordestan) will supply water for these two urban centres. Both are hoped to be completed by the end of the Fifth Plan or early in the Sixth Plan[60].

With the rapid growth of urbanization, the authorities are currently undertaking studies on an even larger scale for the inter-basin transfer of water. The most important scheme is the diversion of water from the Shah river to Tehran via the Karaj district. This involves the transport of water over a distance of more than a hundred kilometres to help the growing water demands of Tehran[61].

Domestic water supply in rural areas is the responsibility of the Ministry of Co-operation and Rural Affairs. Up to the beginning of the Fifth Plan (March 1973) rural domestic water supply was neglected. Under the Fifth revised plan the Ministry of Co-operation and Rural Affairs has planned to carry out some 17,000 rural water supply projects at a cost of 19 billion rials[62]. This is the first major development in the field of rural water supplies since the Second World War.

## 3-4 Dams and Hydro-electric Power Generation

### 3-4-1 Electric power supply up to 1960

Electric power is a basic necessity for economic development in any country. In 1920, Lenin's view was that "the future development of the U.S.S.R. is entirely dependent upon the electrification of the country." Today this is reiterated for every developing country[63].

The role of electricity in economic development lies in the fact that it provides an important service to industry, as well as to the domestic and commercial consumers. Thus it must be regarded as an integral factor in national development planning.

In Iran systematic efforts at industrialization have occurred only since the 1930's. The electric power industry dates back to that period but most of the country's generating capacity has been built in the last few years.

Prior to the 1930's electricity was almost unknown in Iran. Around the turn of the century the Shah granted a concession to a Russian Company to build a small plant to supply the Royal Palace in Tehran. By the time Rezashah came to power in 1925 there were also several small private plants, owned by one man, which supplied electricity for a few street lights and several prominent homes in Tehran. These plants had a generating capacity of about 400 kilowatts[64].

In 1935 a municipal electricity generating plant was built in Tehran, with the capacity of 6,000 kilowatts. At that time the city had a population of 400,000 people. In 1956 the entire installed generating capacity in the country was 253,000 kilowatts. 85% of this capacity was concentrated in 26 load centres, of which Teheran was the principal one[65]. At this time there were fifty different power generating plants in the city of Tehran with a total capacity of 62,010 kilowatts. Their actual capacity was only 56,870 kilowatts. Twenty-nine of these were privately owned plants; 14 were industrial power companies owned by the government, and one was the municipality-owned company. The Electric Bongah (Company) which was owned by the government had a capacity of 18,460 kilowatts.

This was more than the total capacity of the private companies. A total of approximately 94,700 consumers received electric power. 58,700 were served by the Bongah and 36,000 by the private companies . The number of persons living in Tehran exceeded 1,600,000 , while the metropolitan area encompassed a population of over 1,800,000 . The number of potential customers was at least three times the number being served. This situation was more serious in other cities, notably in Tabrize, Shiraz and Mashad. In these cities the electricity demand exceeded the supply by as much as five to six times[66].

Most plants used diesel engines, although there was a steam station at the refinery in Abadan and a few steam turbines in other large cities.

The equipment was often poorly maintained and much of it had fallen into disrepair. Of the 183 generators in Tehran only 79 could be classified as being in good condition . The antiquated electricity network of Tehran was characterized by over-loading, by being unsafe and by losing about 50 percent of the energy supplied[67]. In many places potential consumers were required to pay a substantial fee, and even so they received no guarantee that electricity would actually be supplied without years of delay. In Tehran application fees of 10,000 rials were common and applicants were required to pay an additional 6,000 rials as a connection fee[68]. The number of paid up applicants was great. People might have to wait as long as eight years to get electricity. The difficulty of obtaining supplies had given rise to the idea that power supply was a luxury. When power was regarded as a necessity, as in the case of industrial establishments it was provided by the user himself.

More than half of the power for domestic and commercial use in Iran was sold at 4 rials per Kwh. To this there was usually added a local tax of 1 rial, making a total of 5 rials/Kwh. In many districts the rate was 5 rials plus tax, making a total of 6 rials/Kwh. There were some small plants that charged as much as 10 rials plus tax, making a total of 11 rials/Kwh. Industrial and municipal consumers paid from 1.5 to 3.5 rials/Kwh. exclusive of tax[69].

In 1962 the production of energy in Iran indicated that oil was the main source. Energy produced from oil constituted 60.6% of the total, and the corresponding percentages for other energy sources were:-

| | |
|---|---|
| wood and others | 21.2% |
| natural gas | 15.1% |
| coal | 2.2% |
| hydro-electric power | 0.5%[70]. |

With regard to the per capita energy consumption as a function of per capita income, low income in Iran resulted in a low rate of energy consumption compared with the advanced countries (Table 3-4).

Table 3-4

Per Capita Consumption of Energy and Per Capita Income of Iran and Selected Developed Countries in 1963

| Country | Per capita energy consumption (Kg coal equivalent) | Per capita income (dollars) |
|---|---|---|
| U.S.A. | 8,588 | 2,562 |
| Canada | 6,558 | 1,602 |
| Great Britain | 5,110 | 1,300 |
| Australia | 4,202 | 1,472 |
| Japan | 1,534 | 559 |
| Iran | 336 | 182 |

Source: Vatanian, A., 1971, p34. Table 6.

The per capita income of Iran was 14 times less than that of the U.S.A. while the per capita energy consumed was 25 times less than that of the U.S.A.

3-4-2 Development plans and electricity supply

During the second Seven Year Development Plan (1955-62), Plan Organization's undertakings for electricity supply were divided into two programmes. The first was concerned with those undertakings aiming at the supply of electricity to 181 towns, with a total projected investment of 1,500 million rials[71]. The programme was essentially short-term, and did not establish a basis for future economic growth, since it consisted of very small diesel units. The average size was 50 Kw .

The second was a series of hydro-electric dams, which were considered as a major source of electric power supply. The plan called for the installation of electricity generating equipment in the Dez, the Karaj and the Sefid River dams. The initial total capacity of these dams in the early years of the Third Plan was 290,000 Kwh. These dams, once completed, would provide industrial consumers situated within their economic transmission limits.

At a late stage of the Second Plan the total installed electricity capacity reached 400,000 kilowatts compared with 235,000 kilowatts at the beginning of the plan. Half of the installed capacity (204,500 Kw) was produced by hydro-electric plants[72].

Industrial uses of water, especially for power generation purposes were the responsibility of the private industries. No specific law dealing with power production for the whole country governed this important use of water.

Under the Third Plan, the Plan Organization set up a government agency known as the "National Iranian Power Authority". It evolved appropriate administrative, financial, economic and technical procedures on a uniform national basis for the whole of Iran. The authority extended its control through eight regional authorities to carry out the regulation and operation of plants within their regions according to national norms[73].

The need for the co-ordination of activities among the autonomous and individual producers of power led to the creation of the Ministry of Water and Power on 5th April 1964. As far as the industrial uses of water are concerned, the tasks of this Ministry include:-

a) Planning and implementation of the power generation and transmission projects.

b) The management of the electric installations.

c) The supervision of electricity supply, transmission and distribution[74].

Under the new organisation, the Third Plan provided for the installation of 433,000 kilowatts of new generating capacity to meet public and non-industrial demand, and a further installation of 361,000 kilowatts for industrial needs[75].

In practice, the capacity of generating plants, purchased during the Third Plan period in the public sector alone amounted to about 777,000 kilowatts, and with the four hydro-electric plants commissioned at the beginning of the Third Plan the new capacity totalled 894,000 kilowatts[76]. This cost 21 x $10^9$ rials or over 9% of the total Plan's development funds[77]. Dams produced over one-third of the total installed capacity, i.e. 369,500 kilowatts.

Per capita electricity consumption rose to 144 kilowatt hours by the end of the Third Plan[78]. No data are available to allow comparisons with the results of the Second Plan. The Development and Resource Corporation of New York[79] reported a figure of 139 kilowatts/capita/yr for urban areas, and 60 kilowatt hours/capita/yr for rural and urban areas combined in the province of Khuzestan. These figures were twice the national average electricity consumption. Based on these data, assuming the national average electricity consumption to be 30 kilowatt hours/capita/yr in the Second Plan, per capita electricity consumption has increased 5 times up to 1968.

By the end of the Third Plan, per capita energy consumption rose to 451 kg coal equivalent. Therefore an increase of 34% was achieved in five years. This was still far behind the standard of the advanced countries such as that prevailing in the U.S.A. (4,790 kg coal equivalent).

Since the beginning of the Fourth Development Plan, the electricity supply policy has been affected by the whole strategy of power supply put forward by the Shah in his book "The White Revolution"[80]. The explained objective is as follows:

> One of our prime objectives in economic development is the maximum supply and distribution of electricity, even to every smallest individual hamlet... The creation of the Ministry of Water and Power was partly due to the implementation of this policy.

During the Fourth Plan it was hoped to increase installed capacity to a figure of twice that of the Third Plan. The total installed capacity at the end of the Fourth Plan was $3,354 \times 10^3$ Kw of which $2,094 \times 10^3$ Kw or 62.4% was produced by the Ministry of Water and Power at a cost of $48 \times 10^9$ rials[81]. This is compared with the total installed capacity of $1,559 \times 10^3$ Kw at the end of the Third Plan, of which the Ministry of Water and Power supplied $894 \times 10^3$ Kw or 57.9% of the total. The increase in the rate of electricity supply in the Fourth Plan was 23% per annum[82].

Per capita installed capacity of the power systems at the end of the Third Plan amounted to 59 w. and at the end of the Fourth Plan it increased to about 168 w.

The total electric energy generated in 1972 was 9,953 x $10^6$ Kwh of which the Ministry of Water and Power produced 6,870 x $10^6$ Kwh (71.9% of total). The corresponding figure for the Third Plan was 4,133 x $10^6$ Kwh out of which 1,842 x $10^6$ Kwh or 44.6% was supplied by the Ministry of Water and Power. Therefore, the average compound annual increase of national power generation during the Fourth Plan was 28% per annum . Per capita electricity generation at the end of the Third Plan amounted to 157 Kwh and at the end of the Fourth Plan was 307 Kwh.

Per capita electricity consumption, which was projected to become 175 Kwh by 1968 and 400 Kwh in 1973, actually reached only 144 Kwh in 1968 and 292 Kwh in March 1973[83]. The latter figure was above that for the per capita electricity consumption of Mexico in 1958 which was 256 Kwh[84]. The corresponding figures for the U.S.A. are 4,000 Kwh and for the Tennessee Valley 10,000 Kwh.

The Fourth Plan target was for the production of a total of 12 x $10^9$ Kwh of electricity. Of this total, industrial demands were expected to account for about 8.5 x $10^9$ Kwh, with non-industrial demands reaching 3.5 x $10^9$ Kwh. In practice the total production did not exceed 9,553 x $10^6$ Kwh. It still reveals an average annual growth rate of 26.2% over that of the Third Plan Production (4,133 x $10^6$ Kwh).

Out of a total generation of 6,870 x $10^6$ Kwh by the Ministry of Water and Power in March 1973, about 36.6% was generated by steam power plants, 51.3% by hydro-electric plants and 12.1% by diesel and gas turbines[85]. Following the basic policy of the Fourth Plan, industrial consumption of electricity grew from 504 x $10^6$ Kwh in 1968 to 2,745 x $10^6$ Kwh in 1973 at an average annual growth rate of 88.9%.

The total number of customers within the power systems of the Ministry of Water and Power totalled 1,669,038 at the end of the Fourth Plan (1973) compared with 797,537 at the end of the Third Plan . Thus a growth rate of 21% was achieved during the Fourth Plan. By February 1976 the number of customers within the power systems of the Ministry of Water and Power reached 2,130,000[86].

The hydro-electric installed capacity to be constructed during the Fourth Plan totalled 343.2 x $10^3$ Kw.

The second unit of the Dez dam hydro-power plant consisted of four turbines with a total capacity of 260 x $10^3$ Kw. This accounted for 75.7 percent of the total. At this time Dez dam power plant reached its full capacity of 520,000 kilowatts[87]. Next to this comes the Shah Abbas dam on the Zayandeh River with an installed capacity of 55,200 kilowatts, the Aras dam on the Aras river with 22,000 kilowatts and the Shahpoor Aval dam on the Mahabad River with a total capacity of 6,000 Kw. The total hydro-electric installed capacity increased to 792,000 kilowatts by the end of the Fourth Plan[88]. The commissioning of the 230 Kv, 568 kilometre long line between the Mohamad-Reza Shah Pahlavi dam and Tehran was the most important electricity transmission project connecting Khuzestan and the Gharb (west) regions to the main National Grid. Another large project was the Tehran-Gorgan transmission line (230 Kv, 385 kilometre long).

### 3-4-3 The future of electric power supply and the contribution of hydro-electric power

Iran has started a dynamic effort to industrialize since the 1950's. The maximum supply and transmission of electricity has been considered as one of the prerequisites for industrialization. To meet the increased energy requirements, electric power generation is to be raised at an average annual rate of 31%[89]. Total installed electricity capacity will increase to 6,200 x $10^3$ Kw by March 1978, compared with 2,094 x $10^3$ Kw in 1973.

Table 3-5 shows the planned electricity generation within the course of the Fifth Plan as well as the actual situation at the end of the Fourth Plan.

Table 3-5

Projected Electricity Generation during the Fifth Plan and that Generated at the end of the Fourth Plan
(Thousand kilowatts = Mw)

| | Existing Generation at the end of the Fourth Plan | | Planned Electricity Capacity at the end of the Fifth Plan | |
|---|---|---|---|---|
| Steam | 746 | (35.6%) | 2,444 | (27.8%) |
| Gas turbine | 172 | ( 8.2%) | 3,766 | (42.8%) |
| Hydro-electric | 804 | (38.4%) | 1,804 | (20.5%) |
| Diesel | 372 | (17.8%) | 778 | ( 8.85%) |
| Total | 2,094 | (100.0%) | 8,792 | (99.98%) |

Source: M.W.P. Power Division, Engineering and Planning Department, 1973.

Hydro-electric generation of power will increase by 126.7 percent over the five year period (1973-78). All of this increase will be produced by the Reza-shah Kabir dam on the Karoon river in Khuzestan[90].

The contribution of hydro-electric power generation of electricity during the Fifth Plan is expected to fall to 20.5%, compared with 38% at the end of the Fourth Plan. The greatest emphasis in the Fifth Plan policy of electricity generation has been placed on gas fuelled power plants, which are expected to produce over 43% of the total generating capacity by the end of the Fifth Plan. By the second half of 1975, 18 gas fuelled 25 MW generators and 9 gas turbine 45 MW generators, mostly located in the southern part of the country, had been installed [91].

Among seven dams which are to be built during the Fifth and the Sixth Development Plans (1978-83), the Lar dam on the Lar river is expected to supply 140 MW of hydro-power, the Pishin dam in Baluchestan 150 MW and the Jiroft dam on the Halilrood in Kerman 15 MW .

The total fixed public investment for electricity development during the Fifth Plan is estimated at $240 \times 10^9$ rials [92] compared with a figure of only $61.3 \times 10^9$ rials [93], in the Fourth Plan.

The projected power generation figures for 1978 and 1983 are $27,500 \times 10^6$ Kwh and $62,730 \times 10^6$ Kwh respectively. Of these the contributions of the Ministry of Water and Power will be $23,159 \times 10^6$ Kwh and $57,940 \times 10^6$ Kw respectively. This is a 263% growth for the first five years (1973-78) and a 250% growth for the following five year period (1978-83) [94].

In the Iranian year 1353 (March 1974 - March 1975), the total electric power generation amounted to $14,022 \times 10^6$ Kwh. This represents a 16% increase over the previous year [95]. Of the total figure of $14,022 \times 10^6$ Kwh, the Ministry of Water and Power produced $11,166 \times 10^6$ Kwh which is well below the projected generating capacity of $12,008 \times 10^6$ Kwh [96].

Taking into account the size of the population which was 32,950,000 in 1974, per capita electric power production is estimated at 426 Kwh [97], compared with a figure of 307 Kwh in 1973. A figure of 700 to 750 Kwh is quoted by Vahidi (1972) as the percapita electric power supply expected by 1978 [98].

The sources of electricity supply were 58.7% from steam generators, 29.3% from hydro-electric power and 12.0% from gas turbine and diesel generators [99].

Table 3-6 shows the contribution of hydro-electric power in the total energy consumption at the end of every development plan. It also indicates the percentage distribution of consumed energy at the end of every development plan (Second to the Fifth).

Table 3-6

The Percentage Distribution of Energy Consumed from Different Sources at the end of every Plan

| Source | 1963 (end of the 2nd Plan) Percent | 1968 (end of the 3rd Plan) Percent | 1973 (end of the 4th Plan) Percent | 1978 (end of the 5th Plan) Percent |
|---|---|---|---|---|
| Oil | 60.5 | 72.6 | 71.0 | 64.0 |
| Natural Gas | 15.6 | 14.1 | 18.0 | 27.5 |
| Coal | 2.2 | 1.4 | 1.1 | 1.3 |
| Hydro-power | 0.5 | 2.6 | 6.6 | 6.0 |
| Total commercial | 78.8 | 90.7 | 96.7 | 98.8 |
| Non-commercial | 21.2 | 9.3 | 3.3 | 1.2 |

Source: (a) Plan Organization, "The Fifth Plan, 1973-78", pp.167-175.
(b) Vatanian, A., 1971, p.18.

The consumption of hydro-electric power was very low (0.5% of the total) in 1963. By 1973 hydro-electric power consumption increased to 6.6% of the total. Since then a decline of its contribution is likely. The consumption of natural gas has shown a steady increase since 1968 and especially during the Fifth Plan. The contribution of natural gas by the end of the Fifth Plan is expected to be 27.5%. The maximum use of oil energy occurred in 1968. Since then the oil consumption rate has declined. These figures simply indicate the overall policy of Iran on energy supply from different resources. The Minister of Energy in December 1974 stated that "To reduce the consumption of fossil fuel, particularly oil, there is to be a big emphasis on the development of natural gas as a major source of energy supply in Iran[100]." The annual gas use should increase steadily from the present level of $30 \times 10^{12}$ kilo calories to $243 \times 10^{12}$ kilo calories by 1981. Two years later, in February 1976, the Minister emphasised that "The policy of energy supply in Iran is to have a great focus on nuclear energy supply which will be supplemented by the maximum utilization of hydro-power resources."[101] Thus natural gas resources are no longer considered as a domestic national resource for energy supply. Although oil has been the major source of energy in Iran so far, over the next decade, natural gas is hoped to replace oil. From then on strategies for energy development will focus on the development of nuclear energy. It is predicted that Iran's power generation system will be completely dependent upon nuclear generators towards the end of the 1990's.

Some twenty nuclear reactors, each with a capacity of $1,000 \times 10^3$ Kwh are needed to supply the required $20,000 \times 10^3$ Kwh which is to be produced in 1984. It is estimated that some $1,908 \times 10^{12}$ kilo calories of energy will be supplied by 1991 compared with $156.8 \times 10^{12}$ kc in 1972, $357 \times 10^{12}$ kc by 1978, 695 x $10^{12}$ kc by 1982 and 1,231 x $10^{12}$ kc by 1987. Nuclear energy will provide almost half of the future energy requirements[102]. After nuclear power, prime emphasis is to be placed on natural gas, followed by other sources of energy supply.

Out of a total of 20,000 x $10^{3}$ Kwh, which is the projected energy supply for 1984, hydro-electric power plants will produce 2,200 x $10^{3}$ Kwh or 11% of the total. Therefore hydro-electric power generation is anticipated to increase by 121.9% in a decade (1973-84).

By the end of the Fifth Plan, a total of 2,848 Km of 132 Kv line 6,033 Km of 230 Kv, and 1,856 Km of 400 Kv line is expected to be built. With the completion of this programme, eight load centres within the authorities of the eight Regional Electricity Organizations will be connected with the National Grid (Fig. 3-2).

The country's use of electric power is to be increased from 8,200 x $10^{3}$ Kwh in 1972 to 32,000 x $10^{3}$ Kwh in 1978 (end of the Fifth Plan). This represents a 58% average annual growth rate. About 67% of the electric power will be obtained from thermal generators, 28% from hydro-electric generators, and the remainder will be supplied by gas and diesel plants[103].

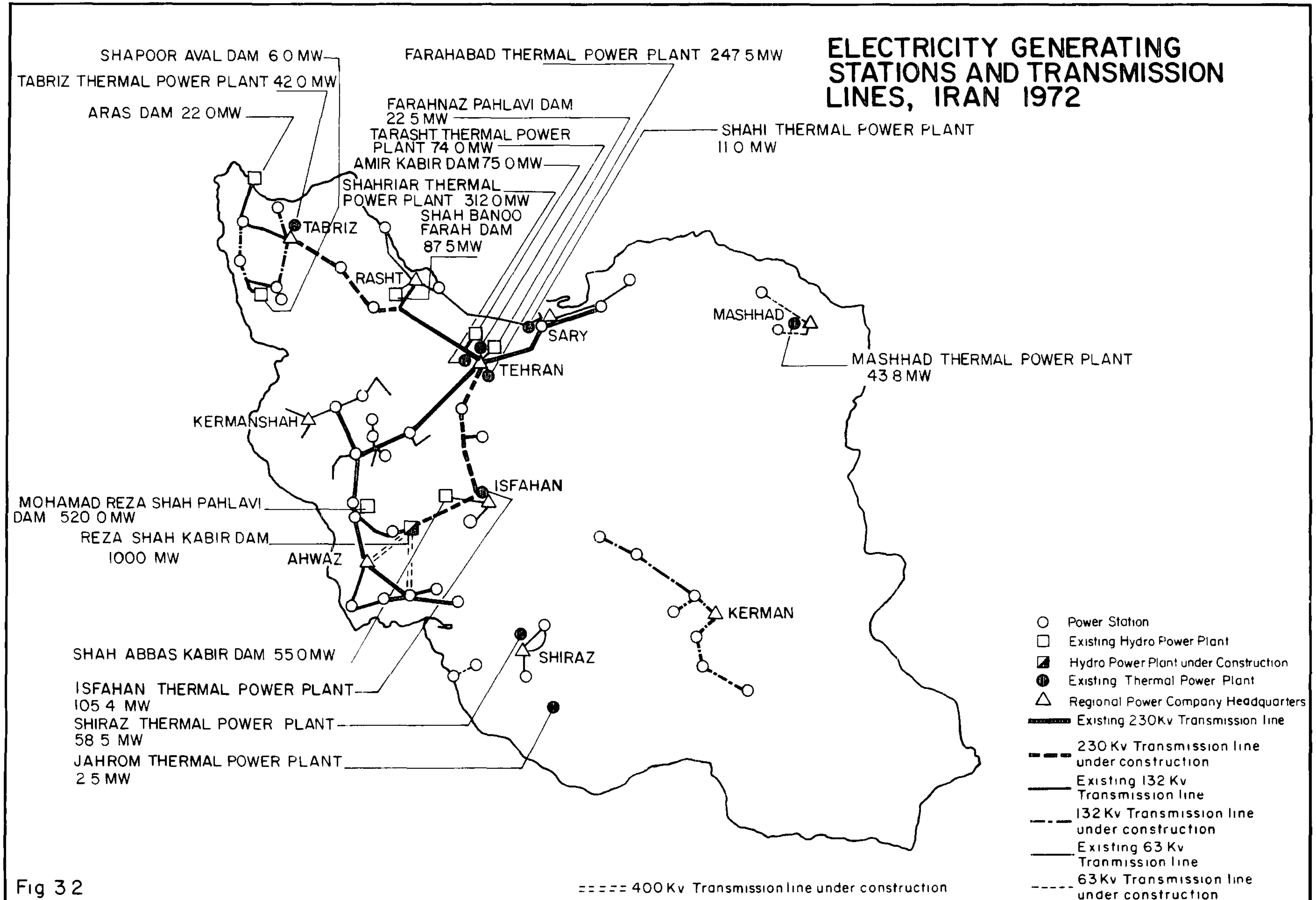

ELECTRICITY GENERATING STATIONS AND TRANSMISSION LINES, IRAN 1972
SHAPOOR AVAL DAM 6 0 MW
TABRIZ THERMAL POWER PLANT 42 0 MW
ARAS DAM 22 0 MW
FARAHABAD THERMAL POWER PLANT 247 5 MW
FARAHNAZ PAHLAVI DAM 22 5 MW
TARASHT THERMAL POWER PLANT 74 0 MW
AMIR KABIR DAM 75 0 MW
SHAHRIAR THERMAL POWER PLANT 312 0 MW
SHAH BANOO FARAH DAM 87 5 MW
SHAHI THERMAL POWER PLANT 11 0 MW
TABRIZ
RASHT
SARY
TEHRAN
MASHHAD
MASHHAD THERMAL POWER PLANT 43 8 MW
KERMANSHAH
ISFAHAN
MOHAMAD REZA SHAH PAHLAVI DAM 520 0 MW
REZA SHAH KABIR DAM 1000 MW
AHWAZ
KERMAN
SHIRAZ
SHAH ABBAS KABIR DAM 55 0 MW
ISFAHAN THERMAL POWER PLANT 105 4 MW
SHIRAZ THERMAL POWER PLANT 58 5 MW
JAHROM THERMAL POWER PLANT 2 5 MW
Power Station
Existing Hydro Power Plant
Hydro Power Plant under Construction
Existing Thermal Power Plant
Regional Power Company Headquarters
Existing 230Kv Transmission line
230 Kv Transmission line under construction
Existing 132 Kv Transmission line
132 Kv Transmission line under construction
Existing 63 Kv Tranmission line
63 Kv Transmission line under construction
400 Kv Transmission line under construction

Fig 3 2

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# SECTION TWO

## THE MOHAMAD REZA SHAH PAHLAVI (DEZ) DAM SCHEME

# CHAPTER 4

## THE AGRICULTURAL PROBLEMS OF KHUZESTAN

### 4-1 The Environment

#### 4-1-a The region

The Khuzestan plain is a continuation of the alluvial lowlands of the Tigris - Euphrates, as well as the Karoon and Karkheh rivers. The plain has an area of 30,000 $Km^2$ bounded on the west by the Iraqi frontier, in the north and east by the Zagros mountains and in the south by the Persian Gulf (Fig.4-1).

#### 4-1-b Precipitation

The climate of the Khuzestan lowlands is primarily semi-arid to arid. The average annual rainfall is about 150 - 200 mm[1], but the recorded figures for Dezful, Gachsaran, Shushtar, Aghajari, Masjid Solaiman and the north of Behbehan are between 350 and 400 mm[2]. In the uplands of the river basins, draining towards Khuzestan, precipitation varies from about 350 to 550 mm, but is considerably more on the exposed slopes of the high mountains. The annual snowfall in the upper Karoon valley appears to average about 1,200 mm of water annually[3]. The amount of precipitation increases from south-east to north-west, which is roughly corresponding to the increase in altitude.

Precipitation is very unequally distributed throughout the year. During the summer, from June to, and including, September, there is virtually no rainfall at all (Table 4-1).

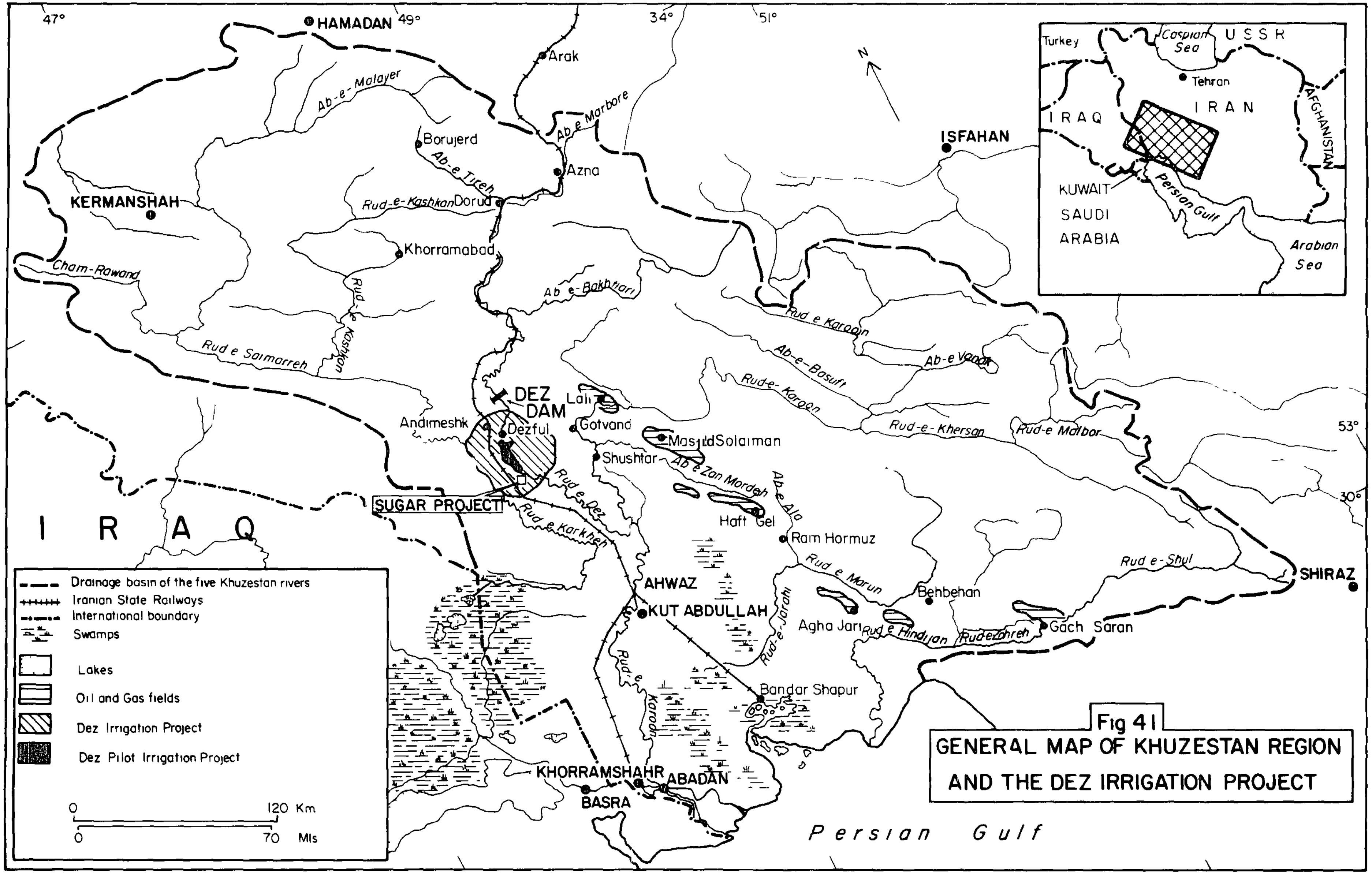


Fig 41
GENERAL MAP OF KHUZESTAN REGION AND THE DEZ IRRIGATION PROJECT

Table 4-1

Climate of the Dez Irrigation Project Area

| Month | Average Temperature at Safiabad C° | Precipitation mean of 10 station in DIP mm | Relative humidity at Safiabad % | Type (A) Pan evaporation at Safiabad mm | Wind Movement at Safiabad M/SKD |
|---|---|---|---|---|---|
| Jan. | 11.2 | 60.2 | 73.0 | 81.0 | 1.09 |
| Feb. | 13.6 | 42.6 | 70.0 | 84.0 | 1.20 |
| Mar. | 16.1 | 22.6 | 62.0 | 140.0 | 1.21 |
| Apr. | 20.5 | 28.5 | 56.0 | 179.0 | 1.33 |
| May | 27.6 | 18.8 | 35.0 | 300.0 | 1.34 |
| June | 32.4 | - | 24.0 | 373.0 | 1.36 |
| July | 33.8 | - | 28.0 | 415.5 | 1.28 |
| Aug. | 33.6 | - | 32.0 | 370.0 | 1.02 |
| Sept. | 29.2 | - | 38.0 | 289.0 | 0.98 |
| Oct. | 24.2 | 5.0 | 47.0 | 221.0 | - |
| Nov. | 17.8 | 34.4 | 60.0 | 129.0 | 1.05 |
| Dec. | 12.6 | 39.1 | 72.0 | 84.0 | 1.13 |
| Year | 22.7 | 284.2 | 60.0 | 2665.0 | - |

Source: Khosro Shahi, K. and Vaelizadeh, M., 1970, "The irrigation and drainage situation of the DIP", in the National Committee of Irrigation and Drainage. Irrigation and drainage seminar, Ministry of Water and Power, Aban 1349 (Nov. 1970), Tehran, pp.266-271.

On the Khuzestan lowlands rainfall is greatly confined to the months of November to April. A comparison of the monthly distribution of precipitation and potential evapo-transpiration indicates that when plants need most water (from May to October), there is little or no water to meet these needs (Table 4-2). The annual potential evapo-transpiration is 2,078 mm while the total precipitation is only 273 mm. The potential evapo-transpiration is 13 times more than that of rainfall. Even in parts of the uplands of Khuzestan, e.g. the Dezful bench, this condition of water deficiency exists. Table 4-2 gives a general picture of how evapo-transpiration exceeds precipitation and Table 4-3 shows the spatial distribution of rainfall of Abadan (2m above sea level) to Tang Pang (520 m) on the Dez river.

The Haft-Tappeh area receives an average annual precipitation total of 260 mm (November to May) while the annual evapo-transpiration exceeds 2,900 mm[4]. Maximum evapo-transpiration at Haft-Tappeh is estimated at 3,720 mm yearly[5].

The rainfall varies not only from year to year, but also from month to month. In the hydrological year 1963/64 total rainfall amounted to 66 mm, while in the following year it amounted to 333.5 mm. Rainfall for January 1969 amounted to 242 mm, while in the following month it was only 28 mm[6]. Despite the fact that most of the rainfall occurs in the winter months, total rainfall in the growing season (summer) is almost non-existent. Even for the growing of winter crops, additional irrigation is necessary during certain months.

The effect of scarcity of water in dry years is so great that, for instance, by 1949 many of the peasants in Khuzestan were reduced to a stage of abject poverty by a succession of dry years[7].

Table 4-2

Potential Evapo-transpiration and Rainfall for Khuzestan

(mms)

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sir A. Gibb (Penman) | 60 | 71 | 119 | 203 | 257 | 297 | 316 | 267 | 202 | 148 | 82 | 56 | 2,078 |
| Thornthwaite 1961-71 | 11 | 15 | 37 | 73 | 176 | 203 | 219 | 198 | 163 | 108 | 43 | 15 | 1,259 |
| Rainfall 1961-71 | 69 | 40 | 28 | 29 | 19 | - | - | - | - | 7 | 45 | 36 | 273 |

Source: Stevens, J. H., 1972, Elementary Appraisal of Problems on Shellcott land. Dezful, Iran. pp.22-23.

Table 4-3

Precipitation and Evaporation of three Synoptic Stations in Khuzestan

| Station | River | Mean evaporation mm | Length of record | Mean precipitation mm | Length of record |
|---|---|---|---|---|---|
| Tang Panj | Dez | 1,810 | 1966-68 | 360 | 1951-65 |
| Ahwaz | Karoon | 2,209 | 1964-69 | 153 | 1957-65 |
| Abadan | Khosroabad | 3,045 | 1968-69 | 124 | 1951-65 |

Source: Mobasheri, F. and Shantia, H., 1972, Vol.3, p.18.

In the mountains an important part of the total precipitation falls as snow. Since precipitation varies over the years, snow storage contributes considerably to the discharges of the rivers during the late Spring and early Summer. When reviewing the overall water resources, snow storage is therefore of the utmost importance, since farming in Khuzestan is more dependent on irrigation than dry farming.

### 4-1-c Temperature

Summer temperatures are extremely high in the Khuzestan lowlands, but during the winter frosts sometimes occur. The maximum temperature reaches 40 - 50°C during the day and falls to 20 - 25°C at night from mid-June to mid-September[8]. The average annual temperature is 25°C. The highest temperature recorded in Iran is 53°C (127°F) registered at Gatvand (23°17'N, 48°30'E) in the northern part of the Khuzestan lowlands. The coldest month is Day (Dec. 22 - Jan. 20) with an average of 11.9°C. Frost is not unusual during this month. At Haft-Tappeh an extreme minimum of -10°C was recorded in 1963 (Table 4-4).

The occurrence of frost has been observed as a great hazard for the crop of sugar cane. High rates of evapo-transpiration caused by abundant sunshine and high temperatures are also an unfavourable factor with an adverse effect on irrigation. In addition, the application of excessive quantities of water has been a common practice throughout Khuzestan. This has resulted in deep percolation, causing the shallow water table to rise, which in turn has led to soil salinity and alkalinity problems[9].

Table 4-4

The Minimum Temperatures and the Occurrence of Frost at Haft-Tappeh, 1338-1352 (1959-1973)

| Year | Extreme minimum | First frost (date) | | No. of hours of frost | | | | Last frost (date) | | Total hours of frost |
|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | -2.9 | 24 Aza | 15 Dec | | | | | 11 Bah | 31 Jan | - |
| 1960 | 0.0 | 21 Esf | 11 Mar | | | | | 21 Esf | 11 Mar | - |
| 1961 | 0.0 | 5 Aza | 26 Nov | | | | | 4 Esf | 24 Feb | - |
| 1962 | -0.4 | 17 Esf | 8 Mar | - | - | - | 2.0 | 17 Esf | 8 Mar | 2.0 |
| 1963 | -10.0 | 17 Aza | 8 Dec | 2.0 | 108.9 | 93.0 | - | 20 Bah | 9 Feb | 203.9 |
| 1964 | -3.5 | 8 Aza | 29 Nov | 0.5 | 25.0 | - | - | 15 Day | 5 Jan | 25.5 |
| 1965 | -4.5 | 27 Aza | 18 Dec | 18.5 | 29.0 | - | - | 27 Day | 17 Jan | 47.5 |
| 1966 | -8.0 | 2 Bah | 22 Jan | - | - | 69.2 | - | 15 Bah | 4 Feb | 69.2 |
| 1967 | -4.2 | 3 Dey | 24 Dec | - | 68.4 | 33.2 | - | 18 Bah | 7 Feb | 101.6 |
| 1968 | -0.5 | 22 Dey | 12 Jan | - | 2.0 | 2.8 | - | 27 Bah | 16 Feb | 4.8 |
| 1969 | -1.8 | 9 Bah | 29 Jan | - | - | 1.0 | - | 9 Bah | 29 Jan | 1.0 |
| 1970 | -1.8 | 23 Aza | 14 Dec | 6.3 | 9.0 | 13.6 | - | 27 Bah | 16 Feb | 28.9 |
| 1971 | -4.0 | 27 Aza | 18 Dec | 1.8 | 25.0 | 15.4 | 9.8 | 8 Esf | 27 Feb | 52.0 |
| 1972 | -4.2 | 29 Aza | 18 Dec | 7.2 | 131.0 | 3.3 | - | 18 Bah | 7 Feb | 141.5 |
| 1973 | -2.8 | 17 Aba | 8 Nov | 27.6 | - | 4.6 | - | 18 Bah | 7 Feb | 54.4 * |

* There were 22.2 hours of frost in Aban in 1352 (Nov. 1973)

Source: Haft-Tappeh Cane Sugar Department. K.W.P.A. Ministry of Water and Power, "Report of the 1352 (1973) Harvest Season, p.4.

## 4-1-d River regims of Khuzestan and associated problems

Five principal rivers drain the uplands of Khuzestan. These are the Karkheh, the Karoon the Ab-i-Dez, the Jarahi and the Hendijan river. Of these the combined systems of the Dez and the Karoon are the most important. The five rivers drain much of south-western Iran, including all of Khuzestan province and parts of the provinces of Kermanshahan, Isfahan and Fars. The drainage area at the point of discharge into the plain is estimated at 120,500 $Km^2$.[10] The Karoon, with its tributary the Ab-i-Dez, together drain a mountainous area of about 54,000 $Km^2$ discharging an average amount of 750 $m^3$/sec. The shaded portion of Fig. 4-1 is an approximation of the Khuzestan province and shows the catchments of streams which flow through the lowlands.

In Khuzestan, only the Karoon river has been gauged over a long period. Measurements have been made at the Ahwaz station since 1894. An extreme maximum discharge of 6,700 $m^3$/sec. was recorded at Ahwaz in 1969[11], but the long-term maximum mean monthly discharge is approximately 1,636.54 $m^3$/sec (Table 4-5).

The most significant point in the river regime hydrographs of Khuzestan is that peak flows arrive too late (Jan. - May) to benefit winter crops, and the period of minimum discharge occurs at the very time that summer crops are in the greatest need of moisture (Tables 4-2 and 4-5). The average total annual discharge of the five Khuzestan rivers in the lowlands has been estimated at about $35 \times 10^9$ $m^3$. This is the amount of water which runs to waste every year[12].

Table 4-5

Long-term Mean Monthly Discharges of the Rivers of Khuzestan - 1961/62 - 1971/72 $m^3/sec$

| River | Station | O | N | D | J | F | M | A | M | J | J | A | S | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Karkheh | Pai-i-Pol | 54.13 | 75.13 | 112.34 | 147.19 | 186.15 | 196.60 | 347.22 | 313.58 | 115.89 | 61.90 | 49.75 | 44.23 | 142.82 |
| Dez | Dez dam | 72.00 | 112.00 | 168.00 | 241.00 | 278.00 | 459.30 | 514.60 | 422.00 | 229.00 | 148.00 | 103.00 | 78.00 | 231.00 |
| Karoon | Ahwaz | 267.31 | 321.15 | 579.23 | 803.08 | 911.54 | 1,454.62 | 1,636.54 | 1,330.00 | 782.69 | 557.69 | 395.00 | 295.77 | 579.71 |
| Maroon | Behbahan | 8.60 | 17.00 | 34.70 | 53.40 | 54.60 | 84.00 | 73.00 | 47.85 | 25.10 | 14.90 | 10.80 | 8.90 | 36.07 |
| Zohreh | Tang-i-Barim | 6.88 | 7.77 | 9.54 | 10.45 | 22.23 | 17.74 | 18.04 | 17.67 | 11.39 | 7.80 | 7.56 | 7.25 | 11.85 |

Source: Table was constructed based on data obtained from Ghazinoori, The Chief Officer of the Department of the Surface Water Resources, Ministry of Water and Power, Tehran, Iran, July 1975.

Tremendous damage has occurred through excess water causing flooding, while at different times of year crop yields have reached a minimum through lack of water in productive areas. In late winter the discharges from the large perennial streams moving westward out of the Zagros may increase ten times over their late-summer minimum. Spring floods ordinarily inundate vast lowland areas, particularly near the confluences of major streams. For instance, south ot Desful and Shushtar an area of perhaps 258.8 $Km^2$, as well as larger areas below Ahwaz are normally submerged by spring flood waters[13]. Direct flood damages are estimated at 30 million rials for floods having an average recurrence of 30 years. The average annual damage amounts to about 80 million rials (one million dollars)[14]. Floods sometimes close the Trans-Iranian railway between Ahwaz and Khorram-Shahr for as long as 100 consecutive days, and travel and commerce are disrupted[15].

Where natural drainage is poor, periodic floods create swamps and ponds. On flooded land salts may accumulate in the soil and salinity discourages and frequently destroys vegetation. These swamps and ponds are important mosquito breeding grounds.

4-1-e Soils

The climate of Khuzestan with its cool winter months followed by a long hot summer with little or no rain has been an important factor in the development of the soils of Khuzestan.

Soil groups: where climatic action has been unrestricted for a sufficient period of time, brown or grey desert soils have been formed. These are a result of the climate and are called the

Zonal soils[16]. The brown soils occur nearer the hills where it is cooler, and the rainfall higher, but there is no line of demarcation between the brown and grey soil groups.

Khuzestan soils have been tested, and classified by the Department General of Water and Soil with the co-operation of F.A.O. soil experts and Iranian technicians[17]. Twelve classes have been differentiated; these can be divided into three main groups in terms of their farming potential.

1) <u>Arable soils</u>

Of the total area of Khuzestan, 39% consists of good arable land.

2) <u>Semi-arable soils</u>

These cover 4.7% of the total area of Khuzestan. Owing to the existence of various soluble salts, (ranging from 0.15% to 0.65%) these soils are salty.

3) <u>Non-arable soils</u>

Such soils which cover more than half the area of Khuzestan are of no use at all for agriculture, due to their high soluble salt content (over 0.65%) or to the presence of excessive chalk and salt.

Salinity in Khuzestan is caused by:-

1) Soluble salts inherent in the parent material, which are added to by salts either in the periodic streams or through irrigation.

2) Salinity associated with a high water table.

Where the ground water level may be within 0.5 metres of the surface, salts accumulate on the surface[18].

Thus the harsh environmental conditions of Khuzestan have limited the cultivated lands to a considerable degree. In 1956 only 200,000 hectares were under irrigation out of a total of 800,000 hectares of land classed as suitable for irrigation in the upper catchment area. The estimated figure for the Khuzestan lowlands was 50,000 hectares out of 750,000 hectares. This leaves a total area of 1,300,000 hectares un-exploited[19].

## 4-2 Socio-economic Problems

### 4-2-a Land use

In 1960 the province of Khuzestan covered an area of some 11.8 million hectares, of which 1.1 million hectares or 10% of the total area was cultivated (pasture, forests and fallow land excluded). The cultivation of annual crops covered 683,000 hectares, 56% of which was dry farmed and 44% irrigated. Fallow land covered an area of 340,000 ha. However 121,000 ha could be improved by irrigation development[20]. The ratio of the dry-land crops to irrigated crops is 5:4. Wheat and barley are the main crops grown in practically all the region, with wheat occupying an area two to three times greater than barley. The principal winter crops, in addition to wheat and barley, are broad beans and flax. Of the summer crops, rice occupies the largest area. Sesame is next in importance and is produced over a wide area. Other summer crops are lentils, beans, melons, cucumbers, lettuce and tomatoes.

4-2-b Land ownership

The general national census of 1956 estimated the population of Khuzestan at a little over 2 milion, of which 25% was urban and 75% rural[21].

The general agricultural statistics of 1960 estimated the village-dwelling population at 1.4 million, made up of about 280,000 households, divided as follows: 171,000 households with land, and the remaining 109,000 households or 38.9% of the total without land. The latter group is considered as Khoshneshines within the social structure of villages in Khuzestan (see Chapter 2).

The amount of land per holder was 6.3 ha, thus the per capita land area was 1.3 ha (the average family size was 5). Taking into account the 109,000 Khoshneshines with no land, the absolute per capita land area was 0.93 ha. 53% of the holders owned between 0.5 and 5 ha. or 20% of total land area. Plots of 5 to 10 ha. were owned by 28% of the holders, who accounted for 34% of the total land area. The remaining 48% of the land was owned by 19% of the holders, who had 10 - 100 ha each. Therefore over 50% of the holders had less than 5 ha. This is too small to raise the level of rural incomes and to improve the peasants' economic status.

The size of the holdings varied considerably from dry to irrigated lands. The common unit of land measurement in Khuzestan is the Khish, which corresponds to Joft in most other parts of Iran and in some parts of Khuzestan too. At Hamidieh (Public domain) and Hosain Abad (Private domain), the average size of irrigated farms was 14 to 15 ha, but they ranged from 1 to 190 ha[22].

4-2-c Crop yields and peasants' income

The yield of the land was very low in the late 1950's. While wheat formed the principal diet of the population, the yield of the irrigated wheat was 900 kg/ha and that of non-irrigated wheat was about 450 kg/ha. By the application of fertilizers in Hamidieh in 1964 the yield of wheat was raised to 2,500 kg/ha, whereas it had only been 450 kg/ha in 1954[23].

Ataî's (1962) yield figures show a 37.6% decline of the irrigated wheat and barley yield for Khuzestan during 34 years (1926-60). The corresponding figure for dry wheat was 5.4% and for rice 48%[24]. The consequence of this situation was a decrease in the farmers' income to one third.

This low yield resulted in an extremely low per capita income for the peasant. The Development and Resource Corporation of New York quotes a figure of 6,000 rials[25]. The figure recorded by a research group working in Hamidieh produced a value of U.S.$35/capita/yr, and in Wayce (a village immediately north-east of Ahwaz) U.S.$75[26]. The major causes of this low income, besides the harsh environmental conditions of Khuzestan are as follows:-

a) Farming technology

The extremely low level of machinery application in farming stresses the primitive nature of the agricultural activities. In 1960 less than 1% of the land holders used agricultural machinery while 85% used animal power, 12% man power and 2% animal and machinery together[27]. As a result, when it was the best planting time for summer crops, farm labourers were still occupied in harvesting winter crops.

b) Peasants debts and the sources of loans

The Government and landlords' investment in agriculture was minimal in the early 1960's. Debts and high interest rates were common among the Khuzestan peasants. Out of 170,889 landholders, 109,579 (56%) received loans in 1960. 2,106 of them, or 2%, obtained loans from the government (Agricultural Bank) and the rest from non-government authorities. The total government loan amounted to about 59 million rials and the non-government one to 777 million rials, (13 times the government loan). 737 million rials (95%) were obtained from pedlars and storekeepers. A 50% rate of interest was used. Thus the landlords' and government's assistance to the farmers and their control over the interest received by the pedlars were quite insignificant[28].

c) Tenure pattern

In Khuzestan a tenure pattern which involved an intermediary (Mobasher) between the landlord and the cultivator existed. He rented a substantial part of a village (ranging from 60 to 500 ha), and assumed responsibility for supplying and controlling the labour force to work the land.

Tribal leaders, known as Khans or Shaikhs, (in the case of Arabic tribes) with full economic and social power over the members of their tribes, acted as intermediaries. They rented the farmlands directly from the Public Domain or from private landlords and put it at the disposal of their people from whom they collected shares as the landlords did, or they got a share from those who had obtained lands from the Public Domain for cultivation.

Land and water was usually owned by a landlord, but where irrigation companies were established, another element was introduced into the crop-sharing system. Some dues were levied on the total harvest, before it was divided between the various parties concerned[29].

On the whole the reasons for the under-developed rural economy of Khuzestan can be summarized as: share cropping, indebtedness, the payment of dues, the foreselling of crops, heavy interests, and the presence of intermediaries and labour services. Owing to these chronic obstacles, no water development for Khuzestan could be achieved without first solving these problems.

Therefore, the ultimate outcome of regulating and making efficient use of the abundant water resources in the region will depend largely on the extent to which this additional water will be used on new land and the manner in which such land will be owned and operated.

4-2-d Land Reform

The implementation of the first phase of land reform law in Khuzestan affected only 22,000 peasant household landholders or 12.8% of the total[30]. Taking into account the total number of rural households in Khuzestan which was 280,000, the percentage falls to 7.8%.

At the second phase, a total 86,875 landholders became owners of the land. Thus in total 108,875 out of a total 171,000 or 63%

of the peasant landholders benefited from the land redistribution[31]. If we take into account some 52,026 households, which became owners of Public Domain lands the percentage rises to 94%. Still, however, over 9,000 household landholders, and 109,000 landless households have not got any land. This means that 41% of all the rural households of Khuzestan have been left without land.

4-2-e <u>Employment opportunities outside the agricultural sector</u>

The dominant pattern of agriculture in Khuzestan, except where touched directly by the production and processing of oil, has remained unaffected by the surrounding wealth of the natural resources. (The region's oil and gas fields and the refinery installation employed more than 40,000 workers which represents one third of the total Iranian industrial labour force in 1959.) The pressure of population on the cultivated lands and the seasonal unemployment and under-employment of labour are the two major reasons for village out-migration. Hopes of finding temporary or permanent work and better conditions of life have stimulated this decision. In the prevailing conditions, neither private enterprise nor the oil industry were able or willing to absorb the surplus urban and rural populations and offer them the required wage. Even a good many of the oil workers have, for some reason or another, been discharged and have been engaged in non-productive activities[32].

4-2-f <u>Rural social welfare</u>

Inadequate food consumption , bad health and poor education are the immediate outcome of the prevailing economic and social structure in Khuzestan. F.A.O. dietary experts quoted per capita/calorie intakes ranging from 1,217 to 2,000 for the Khuzestan, Fars and Kerman provinces[33]. Some 94 to 98% of these calories were derived from wheat bread consumption.

The health situation was no better than nutrition. The ratio of population to physicians was 5,118:1 in 1964. No hospitals existed in the villages and only 19 hospitals with a total of 790 beds served a population of over one million urban residents in 1964[34].

The recorded medical statistics demonstrate the human suffering resulting from the lack of health and sanitation services. In the early 1960's 23% of the population of Abadan and Ahwaz suffered from parasites (ascaris), and 4.5% of the population of the province had malaria, although previously the figure had risen to 80 to 90%. Fifty-five percent of school children suffered from trachoma, 25% of the people of Dash-i-Mishan had endemic syphilis and 30% of the rural population had bilharziasis schistosomasis[35].

In addition there was a high illiteracy rate. The literacy rate for Khuzestan was only 34.2% in the national census of 1966. The percentage for the urban population was 51.4% and for the rural 11.9%[36]. Therefore, ten years ago approximately 50% of the urban and 90% of the rural population were considered to be illiterate.

Since the rate of energy consumption is one of the indicators of higher living standards, Khuzestan provides an example of under-development. Some 134 Kwh/cap/yr is considered to be the electricity consumption in urban areas and less than 60 Kwh/cap/yr in rural and urban areas combined, compared with 4,000 Kwh in the U.S.A. and 10,000 Kwh in the Tennessee valley[37].

Successful development of the natural resources of Khuzestan rests ultimately on the ability of the region's people to realize their individual capabilities. It can not be achieved as long as there persist the major barriers of poverty, disease and ignorance. To abolish these barriers a unified development of the natural resources of Khuzestan was considered to be the most effective way of improving farming production, and the development of the socio-economic status of the region's population.

## 4-3 Resources available for potential development

Khuzestan possesses abundant resources of water and land, and also rich resources of energy in the form of oil, natural gas and sunshine. Water is the greatest natural resource that has not been used efficiently. The rivers have sufficient discharge to permit the development of irrigated agriculture, and to make electricity available to cities, towns, and rural villages.

### 4-3-a Water resources

The average total annual discharge of the five major rivers of Khuzestan ignoring the use of water upstream, is estimated at $35 \times 10^9\ m^3$. Out of this, $20 \times 10^9\ m^3/a$ of water could be counted as water available for irrigation. This amount of water will be sufficient to irrigate 1,760,000 hectares.

The Karoon with its main tributary Ab-i-Dez, together drain a mountainous area of about 54,500 $Km^2$, and the average discharge is 750 $m^3$/sec. (1894 - 1966). The drainage area of the Karoon at the Ahwaz gauging station is 58,100 $Km^2$.

Next in order comes the Karkheh river, with a mountainous catchment of about 43,000 $Km^2$ and an average discharge of about 200 $m^3$/sec.

In the south-eastern part of the lowlands the Jarahi (about 10,000 $Km^2$) and the Hendijan (about 13,000 $Km^2$) together discharge an average estimated amount of 150 $m^3$/sec. Therefore the total mountainous part of about 120,000 $Km^2$ discharges an average of 1,100 $m^3$/sec, of which more than 66% is discharged by the Karoon and the Dez rivers together[38].

In Khuzestan it has been estimated that one $m^3$/sec of regulated water supply can meet the irrigation needs of more than 835 ha under intensive agriculture[39].

The combined minimum flow of Khuzestan's five rivers without water regulation was sufficient to irrigate only 250,000 ha. Regulation of the rivers will increase the available water by four times and the amount of irrigated land by a similar amount, (Table 4-6).

Table 4-6

Potential Water Supply for Irrigation

| | Min. discharge $m^3$/sec in 1959 | Ultimate min. regulated flow $m^3$/sec |
|---|---|---|
| Karkheh | 25 | 150 |
| Dez | 50 | 190 |
| Karoon | 115 | 495 |
| Jarahi | 5 | 30 |
| Hendijan | 10 | 35 |
| Total | 205 | 830 |

Source: D.R.C., 1959, p.D-19.

## 4-3-b Land resources

The area of land in Khuzestan suitable for irrigation is estimated as follows[40]:

| | | |
|---|---|---|
| Upper catchments: | Karkheh | 500,000 ha |
| | Ab-i-Dez | 150,000 ha |
| | Karoon | 100,000 ha |
| | Jarahi and Hendijan | 50,000 ha |
| | Total | 800,000 ha |

Out of 800,000 ha, 200,000 ha were under irrigation in the early 1960's.

In the Khuzestan lowlands, out of a total area of 4 million ha, about 750,000 ha were classified as suitable for irrigation without prohibitive reclamation measures being necessary. Out of this total only 50,000 ha were under irrigation.

Adding the two figures of 700,000 ha of available land in the lowlands and 600,000 ha of land on the upper catchments, a total of 1,300,000 ha is available for development by means of irrigation.

Against 1,300,000 ha of available land, there is sufficient water for the irrigation of 1,750,000 ha of land. This means that about 30% of the total area can be double-cropped.

## 4-3-c Other resources in Khuzestan available for development

Khuzestan's climate makes possible an agriculture that includes both summer and winter crops. Its sub-tropical climate makes possible very good winter pasture, therefore in addition to its 3 million settled livestock, 3.5 million livestock from the neighbouring areas, namely, Fars, Isfahan, Shahr-i-Kord and Ilam move to Khuzestan to utilize its pastures.

Khuzestan contains Iran's major oil and gas fields. Abundant electricity from water and gas would make possible the creation of chemical industries.

The suitable natural reservoir sites, found on every major river, and also the long drop from the Zagros mountains and the Karkheh plain provide the best sites for multi-purpose dam construction. These could regulate water for hydro-power supply and for the development of agriculture. The region's ready access to world trade routes through the Persian Gulf, domestic markets via the Trans-Iranian railway and Iran's expanding highway systems offer great possibilities which can help the development of all the resources of Khuzestan.

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# CHAPTER 5

## A TENNESSEE VALLEY AUTHORITY (TVA) FOR THE KHUZESTAN REGION

### 5-1 History

A new approach to the challenging problems of economic development has been taken in the Khuzestan region of south western Iran.

One of the highest priorities of the Iranian government during the first Seven Year Development Plan was given to a scheme to revitalize the Khuzestan lowlands.

Interest in the comprehensive development of the region is not a recent phenomenon. Thousands of years ago the Khuzestan lowlands were the home of the Elamite civilization based on irrigated agriculture and later the region was the seat of the great Persian Empire. The plain watered by the Karoon and Karkheh rivers was the site of ancient irrigation works[1]. After long periods of misuse and neglect the region has become a wilderness, characterized by the three inter-related problems of aridity, salinity and water-logged soils. Since the first Development Plan, the region has been marked by Iranians, U.S. Point IV experts and United Nations technical assistance missions as a place of great promise for diversified agriculture and industry.

The U.N. Food and Agricultural Organization selected the Khuzestan region for special study several years prior to 1956. Its preliminary report described the need and the opportunity for comprehensive development of the Karoon and Karkheh basins.

In 1956, Plan Organization commissioned the Development and Resources Corporation (DRC) of New York to draw up a master-plan for the region similar in overall concept to that executed by the Tennessee Valley Authority of the United States of America. The result was an integrated scheme to control and utilize the waters of the five major streams of the region[2]. In total about $20 \times 10^9$ $m^3$/annum of water out of a total of $35 \times 10^9$ $m^3$ were estimated to be available. Fourteen sites for the construction of dams were chosen. Seven of these were on the Karoon, three on the Karkheh, two on the Dez and the remaining two on the Jarahi and the Hendijan rivers. When the project is completed it is hoped that at least one million ha can be irrigated and 6.6 million Kw of electricity produced (Table 5-1).

## 5-2 The Dez Multi-purpose Project

The first dam which was constructed was the Dez dam. It is called the Mohamad Reza Shah Pahlavi dam because of the opening of the dam by the Shah in 1962. The Dez multi-purpose project included the Pahlavi dam, power house and associated transmission lines, and the development of an irrigation system to substantially increase production on agricultural lands.

The Development and Resources Corporation of New York has been responsible for the planning, execution and operation of this programme. The programme includes, besides the Dez project, a sugar cane plantation, cane mill and sugar refinery near Haft Tappeh. As part of the Dez scheme, an electric transmission line was erected from Abadan to Ahwaz. The reconstruction and expansion of the electricity distribution systems of Ahwaz and other cities was also completed and a fertilizer testing establishment was installed.

An extension programme and other regional surveys and investigations

Table 5-1

Khuzestan Multi-purpose Projects

Principal Features

| River system | River | Project | Drainage area $km^2$ | Average annual discharge $m^3$/sec. | Minimum natural discharge $m^3$/sec. | Height of Dam m | Reservoir Volume million $m^3$ | | Ultimate System Development | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Total | Useful | Minimum regulated flow $m^3$/sec. | Installed power capacity Kw |
| Karkheh | Karkheh | Karkheh 1 | 39,000 | 170 | 25 | 170 | 6,000 | 4,500 | 150 | 240,000 |
| | Saimareh | " 2 | 26,500 | 100 | 15 | 165 | 3,550 | 2,250 | 75 | 240,000 |
| | " | " 3 | 20,000 | 80 | 10 | 170 | 1,950 | 1,380 | 40 | 240,000 |
| Dez | Dez | Dez | 17,000 | *305 | *50 | *190 | 3,350 | 2,550 | *190 | 520,000 |
| | | | | **220 | **48 | **203 | | | **183 | |
| | Bakhtiari | Bakhtiari | 6,000 | 190 | 30 | 120 | 720 | 630 | 60 | 180,000 |
| Karoon | Karoon | Karoon 1 | 32,000 | 465 | 115 | 180 | 9,100 | 4,400 | 425 | 600,000 |
| | " | " 2 | 27,500 | 355 | 90 | 195 | 8,600 | 4,600 | 325 | 900,000 |
| | " | " 3 | 24,500 | 340 | 80 | 150 | 4,300 | 2,050 | 250 | 750,000 |
| | " | " 4 | 23,500 | 330 | 80 | 160 | 1,800 | 1,150 | 225 | 1,000,000 |
| | " | " 5 | 15,000 | 190 | 55 | 215 | 3,000 | 1,780 | 140 | 1,200,000 |
| | " | " 6 | 10,500 | 135 | 30 | 160 | 1,250 | 850 | 95 | 360,000 |
| | " | " 7 | 7,000 | 110 | 25 | 165 | 1,050 | 870 | 70 | 200,000 |
| Jarahi | Maroon | Maroon | 3,500 | 60 | 5 | 190 | 1,200 | 800 | 30 | 100,000 |
| Hindijan | Zohreh | Zohreh | 7,000 | 55 | 10 | 150 | 1,500 | 1,020 | 35 | 70,000 |
| | | | | | | | | | | 6,600,000 |

Average Annual discharge (Five Rivers) = *1,055 $m^3$/sec. **975 $m^3$/sec.

Minimum Annual discharge (Five Rivers) = *205 $m^3$/sec. **203 $m^3$/sec.

Ultimate total minimum regulated flow (Five Rivers) = *830 $m^3$/sec. **823 $m^3$/sec.

* Original plan.

** Actual

Sources: (1) D.R.C. 1959. Table B-1.

(2) For the actual figures see Chapter 6 and Appendices B and C.

were also carried out.

Based on recommendations made by DRC a state regional development organization known as the Khuzestan Water and Power Authority (KWPA) was created in 1960. The responsibility of organisation, manpower training and assuming responsibility for the development projects was given to KWPA.

The construction of the Pahlavi dam was completed in May 1963 and the regulation of the Dez River started in November 1962. Construction of the irrigation system was commenced in 1959 on a 20,000 hectare pilot area, and water was delivered to these lands in late 1963.

In 1962 part of the responsibility of DRC was transferred to KWPA, and a further agreement was made between KWPA and DRC under which the Corporation would extend its services until April 1965. These services included consultation and the provision of all technical services required for the project. In addition the management of the Dez project; the power plants and installations, the construction of the transmission lines, the Dez pilot irrigation project (DPIP) and the sugar cane project were to remain in the hands of DRC. KWPA would assume the responsibility for these undertakings when it was capable of managing them.

In 1960 the government secured a loan from the International Bank for Reconstruction and Development (IBRD), of U.S.$42 million to finance the construction of the Pahlavi Dam, the associated hydro-electric works and the Dez Pilot Irrigation Project[3]. A second IBRD loan of U.S.$30 million was secured in April 1969 for the development of Stage 1 of the Dez Irrigation Project. This included the construction of irrigation delivery systems, drainage and road facilities for an additional 37,000 hectares, and the development of organization, management and agricultural programmes.

The completion of the DIP was scheduled for April 1975. Stage I comprised a net irrigated area of 53,910 ha with a gross area of 63,200 ha, and Stage II a net area of 28,740 ha and a gross area of 29,680 ha. Therefore a total area of 82,650 ha is the ultimate DIP area[4]. (The Haft Tappeh Sugar Cane area with a gross area of 14,700 ha is not included in the above figures.)

Creation of intensive farming on a commercial basis was planned in the form of the establishment of new institutions such as Agro-businesses and Farm Corporations, which were begun in 1969 in the DIP. The most important consideration in the creation of these enterprises was the most efficient use of the regulated waters. This plan includes a peasant resettlement programme which has been carried out since 1971.

## 5-3 The Objectives of the Dez Dam Scheme

The Dez dam has a reservoir capacity of 3,350 million $m^3$. The water will eventually be utilized to irrigate 125,000 ha in the Dezful lowlands and to produce 520,000 Kw of electricity. The goals of the project, which were outlined by the DRC are as follows:-

1) The dam was to provide enough water for the development of agriculture and a better standard of living for the people.
2) It was to be an everlasting source of water and electricity which combined with thermal sources would make electric power plentiful and cheap.

3) It was to be used for flood control in the Dez basin[5].

The objective of this study is to test if these objectives have been realised.

## 5-4 The Location of the DIP

The DIP comprises the northern part of the Khuzestan lowlands. It is bounded by the Karkheh river in the west, the Khor Shaura river in the east, hilly ridges in the north and Haft-Tappeh in the south. The lowlands end where the Bakhtiari mountains rise up sharply (Figs. 4-1 and 6-1).

## 5-5 The Area

The gross area of the DIP is 160,000 hectares. It consists of towns and industrial site services (2.3%), eroded and hilly land and the flood plains of the river (24.1%) and the remaining 73.6% (i.e. 117,760 hectares) is the net agricultural area[6]. The later studies put a figure of 94,000 ha as the area of the Dez Irrigation land (the Haft-Tappeh Sugar Cane Project is included). Subtracting the 21,500 hectares, of the Haft-Tappeh Sugar Cane Project from the total 94,000 ha, the total DIP area is 72,500 ha[7].

## 5-6 The Climate of the Project Area

The climate of the project area is arid, with hot summers and mild winters. The hot period is of long duration from mid-June to mid-September. Maximum temperatures often approach 50°C (Appendix A). Virtually no precipitation falls during this period and frequent dust storms cause a persistent haze. Winters are mild and pleasant with intermittent periods of rain occurring from mid-November to early May. The mean annual rainfall in the DIP area over the past twenty years

(1950-70) is approximately 284.2 (Table 4-1). Precipitation usually occurs between December and February, and temperatures may remain above freezing for five or more years at a time.

5-7 Soils

Soils in the project area have been transported and deposited by the Dez and Karkheh rivers. The Karkheh soils are in general heavier than those of the Dez region, but both are fertile and provide large blocks of land suitable for irrigation without further treatment.

About 80% of the land could be classified as suitable for irrigated agriculture (Classes 2 & 3). Class 1 has been omitted because of the poor chemical fertility and low humus content. The remaining 15% has been divided into Classes 4 and 5 owing to certain limitations, such as the depth of the topsoil, the complex character of the soils, drainage limitations and salinity problems[8].

The calcareous nature of the constituents of the soil and the underlying gravels generally assist in preventing excessive salinity in the project lands. The topsoil of the dry farmland is characterized by good permeability, but this will decrease after irrigation. The topsoil in the irrigated areas has poor permeability, but the subsoil permeability is good.

The localized salt accumulations and poor drainage conditions have required, and will continue to require, special provisions if the lands are to be made fully productive[9]. The general slope of the project area is from north to south giving ample opportunity for irrigation by gravity flow. The land slopes down from approximately 160 metres above sea level, along the foot of the mountains in the north, to about 50 metres east of Haft-Tappeh[10].

## 5-8 Water Resources

Out of the total Dez project area of 160,000 ha, 94,500 ha of farmland was under irrigation in 1958 (Table 5-2). These irrigated lands received their water from different sources and the intensity of cultivation varied in accordance with the flow of the rivers in the various seasons.

Table 5-2

Area of the Dez Irrigation Project under Irrigation and Water Sources

1958

| Source | Area under irrigation (ha) |
|---|---|
| Karkheh River | 31,300 |
| Dez River, east bank | 30,000 |
| Dez River in flood plain * | 1,500 |
| Irrigation from qanats on Dez | 4,950 |
| Irrigation from Shah Mansoor/Khor Shaura | 4,500 |
| Ojirub | 6,240 |
| Shaur | 6,000 |
| Balarood* | 1,600 |
| Dez and Balarood | 8,400 |
| Total | 94,500 |

* These areas were left out of the new project.

Source: Heidemaatschappij. 1958, p.4.

## 5-9 Problems of Irrigation in the DIP

The total area of 94,500 ha was served entirely by gravity flow through twenty-three canals from the Dez river and a further thirty canals from the Karkheh river.[11] The majority of the canals served an area of between 1,000 and 3,000 ha. A few had a larger capacity ranging from 3 - 11 $m^3$/sec[12].

Because of the irregularities in the river regimes, in the winter and spring, at the turnouts of the rivers from the mountains there was only 1 $m^3$/sec available for each 2,500 - 3,000 ha of land. In summer owing to low river water levels the latter figure was increased to 4,500 to 6,000 ha and in the southernmost areas, irrigated by the Karkheh river the figure was as high as 10,000 ha .

Each summer the land owners took measures to have brushwood and stone barrages constructed to divert the stream into the heads of the canals. Despite this, the canal discharges were very limited and transport losses probably amounted to some 60% .

The summer cultivation in the Shah Monsoor/Khor Snaura districts and in the Balarood area north of Andimeshk was practically non-existent.

For the summer crops, June, July, August and September are the key months, when, owing to high temperatures, evapo-transpiration is at its maximum (Table 4-2). This is the time that the Dez river discharge approaches its minimum (Appendix B). For this reason the summer cultivation is restricted to 20% of the cultivable area[13].

The irrigation system had not been designed according to modern engineering practices. For centuries many systems existed with uncontrolled inlets and diversions. The regime of the main canals and laterals was governed by the water level of the rivers and certain simple constructions such as temporary drops and checks of earth, constructed by the water distributors of the land-owners.

There were strict regulations governing land-ownership and ownership of the canals serving the fields. The canals belonged to the landowners or to groups of landowners. Only in exceptional cases were two districts supplied from one canal and in such a case careful regulations existed regarding the division of the water. The landowners saw to the construction of temporary diversion works and the de-silting of canals. The annual cost of silt clearance and the construction of diversion barrages was high. A total annual sum of 10,000,000 rials is estimated for the area of the Karkheh and the Dez rivers[14]. The silt load for the Dez river at Taleh Zang with a catchment area of 16,152 $Km^2$ is estimated at 3,897 $M^3$/annum and for the Karkheh river at the Hamidieh station, with a catchment area of 45,880 $Km^2$ 4,393 $m^3$/annum[15].

Water yield is quite different for the Dez and the Karkheh basins. The Karkheh, with 35% (42,000 $Km^2$) of the total catchment of the Khuzestan rivers (119,500 $Km^2$) delivers only 13% (140 $m^3$/sec) of the water supplied, whereas 22% (228 $m^3$/sec) of the total 1,054 $m^3$/sec of all Khuzestan river discharge is accounted for by the Dez at Dezful station (Table 5-3). Also 59% of the total annual run-off of the Karkheh river occurred in the period March to May[16] and the ratio of maximum to minimum mean monthly discharge is 17.08[17]. Therefore there is a great shortage of water for irrigation during the peak summer demand in the lower Karkheh plain. The modern Dez irrigation network delivers

Table 5-3

Discharges of the Five Rivers of Khuzestan

1954/55

| River | Station | Basin Area | | Discharge | | Reliability |
|---|---|---|---|---|---|---|
| | | ($Km^2$) | % of total | $m^3$/sec | % of total | |
| Karkheh | Pai-i-Pol | 42,000 | 35 | 140 | 13 | Fair |
| Karoon | Ahwaz | 54,500 | 46 | 664 | 63 | Fair |
| Jarahi | Khalafabad | 10,000 | 8 | 128 | 12 | Approximate |
| Hindijan | Deh-i-Molla | 13,000 | 11 | 122 | 12 | Fair |
| Total | | 119,500 | 100 | 1,054 | 100 | |
| Ab-i-Dez | Dezful | 18,000 | 15 | 228 | 22 | Fair |
| Karoon | Gatwand | 33,500 | 28 | 372 | 35 | Fair |

Source: Bakker, A.J., 1956. p.131.

20 $m^3$/sec to the Karkheh river at Pai-i-Pol which is sufficient water for the irrigation of 30,000 ha of land in the lower Karkheh region[18].

5-10 Drainage Systems

Prior to the introduction of modern works, the drainage canals in the project area were widely spaced and natural in character. No field drains and collectors existed. The drainage situation was generally satisfactory. This is a result of the high elevation of the ground above the rivers and the drainage channels. Although the top soils have a low permeability in the irrigated area, the deeper soils are rather porous and with ample head available, drain off very well[19]. The major part of the waste water is drained by surface run-off. Natural drains in the project area are:

a) The Karkheh river, the Shaur, the Atidj, and a continuous depression between the Shaur and the Dez.

b) The Ab-i-Dez with its tributary the Balarood, the Ojirub, and a deep, but eroded channel between the Dez and Siah Mansoor rivers.

c) The Khur-i-Shaura and Siah Mansoor.

5-11 Water Quality of the Dez River

As far as water quality is concerned there has been no problem with the Dez water for agricultural purposes. The analyses of water from the Dez river and the Colorado river, delivered to the Imperial valley are as follows:-

| | Colorado River[a] | Dez River[b] |
|---|---|---|
| Conductivity Ecx $10^{o}$ at $25^{o}$C | 1260-1368 | 530 |
| Boron ppm | 0.2 | 0.02 |
| Sodium percent | 45 | 33 |
| pH | 8.0 | 8.0 |

| | Colorado River[a] | Dez River[b] |
|---|---|---|
| Dissolved solids ppm | 858 | 315 |
| Calcium ppm | 103 | 49 |
| Magnesium ppm | 32 | 12 |
| Sodium and Potassium ppm | 143 | 41 |
| Bicarbonate ppm | 192 | 143 |
| Sulphate ppm | 323 | 61 |
| Chloride ppm | 146 | 55 |

Source: (a) DRC, July 1969, Agri-business opportunities prospectus series No.2. Commercial potential for fresh vegetable production and marketing, p.23.

(b) KWPA, Resource investigations project, Ahwaz. Quality of Khuzestan surface waters. Part III, Water Years 46-47, 47-48 and 48-49, Day, 1350. p.42.

A comparison of the above data emphasises the fact that salt accumulation problems are not encountered with the Dez waters.

According to the classification of the U.S.A. Salinity Laboratory, Dez water falls into $C_2$-$S_1$ class. There is no alkalinity hazard and as to salinity, the water can be used if a moderate amount of leaching occurs[20].

## 5-12 Socio-economic Problems of the DIP Area

### 5-12-a Population and Unemployment

According to the census of 1956, the total population of the Dezful district was 108,460 of which 59,445 were urban dwellers[21].

The population of the DIP area was estimated in 1951 at 130,000 of which 70,000 were in the urban areas and the remaining 60,000 were rural dwellers in the 159 villages of the DIP[22]. According to the National Census of 1966 the population of Dezful was estimated at 84,499 and that of Andimeshk at 16,195. The estimated population of the rural areas of the Dezful District was 72,965[23].

KWPA quoted a figure of 228,000 for the DIP in October 1974 of which 72,000 were considered as rural dwellers, settled in 197 villages and in five newly established rural towns of the DIP[24]. Therefore the remaining 156,000 were urban dwellers of the towns of Dezful, Andimeshk and Shush in the Dezful district.

In 1958 the labour force of the DIP area was made up of 6,800 peasant families (the average size of family was 5.8), 3,800 barzegar[25], 840 agricultural wage workers and 450 non-agricultural workers. The total number of employed people in the rural and urban areas of the DIP area was estimated at 18,000 in 1958. The area is therefore almost entirely rural. Even in the town of Dezful a great part of the inhabitants were farmers, cultivating the fields in the surrounding dry farming areas or growing vegetables. Industry and handicrafts were absent except in the form of a number of small workshops and several brick kilns. There was practically no source of employment. In the villages there was nothing but agriculture. There were no shops or other facilities. Serious seasonal under-employment existed in the rural areas. Economically active people seeking work numbered 1,825 in the Dezful District, 732 in the town of Dezful and 1,093 in the rural areas[26].

According to the National Census of 1966, the economically active population seeking work was 3,766, of which 1,198 were in the town of Dezful, 745 in Andimeshk and 1,823 in the rural areas[27]. Therefore the total of unemployed and economically active population seeking work increased by 206.3% in the Dezful District during the decade (1956-66). The corresponding figures for the town of Dezful and the rural areas were 163.6% and 166.78% respectively.

5-12-b Land use and Cropping pattern of the DIP area in 1958

The gross area of the DIP lands is estimated at 169,000 ha comprising:-

| | | |
|---|---|---|
| 3,900 ha | (2.3%) | towns and land reserved for industrial and urban development |
| 33,400 ha | (19.7%) | gross dry farmland |
| 91,400 ha | (53.9%) | gross farmland within the limits of the existing irrigation system |
| 40,800 ha | (24.1%) | eroded and hilly lands, flood plains and river beds |

Source: Heidemaatschappij, 1958, p.II-1

In the area of dry farming, 50% of the land was planted with wheat, 10% with barley and 1% with broad beans. Basically the cropping pattern of dry farming was 50% cropped in winter and 50% left fallow.

The cropping pattern on irrigated lands was much more complicated as it was dependent on the quantity of irrigation water available in summer. In winter 78% of the land was planted with wheat and barley and 22% was left uncultivated. In summer 14% of the land was planted with rice, 6% with sesame and 2% with vegetables, leaving a total 78% uncultivated (Table 5-4).

Table 5-4

Cropping Pattern in the DIP Area in 1960

| | Total Area (ha) | Irrigated Areas (ha) | % | Dry farming areas (ha) | % |
|---|---|---|---|---|---|
| **Winter Crops** | | | | | |
| Wheat | 60,100 | 45,100 ) | ) 78.0 | 15,000 | 50.0 |
| Barley | 18,600 | 15,600 ) | | 3,000 | 10.0 |
| Beans | 1,650 | 1,350 | | 300 | 1.0 |
| Vegetables | 420 | 420 | 0.5 | - | - |
| Landlords' gardens | 200 | 200 | - | - | - |
| Forage crops and/or fallow | 28,730 | 16,930 | 21.5 | 11,800 | 39.0 |
| Total | 109,700 | 79,600 | 100.0 | 30,100 | 100.0 |
| **Summer Crops** | | | | | |
| Rice | 11,000 | 11,000 | 14.0 | - | - |
| Sesame | 4,900 | 4,900 | 6.0 | - | - |
| Vegetables | 720 | 720 ) | ) 2.0 | - | - |
| Lardlords' gardens | 920 | 920 ) | | | |
| Fallow | 92,160 | 62,060 | 78.0 | 30,100 | 100.0 |
| Total | 109,700 | 79,600 | 100.0 | 30,100 | 100.0 |

Source: Plan Organization, February 1960. Dez Project. A proposal for Power, Flood Control and Irrigation Development submitted to the Development Loan Fund, Annex 2.

5-12-c Land ownership

Except for a small area of peasant freeholdings in the vicinity of Dezful, some public land and a small area of waqf (shrine-lands), the land tenure was basically the old feudal system of landlords and tenants over the entire DIP area. No official data are available on land ownership in the DIP area. A research group of the institute for social studies at the University of Tehran made a study of the city of Ahwaz in 1963. In this study data are presented on land ownership in the Dezful District (Table 5-5). 195 villages, or 64.8% of the land was owned by large land owners. The agricultural census of 1960 quoted a figure of 65% for the large land owners holding arable lands and 17.6%, or 53 villages, for the land owned by farmers.

In the DIP area, 68% of the farm land was owned by large land owners and only 9% by small holders. 40% out of 68% of the large holdin land category was owned by seven landowners, and the remaining 28% by four[28].

In total 84% of the DIP area was privately owned. The landlords usually lived in the towns of Dezful or Andimeshk. These men were in fact not only the proprietors of the land, but also the administrators and organizers of the rural community (see Chapter 2).

5-12-d Size of holdings

In the DIP villages there were peasants who were recognised to have a right to a farm unit called khish. This was a farming unit for one farmer and his family, and the size was dependent on the skill and working capacity of the farmer, which normally meant the

Table 5-5

The Land-ownership Pattern of the Dezful District

| Public Domain | | Agricultural Corporations | | Small land owners | | Large land owners | | Institutionally owned (non-governmental) | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % of the area | No. of villages | % of the area | No. of villages | % of the area | No. of villages | % of the area | No. of villages | % of the area | No. of villages | % of the area | No. of villages |
| 21.3 | 64.0 | 2.3 | 7.0 | 17.6 | 53.0 | 64.8 | 195.0 | 1.0 | 3.0 | 100.0 | 301.0 |

Source: University of Tehran. Institute for social studies, with support of the National Iranian Oil Company, 1963. "A study of the city of Ahwaz", p.207.

tillage capacity of the draught animals he owned. A man who owned only one draught animal was entitled to ½ khish. He had to co-operate with another peasant, who, because he perhaps owned three draught animals, was entitled to 1½ khish. The average area of the khish was 30 hectares on dry farmland and on irrigated land it ranged from 9.7 to 16 ha. A khish of wheat in the villages of Kutian and Biatian Raffat in the centre of the DPIP area amounted to 8 and 10 ha respectively. For rice it was, respectively, 3 and 0.8 ha[29].

It is estimated that 32% of the peasants were entitled to ½ khish and 3% to more than 2 khish. The overall average was 1 khish. The tenant had no constant area of farmland to farm, the land being re-divided each year by ballot before the wheat season.

5-12-e Crop yield and crop sharing system

The yield was generally low in the DIP area because of the low level of agricultural technology and the tenancy system. KWPA quoted figures of 675 Kg/ha for wheat, 735 Kg/ha for barley, 925 Kg/ha for broad beans, 1,600 Kg/ha for rice and 220 Kg/ha for sesame[30]. The quoted figures of a research group are 400 - 700 Kg/ha for wheat and 900 - 1,100 Kg/ha for paddy rice[31].

The land owner's share in the harvest varied according to the area and field conditions. For dry wheat and barley the land ownerps share was 1/10th and for irrigated wheat and barley his share ranged from 1/5th to 1/8th. The share for broad beans was 1/3rd to 1/8th and that of sesame and rice was 1/2. For vegetables the share usually was 1/4 to 1/6 and for truck gardening areas the landlord's share was $\frac{1}{4}$ provided that gravity-flow water was available. The rice and wheat field watchmen and sesame water distributors were paid by the peasant in kind.

The gross income per khish was 49,300 rials for the irrigated areas of which 11% was paid to the barzegar and/or wage workers, 20% to the land owner, 3% spent on debts, 1% to officials and 22% on seed and food for the cattle. Thus the total cost was 28,100 rials and the net income per khish, 21,200 rials, out of which 18,000 rials came from crops[32]. On dry farm land the gross income was estimated at 33,600 rials. The cost per khish was 18,200 rials and the net income per khish was therefore 15,400 rials[33].

Taking the average size of family at 5.8, per capita net farm income amounted to 3,655 rials/annum on the irrigated land and 2,655 rials/annum on the dry farmland.

5-12-f Land reform implementation

During the years 1963 to 1966, phases I and II of the land reform programme were carried out in the DIP area. No official statistics on the implementation of the law in the DIP area are available. It seems that the DIP area status with regard to land reform was no different from that prevailing in Khuzestan province.

By 1966 in the DPIP area (22,000 ha gross area) 30% of the land was owned by the peasants, 60% was leased to the peasants for a period of 30 years and 10% was owned by the landowners[34].

In 1971, of the total area of 9,609 ha of the DPIP area which had been allocated to the Farm Corporations, 16 villages were divided between the landlords and the peasants and the remaining 12 were sold to the peasants.[35]

The system of farming in both areas, the DPIP area and the DIP area which assigns a farmer to a different khish or joft (holding) of land each year, was a carry over from the pre-land reform period in 1971[36]. During that era, landlords, through their (kadkhodas) overseers, assigned lands to various farmers to work. In 1971 the decision on assignment of lands to the previous peasant belonged to the kadkhoda, who was a government-appointed overseer. In 1971 in the Karkheh plain on 5,290 hectares of irrigable lands, located at the south-west corner of the DIP area, several Shaikhs (Arab tribal leaders) still owned the land. They started the process of selling and/or dividing their land according to the provision of the third stage of the land reform law[37]. Since 1969 the pattern of land ownership in the DIP area has been completely changed. To encourage the more efficient use of water resources, consolidation of land has been considered a prerequisite. The outcomes of this new strategy will be either the establishment of Agro-business enterprises or Farm Corporations.

## 5-13 Social Welfare

### 5-13-a Health and sanitation

At the commencement of the Dez scheme, the health and sanitation services were very inadequate. According to the National Census of 1956 only three villages, or 1% of the total number of villages in the Dezful district, had clinics or other medical facilities[38]. Out of 301 villages in the Dezful district only four villages had public baths. The town of Dezful had only a government hospital

(3 doctors, 5 nurses and 25 beds) and three dispensaries, in 1958. The others were located in Andimeshk, Shush and the village of Khosroabad (in the DPIP area) and were under-staffed. Through the entire region of the Dezful District only seven doctors were available. These government doctors made tours through the rural areas visiting the villages about once a year.

5-13-b <u>Education</u>

The educational services were not adequate either. Only 24 primary schools existed in the Dezful District, of which 15 were located in Dezful, Andimeshk and Shush and only 9 in the villages. Hence 97% of the villages had no school.

Illiteracy was very high. The percentage of illiterates in the Dezful district of 10 years of age and over was 92.4%. The corresponding figures for the town of Dezful was 83.1% and for the rural areas, 96.1%. Even ten years later, in 1966, the figures for illiteracy for the age group 10 years and over were 70.9%, 57.5% and 89.7% respectively, (Table 5-6).

The lack of road facilities enhanced the inaccessibility of the urban services to the rural dwellers, and the road system was inadequate. Through the area between the Karkheh and the Dez rivers, the highway and the Trans-Iranian railway, from Abacan to Tehran crossed the land from south to north. An all-weather road connected Andimeshk with Dezful and later with Shushtar in the east of the DIP area. These roads did not comprise a well developed system. On rainy days many parts of the roads were inaccessible, and in many cases bridges were non-existent or broken down. East-west connection

Table 5-6

Illiteracy in the Dezful District in 1956 and 1966

| Region | 1956[a] | | | | 1966[b] | | | |
|---|---|---|---|---|---|---|---|---|
| | 10 yrs old and over | Total of literate | % of literate | % of illiterate | Total 10 yrs old and over | Total of literate | % of literate | % of illiterate |
| Dezful District | | | 7.6 | 92.4 | 110,170 | 32,062 | 29.1 | 70.9 |
| Urban areas | 37,408 | 7,290 | 19.5 | 80.5 | 64,290 | 27,317 | 42.5 | 57.5 |
| Dezful town | 32,884 | 5,562 | 16.9 | 83.1 | 53,868 | 21,734 | 40.3 | 59.7 |
| Andimeshk town | 4,524 | 1,728 | 38.2 | 61.8 | 10,422 | 5,583 | 53.6 | 46.4 |
| Rural areas | | | | 96.1% | 45,880 | 4,746 | 10.3 | 89.7 |

Source: (a) Ministry of Interior, National Census of 1956, Vol.XIX, p.20.

(b) Plan Organization, Iranian Statistical Centre, National Census of Population and Housing, Vol.LXXVII, p.15.

over the Dez river was either by bridge at Dezful or via a derelict ferry across the Dez river in the south, near the hills of Haft-Tappeh.

In summary, all services were inadequate for the economic and social development of the local population.

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# CHAPTER 6

## ESTABLISHMENT OF INFRA-STRUCTURES FOR DEVELOPMENT

### 6-1 The Dez Dam and the Modern Irrigation and Drainage Networks

#### 6-1-a The antiquated structures

The antiquated irrigation systems of Khuzestan diverted water from the various rivers by means of barrages. The remains of these structures still exist. Among them is a multi-purpose structure at Shushtar on the Karoonriver, built in the Third Century A.D., part of which is still in operation[1].

In the northern part of the Karkheh plain, within the DIP area, the river enters the Khuzestan lowlands. In both Acheamenian and Sassanian times the dam-bridge on the Karkheh near to Pai-i-Pol diverted water to several big canals[2]. Of these the Dariush canal is still in existence, and serves part of the sugar cane project lands at Haft-Tappeh[3].

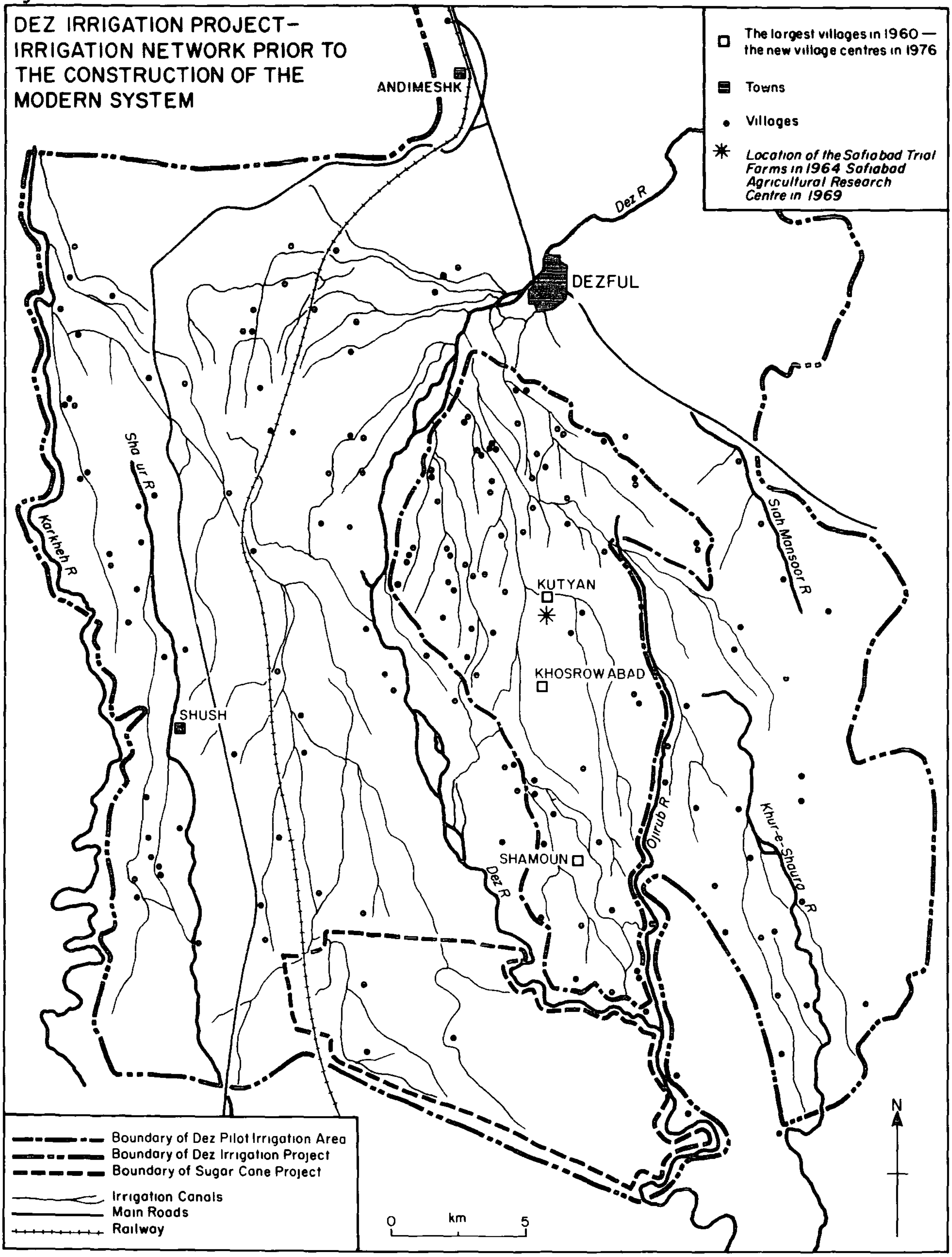
On the Abi-i-Dez, ancient structures existed upstream of Dezful. The ancient dam-bridge at Dezful is incorporated into the modern bridge. In the Middle Ages, Dezful had an ingenious system whereby water was supplied to the town. This was built on the high banks above the river. Le Strange pointed out that a canal cut in the rock supplied the water, and turned a large water wheel, which lifted the town water supply over "50 ells".[4]

A system of regular supply of water was developed in Sassanian times at Dezful and Shahabad (Jondishapoor) by the construction of qanats. These qanats were partly dug in gravelly deposits to collect ground-water, and partly constructed to tap water from the deep bed of the river. The water was transported to the lower lying agricultural lands of the towns. In the high fertile lowlands of the Karkheh and the Dez basins, these qanats have been constructed to supplement the water available during the periods when the surface water was insufficient.

### 6-1-b The irrigation system of the DIP area before the modern system was introduced (1960)

An intricate canal system irrigated the DIP area until 1960. It consisted of a large number of separate diversion systems. Small areas near Dezful were exceptional, being irrigated by ancient qanats which branched off from the Dez river north of Dezful and provided water for gardens and the production of horticultural cashcrops on shallow and gravelly soils. Most water was directly diverted from the Dez and the Karkheh rivers by open canals, (Fig. 6-1). Each diversion system had its own take off higher or lower along the course of the rivers, depending on the destination of the water. With the help of weirs the water was led into the primary canals. The further eastward the water had to be brought, the more upstream the take off was situated. The river Karkheh served the Shush plain and the northern part of the Karkheh plain. The Dez river served the eastern part of the Dezful plain, the western part of the Dezful peninsula and the flood plain of the Balarood (Fig. 6-1). In the southern parts of the DIP area the water supply of the irrigation systems originated from the north, collecting in low-lying streams or drainage channels like the Shaur, the Atidj, and the Ojirub. This supply was greatly insufficient in the main cultivation periods of cereals, and also possessed a high salt content[5].

Fig 6 I


DEZ IRRIGATION PROJECT–
IRRIGATION NETWORK PRIOR TO
THE CONSTRUCTION OF THE
MODERN SYSTEM
The largest villages in 1960 — the new village centres in 1976
Towns
Villages
Location of the Safiabad Trial Farms in 1964 Safiabad Agricultural Research Centre in 1969
ANDIMESHK
DEZFUL
Dez R
Sha ur R
Karkheh R
Siah Mansoor R
KUTYAN
KHOSROW ABAD
SHUSH
SHAMOUN
Dez R
Ojirub R
Khur-e-Shaura R
N
Boundary of Dez Pilot Irrigation Area
Boundary of Dez Irrigation Project
Boundary of Sugar Cane Project
Irrigation Canals
Main Roads
Railway
0
km
5

In the Dez Pilot Irrigation Project, thirteen canals served an estimated area of 20,000 ha[6]. The diversion of water to the fields was achieved by the temporary construction of brush-wood and stone dams. The system dated back some 70 - 100 years .

## 6-1-c Modern hydraulic structures

### 6-1-c-1 Location of the Dez Dam

The Dez reservoir dam is located in a deep canyon of the Dez river, about 30 Km north of Dezful. At the dam site, the river has cut a 500 metre deep gorge through a north west-south east trending mass of Pliocene conglomerates, known as the upper and lower Bakhtiari formations. The dam has its foundations in the lower portion of the Upper Bakhtiari conglomerate, which has a maximum thickness of 500 to 600 metres in the area. It consists of calcareous sandstone. At the location of the dam-site the level of the river bed is at an elevation of 160 metres and the width of the river at the water line is about 12 metres[7].

### 6-1-c-2 Hydrology of the Dez River Basin

The Dez river has a total drainage area of about 22,500 $Km^2$ at the Molla Sani station and is the principal tributary of the Karoonriver. The drainage area at the Pahlavi dam is 17,430 $Km^2$.

The annual precipitation total in the Khuzestan lowlands ranges from 150 to 250 mm. Normally, about 350 to 550 mm occurs on the upland plains and considerably more on the exposed slopes of the mountains. The annual snowfall in the high mountains, upstream from the Dez dam site, is equivalent to approximately 1,200 mm of water, with a recorded maximum of 2,170 mm in 1969[8]. Snow cover is generally limited to areas above 1,500 - 2,000 metres elevation.

Precipitation is normally limited to the period between November and April, with a yearly maximum occurring between December and March depending upon the location.

Virtually no precipitation occurs during the remaining part of the year. The annual variation in precipitation is large. Table 6-1 compares the variation in precipitation in the years 1968/69 and 1971/72 with an average year.

Long-range stream flow records covering approximately 15 years are available at the dam site, (Appendices B and C). While the mountainous catchment area of the Dez basin at the dam site comprises only 15% of the total mountainous watershed of the five rivers of Khuzestan, its mean discharge amounts to about 22% of the total run off of all basins (1,070.90 $m^3$/sec). The average contribution from the Dez river to the Karoon flow is 30% at low flows and 45% during very high flows[9].

The long term annual mean flow (1954-1962) of the Dez river at the Dezful station is 220 $m^3$/sec, with a minimum discharge of 48 $m^3$/sec at Dezful[10]. The maximum floods on record at Dezful are 2,250 $m^3$/sec in March 1959, 2,555 $m^3$/sec[11] in March 1969 and 2,328 $m^3$/sec in March 1972[12].

6-1-c-3 <u>Characteristics of the Dez Dam and the associated reservoir</u>

The characteristics of the Dez dam and the reservoir are summarized as follows[13]:

Table 6-1

Variations in Precipitation for the Years 1968/69 and 1971/72 compared with an Average Year

| Station | Mean average annual precipitation mm | Mean precipitation of 1968/69 mm | Mean precipitation of 1971/72 mm | Variation of 1968/69 from the normal mm | Variation of 1971/72 from the normal mm | Variation of 1968/69 from 1971/72 (+-) mm |
|---|---|---|---|---|---|---|
| 1 Ahwaz | 206.7 | 359.9 | 322.1 | 153.2 | 115.4 | + 38.8 |
| 2 Hamidieh | 171.1 | 351.0 | 303.0 | 179.9 | 131.9 | + 48.0 |
| 3 Dezful | 320.4 | 509.5 | 390.5 | 189.1 | 70.1 | +119.0 |
| 4 Haft Tappeh | 200.2 | 571.2 | 334.3 | 371.0 | 134.1 | +237.1 |
| 5 Sangtarash | 874 | 1,337.0 | 1,258.0 | 462.0 | 383.0 | + 79.0 |
| 6 Tal-e-Zang | 747.1 | 1,349.9 | 1,354.0 | 602.8 | 606.9 | - 4.6 |
| 7 Godar Landar | 408.4 | 737.5 | 621.0 | 212.6 | 212.6 | +116.2 |

Source. Ministry of Water & Power, KWPA. Resource Investigations Project.
A summary report on the Flood of March 1972 in Khuzestan. January 1973. Ahwaz, p.5.

| | | |
|---|---|---|
| 1) | Type of dam: | Thin-arch concrete. |
| 2) | Height of the dam: | 203 m. |
| 3) | Reservoir capacity: | $3\frac{1}{3}$ billion cubic metres |
| 4) | Area of reservoir: | 6,300 hectares |
| 5) | Length of reservoir: | 60 kilometres |
| 6) | Regulated flow of water: | 187 $m^3$/sec. on an annual basis. |
| 7) | Irrigable area: | 125,000 hectares |
| 8) | Flood control benefits: | $1 million annual loss on the Karoon and the Dez rivers will be prevented. |
| 9) | Flood control storage:[14] | $850 \times 10^6\ m^3$ |
| 10) | Hydro-plant power capacity: | 520,000 kilowatts. |
| 11) | Spillways: | Two separate tunnels fitted with 15 by $10\frac{1}{2}$ metre radial gates.<br>No.1 spillway: 400 metres in length, 14 metres in diameter<br>No.2 spillway: 400 metres in length, $12\frac{1}{2}$ metres in diameter |
| 12) | Sluiceways: | Three in number fitted with conical dispersion valves $1\frac{1}{2}$ metres in diameter, capable of releasing up to 200 metres per second for irrigation and flood control. |
| 13) | Underground power house: | Turbines: Francis 110,000 h.p. under 152 metre average head: Speed - 250 r.p.m.<br>Generators: 65,000 kilowatt, three phases, 50 cycles.<br>Transformers: 84,000 Kv, three phases, operational centre is the remote control house on the transformer platform above the powerhouse. |

| | | |
|---|---|---|
| 14) | The height of the reservoir above sea level: | 354 metres[15] |
| 15) | The height of the dam's foundation above sea level: | 151 " |
| 16) | The thickness of the bottom part of the dam: | 21 " |
| 17) | The thickness of the top part of the dam: | 4.5 " |
| 18) | The maximum height of the reservoir level: | 350 " |
| 19) | The minimum height of the reservoir level: | 290 " |
| 20) | The average height of the reservoir level: | 310 " |
| 21) | The useful reservoir storage capacity of the reservoir, when the water level is between 350 and 290 m: | 2,530 x $10^6$ $m^3$ |
| 22) | The useful reservoir storage capacity of the reservoir, when the water level is between 350 and 310 m: | 1,950 x $10^6$ $m^3$ |
| 23) | The date of the commencement of construction: | December 1958 |
| 24) | The date of the completion and the dedication of the dam: | March 1963 |

The responsible organizations for the project were:-

1) Plan organization of Iran, which initiated the Khuzestan Development Programme under the Second Seven-Year Development Plan and in 1960 turned over its responsibility for the execution of the programme to KWPA.

2) KWPA, which was created by an Act of Parliament in 1960. KWPA has been responsible for the planning, execution and management of the Khuzestan Development Programme.

3) Development and Resource Corporation of New York has provided management and supervision of the construction and operating activities of the Dez dam and the Khuzestan development programme.

4) The hydro-electric power commission of Ontario (Canada), under

contract with DRC has operated the dam's hydro-electric power installations.

Major contractors were:-

1) Impresit-Girola-Lodigiani, an Italian Contractor for the second phase (Dam construction, powerhouse, spillways, switchyard, access tunnel road, etc).

2) Morrison-Knudsen International, U.S.A. Contractor for the first phase (camp construction, water and electricity supply, diversion tunnel, access road tunnel, etc).

In addition, more than twenty other European and American companies have participated in the Project.

In 1963, when the responsibility was taken over by KWPA, 94% of the constructional works of the Pahlavi dam and its transmission lines was completed which includes:

a) The reservoir dam.

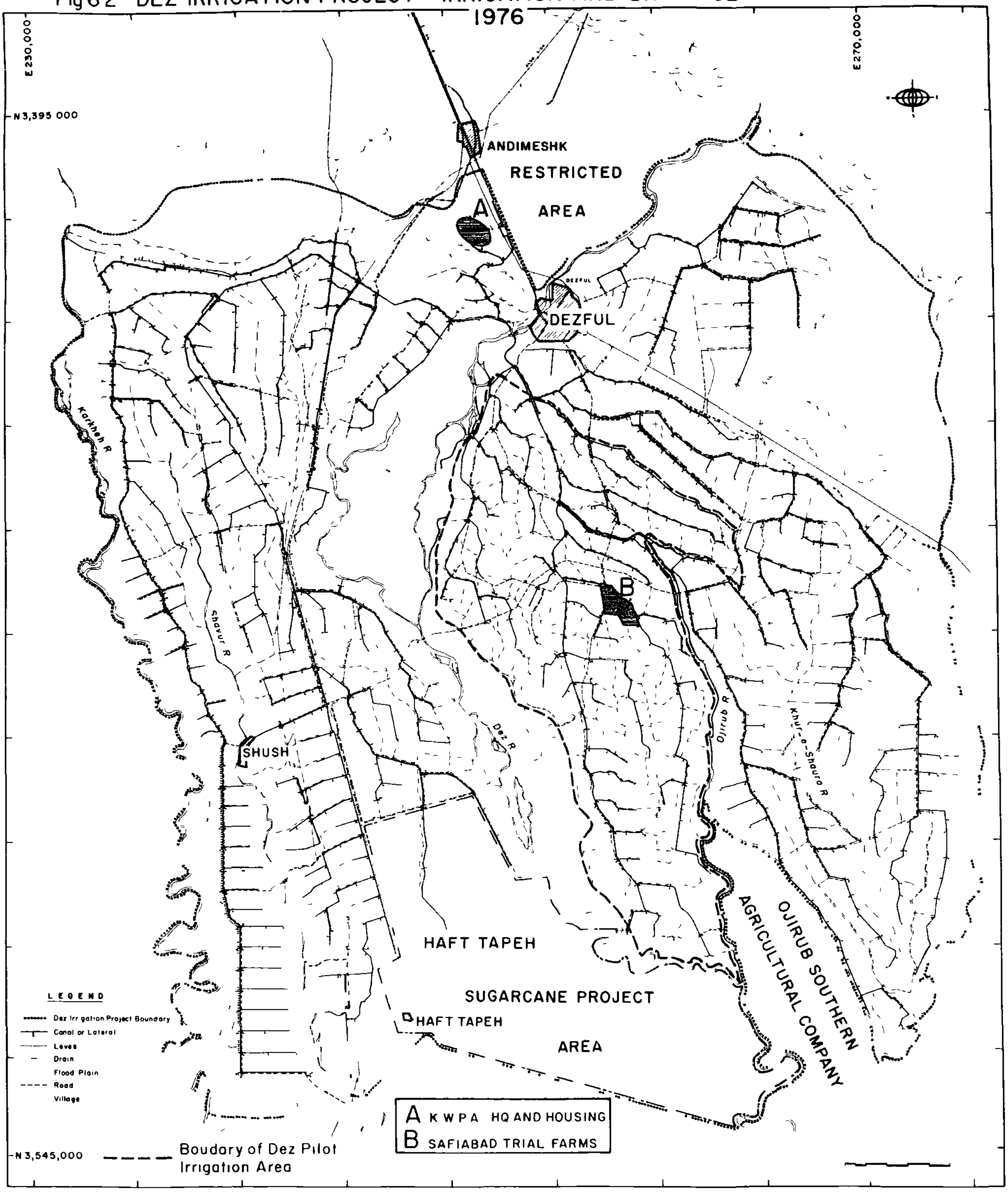
b) A powerhouse with two generators and the house for an additional two generators.

c) A transmission line of 230 Kv from the Pahlavi dam to Ahwaz, a transmission line of 132 Kv from Andimeshk to Dezful and two 132 Kv lines from the Abadan sub-station to the secondary distribution stations of Abadan and Khoramshahr. A new sub-station in Andimeshk, high tension lines to the Ahwaz and Abadan sub-stations and secondary distribution stations in Dezful, Andimeshk, Ahwaz, Abadan and Khoramshahr.

6-1-c-4 <u>The modern Dez irrigation and drainage networks</u> (Fig.6-2)

The initial phase of the Dez dam scheme included the construction of the Pahlavi dam, power house and the associated transmission lines.

Fig 6 2 DEZ IRRIGATION PROJECT— IRRIGATION AND DRAINAGE NETWORK 1976



In addition there was a Pilot Irrigation area of 21,467 ha which was to serve as a model for an ultimate irrigation development of 125,000 ha.

The next phase is the Dez Irrigation Project, consisting of a regulating dam, a diversion dam, the main canals, laterals and sub-laterals.

With the completion of the DIP, a total net area of 72,500 ha out of a gross area of 96,259 ha will be irrigated.

The Pilot Area Irrigation and Drainage Networks

The irrigation network of the Pilot area is summarized as follows:

a) A river diversion structure with a 205 metre concrete capped crib dam with spillways for passing a flood of up to 2,000 $m^3$/sec. A left bank control structure and a 1 kilometre dike connecting the spillway and the left bank control structure.

b) A 107 kilometre diversion canal between the left bank control structure and the headworks, with a capacity of 67.5 $m^3$/sec.

c) The Alam Canal (East Canal), 27 kilometres in length with a capacity of 54 $m^3$/sec.

d) West branch canal, 12 kilometres in length with a capacity of 13.5 $m^3$/sec.

e) A total of 122 kilometres of laterals and 20 kilometres of sub-laterals which deliver water from the two main canals to 225 individual headgate units varying in size from 60 to 140 ha per unit.

f) Structures include: 24 division structures, 6 traffic bridges, 46 waste outlets, 39 lateral and sub-laterals, 111 checks and drop structures, 225 headgates and 222 parshal flumes.

g) 150 kilometres of main and secondary collectors and deep drains ranging in capacity fron one to twenty $m^3$/sec. In addition a total of 100 kilometres of old irrigation canals serve as the project drains[16].

The DIP Irrigation and Drainage Networks

In 1967 after an evaluation of the achievements of the Pilot area three feasibility reports, in November 1967, September 1968 and November 1970, were provided by DRC. These reports have emphasised the importance of the extension of the modern irrigation and drainage networks of the Pilot area to the entire DIP. A second IBRD loan of U.S.$30 million was executed in April 1969, for the development of stage one of the DIP which would supply regulated water to an additional 37,000 ha, and permit the development of agricultural programmes. This stage was planned to be completed by 1972. The second stage of the DIP will be financed by Fifth Development Plan funds and it was planned to be completed by March 1975. Once the DIP (Stages 1 and II) is completed a net area of 72,500 hectares will be irrigated.

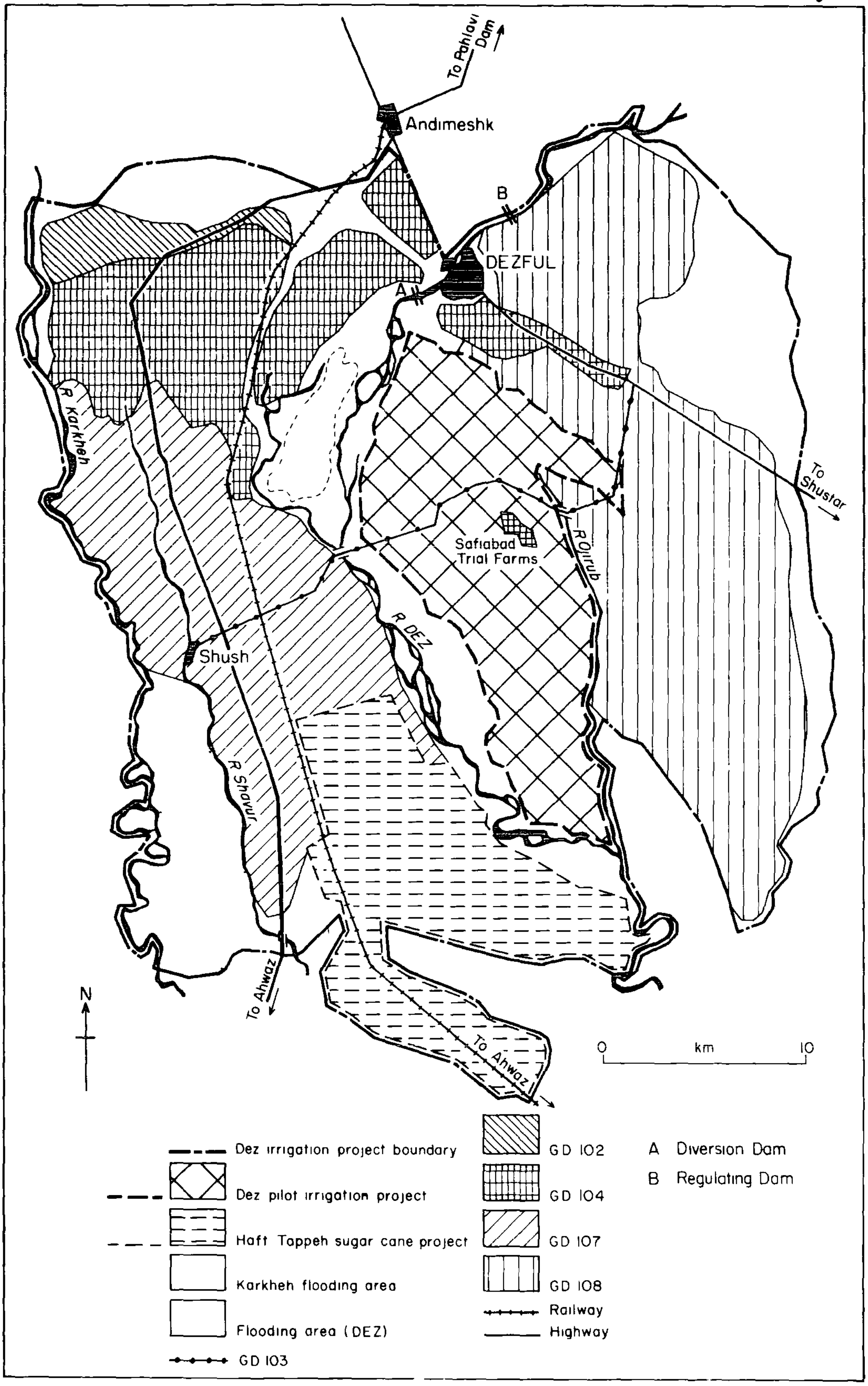
The whole DIP area has 650 kilometres of concrete lined and earth lined canals and laterals, with capacities ranging from 150 $m^3$/sec to 300 letres/sec. There are over 3,700 associated concrete structures, including bridges, siphons, turnouts, checks, five major pumping plants, 419 kilometres of roads and 436 kilometres of drains. (Figure 6-2).

The projects were planned and designed in Sacramento, California, by DRC consultant engineers[17] and have been carried out by International and local contractors.

Contracts

The DIP has been broken down into six civil contracts: GD102, GD103, GD104, GD107, GD108 and GD110. There are six supplementary contracts: GD101, GD105A and B, GD106, GD109, GD111A and B, and GD112A and B. Fig.6-3 shows the irrigation service areas covered by each civil contract[18].

DEZ IRRIGATION PROJECT, CIVIL WORK CONTRACTS Fig 6 3



A brief summary, outlining the details of each contract, is as follows

Contract GD102

This contract is for the construction of irrigation works to irrigate 1,850 gross ha of land north west of the Dez River. It consists of 15.8 kilometres of major concrete lined canals, 9.4 kilometres of earth-lined secondary canals, the Pai-i-Pol lateral of 8 kilometres, (also concrete lined) and a 7.6 kilometre earth lined section which is now completed. 45 kilometres of drains, 103 irrigation structures, diversion dam and a regulating dam are also parts of this contract. Contract GD102 includes:

a) The diversion dam

The diversion dam, located 4 kilometres south-west of the town of Dezful, consists of a 394 metre uncontrolled spillway section, 4 metres high with a radial gated sluiceway and canal headworks on the right and left banks. The dam has been designed for about 6,000 $m^3$/sec. of river flow.

b) The regulating dam

This dam is situated 4.5 kilometres north of the old Dezful bridge. It is a concrete dam 20 metres high and 136 metres long with approximately 14 million $m^3$ of reservoir capacity.

Contract GD103

This is a civil contract for the construction of the Shush-Shushtar road (33 kilometres long), connecting the Tehran-Khorramshahr Highway and the Dezful-Shushtar road. The road serves as a main access road for the project. The Dez river crossing at Hamid Abad is one of the important features of this contract as well as two bridges crossing the railway.

Contract GD104

This covers the northern distribution system of about 145 kilometres of canals and laterals (36 kilometres of the west main canal), 41 kilometres of drains, 111 kilometres of roads and 835 related concrete structures. The gross area of irrigation is 14,800 ha.

Contract GD107

This is a contract to irrigate 24,200 ha west of the Dez river. 32 kilometres of main canals, with maximum capacities of 25 $m^3$/sec, 128 kilometres of laterals, 105 kilometres of gravel roads, 135 kilometres of drains and 1,100 related structures are included.

Contract GD108

24,972 ha east and north of the Dez river will be irrigated according to this contract. The facilities include a total of 300 kilometres of main and secondary canals, 170 kilometres of gravel roads, 220 kilometres of drains and 1,700 related structures. The civil contracts are responsible for the irrigation of a total area of 65,822 ha (Fig.6-3). The remaining 6,678 ha are the Karkheh and the Dez flood plains[19]. No contract covering this area has been drawn up. The dates for the completion of contracts 107 and 108 are March 1977 and July 1978 respectively[20].

The capacities of the field intake systems

In a modern irrigation system, the net capacities of the gates are different, and are summarized as follows[21]:

a) 4 l/sec. ha, when using gravitational forces.

b) 2.4 l/sec. ha, when using a pump for any crop pattern.

c) 3.24 l/sec. ha, when using a pump for the irrigation of rice.

d) 2.7 l/sec. ha, for the irrigation of rice (gravity flow).

e) 2 l/sec. ha, for the irrigation of any crop pattern, except rice.

f) 30 $m^3$/sec. for the Haft-Tappeh sugar cane irrigation project.

g) 2 l/sec. ha, for the irrigation of the Karkheh flood plain.

h) 15 $m^3$/sec. for the irrigation of the lower Karkheh area.

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# CHAPTER 7

## THE DEZ PILOT IRRIGATION PROJECT (DPIP)

The DPIP was about $^1/6$ of the DIP area comprising 22,200 ha gross. The net irrigated area was 20,900 ha.

The DIP began on the pilot area, rather than on the total area, to test the new management features of this project over a short period. These included:-

a) A new type of water use agreement with landlords, and cultivators, involving payments by the operators to the Government for water use, and extensive changes in agricultural practice.

b) A new government agency (KWPA) was to be created by law..

c) A new government agricultural service to the cultivators, such as agricultural training, extension, credit and mechanization, was to be employed.

### 7-1 Location

The pilot area was located immediately south of the town of Dezful and on the east of the Dez riverbank, forming a triangle approximately 25 kilometres north to south and 10 kilometres west to east. It was bounded on the north by lands irrigated by several Dez river qanats, in the north east by the river bed of Siah Mansoor, in the east by the Ojirub river and in the west by the Dez river (Fig. 6-1).

### 7-2 Criteria for the selection of the DPIP area

The following criteria were considered by Plan Organization in the selection of the pilot area:-

a) It was sufficiently representative of the 125,000 ha in terms of soils and landlord-tenant relationships. Also the economic benefits gained in the pilot area could be assumed to be obtainable in the DIP as a whole.

b) The pilot area was a natural drainage unit. The construction of new canals would not reduce the water use pattern in the areas outside the pilot area.

c) Public canals to be built in the pilot area would be an integral part of the DIP as a whole.

d) It was expected that a three-year trial with controlled water in the pilot area from 1963 would permit judgements to be made on the adjustment of landlords and tenants to the new water control, the management efficiency of KWPA and the performance of the agricultural services. There would be a definite indication of economic benefits in the pilot area by 1966, although it was expected to take 10 years to obtain the full transition to modern farming methods in the area.

## 7-3 Existing Agricultural conditions in the Pilot Area in 1960 compared with the DIP area

The key differences in agricultural conditions between the pilot area and the DIP were:

a) No dry farming existed in the pilot area.

b) Land conditions were uniform and no waste land existed there.

c) All the pilot area was under a tenant share cropping system.

d) Mechanised agriculture did not exist in the pilot area.

e) There were more villages in the pilot area (58 compared with 159 in the entire DIP) and a higher population density per $Km^2$ ($59/Km^2$ in the DPIP against $50/Km^2$ for the DIP).[1]

## 7-4 Environmental Conditions of the Pilot Area

### 7-4-a Climate

The mean annual rainfall of the pilot area is 350 mm, with a range from 365 mm at Dezful to approximately 330 mm at the eastern part of the area. The rainfall occurs in the months November to May. Mild winters and hot summers are the general climatic characteristics of the area. Winters generally have sunny days, with infrequent frosts at night. Humidity is usually low[2].

### 7-4-b Soils

The soils are calcareous, of fine texture, with low surface permeability, and good internal permeability[3]. The northern two-thirds of the pilot area is underlain by gravel deposits at a depth of 4 to 6 metres and below. Although the soils above the gravel are heavy textured, there is good internal drainage in the gravel layers.

#### Land Classification

About 93% of the pilot area land is of Class II compared with 68% of the whole DIP, and 76% of the existing irrigated areas of the DIP[4].

### 7-4-c Drainage

Surface drainage in both the pilot area and the DIP is not a critical factor. The average slope of the terraces is two to three metres per kilometre. The Ojirub, and Siah-Mansoor rivers form the natural drains. Smaller natural drains occurred at regularly spaced frequent intervals. There is little evidence of salinity build-up or restricted natural drainage except in small localized areas.

## 7-5 Population of the Pilot Area and the Social Services

### 7-5-a Population

No reliable figure is available on the population of the DPIP. Plan organization estimated a population of 13,800 living in 57 villages of the pilot area of an average size of 45 families in 1959. KWPA quoted a figure of 12,000 in 1966[5]. According to the 1969 census carried out by the DIP Health and Sanitation Department, there were 15,795, living in 58 villages covering a total area of 22,000 ha. Of the population total, 5,753 were living in 9,006 ha of the northern part of the pilot area. This was devoted to four Farm Corporationsin 1971. The population of this area was 4,241 in 1961[6].

Using the above figures, the population of the pilot area was calculated as 11,645 in 1961, which is close to the figure of 11,508 of the 1960 Census made by the DIP Khuzestan Development Service. No official data are available on the number of land holder peasants in the pilot area. Gremliza quoted a figure of 2,979 as the number of DPIP households of which 2,591 were land holder peasants, 128 shepherds, 85 gardeners, 30 Haft-Tappeh workers and 95 others[7].

### 7-5-b The Make-up of the Population

Three main tribal groups inhabit the villages, namely Desfuly, Arabs and Bakhtiaries. 79.6% of the population of the pilot area were Dezfuly, 4.8% Arabs, and 5.6% Bakhtiaries. The Dezfulies lived mostly in the east, north-east, and northern part. The Bakhtiaries lived in the north-west, and western parts, and the Arabs mainly in the south-west.

7-5-c Health and Sanitation

In 1960 the Dez Pilot area lacked health and sanitation services and facilities. The majority of the health problems in the villages can be attributed to poor housing conditions, over-crowding, lack of sanitary services and facilities and the absence of health education. These factors have contributed to the presence of malnutrition, Bilharzia, Helminths (internal parasites), Glaucoma, and Malaria[8]. One room frequently served as the living quarters for the whole family in the villages of the pilot area. In surveys conducted in 1961 and 1966, the occupation rate was found to be between 3.9 and 4 people per room, respectively in the villages[9]. In 1966, it was found that 20.6% of the houses were shared by humans and cattle and 28.3% were shared by humans and poultry[10]. Pools of stagnant water around the villages offered breeding grounds for the bulinus truncatus snail, the carrier of Bilharzia. Water from these pools is sometimes used for household purposes. A United Nations' study found that more than 90% of the people in the Dezful area have internal parasites whose existence can be attributed to the drinking water. Rosenfield quoted a figure of 22% for the population infected with Bilharzia in the pilot area in 1961[11].

7-5-d Education

In 1960, there were only four schools in the villages of the pilot area. Plan Organization quoted a figure of 15% for the literate people of the pilot area compared with 10% for the whole DIP area[12]. According to a survey carried out in 1961, the illiteracy rate was estimated at 97.7%[13].

7-6 Land Use

The pilot area consisted of 22,200 ha of which 1,700 ha were non-agricultural (Housing areas, roads, small eroded areas, and grazing areas). The agricultural land area was 20,500 ha of which 20,000 ha were cultivable. The percentage of non-agricultural land was 8% compared with 26% in the DIP), resulting in a gross agricultural area of 92% (compared with 74% in the DIP)[14]. About 14,073 ha or 70.36% of the total 20,000 ha were cultivated in winter and 6,077 ha or 30.38% were cultivated in summer. Insufficient water and inadequate seasonal distribution of the Dez river discharge caused some land to be left fallow ranging from 29.64% in winter to 69.62% in summer. The corresponding figures for the Kutian village at the centre of the pilot area were 20 - 25% to 65 - 70% respectively[15].

7-7 Cropping Pattern and Yield

The winter crops were mainly wheat, barley and broad beans. 75.09% of the cultivated area was under wheat and 20.46% barley. Rice, sesame and vegetables were produced in summer depending on the amount of water available. Even the limited area of 6,077 ha of summer crops suffered from water shortage. Rice formed 75.82% and sesame, 16.02% of the cultivated area (Table 7-1). The crop yields were generally low because of the use of primitive agricultural methods. The land was ploughed by wooden ploughs pulled by a yoke of oxen. The use of improved seed, and chemical fertilizers was non-existent. Manure was only applied to vegetables and broad beans. As a result, the yield of wheat was 675 Kg/ha and the yields of barley, rice and sesame, 735 Kg/ha, 1,600 Kg/ha and 220 Kg/ha respectively (Table 7-1).

Table 7-1

Cropping Pattern and Yields in the DPIP Area

1959

| | Area (ha) | % of the total area under cultivation | Yield (Kg/ha) |
|---|---|---|---|
| Winter Crops | | | |
| Wheat | 10,567.000 | 75.090 | 675 |
| Barley | 2,880.000 | 20.460 | 735 |
| Beans | 0.470 | 0.003 | 925 |
| Landlords' gardens | 0.156 | 0.001 | |
| Total | 14,073.000 | | |
| Fallow | 5,927.000 | 29.600 | |
| Sub-total | 20,000.000 | | |
| Summer Crops | | | |
| Paddy | 4,608.000 | 75.820 | 1,600 |
| Sesame | 974.000 | 16.020 | 220 |
| Peasants' vegetables | 345.000 | 5.670 | |
| Landlords' gardens | 150.000 | 5.460 | |
| Total | 6,077.000 | 30.380 | |
| Fallow | 13,917.000 | 69.585 | |
| Sub-total | 20,000.000 | | |

Source: Plan Organization, 1959, Annexes 2 and 4.

## 7-8 Land Ownership and Tenancy

All land in the pilot area was privately owned. Most of the land was owned by the leaders of the tribes (Shaikhs or Khans). Eleven of these leaders owned over 60% of the pilot area. Their holding ranged from 400 to 2,800 ha per family. Many landlords lived in the town of Dezful and engaged in trading, smuggling, money lending, very small manufacturing or other profitable activities. A single representative of each tribe acted as a manager of the large estates and was referred to as the owner. When the building of the Dez dam began, landowners had a feeling of insecurity and uncertainty as to their future land and water rights.[16]

## 7-9 Marketing

The gross value of products in the pilot area was estimated at 93,800,000 rials or 4,690 rials per hectare[17]. The main markets were Dezful, Ahwaz, Abadan, Khorramshahr and Tehran. Wheat and broad beans represented the main subsistence crops. Barley was fed almost entirely to animals. The surplus wheat, all of the rice and sesame and a large proportion of the vegetables were sold for cash. Most of the landowners' share of vegetables was sold in markets. Some of the wheat was sold to the government. The peasants' surplus entered the market in small quantities, and in numerous ways. Part of it was sold to merchants before the harvest or was assigned to money lenders. The peasants' indebtedness and lack of marketing organization were the major reasons for their poor bargaining position at the time of selling products.

## 7-10 Land Reform in the Pilot Area

During the years 1963 to 1966, phases I and II of the land reform programme were implemented in the pilot area. In 1966, 30% of the land was owned by peasants, 60% was leased to the peasants for a period of 30 years and 10% was owned by landlords[18]. In 1968, 12,500 hectares of the pilot area was purchased from the peasants for the establishment of agro-business enterprises[19]. In 1971-72 the remaining 9,009 hectares were assigned to four Farm Corporations of the DIP.

## 7-11 Evaluation of the Dez Pilot Irrigation Project

The pilot project originated in conditions set out by the IBRD in its negotiations with Iran in 1959/60 on the possibilities of a loan for the irrigation project. The bank emphasized that the loan of $42 million would be granted provided that an initial project covering 22,000 ha was undertaken. The hope was that during the first three years of implementation, the farmers of the region would acquire a knowledge of modern agricultural technology and prove their abilities in participation and collaboration for the development of the area. The bank would investigate the progress of the operations after three years, then the payment of the loan would be authorized[20]. Fifty-five landlords, as the representatives of 95% of the owners took part in many sessions held in 1960 and 1961. All the programmes of irrigation and agricultural development were authorised by them[21].

In 1961 the IBRD Agents visited the area. Since the confidence of the owners had been obtained previously, the agents were satisfied and arrangements for payment were finalised.

Besides the provision of regulated water, with the application of other modern agricultural techniques such as the use of fertilizer, improved seed and agricultural machinery, the irrigation project focused on the following objectives:

a) To extend the area under cultivation

b) To raise the productivity of land

c) To diversify the crop pattern.

The quantitative objective of the irrigation project was to increase the gross value of crops by a factor of three within three years of the availability of regulated flow, and by a factor of five within ten years.

7-11-a Regulated water supply for the pilot area

Water supply to the pilot area had been scheduled as follows:

a) The first unit of 6,000 ha would be supplied by summer 1963,

b) The second unit of 9,000 ha by summer 1964, and

c) The third unit of 5,000 ha by summer 1965.

In practice, the regulated water was first delivered to 3,440 ha in summer 1963. In the following summer a total area of 11,567 ha received regulated water and by summer 1965, with the provision of water to a further 8,352 ha, a net irrigable area of 19,923 ha was supplied with regulated flow[22].

7-11-b <u>Agricultural Services</u>

Between 1960 and 1967 the following agricultural services were supplied to the pilot area:

A) Field trial farms

B) Credit services and fertilizer

C) Farm machinery

D) Agricultural extention services

A) <u>Field trial farms</u>:

Agricultural research began in 1959, with fertilizer trials, conducted with the assistance of F.A.O. KWPA undertook an agricultural programme which included training of Iranian staff and farmers in modern agricultural methods and management practices. Experiments began on the Field Trial Farm in 1964. Trials covered aspects of irrigation methods, farming techniques, fertilizer use, etc. Attention was also paid to the production of improved seeds. The tests were conducted on new crops such as cotton, sugar beet and alfalfa which were ultimately planted in large scale agricultural farms. 200 ha were allocated to the establishment of a research centre known as "The Safiabad Agricultural Research Centre". The land assigned for the Safiabad Research Centre was extended to 400 ha in 1975. The land was levelled and a modern irrigation system installed on the farms. A soil and water laboratory was established, and a pest control laboratory was added later on. Research also has been done on livestock production. The know-how gained on the trial farms was introduced to the villages by extension services.

## B) Credit services and fertilizer

### a) Credit

Credit services in the pilot area were an effective tool for encouraging higher investment on farm improvements and therefore an increase in production. A sum of 61 million rials was the KWPA budget for the granting of agricultural credit to 1,750 farmers in 1966 whereas it was only 3.4 million rials in winter 1962[23]. KWPA was careful to see that the use of this sum was properly supervised in order to ensure its use for the purposes granted.

Short term credit was given for seasonal requirements, such as seeds, fertilizers, insecticides, machinery servicing, etc. Medium and long-term credit was extended for long range investments such as the establishment of poultry and livestock units, the purchase of farm machinery, land levelling and general village improvements. Short-term credit in kind and repayment was made possible for the period after the harvest and sale of crops.

### b) Fertilizer

Prior to the development of the pilot area no chemical fertilizer was ever used in the DIP. Fertilizer testing in Khuzestan began in 1957. More than 54,000 plots and trials were established for a variety of test purposes in various parts of Khuzestan, especially in the DIP areas, including the Sugar Cane Project area. Application of chemical fertilizer in the pilot area began with 80 tons in 1961-62 and by 1966 the consumption rate had risen to 2,000 tons (Table 7-2). 50% of the cost of fertilizers was paid by KWPA and credit was granted to the farmers to cover the other 50%[24].

Table 7-2

Fertilizer Consumption in the DPIP

1961-66

| Year | Period | Tonnes |
|---|---|---|
| | Pre project | 0 |
| 1961/62 | Winter | 80 |
| 1962 | Summer | 235 |
| 1962/63 | Winter | 740 |
| 1963 | Summer | 570 |
| 1963/64 | Winter | 700 |
| 1964 | Summer | 550 |
| 1964/65 | Winter | 750 |
| 1965 | Summer | 750 |
| 1965/66 | Winter | 1,200 |
| 1966 | Summer | 2,000 |

Source: Ahmadi, A. A. 1966, p.15.

C) Farm machinery

KWPA established a Farm Machinery Service at Safiabad to provide mechanical services to the farmers of the pilot area. In 1966 the unit had 43 tractors, 13 combines, 17 grain drills and 18 disc harrows. This equipment permitted a mechanized winter crop programme of approximately 6,000 ha and a summer crop programme of about 5,500 ha

D) Agricultural extension services

In 1966 college graduates assisted 40 agricultural extension workers. The agricultural extension workers usually lived in quarters, which were built by the farmers themselves. They gave on-site assistance to the village cultivators. Their services included the introduction of fertilizer, improved seeds, new crops, modern farming techniques and pest and insect control.

7-12 Achievement of the Development Objectives.

7-12-a Extension of the area under cultivation

With the completion of the pilot area irrigation system the supply of water during the shortage months (June to October) was assured (Table 7-3). As a result the area under winter crops increased from 69.9% to 70.63% in 1961-66 and that of summer crops from 23.5% to 45.2% (Table 7-4). Thus the greatest development was obtained for the summer crops. For winter crops the area under cultivation of wheat and barley was reduced and that of gardens and broad beans was increased. The area where rice the major summer crop, was reduced but that of sesame, beans, vegetables and gardens was increased (Table 7-4).

7-12-b Land productivity

After three years of the supply of regulated water and the implementation of modern agricultural techniques, crop yields generally increased (Fig.7-1). The planned goal was to increase yields by a factor of three after three years and of five after ten years of regulated water supply. In 1966 the yield of local wheat increased from 675 Kg/ha to 1,200 Kg/ha. The yield of improved seed, however, was 1,600 Kg/ha. The yield of local barley increased from

Table 7-3

Summary of Water Inflow to the Dez Pilot Irrigation Project Area

From 1960-63 to 1965-68 in $m^3$/sec

| | | Year | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-regulation of water | (1) | 1960-61 | 25.12 | 19.65 | 21.68 | 31.51 | 24.29 | 22.19 | 24.67 | 23.66 | 33.60 | 13.51 | 26.28 | 32.67 |
| | (2) | 1961-62 | 22.59 | 24.04 | 25.42 | 31.99 | 31.17 | 29.99 | 33.43 | 29.86 | 15.94 | 15.18 | 17.06 | 21.72 |
| | (3) | 1962-63 | | | | | | | | | | | | |
| | | 1963-64 | | | | | | | | | | | | |
| | (4) | 1965-66 | 18.22 | 31.16 | 36.98 | 54.44 | 55.32 | 47.30 | 12.35 | 19.36 | 22.69 | 4.42 | 20.64 | 23.60 |
| Post-regulation of water | | 1966-67 | 17.88 | 33.12 | 39.84 | 47.14 | 46.66 | 43.26 | 18.21 | 21.06 | 18.48 | 8.76 | 25.93 | 22.44 |
| | | 1967-68 | 13.51 | 27.20 | 37.01 | 48.31 | 49.00 | 48.44 | 13.32 | 6.52 | 21.00 | 15.32 | 30.18 | 19.72 |
| | | 1968-69 | 19.00 | 31.50 | 39.50 | 54.90 | 57.80 | 55.00 | 14.50 | 6.63* | | | | |

Source: (1) Nederlandsche Heidemaatschappij, June, 1961. Dez Irrigation Project, Second Annual Report on Water Utilization, Part 10, p.12, Table 10-2.

(2) N. Heidemaatschappij, June, 1962. Dez Irrigation Project, Third Annual Report on Water Utilization, Part 9, p.16, Table 9-6.

(3) The time of the construction of the pilot area irrigation network.

(4) Vaelizadeh, M., Khosroshahi, K. 1970. "Dez irrigation and drainage situation." KWPA in the International Commission on Irrigation and Drainage, Irrigation and drainage seminar, .1970. Tehran, pp.266-276.

* In 1969 the lands of the pilot area were allocated to the agro-business enterprises and the farm corporations.

## Table 7 - 4

Summary of Winter Crop Survey - 1961-1966

| Year | Area | Irrigated Area | | Irrigated Winter Crops in Ha and % of Irrigated | | | | | | | | | | Fallow | | Threshing Land | | Non-cultivated | | Crops under improved practices | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Wheat | | Barley | | Vegetables | | Garden | | Broad Beans | | | | | | | | | |
| | | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % |
| 1961 | Dez Pilot Irrigation | 21,600.0 | 100 | 11,678 0 | 54.4 | 2,361.0 | 10.4 | 328.0 | 1.5 | 422.0 | 2.0 | 334.0 | 1.6 | 5,675.0 | 26.5 | 101.0 | 0.5 | 661.0 | 3.1 | 30.0 | 0.1 |
| 1962 | | 21,600.0 | 100 | 11,383.0 | 52.7 | 2,317.0 | 10.7 | 337.0 | 1.6 | 440.0 | 2.0 | 317 0 | 1.5 | 6,193.0 | 27.9 | 101.0 | 0.5 | 502.0 | 2.3 | 167.0 | 0.8 |
| 1963 | | 21,570.0 | 100 | 10,661.8 | 49.4 | 1,840.0 | 8.5 | 178.0 | 0.8 | 455.0 | 2.1 | 276.0 | 1.3 | 6,021.7 | 27.9 | 113.1 | 0.5 | 515.8 | 2.4 | 1,507.4 | 7.0 |
| 1964 | | 21,378.0 | 100 | 9,858.9 | 46.1 | 1,909.0 | 9.2 | 173.1 | 0.8 | 466.7 | 2.2 | 343.3 | 1.6 | 7,059.4 | 33.0 | 108.7 | 0.5 | 524.4 | 2.5 | 1,667.9 | 7.7 |
| 1965 | | 20,803.0 | 100 | 10,500.1 | 50.5 | 2,062.6 | 9.9 | 352.3 | 1.7 | 497.7 | 2.4 | 565.6 | 2.7 | 5,056.8 | 24.7 | 207.4 | 1.0 | 716.0 | 3.4 | 3,233.3 | 16.0 |
| 1966 | | 20,826.0 | 100 | 11,278.3 | 54.2 | 1,847.6 | 8.9 | 324.6 | 1.6 | 537.2 | 2.6 | 719.9 | 3.5 | 4,737.8 | 22.7 | 207.4 | 1.0 | 709.2 | 3.4 | 4,848.3 | 23.3 |

Summary of Summer Crop Survey

| Year | Area | Irrigated Area | | Irrigated Winter Crops in Ha and % of Irrigated | | | | | | | | | | Vegetables | | Garden | | Fallow | | Total Crops | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Rice Nursery | | Rice | | Sesame | | Murg Beans | | Black eye Beans | | | | | | | | | |
| | | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % | Ha | % |
| 1961 | Dez Pilot Irrigation | 21,600.0 | 100 | 429.0 | 2.3 | 3,630.0 | 16.8 | 235.0 | 1.1 | 57.0 | 0 3 | - | - | 294.0 | 1.4 | 423.0 | 2.0 | 15,715.5 | 72.7 | 5,068.0 | 23.5 |
| 1962 | | 21,600.0 | 100 | 518.0 | 2.4 | 3,480.0 | 15.9 | 69.0 | 0.3 | 101.0 | 0.5 | - | - | 185.0 | 1.9 | 423.0 | 2.0 | 16,219.0 | 75.2 | 4,746.0 | 23.0 |
| 1963 | | 21,378.8 | 100 | 549.3 | 2.6 | 3,736.6 | 17.6 | 258.7 | 1.2 | 274.5 | 1.2 | - | - | 369.2 | 1.7 | 448.0 | 2.1 | 14,934.5 | 69.9 | 5,636.3 | 26.4 |
| 1964 | | 20,596.2 | 100 | 470.2 | 2.2 | 3,590.6 | 17.4 | 508.1 | 2.5 | 781.7 | 3.8 | - | - | 485.0 | 2.3 | 469.4 | 2.2 | 13,445.5 | 65.3 | 6,305.0 | 30.4 |
| 1965 | | 19,791.6 | 95.1 | 556.8 | 2.7 | 3,414.6 | 16.4 | 1,631.6 | 7.9 | 764.8 | 3.7 | - | - | 502.2 | 2.4 | 469.4 | 2.2 | 12,040.0 | 57.9 | 7,339.4 | 35.3 |
| 1966 | | 20,802.2 | 100 | 475.6 | 2.3 | 3,377.6 | 16.2 | 3,467.1 | 16.7 | 134.6 | 0.6 | 593.9* | 2.8 | 474.9 | 2.3 | 469.4 | 2.2 | 10,474.4 | 50.5 | 9,411.5 | 45.2 |

* Included in vegetables Ha. from 1961 - 1965.

Source: Data were obtained from KWPA, Safiabad Agricultural Research Centre.
Vaelizadeh, M., Personal communication, April 1975.

750 to 1,300 Kg/ha, but the yield of improved local barley was 2,000 Kg/ha. For the summer crops, the yield of rice increased from 1,600 to 2,200 Kg/ha and that of sesame from 220 to 450 Kg/ha. The yield of improved sesame was 700 Kg/ha, (Table 7.5).

The planned goals were almost achieved in the case of winter crops and for sesame amongst the summer crops.

In 1968 the yields of wheat, barley, rice and sesame increased to 2,000 Kg/ha, 2,062 Kg/ha, 2,900 Kg/ha and 1,200 Kg/ha respectively (Fig.7-1). Although by 1968 the production of wheat and barley increased by three times, and even by five times for sesame, the planned goal, which was for an increase of 3.54 times for all crops was still not achieved, especially for rice and beans whose yields did not increase more than 1.2 and 1.6 times respectively (Table 7.5).

7-12-c Diversification of crops

The original cropping pattern for the pilot area was planned by Plan Organization in 1959. The planned cropping pattern focused on the elimination of the area under the cultivation of wheat and barley. Cotton and forage crops were the two most important new crops introduced into the DIP area. By 1966 the area under cultivation of wheat had been increased from 10,567 ha in 1959 to 11,278 ha. The area under the cultivation of rice was reduced to 3,378 ha in 1966 against the planned target of 7,400 ha and no areas were under the cultivation of cotton and/or alfalfa. In 1968 a total of 184 ha was allocated for the cultivation of forage crops, (30 ha for alfalfa and 154 ha for berseem clover). Also 5 ha were under cotton and a further 6 ha under the cultivation of maize (Table 7-6).

Table 7-5

Production of Crops in the Dez Pilot Irrigation Project, 1960-66 and 1968

(Kg/ha)

| | | (1) 1960 | Planned 1966 | (2) Actual 1966 | Planned 1968 | (3) Actual 1968 | Percentage increase in 1968 against 1960 | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Planned | Actual |
| Winter Crops | Local wheat | 675 | | 1,200 | | | | |
| | Improved wheat | | 2,025 | 1,600 | 2,386 | 2,000 | 354% | 290% |
| | Local barley | 735 | | 1,300 | | | | |
| | Improved local barley | | 2,205 | 2,000 | 2,602 | 2,062 | 354% | 280% |
| Summer Crops | Rice | 1,600 | 4,800 | 2,200 | 5,664 | 2,900 | 354% | 118% |
| | Sesame, traditional method | 220 | | 450 | | | | |
| | Improved sesame | | 660 | 700 | 779 | 1,200 | 354% | 540% |
| | Beans | 925 | 2,775 | | 3,275 | 1,500 | 354% | 160% |

Sources: (1) Plan Organization, 1960, Dez Project, Annex 4.

(2) Ahmadi, A.A., 1966, pp.24.

(3) Data were obtained from Fatemifar, Senior Officer, Bureau of Agro-industry and Resettlement, KWPA, Dezful, April 1975.

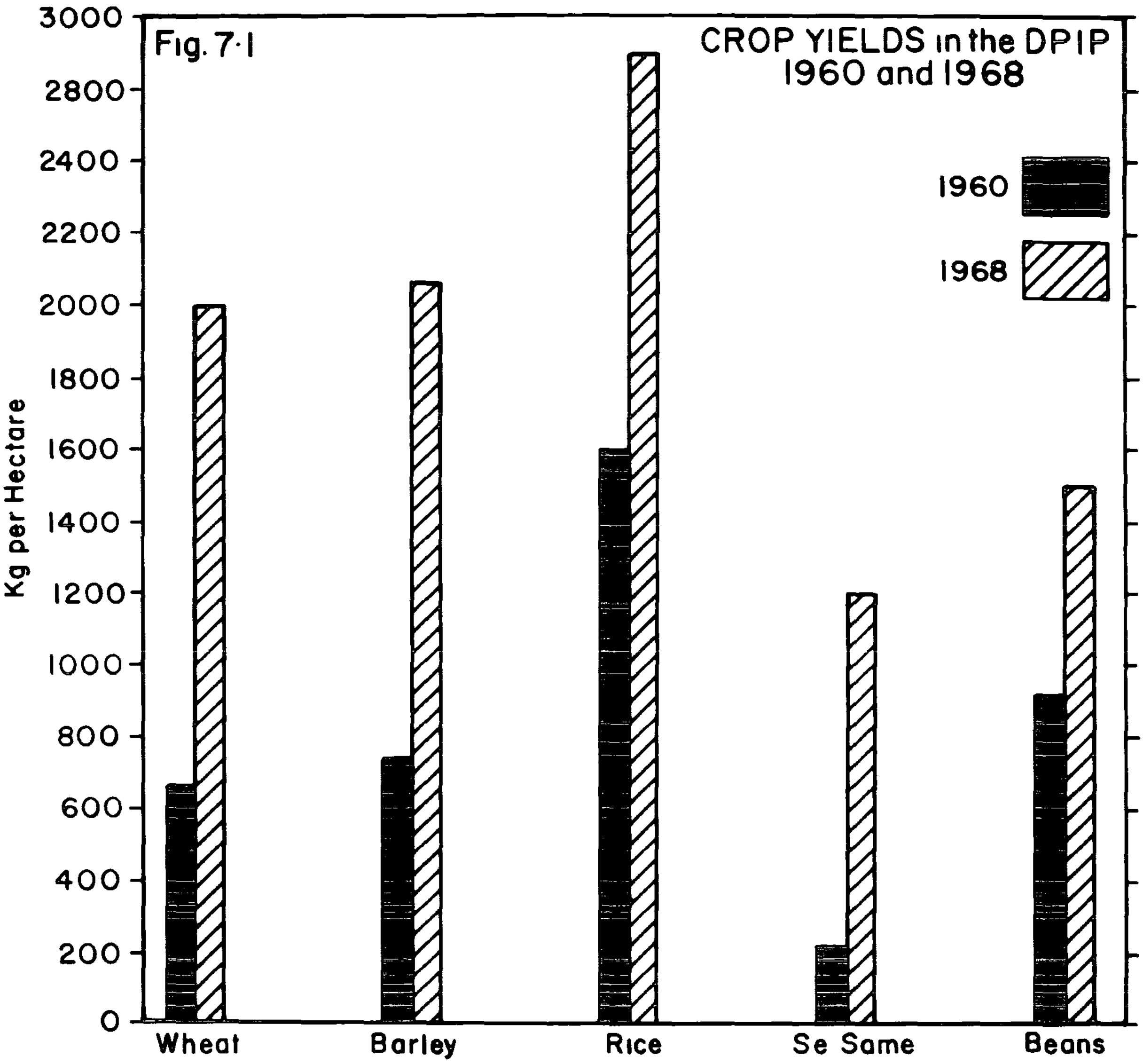


Fig. 7·1
CROP YIELDS in the DPIP
1960 and 1968
1960
1968
Kg per Hectare
3000
2800
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Wheat
Barley
Rice
Se Same
Beans

Table 7-6

Cropping Pattern of the DPIP

Planned and Actual (net ha)

| | (1) 1959 | (1) Planned Pattern | (2) Actual 1966 | (3) Actual 1968 |
|---|---|---|---|---|
| Winter Crops | | | | |
| Wheat | 10,567 | 8,800 | 11,278 | 10,500 |
| Barley | 2,880 | 1,200 | 1,847 | 2,062 |
| Beans | 470 | 1,000 | 720 | 585 |
| Peasants' vegetables | - | 400 | 325 | 176 |
| Research farms | - | 200 | 200 | 200 |
| Landlords' gardens | 156 | 300 | 537 | 156 |
| Forage crops | - | 8,200 | - | 184* |
| Total | 14,073 | 20,000 | 14,907 | 13,863 |
| Fallow | 5,927 | - | 5,630 | 6,137 |
| Sub-total | 20,000 | 20,000 | 20,000 | 20,000 |
| Summer Crops | | | | |
| Rice | 4,608 | 7,400 | 3,378 | 3,590 |
| Cotton | - | 2,600 | - | 5 |
| Sesame | 974 | 2,000 | 3,467 | 508 |
| Peasants' vegetables | 345 | 2,400 | 475 | 176 |
| Landlords' gardens | 156 | 300 | 469 | 156 |
| Mung beans | - | -- | - | 781 |
| Maize | - | - | - | 6 |
| Research farms | - | 200 | 200 | 200 |
| Total | 6,083 | 14,900 | 7,989 | 5,522 |
| Fallow | 13,917 | 5,100 | 12,011 | 14,478 |
| Sub-total | 20,000 | 20,000 | 20,000 | 20,000 |

* Alfalfa - 30, Sudan grass - 154.

Source: (1) Plan Organization 1960. Dez Project, Anex 1.

(2) Vaelizadeh, M, KWPA, DIP. Safiabad Agricultural Research Centre, Personal communication 1975.

(3) Fatemifar, KWPA, DIP. Bureau of Agro-industry and Resettlement. Dezful, Personal communication, April 1975.

7-13 Gross Value of Crops of the Pilot Area

The gross value of crops of the DPIP area was estimated at 287.7 million rials by KWPA in 1966[25]. Taking into account the total area of 19,756 ha which was under cultivation in the same year[26] the gross value of production per hectare is estimated at 14,563 rials which is approximately 2.6 times that of 1959. A survey carried out by KWPA in 1968 reveals an increase in the gross value of crops of 2.7 times compared with that of 1959 (Table 7-7). In this survey the total gross value of products is estimated at 295.79 million rials. Taking into account the total area under cultivation of 18,573 ha, in the same year, the gross value of products per hectare is estimated at 15,926 rials. Although the gross value of products increased to approximately 3 times that of 1959 it was still below the planned target. The planned goal was 308.9 million rials gross value of products for 1966[27]. This target is based on the prices of 1957 which were generally lower than those of 1965 and 1968. Even if the figure of 308.9 million rials is accepted, the achieved results of 1968 are somewhat below those which had been expected.

The average annual gross income of a farmer was 102,750 rials and 105,639 rials in 1966 and 1968 respectively. These figures are almost double those existing before the modern irrigation system.

No data are available on the cost of production and the net farming income of a farming family. According to the figures supplied by the Resource Investigations Project of KWPA, the gross value of crop production in 28 villages (9,006 ha) located in the North of the Safiabad research centre increased from 57.2 million rials in 1961

Table 7-7

D.P.I.P.

Gross Value of Agricultural Products

1968

| Crop | Cultivated area (ha) | Yield (Kg/ha) | Value (Rials/Kg) | Total Value (1,000 rials |
|---|---|---|---|---|
| Wheat | 10,500 | 2,000 | 8 | 168,000 |
| Barley | 2,062 | 1,500 | 5 | 15,465 |
| Vegetables | 352 | (20,000 rials) | - | 6,500 |
| Beans | 585 | 1,500 | 12.6 | 10,584 |
| Rice | 3,590 | 2,900 | 7 | 72,877 |
| Sesame | 508 | 1,200 | 15 | 9,144 |
| Mung beans | 781 | 1,500 | 8 | 9,372 |
| Cotton | 5 | 3,000 | 15 | 225 |
| Sudan Grass | 154 | 10,000 | 1 | 1,540 |
| Alfalfa | 30 | 15,000 | 4 | 1,800 |
| Maize | 6 | 8,000 | 6 | 288 |
| Total | 18,573 | | | 295,795 |

Source: The table is constructed on the basis of data obtained from Fatemifar, Bureau of Agro-industry and Resettlement, KWPA, DIP. Dezful, April 1975.

to 127.3 million rials in 1968. This was a 123% increase in an 8 year period (Table 7-8). Per capita net income however did not double during that period. Not all this production was marketed. The increase in production also must be weighed against the growth in population which in the years 1966 to 1968 averaged five per cent per year.

Table 7-8

Gross Value of Agricultural Production from 9,006 ha on Farm Corporation Lands

(1961 - 1968 (1340 - 1347)

| | Gross value of production (million rials) | Index 1340 = 100 |
|---|---|---|
| 1340 (1960-61) | 57.2 | 100 |
| 1341 (1961-62) | 73.7 | 129 |
| 1342 (1962-63) | 102.4 | 179 |
| 1343 (1963-64) | 97.4 | 170 |
| 1344 (1964-65) | 114.4 | 200 |
| 1345 (1965-66) | 118.7 | 207 |
| 1346 (1966-67) | 128.7 | 226 |
| 1347 (1967-68) | 127.3 | 223 |

Source: KWPA. Resource Investigations Project, Cited in DRC. Farm Corporations for the Dez Irrigation Project, Part II, Imperial Government of Iran, Khuzestan Water and Power Authority, p.70, Table A.3.

What is obvious is that the Dez farmers have had to pay 750 rials per hectare as a water charge to KWPA in addition to those charges for fertilizer, improved seed, agricultural machinery services etc.

Since farmers could not afford the cost of the farming inputs, they refused to pay the water charges.

Another significant point which should be mentioned is that the water charge of 750 rials per hectare was a base charge in the pilot area. A surcharge of 1,500 rials per hectare was intended to be collected by KWPA based upon attainment of the goals set for the crop yields, also for any new crop which would have to be cultivated.

Above all, 70% of land in the pilot area was either owned by large land owners or leased to the Dez peasants by 1968. The majority of peasants had to pay the landowners' share of the crops, or the land rent, in addition to charges which they had to pay to KWPA. These conditions did not help the Dez peasants to escape from chronic poverty. In such circumstances it is not surprising that in 1968 the net area of cultivation had been reduced to almost 18,500 ha against 20,000 ha in late 1959 and the early 1960's. Also the planned programme of the diversification of crops was not realized[28].

7-14 Social Welfare of the DPIP in 1968

Education and health services which were made available to the villagers during 1961-69 were part of the development programme which was carried out by KWPA until 1969.

7-14-a Health and sanitation

In 1967 the number of bath houses increased to nine, compared with two in 1960 in the DPIP area. KWPA, through the Health and Sanitation Department, maintained the bath houses in the area.

Three Mobile Medical Field Units visited the villagers in their villages. Medical and sanitation services were offered to them including health education. Table 7-9 shows the medical treatment and observations made in 1347 (1968) and 1348 (1969). As a result the mortality rate was reduced from 2.5 percent to 1.5 percent[29].

Table 7-9

Number of Sick, Treated and Observed Patients in the Pilot Area - 1347 and 1348 (1968 and 1969)

| | 1347 1st half | 1347 2nd half | 1348 1st half | 1348 2nd half |
|---|---|---|---|---|
| Number of sick treated | 38,866 | 35,632 | 33,163 | 41,511 |
| Laboratory tests (Blood test) | 4,206 | 4,368 | 4,168 | 4,906 |
| Number of baths taken | 44,730 | 50,714 | 40,170 | 54,174 |

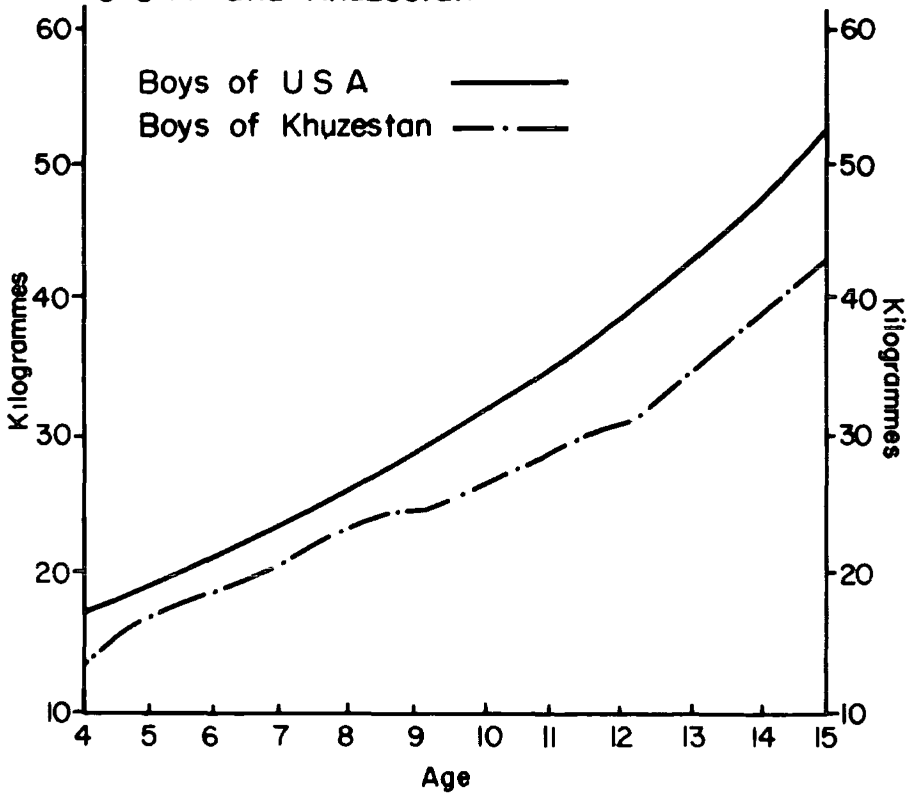
Source: KWPA, DIP, Health and Sanitation Department. (Dr. Setayesh, personal communidation, April 1975).

The housing conditions remained the same as before. Only a campaign to have villagers build their own latrines was successful. In 1969 there was one latrine for every 15 persons which was a considerable improvement over 1961 when there was only one latrine for every 132 people. KWPA also participated in the Meals for Millions Programme. The Meals for Millions Foundation developed a high protein multi-purpose food which was made available to the DIP on a 50-50 basis. Half the cost was met by KWPA and the other half by the Foundation.

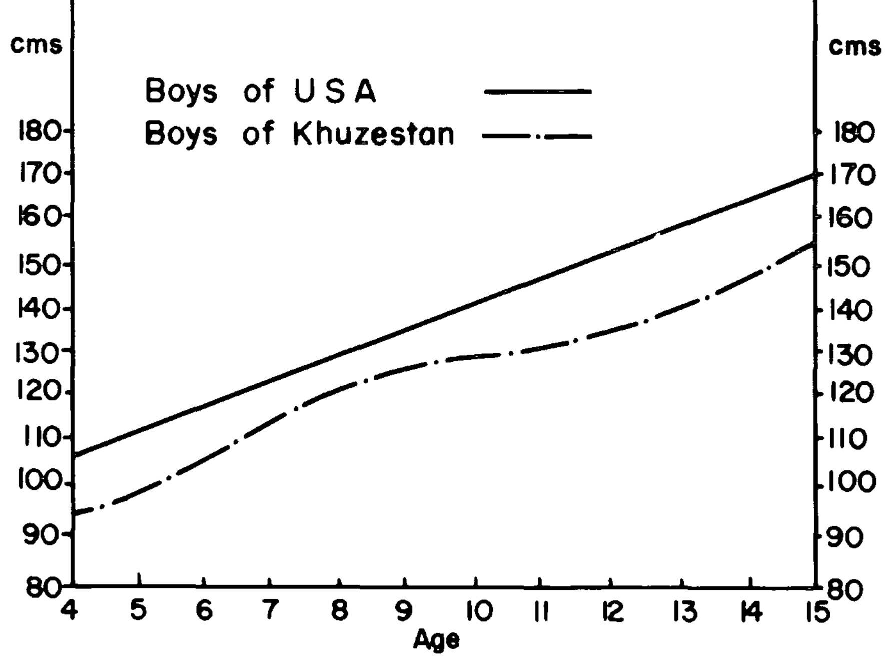
In the 1960's a survey carried out by the Food and Nutrition Institution of Iran indicated a significant difference between the boys of the U.S.A. and those of Khuzestan both in weight and length of body[30] (Fig. 7-2).

Fig 7·2

Weight Comparison Between Boys of the U S A and Khuzestan




Height Comparison Between Boys of the U S A and Khuzestan



These differences were partly owing to malnutrition. To carry out the programme of Meals for Millions, 1,952 pupils of the DPIP area were provided with food (1,363 boys and 589 girls). The results suggested that the size of the under weight group was reduced from 10.28% to 0.77%. The percentage whose weight increased by 600 gr per month went up from 24.82% to 68.34% (Table 7-10). The programme was not followed up by KWPA and ended in 1969. Besides malnutrition, bilharzia, helminths, glacoma and malaria and the mental health of the villagers in the pilot area was a matter of concern in 1968. The basic cause of the mental health problem was insecurity which should have been considered[31].

7-14-b Education

When the educational function of the Pilot Project was first investigated in 1961, the results of a survey revealed an illiteracy rate of 97.7 per cent. By 1967 this rate for the area had dropped to 86.5 per cent[32].

In 1961 there were two schools in the entire area of the Pilot Project. By 1968 the number of schools increased to 31. According to the 1969 Census, compiled by the Dez Irrigation Project, Health and Sanitation Department, there were 10,891 men, women and children living within the 31 villages of the Pilot area. Of the total population, 51.9% were under sixteen years of age and 20.9% under five. Thus the number of school age children was 3,376[33]. Out of this total 2,570 were educated in classrooms with an average occupation rate of 12.8/room.

Table 7-10

Number of Pupils treated by MPF, and the percentage distribution of the Weight Variations

1968/69

| | Under weight | Unchanged weight | Increased weight 200 grams/month | Increased weight 400 grams/month | Increased weight 600 grams/month | Total |
|---|---|---|---|---|---|---|
| | Number of treated pupils | | | | | |
| Control group | 29 | 70 | 4 | 109 | 70 | 282 |
| Feeding group | 15 | 86 | 29 | 488 | 1,334 | 1,952 |
| | Percentage | | | | | |
| Control group | 10.28 | 24.82 | 1.43 | 28.65 | 24.82 | 100 |
| Feeding group | 0.77 | 4.41 | 1.48 | 25.00 | 68.34 | 100 |

Source: Ministry of Water & Power, KWPA, DIP, Department of Health and Education.
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# CHAPTER 8

## THE CRITICAL POSITION OF THE DIP IN 1968 AND THE NEED FOR A NEW STRATEGY FOR A MORE EFFICIENT USE OF WATER AND LAND RESOURCES

Except for the pilot area (DPIP) of the DIP, other parts of the area had not received regulated water by 1968. The total irrigated area of the DIP is estimated at 84,007 ha of which 51,376 ha was under the cultivation of winter crops. The area of summer crops was 14,446 ha in 1968. Comparing these figures with those of 1960, the area under cultivation of winter crops fell from 78.73% in 1960 to 61.2% in 1968 and the area of summer crops from 21% to 17.2% (Table 8-1).

In general the areas under cultivation of wheat, barley, and beans were reduced, but the areas of vegetables and gardens increased. About 1,000 ha were allocated to the cultivation of alfalfa and berseem clover. For summer crops, the area under the cultivation of rice fell to 21.5% and that of sesame to 60.9%, while that of vegetables increased by 226%. Cotton was the only new summer crop. Only 97 ha of land were allocated to the cultivation of cotton. Ehlers (1975, p.88) quoted a figure of 31,431 ha as the area under cultivation of winter crops and 12,834 ha as being under summer crops in the DIP in 1968/69. These figures represent the areas of irrigated agriculture in the Dezful region. The irrigated lands around Shush on the west bank of the Dez river have been excluded.

There is no correlation between the reduction of the area under cultivation in the DIP and the hydrological conditions of the area in 1968. The mean annual discharge of the Dez river at the dam site station was relatively high in comparison with the values of 1954 to 1967, with the

Table 8-1

D.I.P.

Area under cultivation of irrigated crops

1960 and 1968

(ha)

| | 1960 (a) | 1968 (b) |
|---|---|---|
| Winter Crops | | |
| Wheat | 45,100.0 | 41,899.0 |
| Barley | 15,600.0 | 5,503.0 |
| Broad beans | 1,380.0 | 1,093.0 |
| Alfalfa | - | 235.0 |
| Gardens | 200.0 | 1,086.0 |
| Vegetables | 420.0 | 804.0 |
| Berseem clover | - | 756.0 |
| Total | 62,670.0 | 51,376.0 |
| % of total irrigated area | 78.7 | 61.2 |
| Fallow land | 16,930.0 | 32,631.0 |
| Sub-total | 79,600.0 | 84,007.0 |
| Summer Crops | | |
| Rice | 11.000.0 | 8,630.0 |
| Sesame | 4,900.0 | 1,920.0 |
| Mung beans | - | 997.0 |
| Vegetables | 720.0 | 2,349.0 |
| Beans | - | 453.0 |
| Cotton | - | 97.0 |
| Total | 16,620.0 | 14,446.0 |
| % of total irrigated area | 20.9 | 12.2 |
| Fallow land | 62,060.0 | 69,561.0 |
| Sub-total | 79,600.0 | 84,007.0 |

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exception of 1965-66 (Appendices B and C). For the Karkheh river the mean annual discharge was higher than the preceding years (1963-67) and lower than the subsequent year (1969) which was an extremely wet year, (Appendix D). In 1968, during the critical months of peak irrigation demands, i.e. June to October, the Dez river discharges were higher than those of the preceding years. These conditions were more pronounced for the Karkheh river.

Precipitation within the Dez basin was almost normal and for October to December was even higher than those of many preceding and subsequent years (Appendix C).

Water release from the Dez reservoir was even higher in 1968 than in the preceding years, especially during the severe months of June to September. Comparing amounts of water released from the dam, and agricultural water use in the DIP, no shortage of water is revealed (Appendix C). This shows that no environmental conditions were responsible for the reduction of the area under cultivation in the DIP area in 1968.

The gross value of products of the DIP area was approximately 750,000,000 rials in 1968. Thus the gross value per hectare of products is estimated at 10,753 rials[1]. KWPA believed that this was too little to improve the standard of living of the rural population and to create employment. In addition to that, the situation in the DIP area contrasted with that of the Haft-Tappeh Sugar Cane agro-industrial unit in the south of the DIP area, in terms of per capita cultivated land and the gross value of products. The area under the cultivation of cane sugar was 21 ha/worker whereas in the DIP area it was 10.25 ha in 1967. The gross value of the products of the Haft-Tappeh Sugar Cane project is estimated at 750 to 800 million rials, from a total cultivated area of 5,000 ha. The gross value of the agricultural products was 160,000 rials/ha at Haft-Tappeh Sugar Cane Project[2] whereas that of the pilot area was 15,926 rials/ha, and that of the DIP area only 10,753 rials/ha[3].

Insufficient progress in agricultural production was not the problem of the DIP area alone but is common to all of Iran. A decade after the implementation of the first land reform law of 1962 the officials saw insufficient progress in farm production. The Central Bank figures showed that during the Third Plan (1963-67) the growth rate of agriculture had been 4.6% against 8.4% for the economy as a whole[4]. In the Fourth Plan Period (1968-72), the growth rate of agriculture had been 3.9%, against the Plan target of 4.4% and much lower than the overall growth rate of 11.6%[5].

It may be argued that the low growth rate of agriculture is relative and that the country only needs a 3.4% agricultural growth rate to keep pace with the rising population and standard of living[6] (the population gorwth rate is 2.9%). Central Bank figures showed that the rate of agricultural growth had been 1.7% in 1969[7], and therefore, the increase in per capita agricultural production had been negative in that year. Also in 1969, there had been no significant change in per capita agricultural production but, on average, the per capita agricultural production has increased by 1.3% during the decade 1963-72.

Population growth has not been the only factor in increasing domestic demand. Another stimulus is the continuous rise in per capita income and the standard of living of the people. This has caused demand for various products, particularly agricultural products, to increase at a rate greater than the increase in population growth. As has been already discussed the income elasticity of demand for food is estimated at an average figure of 0.58 for all the urban areas of the country[8]. A comparable figure for rural areas is not available. The only published estimate appears to be one made by planners in the Third Plan for the projection of demand for food over the plan period. The figure they arrived at, through international comparison, was of the order of 0.8 for rural areas[9]. On this basis it seems that 0.7 is a realistic estimate of income elasticity of demand for agricultural products in Iran.

With the growth of the National Income being 10.1% for the period 1963-72[10], the average increase in per capita income per annum was equal to 7.2% , and the increase in per capita demand for agricultural products was approximately 5%[11]. This indicates that the annual increase in demand for agricultural products has been, on the average, five per cent, whereas the average increase in supply has been 1.3% between 1963-72. The gap has been bridged by ever-increasing imports of agricultural products in order to prevent a rapid increase in the prices of agricultural commodities.

After the land reform law was passed, optimism was high. It was hoped that through the new institutions such as the rural cooperatives, which were to aid land redistribution, agricultural production would be raised to meet the increasing demand. On the implementation of the new law, Lambton commented that "the foundations had been laid for the emergence of a self-reliant and independent peasantry, but this could not be achieved without a rise in living standards. The problem of increased productivity had still to be tackled on a large scale -

many problems were still outstanding, including the difficult question of the minimum size of holdings and mechanization[12].

In the absence of mechanization or economic farm sizes, more than 8,500 rural cooperatives were founded after the beginning of land reform but they have not had a great effect upon increasing agricultural productivity. The cooperatives with merely one and a half million members, were seriously under-capitalized. Between 1964 and 1967 the total credit supplied to 992 farmers was 1,590,000 rials with an average annual figure of 398,000 rials. This forms only 4.2% of the total 38,664,000 rials of loans obtained through different sources by farmers[13]. The bulk of the funds of the Second and the Third Agricultural Plans were spent on large structural improvements such as dams. By the end of the Third Plan, six reservoir dams were in operation[14]. In preparing the rural section of the Third Plan, it was calculated that a 13% rise in wheat and barley output could be achieved by investing $14 million in the distribution of better seed. It was soon realized that the government seeds in themselves would not increase production[15].

Warriner was led to remark that "owing to the conflict between socio-political and economic objectives there was no obvious connection between land reform and development".[16]

The conflict was aggravated in areas where the government, in cooperation with public and private banks, had irrigated large areas of land. By doing so it had been hoped to increase production by giving the small farmer all the water he needed. A full and efficient utilization of irrigation water requires land development and the construction of lateral and sub-lateral irrigation canals as well as land levelling and the construction of a drainage system. Clearly no farmer could accomplish these tasks without government assistance.

In the DIP, responsibility for water regulation, distribution, operation and maintenance of the canals and the implementation of land improvements are vested in KWPA. KWPA was, and is today, in charge of electric power distribution as well as determining and collecting both water and electric power fees. In 1961 agreements were formalized between landlords and KWPA. Land levelling and preparation would be jointly financed and KWPA and landlords would share the costs of making improvements for private canals and drains. The amount of the investment was purposely left vague, but it was understood that the landlords would undertake the financial commitments required.

The landlords and KWPA agreed that all irrigation works except tertiary canals and drains would be publicly owned.

The delay in the completion of the DPIP irrigation system was the result of a number of reasons. (The project was completed in December 1965 instead of June 1963). The most important reason for this delay was the difficulties with labour, equipment and weather encountered by different construction companies. Delays were owing also to the Land Reform Act of 1962 which was "perhaps the most significant development in the lives of the villages of the Dez area ..."[17]. The immediate impact of the law was to make landlords hesitant about cooperating with KWPA for the improvement of land which they feared would not continue to belong to them[18].

This was particularly noticeable with regard to irrigation, because the landlords had agreed to pay for canal and drain improvements.

The beneficial aspects of land reform outweighed the negative impact of the delay associated with the supply of irrigation water. KWPA was able to work successfully in the beginning with villagers who bought the land. Several villages joined in land-preparation programmes. By 1969 crop production was beginning to show improvements. Tangible results showed also in the villagers' acquisitions of new possessions. People bought bicycles, radios and electric fans. They did not invest in sanitary improvements[19]. It seems to have been a merely superficial improvement because later it was found that the farmers were heavily in debt. For instance dues charged by KWPA were approximately 8,553,067 rials for water charges and 6,518,234 rials for other purposes such as seed, fertilizer, etc. in the 28 villages of the northern part of the pilot area by early 1970[20].

DIP has become a costly proposition. The DPIP budget had been estimated to be 1,537 million rials in total[21]. The foreign exchange component of the DPIP was with local funds approximately twice as much. In spite of this enormous investment, production did not increase as fast as it had been hoped it would.

Experience gained from the DPIP led the Minister of Water and Power (Roohani) to put forward an important policy for agriculture in 1968. He made the remarks that "the control of flood waters by dams and the conveying of such water in major canals is not considered as the only means of developing agriculture. The most important problem in irrigation development is the question of farm size. The lateral canals deliver water to farms with a minimum size of 30 ha, while many villages possess only 40-50 ha of cultivated land which is owned by almost 50 farmers.

Because of the implementation of the land reform law, land was eventually owned by the farmers who had tilled it for centuries but the land still remained in uneconomic plots caused by excessive division. Even if the development of modern irrigation and drainage systems was practically possible, the expected efficiency of water usage could not be achieved with the continuance of traditional land ownership and agricultural techniques[22]. Also he argued that at the end of the Tenth Plan, or in 25 years time, instead of 68,500 uneconomic farming units (that is independent villages) we should have between 1,500 to 2,000 large agricultural enterprises, each consisting of an average size of 8,000 to 12,000 ha[23].

Due to this great social problem, land development lagged far behind the development of water delivery. As a result the DIP, begun in 1958, had provided water to about 25,000 ha of irrigable, unlevelled and undeveloped land for improved mechanized agriculture after almost one decade[24]. This is not only the case of the DIP, but also the case for the irrigation project of the Shah-banoo Farah dam in Gilan. This project began in 1958 and provided water to about 3 ha irrigable, levelled and developed land out of 240.000 ha of the project area by 1971. This had been increased to 10,000 ha by March 1975[25]. In view of these problems the government decided to wait no longer and adopted another approach to the agricultural sector at the beginning of the Fourth Plan (1968-72). This was the creation of "intensive farming on a strictly commercial basis".

In one of its agricultural chapters the Plan states that "the general objective of regional development is the evaluation of the resources and the potentials of suitable regions and the determination of the level of investment in order to attain maximum output and to accelerate the rate of national economic growth." It adds that "there will be an emphasis on the creation of large farming and animal husbandry units to be operated by advanced techniques. Such units will be situated in the vicinity of the large dams and in places where modern irrigation methods are applied."[26]

It is estimated that the total available water in Iran can irrigate 10 million ha of land. The most suitable land for irrigation is estimated to be 3 million ha, together with a further 2 million ha of slightly poorer quality land which is already under cultivation. A total of 5 million hectares will therefore ultimately be operated by the farm corporations. The remaining 5 million ha are lands below dams, or close to ground water resources. Utilization of the latter will be on a large scale and with modern technology run by agro-business corporations. This policy will be carried out by encouraging the private sector. In the absence of voluntary know-how or capital in the private sector, direct government initiative to establish large scale farming will be introduced[27].

Consolidation of land through the creation of Farm Corporations with selective mecanization and professional management was considered as one alternative, which would allow the government to develop irrigation projects and introduce mechanization onto the lands owned by farmers. The Bill for the formation of Farm Corporations was passed on January 16, 1968. Article One of the law summarized the goals of Farm Corporations as follows:[28]

a) To increase the per capita income of farmers.

b) To utilize the maximum man-power in villages.

c) To acquaint farmers with modern farming techniques.

d) To create wide-spread facilities for the mechanization of agriculture.

e) To prevent the division of land into uneconomic units.

f) To increase the area under cultivation through the reclamation of barren and uncultivated land.

A five year experimental programme was begun in 1968. By 1972, 43 Farm Corporations were established of which four are located in the northern part of the DPIP. The target for the Fifth Plan (1972-77) has been the establishment of a further 97 Corporations. When there are 140 Farm Corporations, by 1977, 420,000 ha gross area, with a net area of 280,000 ha, will have been assigned to the Farm Corporations[29]. By January 1976, 85 Farm Corporations, with 31,565 shareholders were established on 375,159 ha. These included 754 villages and 133,532,000 rials of capital[30].

In brief the Iranian Farm Corporation combines the traditional village structure with modern farm management by consolidating individual farm plots into large units.

Another strategy is the long-term 30 year leasing of irrigated lands to foreigners and domestic agro-business companies. The legislative support for this programme came from the Law of 20th May 1968 which governed the establishment of companies for the development of land downstream of dams. This law gave the Ministry of Water and Power the authority to establish agro-industrial companies. Article One of the law summarizes the objectives of agro-business companies as follows:

> For the purpose of the maximum utilization of water resources and land irrigable from dams and irrigation installations downstream from major dams, by the application of a coordinating programme. For the purpose of developing agricultural and animal husbandry, the Ministry of Water and Power has been given authority over the formation of agro-industrial companies. These may be founded by the government, by domestic and/or foreign companies, or a combination of government, domestic and foreign capitalists.[31]

The industrial half of the agro-industrial business (if any) falls under the jurisdiction of the Ministry of Economics and the agro half under the Ministry of Water and Power[32]. The Ministry of Water and Power provides canals for units down to 100 ha, and roads down to 1,000 ha[33]. The rest, including minor canalization, inter-field road building and the employment of ex-peasants (now agricultural labourers) is left to the companies[34]. The size limit of leased land is 1,000 ha[35].

The Fifth Plan was begun when agriculture, traditionally a source of foreign exchange earning, changed its position and the country became a net importer of agricultural products. The ever-increasing gap between supply and demand for agricultural products, together with the need to increase the income of the farmers, led the policy-makers to lay more stress on agriculture in the Fifth Plan. The agricultural budget increased substantially to four times the amount allocated to agriculture in the Fourth Plan[36]. The revised plan with a 7 per cent per year growth rate for the agricultural sector, twice as much as its normal growth. With more funds available in the Fifth Plan, a wise agricultural policy is a key factor in the success of the agricultural sector. With the completion of the three stages of land reform and the clarification of the legal status of persons engaged in agricultural activities, the government is in a proper position to undertake adequate policies for the rationalization and modernization of the farming system. In this respect the Fifth Plan has not undergone major changes. The major policies have been based on the belief that small and scattered farmers by themselves cannot quickly achieve the large increases in production. Therefore the policy of establishing large agricultural units, such as agro-businesses, farm corporations and meat and dairy complexes with the intention of taking advantage of the so-called economies of scale, which was conceived in 1967-68, has been emphasized. In the meantime, the rural cooperatives provide services and cheap credit (lowering from 6% to 5% on March 21, 1974)[37] to members of cooperatives.

The agricultural section of the Fifth Plan has placed major emphasis upon agro-industrial units and states:

> Agro-industrial units, both private and public, will be established to farm 300,000 ha, using advanced agricultural techniques. These will be provided with adequate investment so as to raise output and improve the marketing of produce, and such units shall receive government protection.

With this concept the major responsibility for increasing production lies with large-scale, commercial farms, particularly agro-businesses.

Further to the approval of the new regulations, regarding the provision of credit and subsidy for the agricultural activities, the government has decided to encourage agricultural production through subsidies for mechanized, large-scale agriculture in the country. In these regulations the government undertakes to subsidize 80% of the cost of feasibility and preparation of projects (the minimum size of farms must be at least 25 ha of land), 10 - 60% of land levelling costs (up to 25 ha - 50%, 25 - 50 ha - 40%, 50 - 100 ha - 20%, over 100 ha - 10%, the balance can be obtained as a loan), 50% of irrigation and drainage costs within the fields, provision of low interest credit up to 60% of the total investment required for the project (at 6% interest rate during 15 years and particularly for light rural industries) and 100% of the transportation costs of thoroughbred animals[38].

So far particular attention has been given to the DIP concerning the establishment of agro-business enterprises. It is here that pioneering efforts in large scale irrigation,land reform, agro-businesses and farm corporations have been made. By 1968/69, 67,556 ha of land of the DIP were assigned to five agro-business corporations. These companies have gradually been established since 1969. Besides these new ventures, the old government agro-industrial unit at Haft-Tappeh was founded to the south of the DIP area in the early 1960s. It functioned as a motivating model for the establishment of the later agro-business corporations.

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# CHAPTER 9

## FARM CORPORATIONS OF THE DIP

For the execution of the new agricultural policy, the Development and Resources Corporation of New york recommended the establishment of four farm corporations in the northern part of the DPIP area. It suggested that 9,006 ha of the Pilot area, including 28 villages should be allocated to farm corporations, and the remaining area of 12,500 ha to agro-business companies. Out of 9,006 ha gross area, 8,839.6 ha were cultivated land, of which 7,708.7 ha belonged to the Dez peasants. This area included 524.81 jofts with a total population of 5,753 and with 730 land holding peasants[1].

By the late spring of 1972, four farm corporations, namely the Dez, the Shamsabad, the Shush and the Dezful, were established on a gross area of 12,109 ha, with a net area of 8,241 ha (Fig. 9-1). The total population of the four corporations was 7,630, of which 1,105 households were considered as share holders. The population of all the share holding households was estimated at 5,562. Hence 2,068 persons had neither land nor shares in the corporations and were classified as "Khoshneshines". There were 79,588 shares with a total capital of 79,588,000 rials (Table 9-1).

### 9-1 Evaluation of the DIP Farm Corporations

For an evaluation of the farm corporations of the DIP the Dez F.C. is chosen as an example for a number of reasons. These are:-

a) The Dez F.C. was the first corporation which was established in 1971. The others were established later.

b) The land of the Dez farm corporation was entirely irrigated land, before and after its establishment, while this is not the case for the others, especially the Dezful Farm Corporation.

Fig 9 1 FARM CORORATIONS of the DEZ IRRIGATION PROJECT 1976

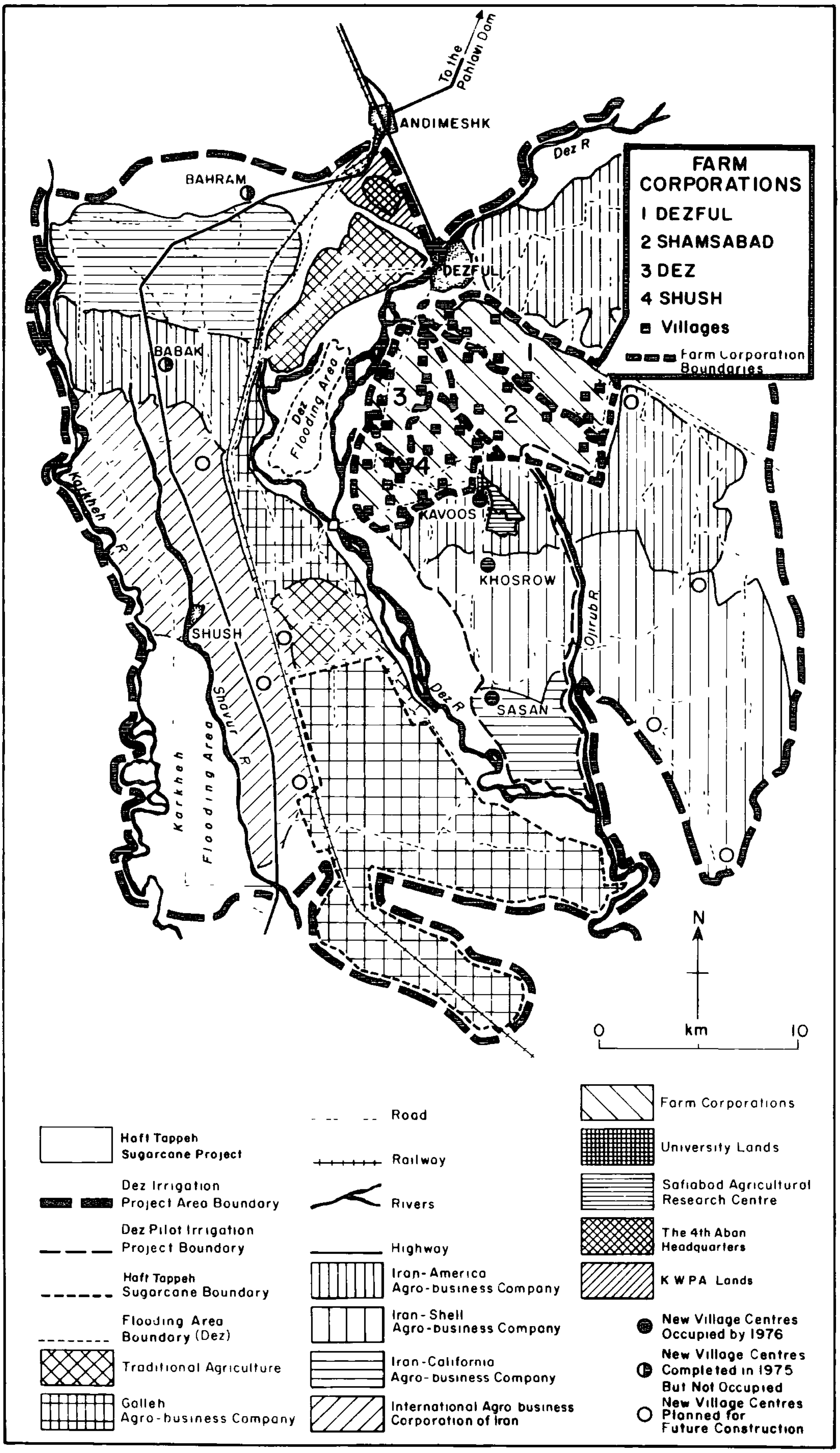

Table 9-1

Farm Corporations of the Dez Irrigation Project

| Farm Corporations | No. of villages | Date of establishment | Gross area ha | Net area ha | Area under irrigated agriculture (ha) | | | Water resources l/sec | Population | Population of share-holders | No. of share-holders | No. of shares | Capital 1,000 rials |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Winter | Summer | Total | | | | | | |
| Dez | 8 | 50.3. 4 | 2,191 | 1,587 | 735 | 673 | 1,410 | 2,000 | 1,795 | 1,130 | 222 | 15,423 | 15,423,000 |
| Shams-Abad | 6 | 51.4.10 | 2,758 | 1,434 | 870 | 790 | 1,660 | 2,800 | 1,292 | 1,194 | 235 | 16,211 | 16,211,000 |
| Shush | 14 | 51.2.26 | 2,920 | 2,210 | 1,400 | 792 | 2,192 | 3,600 | 1,925 | 1,763 | 357 | 22,832 | 22,832,000 |
| Dezful | 9 | 51.4.10 | 4,240 | 3,010 | 460 | 225 | 685 | 200 | 2,618 | 1,475 | 291 | 25,123 | 25,122,000 |
| Total | 37 | | 12,109 | 8,241 | | | | 8,600 | 7,630 | 5,562 | 1,105 | 79,589 | 79,588,000 |

Source. Ministry of Co-operation and Rural Affairs, Department of Farm Corporations and Production Co-operatives "The performance of the Ministry on the establishment and management of the Farm Corporations and the Rural Co-operatives until March 1972". September 1973. p.82.

c) Data on the background of the corporations are available only for the Dez Farm Corporation. These are important for a comparison study before and after the establishment of the corporation.

## 9-2 Land Use of the Dez F.C. in 1970

The gross area of the Dez F.C. is 2,191 ha of which 1,411 ha were cultivated by peasant farmers. 437.1 ha were cultivated by small landowners, and 153.9 ha by others in 1971. 10.2 ha were non-irrigated land and 179.1 ha were accounted for by canals, roads, buildings, etc. Wheat and barley formed the major winter crops and rice, melons and sesame the summer crops. 45.5% of the area was cultivated with wheat, 14.5% with rice, 11.7% with melons, 11.5% with barley. 10% with sesame and 6.6% with mung beans[2].

Eight villages of the Dez F.C. are irrigated by the Dez river water. The modern irrigation system supplies 2,000 l/sec to the corporation.

## 9-3 Population, Labour force and the Employment Situation of the Dez Farm Corporation

The total population of the Corporation is estimated at 1,795, consisting of 280 households, of which 214 households are peasant households and the remaining 66 are khoshneshines, (peasant households without land). The corresponding figures for total population for the latter two groups are 1,418 and 291 respectively[3]. The total active population is estimated at 523 (age group of 16 to 60) of which 369 or 70.55% of the total is the male labour force.

The total available labour force is estimated at 110,700 man days of work (300 days per year per person). Out of this total

90,000 man days of work are expected from the peasant land holders and 20,700 from the landless peasants.

The total labour demand was 51,179 man days in 1971. Therefore a total 38,821 man days were not needed out of the total available figure. Taking into account the 300 days of work per year per person, each land holding peasant had employment for only 170 days per year, and 130 days of unemployment. Adding the two figures of 20,700 days of unemployment of the landless peasants with that of 38,821 days of unemployment of the landholding peasants, gives a total number of days of unemployment annually of 59,521.

## 9-4 Land Reform

Before land reform all the village lands belonged to large absentee landlords. The first phase of land reform affected only 1.4 dangs out of 6 dangs of the village of Dehbar. (Each village in Iran has six dangs regardless of the area). The remaining 7 villages were untouched.

After the second phase of the land reform law the villages of Kermalak Tahmasebi, Kermalak Aliabad, Bandebal, Sharafabad Mostofi, 1.4 dangs of the village of Sharafabad Ashrafi, 0.4 dangs of Ghaleh Shaikh and 4.6 dangs of Dehbar were divided. All the lands belonging to the village of Sharafabad Arfaa, 5.6 dangs of Ghaleh Shaikh and 4.6 dangs of Sharafabad Ashrafi were leased to peasants.

After the third phase of the land reform law the leased lands were sold to peasants.

## 9-5 Distribution of Holdings

The total 1,411 ha of peasant farmers' lands comprised 151 jofts. Therefore, each joft represents 9.34 ha. The majority of peasants, i.e. 148 or 66.6% hold $\frac{1}{2}$ joft. Next come the peasants with one joft holding. They formed 58 or 26.1% of all the farmers. Only two peasants had 2 or $2\frac{1}{2}$ jofts (Table 9-2).

### Farmers' income in 1971

Before the establishment of the Dez F.C. each peasant owned 6.35 ha of cultivated land. The gross farming income of a peasant was 52,752 rials. Taking into account the total farming cost of 35,910 rials, the net farm income of a peasant household was 16,842 rials. If the labour value of the peasant family member of 15,261 rials is added to the net income, the total annual income of a farmer family was 32,103 rials.

## 9-6 Social Institutions of the Villages in 1971

There were six primary schools run by 12 teachers in eight villages of the Dez F.C. in 1971. The total percentage of literate people of seven years of age and over in the eight villages of the Dez F.C. was 37.7% No clinic existed in the area. One bath house served the total population of eight villages. Most of the people therefore used ponds and canal water for bathing.

Even small children of one and two years old were taken to bathe in irrigation and drainage ditches and ponds. This is one of the factors which causes bilharziasis infection.

Each village had a village society which has been replaced by the society of the rural unit.

Table 9-2

Dez Farm Corporation

Village Property Distribution and Land Reform Status

| Village | Area (ha) (1) | No. of bonkuh (work team) (1) | No. of jofts (1) | No. of peasant land-holders (1) | Total population of land-holders (1) | Land reform status (1) | Joft distribution by size (2) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1/3 | 1/2 | 3/4 | 1 | 1½ | 2 | 2½ |
| Bandebal | 456.9 | 2 | 24 | 41 | 278 | divide | - | 35 | - | 5 | 1 | - | - |
| Kermalak Tahmasebi | 202.5 | 2 | 12 | 20 | 127 | " | - | 15 | 2 | 3 | - | - | - |
| Kermalak Aliabad | 181.0 | 2 | 12 | 19 | 139 | " | 3 | 11 | - | 4 | 1 | - | - |
| Dehbar | 425.6 | 2 | 24 | 43 | 268 | " | - | 38 | - | 5 | 1 | - | - |
| Qualeh Shaikh | 403.1 | 4 | 24 | 32 | 144 | divide/sold | - | 17 | - | 13 | 2 | - | - |
| Sharafabade mostofi | 367.8 | 4 | 32 | 41 | 152 | divide | - | 24 | - | 16 | - | 1 | - |
| Sharafabade Ashrafi | 70.8 | 2 | 10 | 11 | 201 | divide | - | 4 | 2 | 4 | - | - | 1 |
| Sharafabade Arfaa | 102.7 | 1 | 13 | 15 | 109 | sold | - | 4 | 2 | 8 | 1 | - | - |
| Total | 2,010.4 | 19 | 151 | 222 | 1,279 | | 3 | 148 | 6 | 58 | 5 | 1 | 1 |

Source: (1) Ehlers, 1975, pp.208-211.

(2) Mahdavi (Managing Director of the Dez Farm Corporation) 1975, Personal communication.

Schools and baths were built by the farmers.

All villages had rural cooperatives which functioned only to supply credit to the peasants.

## 9-7 Distribution of Shares

The Dez F.C. was established in May 1971 with an initial capital of 15,423,000 rials. The number of shares of the corporation is 15,423. Each share represents a value of 1,000 rials. The average number of shares held is 69 and the shares' distribution ranged from 31 to 207 (Table 9-3). 44.6% of the farmers own 31 to 50 shares. 85.2% of the farmers have 31 to 90 shares and the remaining 15.8%, 91 to 207 shares.

Table 9-3

Share Distribution of the Dez F.C.

| Share distribution | Share holders | Percentage of shareholders |
|---|---|---|
| 31 - 50 | 99 | 44.6 |
| 51 - 70 | 37 | 16.8 |
| 71 - 90 | 53 | 23.8 |
| 91 - 110 | 7 | 3.1 |
| 111 - 207 | 26 | 11.7 |
| Total | 222 | 100.0 |

Source: Nowroozi, M., 1973, p.8.

## 9-8 Cropping Pattern and the Crop Yield of the Dez F.C.

### 9-8-a Cropping Pattern

The Cropping pattern has been controlled by the Corporation Manager since 1971. He is assisted by three farming advisers, nine extension corpmen, two tractor drivers, one technician and one accountant.

Before the establishment of the F.C. the total area under cultivation was 1,411 ha. In 1972/73 the area under cultivation increased to 1,446 ha, but in 1973/74 was reduced to 1,076 ha. In 1974/75 the area under cultivation was planned to be 1,391 ha. The actual area under cultivation was 1,091 ha excluding the areas allocated to rice and sesame which were to be planted later (Table 9-4.)

In 1972/73 the area under cultivation of wheat, barley, sesame, mung beans and green beans was reduced. Forage crops such as clover and alfalfa were the most important new crops. Rice was not cultivated in 1972-73 and the area under cultivation of wheat increased. Sugar beet, maize, cotton and soya beans were the new crops. The overall cropping pattern of the Dez F.C. aimed at diversification of crops. Four alternatives have been recommended by D & R for Farm Corporations.

Alternative 1: General Cropping

This is a long-term cropping rotation based upon grains and alfalfa with smaller areas devoted to sugar beet, vegetables and sunflowers.

Alternative 2: Intensive Cropping

A short-term rotation is utilized, based upon the intensive cropping of grains, vegetables, sugar beet and beans.

Alternative 3: Intensive Alfalfa

This intensive rotation assumes that 75% of the land is planted to alfalfa at any one time.

Alternative 4: General Cropping - Livestock

A livestock feeding enterprise is added to the cropping system set forth in Alternative 1. About 17 percent of the farm's land resources would grow fodder for livestock. The remainder of the production would be sold through regular channels.

Table 9-4

Area under Cultivation and Yields of the Dez F C. - 1971 - 75

(Area - ha) (yield - Kg/ha)

| Crop | 1971-72 (1) | | 1972-73 (2) | | 1973-74 (2) | | 1975(2) | DRC Standard yield (3) |
|---|---|---|---|---|---|---|---|---|
| | Area | Yield | Area | Yield | Area | Yield | Area | |
| Wheat | 642 | 900 | 500 | 1,581 | 850 | 2,000 | 750 | 1,500 |
| Barley | 162 | 950 | 100 | 1,070 | 10 | 1,500 | 50 | 1,800 |
| Rice | 207 | 1,400 | 275 | 1,931 | - | - | 200* | 2,400 |
| Sesame | 141 | 400 | 114.5 | 346.9 | - | - | 100* | 700 |
| Mung beans | 94 | 600 | 48.5 | 429.77 | - | - | | 600 |
| Tomatoes | | | 19 | 5,921 | 7 | 7,000 | | 20,000 |
| Egg plant | | | 31 | 8,134.5 | 3 | 6,667 | | 12,000 |
| S - green beans | 165 | | 21 | 1,371.5 | 30 | 800 | 23 | |
| W - green beans | | | 15 | 183.5 | | | | |
| Cucumber | | | 29 | 14,980 | | | | 18,000 |
| W - melons | | | 1 | 14,620 | | | | 15,000 |
| Green peas | | | 7 | 381.8 | | | | |
| Clover | | | 140 | | | | | 65,000 |
| Alfalfa | | | 28 | | 28 | | 110 | 12,000 |
| Poppy | | | 5 | 1,190 | | | 28 | |
| S - blackeye beans | | | 31 | 271.5 | | | | |
| A - blackeye beans | | | 10 | 1,280 | 30 | 1,000 | | 700 |
| Sugar beets | | | | | 50 | 30,000 | 50 | 60,000 |
| Broad beans | | | | | 50 | 1,500 | 50 | 1,000 |
| Maize | | | | | 10 | 900 | 20 | 4,500 |
| Cotton | | | | | 3 | 2,300 | 10 | 2,000 |
| Soya bean | | | | | 5 | 700 | | |
| Total | 1,411 | | 1,446 | | 1,076 | | 1,391** | |

* The area planned to be planted. ** Planned and actual area.

(1) Nowroozi, 1973.

(2) Data were obtained from Mahdavi (The Managing Director of the Corporation) at the Corporation site. April 1975.

(3) DRC, 1970. Farm Corporations for the DIP, p.71.

All alternatives are fully mechanized. This, primarily, requires land levelling. Only 261 ha of the land of four Farm Corporations of the DIP were levelled by November 1974[4]. This was governed by the first contract made between KWPA and the Ministry of Cooperation and Rural Affairs for land levelling. The second contract for the levelling of 6,000 ha was made in January 1975. The schedule for the completion is January 1978[5]. Therefore a total area of 6,261 ha, which is the area of the four Farm Corporations, will be ultimately cultivated, against the total cultivable area of 8,241 ha of 1969. Taking into account the 8,600 l/sec of supplied water to the Farm Corporations and the 2 l/sec/ha for any crop pattern other than rice, the maximum area which can be cultivated is 4,300 ha. Otherwise, the Corporations have to cultivate a variety of crops with smaller water requirements.

9-8-b Crop yields

The yield of all crops of the Dez F.C. declined, other than that of wheat, in the first year of operation (i.e. 1972/73) (Table 9-4). In the following year the yield of wheat increased to 2,000 Kg/ha against that of 1,500 Kg/ha in the year preceding the establishment of the Corporation. The yield of barley which declined in 1972/73 increased to 1,500 Kg/ha which is the same yield as in 1971. The yields of all other crops were below those of 1971.

## 9-9 Shareholders' Income in the Dez F.C.

The ex-peasants now obtain their income from two sources:

a) Agricultural labour wage.

b) Net value of agricultural products, which is divided in the ratio of the shares.

The gross value of the agricultural products of the Dez F.C. was 15,412,403 rials. The total cost of products accounted for 14,658,970 rials[6]. Therefore, a net farming income of 753,473 rials was earned in 1972/73. This is the net income which was divided amongst the farmers in the ratio of their shares. Since the total number of shares is 15,423, the net income of each share is 48.85 rials. Taking into account the distribution of shares, the mean net income of five groups of shareholders ranges between 1,984.5 rials to 7,791 rials (Table 9-5).

Table 9-5

Mean net income distribution of the Shareholders of the Dez Farm Corporation 1972/73

(Net income per share is 49 rials)

| Groups | | Mean Net Income |
|---|---|---|
| First group | 49 x 31 = 1,519 )<br>49 x 50 = 2,450 ) | 3,969 ÷ 2 = 1,984.5 |
| Second group | 49 x 51 = 2,450 )<br>49 x 70 = 3,430 ) | 5,870 ÷ 2 = 2,935.0 |
| Third group | 49 x 71 = 3,479 )<br>49 x 90 = 4,410 ) | 7,889 ÷ 2 = 3,944.5 |
| Fourth group | 49 x 91 = 4,459 )<br>49 x 110 = 5,390 ) | 9,849 ÷ 2 = 4,924.5 |
| Fifth group | 49 x 111 = 5,439 )<br>49 x 209 = 10,143 ) | 15,582 ÷ 2 = 7,791.0 |

The total labour wage was 5,188,942 rials in 1972/73[7]. Taking the number of 222 shareholders, the average wage earning of each ex-peasant is estimated at 23,373.6 rials. Therefore the annual net income of a shareholder ranges between 25,358.1 rials and 31,164.6 rials (Table 9-6).

Since 88.3% of the ex-peasants have a number of shares ranging between 31 and 110, their net annual income was not more than 28,000 rials. Even the shareholders who hold the maximum number of shares, between 111 and 207, earned only 31,164.6 rials which is less than their incomes before the establishment of the Corporation. This low level of income is associated with a number of reasons. Of these the most important are:-

a) Bureaucratic nature of Farm Corporation Organisation.

b) Low yield of crops because of a relatively traditional method of farming.

c) Lack of incentive and interest of the shareholders.

Table 9-6

Annual net income of the Shareholders of the Dez Farm Corporation

1972-73 (rials)

| Group | Income from wages | Income from shares | Total annual income |
|---|---|---|---|
| 1. | 23,373.6 | 1,984.5 | 25,358.1 |
| 2. | 23,373.6 | 2,935.0 | 26,308.6 |
| 3. | 23,373.6 | 3,944.5 | 27,318.1 |
| 4. | 23,373.6 | 4,924.5 | 28,297.1 |
| 5. | 23,373.6 | 7,791.0 | 31,164.6 |

For the Dez F.C. a total of 616,930 rials was spent on development, insurance, legal reservation, etc. in 1972/73[8]. In addition to these, Farm Corporation grants, consisting of a certain amount of cash which was given to the Corporation Manager and his assistants as rewards each year, were made. These are earnings in addition to their annual salaries which come from the government. Therefore it is not surprising that the net agricultural product value which was 2,698.2 rials/ha in 1971[9] declined to 521 rials in 1972/73. In theory, for all farm corporations, policy-making and the general business of the farm corporation are entrusted to the General Meeting of shareholders and a board of directors is responsible for the execution of policy and daily affairs. The board consists of three members elected by shareholders. The board of directors elects a managing director from a panel of three persons, nominated by the Ministry of Cooperation and Rural Affairs. In practice, owing to lack of the farmers' experience in managing large-scale farms, the responsibility of managing the farm corporation rests with the managing director who is appointed and paid by the Ministry of Cooperation and Rural Affairs. A study of farm corporations in the early years of their establishment showed that there was a general feeling among the members that the board of directors was strongly influenced by the managing director and even major decisions were taken by the Farm Corporation Department. As a result the members did not consider the board of directors as a powerful body which could solve their problems[10].

With regard to economic success, the study showed that significant increases in farmers' income and agricultural production have occurred partly owing to an increase in the productivity of land as a result of employing new inputs and modern techniques[11]. The official statistics show a 63% increase, on average, in the yield per hectare compared to the year before the formation of farm corporations[12]. As far as the increase in farmers' income is concerned, there is a variation among the farm corporations. The highest increase amounted to 455% in the Shahnaz Farm Corporation and the lowest amounted to 4.92% in the Moghan Farm Corporation. The great variation amongst the farm corporations regarding income changes is owing to many factors, of which the most notable are: age, capability of management, fertility of the land and water resources. The experiences of the farm corporations indicate that the project has been costly to the government and, therefore, it is unlikely that the model will be expanded throughout the country. In addition, because the farm corporations rely heavily on employing machinery, they release a surplus labour which, unless absorbed by the industrial sector, especially rural industries, causes a serious problem for the country. Because of these limitations, the rate of expansion of the programme has slowed down considerably during the Fifth Plan period.

9-10 Employment

Before the establishment of the Dez F.C. the labour demand was estimated at 51,179 man days for the cultivation of 1,411 ha[13]. Seasonal unemployment was 127 man days out of 300 man days in each year for each farmer. When the Dez F.C. was established, the total labour demand was 51,890 man days for the cultivation of 1,446 ha[14]. The average labour requirement which was 36.2 days/ha before the formation of the corporation was reduced to 35.88 days/ha in 1972/73. Out of the 66,600 man days available from the 222 shareholders, 51,890 man days were employed. In addition to the 14,710 man days which represented the unused labour force of the shareholders, a further 44,100 man days represented the total unused labour force of the active male rural population of the age group 15 - 60 years old. Therefore, the total unused man days is 63,810 in 1972/73. The future employment prospects of the Farm Corporations do not present an optimistic picture. The total area which will eventually be irrigated is 6,261 ha. Since agriculture will be entirely mechanized, with a labour demand of one worker for each fifty to seventy hectares[15] the total ultimate labour demand of the four Farm Corporations of the DIP is estimated at 87 - 125 workers. Therefore, at the stage of full development, 980 of the shareholders, plus 413 shareless labourers will no longer be needed. With this assumption the total unemployed labour force of the four DIP Farm Corporations will be approximately 1,393.

## 9-11 Social Services of the Dez F.C.

### 9-11-a Health

The only additional service supplied to the shareholders, other than those they already had in 1969, is a clinic. A doctor assisted by a nurse is available two days per week. The hours of service are 2 to 5 p.m. each day. Each shareholder has to pay 1% of his income for the health service. In 1972 each shareholder paid 1,060 rials[16]. For 7,630 persons of the four Farm Corporations only six hours of medical services are available per week. People have to go to the medical centres of the town of Dezful. Each ordinary medical service to a patient is given at a cost of 506 rials in the town.

45.2% of patients went to the medical centres in Dezful because of lack of medical services in the 37 villages of the four Farm Corporations and because of emergency cases. 32.2% of patients went to the Dez F.C.'s clinic but they were not served. 19.3% of the patients did not receive medicine, and 3.2% of patients needed a bed and operations which were not available and had to go to Dezful[17]. In 1972/73 the health and nutrition situations of the people did not improve. 30% of the total 3,618 patients suffered from malnutrition, 65% had bilharzia and helminths because of water contamination and 5% other diseases[18].

9-11-b <u>Education and housing</u>

Education services are no better than health services. In 1975 the number of schools remained as in the period before 1968. The only programme which had been planned to promote education on the Farm Corporations was the establishment of a vocational school. The objective was to train technicians for Corporations.

The school, however, has not been built and does not appear likely to be built in the near future. The housing situation of the shareholders has not improved as yet. A new housing policy was intended to be set up by the Farm Corporation but shareholders could not afford to pay for the new housing. The Dez F.C. planned to lend 150,000 to 200,000 rials to each farmer. The shareholders rejected the loans because they could not afford to repay them. Now the policy is changed. It has been decided that 25 per cent of the price of each house is to be granted as a free loan to the shareholders, 50 per cent is to be as a controlled loan and the rest, 25 per cent, is to be paid by the shareholders[19]. 222 houses are to be built for the Dez Corporation shareholders with house sizes of 74 $m^2$, 104 $m^2$ or 124 $m^2$. The total area of each building block is 450, 500 or 650 $m^2$. Shareholders are allowed to have a maximum of two to three animals. The remaining livestock is to be bought or already has been bought by the Corporations. It is planned to establish a joint stock meat and dairy complex with the cooperation of the four Farm Corporations of the DIP[20].

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# CHAPTER 10

## AGRO-INDUSTRIAL CORPORATIONS OF THE DIP

### Haft-Tappeh Sugar Cane Project

Since 1969, 67.555 ha. of the DIP have been assigned to five agro-industrial corporations. They are practising intensive farming on a commercial basis. The oldest of the agro-industrial corporations is the Haft-Tappeh Sugar Cane Project. It is a government owned company, which is located in the south of the DIP. The Haft-Tappeh Sugar Cane Project was formed as part of the planned programme for the economic and social advancement of the local people. More specifically, it was included in the overall Dez scheme to promote the development of large scale agricultural enterprises in the Province of Khuzestan and to re establish cane sugar as a commercial crop.

### 10-1 History

The cultivation of sugar cane in Khuzestan has a history of several thousand years. However, owing to various events, the cultivation of sugar cane was abandoned seven hundred years ago.

In the years 1937 through to 1939, some sugar cane was planted in Ahoodasht, Hamidieh and other areas of Khuzestan. Because of one reason or another, plants died and disappeared. In 1951 the Plan organisation of Iran invited a group of experts from F.A.O. to conduct feasibility studies on the development of Sugar Cane Cultivation. The result was the publication of report no. 129, which was presented in 1953.

In 1956 the DRC commissioned F.A.O. to complete studies for the establishment of a comprehensive programme to re-introduce sugar cane plantations to Khuzestan. In April 1957 the DRC recommended the purchase of 10,000 ha of land at Haft-Tappeh, 120 km north of Ahwaz in the south of the DIP area. The project primarily comprised of a sugar cane milling and refining plant with a capacity of 3,000 tonnes of sugar cane per day. The plant produced 300 tonnes of raw sugar per day in a production period of 100 days from a plantation area of 4,000 ha.[1]

In 1959, land levelling was completed and in 1960, 2400 ha were planted. Since December 1961 the cane has been milled.[2] The Sugar Cane Project had two stages of development. In the first stage, the total gross area was 10,500 ha, of which 5,500 ha were allocated for cane production. When the area under sugar cane cultivation developed to 5,500 ha the plant capacity was increased to 50,000 tonnes of sugar per year. In the second stage the gross assigned area is planned to develop to 29,000 ha, with a net area of 11,000 ha in the 5th development plan (1972 - 77) and to 16,000 ha during the 6th development plan.[3] At the end of the Sixth Development Plan the sugar supply capacity is expected to be 150,000 tonnes annually compared with a figure of 100,000 tonnes in 1974.[4] The cost of the first stage of the project was $26 million. The second stage raised the cost to a total of $68 million by 1971.[5]

## 10-2 Water Supply of the Sugar Cane Project

The Haft Tappeh area has a mean annual precipitation of 260 mm (November - May) while the annual evapotranspiration exceeds 2,900 mm.[6]

The season of cane growth is July to mid-September, when the temperatures reach 40 - 45°C. Little growth occurs in temperature below 12°C.[7]

Since precipitation is very scanty, and the sugar cane water requirement is very high (2,457 mm/ha),[8] the cane cultivation depends entirely on irrigation.

The source of irrigation water is the Dez river. The water need of cane varies in different fields, ranging from 15 - 30 rounds of irrigation during each growing season. Until 1972 the water was pumped by ten 430 hp pumps from the Dez river. The total capacity of the pumps was 26m$^3$/sec. Water was lifted by three pumping plant units over a total height of 36 metres. The capacities of the pumps were 15m$^3$/sec, 8m$^3$/sec and 3m$^3$/sec, respectively.[9] In 1972, with the completion of the west main canal of the DIP and the delivery of 30m$^3$/sec of water to the northern part of the cane plantation, if the above supply drops off one of the pumps with a discharge capacity of 13.3m$^3$/sec can be used as a reserve water supply means. Up to now 34.45 kilometres of main canals and 79.68 kilometres of laterals and sub-laterals supply water for the irrigation of an area of over 10,000 ha.[10] Two water storages in the north and a further two in the south of the Haft-Tappeh area with a reservoir capacity of 751,000m$^3$ are included. Siphoning is the only means of field irrigation.

10-3 Drainage

Most of the soils of the plantation are heavy with low organic matter contents and low permeability. They are 2 to 6 metres deep and lack structure and profile development. Saline areas and some alkali-spots are common to the plantation.

The problem of soil salinity, as well as a rising water table which is the result of heavy irrigation of the cane fields, can be solved only by the application of extensive tiling and leaching programmes. Tile drains with 80 to 100 metres spacing have worked well and have lowered the water table to safe limit.[11]

In 1971 over 4,000 ha of the plantation were tile drained. In total 520 km of tile lines and 134 km of open drains were installed. 95% of the central area and all the areas located at the north and south of the Haft-Tappeh area are drained.[12] The tile drainage costs were 14,393 rials per hectare, whereas that of open draining only 2,350 rials.[13]

After the tile drainage programme was completed the salinity has been reduced to a safe level.[14]

10-4 Development of the area under cane cultivation

In 1959. 50% of the total area of 10,000 ha was allocated to irrigation and drainage canals, roads, milling and refining and residential sites. The remaining 5,500 ha was to be planted during a ten year period (1960 - 70). Once the DIP is completed a further 16,500 ha is to be allotted to cane plantation.[15]

Trial farms were established on 198 ha in 1959 and the commercial cultivation of cane began in 1961 on an area of 2,200 ha. After almost a decade in 1971 the area under cane sugar cultivation had been extended to 5,500 ha, of which 4,536 ha was planted in any one year. A total area of 12,200 ha out of 16,500 ha of the cane sugar cultivation programme is arable land. By 1974 the area under cultivation increased to 9,149 ha. (Table 10-1). The objective for the sixth development plan is an increase of the cane cultivation area to 16,000 ha.

10-5 Sugar Production

The installation of the sugar cane mill and the refinery kept pace with the development of the cane sugar plantation at Haft-Tappeh.

The plant, which is located at the centre of the cane sugar fields, was established in 1961 with a capacity of 3,000 tonnes of sugar cane per day.

The Third Development Plan target (1962-67) was the expansion of the milling plant to 5,000 tonnes of cane sugar per day or 500 tonnes of refined sugar per day during the operating seasons (October to May).

Although the installed capacity was achieved, the annual production of sugar did not exceed 42,394.3 tonnes in 1964 against a target of 50,000 tonnes (Table 10-1).

In the Fourth Development Plan the objective of development was divided into two phases:

Phase 1

a) To double the raw sugar supply.

b) To double the capacity of the milling plant.

c) The capacity of the refinery would not be increased and the extra raw sugar would be stored and refined in the summer months.

Phase 2

a) The establishment of a new milling plant.

b) To double the capacity of the refinery.[16]

In 1971-72 the sugar plant milled 12,000 tonnes of cane per day. 600 tonnes of raw sugar were delivered to the refinery and the remaining half stored in the raw sugar storage, which has a capacity of 70,000 tonnes.[17] Despite this the planned target of cane sugar production, which was 800,000 tonnes/yr, was not achieved.[18]

The capacity of the sugar refinery was increased to 650-700 tonnes per day and is expected to be in operation for approximately ten months per year.

## TABLE 10-1

## HAFT-TAPPEH SUGAR CANE PROJECT

### Area under cultivation, production and yields

### 1961-1974

| Year | Area under cultivation (ha) | Production (Tonnes) | | | | Yield (tonnes/ha) | |
|---|---|---|---|---|---|---|---|
| | | Cane-Sugar | Sugar | Molasses | Bagasse | Cane-Sugar | Sugar |
| 1961 | 2,200 | 179,835 | 12,160 | 10,640 | 63,633 | 81.7 | 5.5 |
| 1962 | 2,421 | 202,139 | 17,003 | 9,587 | 47,747 | 83.5 | 7.0 |
| 1963 | 2,815 | 196,781 | 15,298 | 9,806 | 56,229 | 69.8 | 5.3 |
| 1964 | 3,643 | 292,434 | 25,847 | 9,464 | 94,466 | 80.3 | 7.1 |
| 1965 | 3,919 | 392,136 | 37,023 | 9,311 | 124,327 | 100.1 | 9.4 |
| 1966 | 3,956 | 382.420 | 38,615 | 13,300 | 121,751 | 96.4 | 9.7 |
| 1967 | 4.183 | 433,168 | 42,394 | 15,360 | 142,827 | 103.5 | 10.2 |
| 1968 | 4,284 | 452,317 | 47.833 | 17,317 | 149,833 | 105.6 | 11.2 |
| 1969 | 4,389 | 528,336 | 54,110 | 18,437 | 176,183 | 120.4 | 12.3 |
| 1970 | 4,432 | 521,518 | 54,716 | 19,429 | 173,957 | 117.7 | 12.4 |
| 1971 | 4.536 | 577,577 | 49,346 | 22,300 | 164,028 | 127.3 | 10.9 |
| 1972 | 6,747 | 831,170 | 62,438 | 41.672 | 231,445 | 123.2 | 9.3 |
| 1973 | 8.793 | 1.045.121 | 88,166 | 46,430 | 293,243 | 118.9 | 10.1 |
| 1974 | 9,149 | 1.076,057 | 97,296 | 41,768 | 312,317 | 117.6 | 10.6 |

Source: Agro-industrial Corporation of Haft-Tappeh Department of Agricultural Research. A report on 14 years of performance and development. May 1976. p. 9.

The planned sugar production target of the Fifth Development Plan for the Haft-Tappeh Sugar Cane Project was almost realised in 1353 (1974-75). The sugar supply was 97,296 tonnes against a target of 100,000 tonnes (Table 10-1). It is hoped that the sugar production will increase to 150,000 tonnes per annum by 1982 (the end of the 6th development plan).[19] The Haft-Tappeh Sugar Cane Project achieved a world record of 127.3 tonnes sugar cane per hectare in 1971. Since then although the area under cultivation has steadily increased, sugar cane yields/ha have decreased slightly (Table 10-1).

10-6 By-products of Sugar Cane

Besides the refined sugar the Haft-Tappeh Sugar Cane Project produces two by-products: molasses and bagasse. Molasses is the thick and dark residue of cane juice after most of the available sugar has been removed. Bagasse is the fibrous residue of sugar cane after the sugar has been squeezed out.

Production of molasses increased from 10,640 tonnes in 1961 to 46,430 tonnes in 1973/74 (Table 10-1). All molasses is exported from the ports of the Persian Gulf. Production of bagasse increased from 63,633 tonnes in 1961 to 312,317 tonnes in 1974/75 (Table 10-1). Until 1970, bagasse was entirely used as fuel to fire the steam generators of the Haft-Tappeh Sugar Cane Project. Subsequently it was sold to a recently established paper plant nearby. The plant has a capacity of 105,000 tonnes of paper per annum and uses bagasse as fibre. 520 to 550 kilograms of bagasse is needed to make one tonne of paper.[20] The plant began its production in 1970 with a capacity of 35,000 tonnes per year.[21]

10-7 Contribution of the Haft-Tappeh Sugar Cane Project to Iran's Sugar Needs

At the planning stage of the Haft-Tappeh Sugar Cane Project

(1956) the total production of sugar in Iran was 148,000 tonnes whereas the sugar consumption was 337,000 tonnes. In 1962 the contribution of the Haft-Tappeh Sugar Cane Project to Iran's sugar supply was 10.82% with a total production of sugar of 17,000 tonnes. After a decade, although the Haft-Tappeh Project produced 62,500 tonnes of sugar, its contribution to Iran's sugar supply did not exceed 11% of the total. The total sugar production in Iran was 580,000 tonnes in 1972. One year later the contribution of the Haft-Tappeh plant increased to 17.02%. In 1974, when the total sugar production of Iran was 4.5 times that of 1956, the Haft-Tappeh plant supplied 8 times the amount that it produced during its first year of operation (97,300 tonnes in 1974 compared with 12,000 tonnes in 1962). By 1974 Haft-Tappeh supplied 15.25% of the national sugar production (Table 10-2). The Haft-Tappeh Sugar Cane Project supplied only 4% of Iran's sugar demand in 1962. By the end of the 4th plan, this rate had increased to 9% and in 1974 to 15.25%. The sugar imports of Iran, which were 64,500 tonnes in 1941, increased to 208,300 tonnes with a total value of 1,146 million rials after 20 years. The maximum sugar import of Iran, which was $467.8 \times 10^3$ tonnes at a total value of 4,514 million rials, occurred in 1964 whereas in 1973 the value of the imported sugar had increased to \$75 million.[22] The sugar production of the Haft-Tappeh project as well as that of Iran increased in all years during the period 1961 to 74. Parallel to this development both the population of Iran and the per capita sugar demand increased also. The population of Iran, which was 20.5 million in 1956, increased to 30.1 million in 1972. In these years the per capita sugar consumption was 16.5 kg and 27.22 kg respectively.

Contribution of the Haft-Tappeh Sugar Cane Project to Iran's Sugar Needs

| Year | Iran's Total Sugar Production (1,000 Tonnes) | Haft-Tappeh Sugar Production (1,000 Tonnes) | Haft-Tappeh Sugar Production as a percentage of total production | Iran's Sugar Consumption (1,000 Tonnes) | Haft-Tappeh contribution of production as a percentage of consumption | Sugar Imports (1,000 Tonnes) | Value of Imported Sugar ($10^6$ rials) | Population of Iran (millions) | Per Capita Sugar Consumption (kg/capita) |
|---|---|---|---|---|---|---|---|---|---|
| 1941 | | | | | | c 64.6 | c 107 | | k 16.5 |
| 1942 | | | | | | c 43.29 | c 174 | | |
| 1943 | | | | | | c 25.0 | c 230.5 | | |
| 1944 | | | | | | c 45.31 | c 6.3 | | |
| 1945 | | | | | | c 40.4 | c 820 | | |
| 1946 | | | | | | c 71.2 | c 796 | | |
| 1947 | | | | | | | | | |
| 1948 | | | | | | | | | |
| 1949 | | | | | | | | | |
| 1950 | | | | | | | | | |
| 1951 | | | | | | c 114.32 | c 736 | | |
| 1952 | | | | | | | | | |
| 1953 | | | | | | | | | |
| 1954 | | | | | | | | | |
| 1955 | | | | | | | | | |
| 1956 | d 148 | | | d 337.9 | | c 169 | c 2269 | k 20.5 | k 16.5 |
| 1957 | | | | | | | | | |
| 1958 | | | | | | | | | |
| 1959 | | | | | | | | | |
| 1960 | | (b) | | | | | | | |
| 1961 | | 12.1 | | | | c 208.3 | c 1146 | | k 18.4 |
| 1962 | a 156.81 | 17 | 10.82 | d 429 | 3.95 | | | k 23.3 | |
| 1963 | a 157.08 | 14.7 | | | | c 274.6 | i 2387 | | |
| 1964 | a 170.18 | 26 | | | | c 467.3 | i 4514 | | |
| 1965 | a 225.77 | 37 | | e 508 | | f 354.3 | i 2013 | | e 21.14 |
| 1966 | a 368.6 | 38.6 | 10.46 | d 548 | | f 272.5 | i 1327 | | |
| 1967 | a 410.94 | 43 | | c 582 | | g 203 | i 959 | k 25.7 | e 23.4 |
| 1968 | a 465.12 | 47.9 | 10.45 | a 565 | 8.47 | g 125 | i 600 | | |
| 1969 | a 512.20 | 54.2 | | a 634 | | g 70.1 | i 421 | | |
| 1970 | a 566.81 | 54.8 | | a 648 | | g 61.4 | i 519 | | |
| 1971 | a 585.79 | 49.3 | | a 674 | | g 87.6 | i 793 | | |
| 1972 | a 579.65 | 62.5 | 10.78 | a 702 | 8.9 | h 159 | i 1989 | k 30.1 | e 27.22 |
| 1973 | a 607.98 | 88.1 | 17.02 | 750+ | 11.8+ | | j 5062.5 | | |
| 1974 | a 637.9 | 97.3 | 15.25 | 800+ | 15.23+ | | | | |
| 1975 | a 700.0* | m 105.0 | | | | | | | |
| 75-83 | | 150 L | | | 20 | | | | |

' Estimation   * Prediction

Sources:

a - Riahi, A. 1975. Sugar Supply and Sugar imports of Iran 1962-72 in Tehran Economist April 1975 p.45.

b - Table 10-1.

c - Saidi, Ch. 1965. "The abolition of sugar monopoly in Iran". in Tahqiqat-i-Eqtasadi. The quarterly journal of the Institute for Economic research, Faculty of Law, Political science and economics. University of Tehran, Iran. Vol. III Nos. 9 & 10 August 1965 pp 257-269.

d - Plan organisation February 1967. "Sugar industry in Iran" table 2.

e - Sabet-Ghadar, sh. 1965. P.13.

f - Mahjubi, M. 1971. "Financed funds of the Khuzestan's agriculture, sugar cane and sugar beet projects". The institute of co-operation education and research, Department of Financial and Administrative Affairs of Co-operatives, University of Tehran. Unpublished B.A. Thesis. P.129.

g - Plan organisation. Statistical Centre. Iran's yearbook 1971 pp 562-63.

h - Plan organisation, Statistical Centre, Iran's yearbook 1973 P.559.

i - Central Bank of Iran. Department of Economic Surveys. Agricultural section, 1974 "Statistics of the imports and exports of the agricultural products of Iran". 1963-72. February 1974 pp 28-30.

j - Central Bank of Iran 1974 Annual Report and Balance Sheet of 1973. September 1974 p.51 ($75 million = 5062.5 krials)

l - Kayhan. 28th March 1976. No. 9821 p.20.

k - Mahjubi, M. 1971 p. 141.

m - Kayhan. 4th December 1975. No. 9730 p.18.

Iran's sugar imports which declined regularly until 1970, have begun to increase since then and this increase is mainly because of the increase in the standard of living owing to the rapid increase in oil revenues.

Although the sugar supply of Haft-Tappeh increased to over 17% of Iran's total sugar production in 1973, the total value of imported sugar was over 5,062.5 million rials (75 million dollars), which was the highest value ever[23]. (Table 10-2).

It is expected that the Haft-Tappeh Sugar Cane Project will supply 20% of Iran's total demand for sugar of 1,000,000 tonnes in the years 1978 to 1983 , when 12,000 ha are to be cultivated with cane.

## 10-8 Employment and the operational performance of the milling plant and refinery.

The period of sugar cane planting is from August to November (Amordad to Aban). The first period of cultivation lasts 14 - 19 months, and in the successive years it lasts 12 months. Each cane plantation is harvested 5 to 6 and even 8 times. Sugar cane harvesting begins in November and goes on for 3 - 5 months.

The manpower of Haft-Tappeh includes the staff, and the permanent and temporary workers. When the project commenced in 1958, its staff was 21 with 59 permanent workers. In the first year of operation the staff increased to 220, the permanent workers to 1,218 with 1,041 temporary workers. In March 1976 the total manpower of the Haft-Tappeh Sugar Cane Project was 5,797 of which 396 were the staff, 2,174 the permanent workers and the remaining 3,227 were temporary (Table 10-3).

TABLE 10-3

Employment at Haft-Tappeh Sugar Cane Project

1958-1975

| Year | Staff | Permanent Workers | Temporary Workers | Total Workers | Total Employees |
|---|---|---|---|---|---|
| 1958 | 21 | 59 | | 59 | 80 |
| 1959 | 78 | 234 | | 254 | 312 |
| 1960 | 134 | 666 | | 666 | 800 |
| 1961 | 220 | 1,238 | 1,041 | 2,279 | 2,499 |
| 1962 | 223 | 1,231 | 1,290 | 2,521 | 2,744 |
| 1963 | 235 | 1,370 | 1,509 | 2,879 | 3,114 |
| 1964 | 237 | 1,270 | 1,302 | 2,572 | 2,809 |
| 1965 | 241 | 1,095 | 1,300 | 2,395 | 2,636 |
| 1966 | 257 | 1,157 | 1,429 | 2,586 | 2,843 |
| 1967 | 259 | 1,194 | 1,421 | 2,615 | 2,874 |
| 1968 | 289 | 1,303 | 1,531 | 2,834 | 3,123 |
| 1969 | 326 | 1,511 | 1,350 | 2,861 | 3,187 |
| 1970 | 329 | 1,653 | 1,400 | 3,053 | 3,382 |
| 1971 | 358 | 1,809 | 1,382 | 3,191 | 3,549 |
| 1972 | 376 | 2,052 | 2,500 | 4,552 | 4,928 |
| 1973 | 394 | 2,052 | 2,731 | 4,783 | 5,177 |
| 1974 | 383 | 2,115 | 2,963 | 5,078 | 5,461 |
| 1975 | 396 | 2,174 | 3,127 | 5.301 | 5,797 |

Source: Haft-Tappeh Sugar Cane Project. Annual Report of 1973 P.10

Source for 1974 and 1975. Kayhan, December 4th 1975, No. 9730 P.18

Note: a) In 1969 out of 1,350 temporary workers 1,286 were the cane cutters and 499 irrigators. (Ministry of Water and Power 1971. Irrigation and drainage seminar Pub. no. 2, P.94).

b) In 1975 out of 3,127 temporary workers 1.861 were cane cutters (Kayhan December 4th 1975. No. 9730 P.18)

In 1969 for the cultivation of 4,284 ha, 499 irrigators and 123 planting workers were employed.[24] A mean area of 8.58 ha was covered by each irrigator. In 1975-76 the number of irrigators increased to 1,067 and the cane cutters to about 1,900.

Although the Haft-Tappeh Sugar Cane Project has been a successful project from the point of view of employment, the most important criticism is the seasonal nature of the work. The labour demand for irrigation is almost nil during the harvesting seasons. There exists no work for the cane cutters for over almost 6-7 months per year. The permanent workers of the Haft-Tappeh project actually work for 3-5 months per year, but they receive salaries for the whole year. During the third development plan the milling plant capacity was 3,000 tonnes per day. The days of work ranged between 60 to over 120 days per year. During the 4th plan when the capacities increased to 5,000 tonnes of cane and 500 tonnes of sugar per day respectively, the operational time of the plant declined to 3 months and then increased to 4 months in 1971. Since then the capacity of the milling plant has increased to 12,000 tonnes, and that of the refinery to 700 tonnes per day. In 1973 the milling plant operated with a capacity of 9,600 tonnes per day and therefore the number of operating days per year was 109.

The objective of the 5th plan is the milling of 1,100,000 tonnes of cane within 5 months. Therefore the plant is to be operated with a capacity of 7,333 tonnes per day against its potential capacity of 12,000 tonnes/day.

In the 6th plan, in which 16,000 ha is to be cultivated, with an estimated production of 110 tonnes per hectare of cane, the total cane output will be 1,760,000 tonnes per year. Since the harvesting time is restricted to 3 to 5 months the plant must therefore be operated at a capacity of 11,733 tonnes per day. This requires a high efficiency of management both on the field and at the plant.

For the refinery the objective is ten months of operation per year. Hence when the production of sugar is 100,000 tonnes per year the refinery is to be operated with a capacity of 333 tonnes per day against its potential capacity of 700 tonnes per day. Even when sugar production increases to 150,000 tonnes per year, with the objective of 10 months operation the refinery will only operate at a rate of 500 tonnes per day which is 71.4% of its potential capacity.

10-9 Workers' Wages

The permanent workers of the Haft-Tappeh Sugar Cane Project work for three to five months per year, but they are paid for the whole year. The wages of these workers range between 152 rials and 749 rials per day for 8 hours of work. A total of 48 hours per week is expected. In 1964 the wages ranged between 90 and 452 rials per day. (Table 10-4) The highest wage was that of heavy machinery drivers in 1964 but skilled mechanics, electronic workers and technicians had the highest wages in 1974. Over a decade the wage of an unskilled worker increased by 68%, a carpenter by 171% and that of an assistant mechanic by 157%. (Table 10-4). Ehlers quoted a figure of 340 rials as the wage of a tractor driver.[25]

The wage of the cane cutters is calculated by the formula T (T + 21), where T is the average daily cut of cane over a 14 days period in tonnes. The mean daily cutting of cane did not exceed 7.16 tonnes during the period 1965 to 1973 (Table 10-5).

TABLE 10-4

HAFT-TAPPEH SUGAR CANE PROJECT

Wages of Workers
1964-74

| Profession | 1964 | 1974 | Percent increase |
|---|---|---|---|
| Unskilled worker | 90 | 152 | 68 |
| Irrigator | 148 | 229 | 54 |
| Driver | 324 | 496 | 53 |
| Mechanic Assistant | 164 | 422 | 157 |
| Skilled Mechanic | 412 | 749 | 81 |
| Electric worker | 340 | 749 | 120 |
| Constructional worker | 220 | 488 | 121 |
| Carpenter | 140 | 380 | 171 |
| Technicians | 308 | 749 | 143 |
| Milling operator | 308 | 538 | 74 |
| Guard | 84 | 207 | 146 |
| Refinery operator | 148 | 242 | 63 |
| Heavy machinery Driver | 452 | 587 | 29 |
| Cook | 120 | 242 | 101 |

Source: KWPA, Haft-Tappeh Sugar Cane Project Department of Administrative Affairs and Industrial Communications.

TABLE 10-5

Cane Cutter Productivity at Haft-Tappeh

Average tonnes/worker
1965-73

| Period | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.71 | 3.99 | 4.37 | 4.76 | 4.63 | 5.27 | 4.88 | 3.47 | 4.05 |
| 2 | 3.04 | 4.28 | 5.60 | 5.57 | 5.88 | 6.59 | 4.35 | 4.75 | 5.08 |
| 3 | 4.10 | 6.12 | 4.60 | 5.18 | 5.19 | 6.28 | 4.28 | 5.04 | 6.16 |
| 4 | 6.04 | 5.80 | 5.54 | 4.43 | 6.59 | 5.51 | 4.62 | 5.38 | 7.20 |
| 5 | 6.18 | 8.49 | 5.36 | 6.36 | 6.22 | 5.76 | 5.75 | 5.58 | 6.18 |
| 6 | 6.52 | 7.21 | 6.11 | 4.95 | 5.70 | 5.43 | 5.43 | 7.34 | 5.99 |
| 7 | 6.07 | 5.56 | 6.70 | 5.52 | 7.28 | 6.72 | 6.38 | 8.54 | 6.45 |
| 8 | 6.47 | 5.74 | 6.90 | 5.76 | 6.35 | 7.04 | 5.52 | 7.99. | 4.16 |
| 9 | 6.98 | 4.62 | 6.56 | 5.99 | 6.60 | 7.10 | 5.97 | 8.25 | 5.24 |
| 10 | 6.73 | | 5.85 | 6.34 | 6.80 | 7.30 | 5.72 | 8.58 | 6.66 |
| 11 | | | | 5.97 | 7.94 | 6.13 | 6.81 | 7.88 | 6.90 |
| 12 | | | | 5.99 | 6.99 | 6.08 | 6.95 | 8.04 | 7.65 |
| 13 | | | | 6.79 | 6.94 | 5.11 | 8.10 | 9.72 | 7.48 |
| 14 | | | | | | | 7.76 | 9.72 | 8.16 |
| Mean | 5.5 | 5.64 | 5.76 | 5.63 | 4.85 | 6.17 | 5.89 | 7.16 | 6.16 |

Source: MWP. KWPA Haft-Tappeh Sugar Cane Project Report of the 1352 harvest season (1973-74) P6.

The maximum amount of cane cut was even lower than this mean amount at the early stage of the project. A research group of the Institute of the Social Studies at the University of Tehran quoted a figure of 3 to 4 tonnes per day, which is low in comparison with that of 30 tonnes per day of the imported Australian cane cutters at Haft-Tappeh. Until 1968 a minimum wage of 60 rials per day was paid for 2.5 tonnes of cane cutting. In addition to that, 27 rials were paid for every extra tonne of the cut cane[26]. Between 1968 and 1972 with the application of the wage calculating equation, the maximum and minimum paid wages ranged between 60 rials to 310 rials (Table 10-6). Since the mean cane cut did not exceed 6 tonnes per day the paid wage was almost always 162 rials per day. In 1973 the numeric factor of the equation changed to 26. Since then wages have ranged between 88 and 396 rials per day (Table 10-6). At the present time the majority of workers receive approximately 231 rials per day. Since 1973 the annual wage has exceeded the ex-farmer's incomes of 1962 and 1964. In these years the income of farmers from Hoseinabad village, which was assigned to the Haft-Tappeh project, were 67,073 rials and 64,073 rials respectively[27], whereas that of cane cutters ranged between 50,544 rials and 72,072 rials in 1968.

Taking into account a family size of 5, the per capita income of the family of an agricultural workers is only 39 rials per day. The situation is even worse when the cane cutters cannot work during the working season owing to environmental problems such as rainfall and for other reasons (technical problems).

# TABLE 10-6

## HAFT-TAPPEH SUGAR CANE PROJECT

### Cane cutters wage distribution

Calculating equation: $P = T (T + 21)$ From 1968 to 72
" " $P = T (T + 26)$ since 1973

P = wage in rials T = The cut cane tonnes/worker/per day

| | Cane Cut | Wage (rial/tonne) | Total Daily Wage (rial) |
|---|---|---|---|
| | 3 | | 60 |
| | 4 | 25 | 100 |
| | 5 | 26 | 130 |
| 1968-72 | 6 | 27 | 162 |
| | 7 | 28 | 196 |
| | 8 | 29 | 232 |
| | 9 | 30 | 270 |
| | 10 | 31 | 310 |
| | 3 | | 88 |
| | 4 | 30 | 120 |
| | 5 | 31 | 155 |
| 1973 | 6 | 32 | 192 |
| and | 7 | 33 | 231 |
| there- | 8 | 33 | 246 |
| after | 9 | 33 | 297 |
| | 10 | 33 | 330 |
| | 11 | 33 | 363 |
| | 12 | 33 | 396 |

Notes:

a) The minimum wage rate is 88 rials for three tonnes of the cane cut.

b) The wage rate per tonne is constant for 7 tonnes of the cane cut and over.

In these circumstances the wage is restricted to 88 rials per day. Therefore it is not surprising that the Haft-Tappeh Sugar Cane workers have almost always been ready to strike[28]. The relevant authorities claim that the Haft-Tappeh workers benefit from the profit generated by the project. It is claimed that during 1965 and 1971 a total of 37,723,000 rials were distributed among 11,576 workers of the Haft-Tappeh project in addition to their wages[29]. However this is negligible since the average annual earning from this source is merely 465.5 rials per worker (176 rials = £1 in 1971). Haft-Tappeh workers come from Ahwaz, Dezful, Andimeshk and Shush. They have to travel over a distance of 120 kms every day. No transportation facilities are available.

To illustrate the workers' problems of the Haft-Tappeh Project a section of the statement made by the workers' union representative on June 11, 1975, when the Prime Minister of Iran, Amir Abbas Hoveida, visited the Haft-Tappeh area, is quoted[30]:

a) "Five thousand of the Haft-Tappeh Sugar Cane Project workers are homeless and 'in serious trouble'".

b) "40,000 of the working class of Haft-Tappeh are suffering from the shortage of medical services. The only clinic in the Haft-Tappeh area, which is under-staffed, is absolutely inadequate".

c) "The workers are exploited. The wages are very low and the wage payment chart needs urgent revision".

d) "The Haft-Tappeh workers lose their lives frequently because they have to make a trip over a distance of 120 kilometres every day. The project's authorities

> deny the supply of transportation facilities. Up to now 404 houses of the Project are or have been allocated to single and married staff and a further 629 to single workers. Two nursery, three primary and one secondary schools are supplied to children of the staff only."

However, since the Haft-Tappeh agro-industrial project has been successful in both production and employment creation, it is considered as an efficient model for the development of large scale irrigated agriculture especially of sugar cane.

It is estimated that by 1982 the area under cultivation of sugar cane in Khuzestan will be increased to 27,000 ha and to 70,000 ha by 1992. Sugar cane production will increase to 3,040,000 and 8,400,000 tonnes respectively. The sugar production of these areas will increase to 303,000 and 786,000 tonnes respectively.[31] These objectives are to be realised after the completion of the Reza Shah Kabir dam on the Karoon river of Khuzestan and its associated irrigation project. This initially begins on some 38,000 ha of land located in Shushtar district.[32]

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# CHAPTER 11

## AGRO-BUSINESS ENTERPRISES OF THE DIP

### 11-1 History

On the definition of Agro-business enterprise Butz quoted that:

> Modern agriculture is much broader than the narrow dictionary definition. (The art and science of cultivating the ground) It is the whole business of supply of food and fibre to a growing population and food demand. It is the art and science of cultivating the ground, but this is only one link in the long chain of feeding and clothing population. The chain begins many steps before we reach the farm and continues several processes after the mere production of food and fibre. For this whole complex of agricultural production and distribution functions, some persons use the term "agro-business".[1]

Such a business began in Iran in 1959, when the land for sugar cane plantation at Haft-Tappeh was bought from Sheikh Khalaph, who was one of the biggest landlords of the DIP.

At that time the government was not faced with the problem of numbers of displaced farmers, as happened later in 1969.

The second step for the development of agro-business units has taken place since 1969. Plans were initiated on an area covering 70,130 ha of the DIP lands, of which 12,500 ha are located in the DPIP.[2]

The schedule of the development plan for the DIP was supported by the Plan Organisation, the Ministry of Water and Power and the Act of the establishment of Agro-industrial enterprises on irrigable lands. This was passed by the Majlis (Parliament) in 1347.6.30 (1968).

For the implementation of the agro-industrial Act, the land below the Pahlavi Dam had to be bought from the farmers by the Ministry of Water and Power and KWPA.[3] A committee consisting of five members (delegates from the Ministry of Water and Power, the Ministry of Land Reform and Rural Co-operatives, the Managing Director of the Plan and budget organisation, the High Court of the Ministry of Justice and the General Director of the land regislation bureau) was set up to organise the purchase of the land and to survey the farmers' properties. The Committee had the right to prepare the documents and to evaluate the land and farms according to the number of farmers' holdings, without informing the farmer.[4] In this case the farmer had no option about selling the land to KWPA. Since the majority of the farmers are illiterate they were not able to appeal for revision of the committee's decision.

By the end of 1977 the whole area of 68,000 ha of the DIP will be purchased and delivered to agro-business companies. The first purchase was made in 1348 (1969). The establishment of the companies began on 16th May 1969 and by Autumn 1974 five companies were established.

The most important objectives for the establishment of the companies, quoted by KWPA, are:-

a) To achieve the maximum efficiency of water use, irrigation facilities and the lands of the DIP.

b) To introduce large scale farming based on commercial principles.

c) To develop mechanised farming and livestock produce for food and fibre processing.

d) To increase yields and reduce costs of agricultural production.

e) To train Iranians and increase their contributions to the development of the nation.

f) To introduce the grading, packing and processing of agricultural and livestock produce and to establish standards for products which are to be marketed.[5]

The significant points which called for the emergency introduction of the new policy were:

a) The small and scattered nature of the productive units.

b) The shortage of capital in the agricultural sector.

c) The illiteracy and low levels of technical know-how among the peasants.

d) The absence of a sound marketing system for the sale of agricultural and livestock products.

e) The misuse and inefficient use of water resources.[6]

The objectives of the agro-business companies, which were put forward in their feasibility reports as well as in the reports to the Agricultural Development Fund of Iran (ADFI) are economically sound and socially hopeful. The benefits derived from the projects would be:

a) Regional Contribution to modern commercial agriculture and related industries.

b) Relative reduction in the imports of vegetable oil and meat, and a contribution to the export of produce to the Persian Gulf area and Europe.

c) Increasing job opportunities, the standard of living in and around the project areas and

d) Training indigenous people to be capable of operating modern mechanised farms and machinery.[7]

## 11-2 Land assignment of the DIP - 1970-71 and 1975-76

In 1970 it was planned that out of 57,000 ha of the land of the DIP, 40,000 ha would be assigned to agro-business corporations and the remaining 17,000 ha to form a farm corporation for the Dez farmers.[8] One year later over 67,288 ha was allocated to five agro-business companies (Table 11-1 shows the land utilisation situation of the DIP in 1971).

Field quoted a figure of 51,000 of the DIP as lands allocated to five agro-business corporations and a further 17,000 ha for the farm corporation of the Dez farmers (Table 11-2) in 1972.[9]

TABLE 11-1

Summary of the DIP land areas 1971 (ha)

| | Gross | Net |
|---|---|---|
| H.N. Agro-industries of Iran and America | 20,213 | 18,192 |
| Iran-California (Transworld) | 10,536 | 9,689 |
| Dez Kar (Gang-i-Zar) | 5,351 | 4,816 |
| Ahwaz Sugar Refinery | 10,130 | 9,127 |
| Shell and Mitchell Co. | 16,058 | 14,452 |
| Claussen and Co. | 5,000 | 4,500 |
| Sugar Cane Project | | |
| Field and trial farm | 200 | 180 |
| Traditional farming | 18,266 | 16,439 |
| Ghaleh Ghazi area | | 56 |
| Housing area | | 780 |
| Total | 85,754* | 89,031 |

* S.C. project, Ghaleh Ghazi and housing area are not included.

Source: MWP KWPA 1971. long-term operation and capabilities of Mohammad Reza Shah Pahlavi dam and reservoir on the Dez river in Khuzestan, Resource investigation project, Ahwaz, Table IV-A.

TABLE 11-2

Land allocation to agro-businesses and Farm corporations of the DIP in 1972 (ha)

| Name of User | Allocated Area |
|---|---|
| H.N. Agro-Industries of Iran and America | 20,000 |
| Iran-California Co. | 10,000 |
| Dez Kar Co. | 5,000 |
| Iran-Shellcott Co. | 15,000 |
| Ahwaz Sugar Refinery | 1,000 |
| Dez Farmers' Corporation | 17,000 |
| Total | 68,000 |

Source: Field, M. 1972.

In late 1972, Mobasheri and Shamlia quoted a figure of 68,217 ha of the DIP area which was allotted to six agro-business companies.[10] (Table 11-3)

TABLE 11-3

Land allocation to agro-business corporations of the DIP in late 1972 (ha)

| Name of Corporation | Allocated Area |
|---|---|
| Iran-America | 20,255 |
| Iran-California | 10,536 |
| Iran-Shellcott | 15,736 |
| Ahwaz Sugar Refinery | 10,130 |
| Dez Kar | 5,000 |
| Hawaiian Agronomics | 6,560 |
| Total | 68,217 |

By 1974 Dez Kar Company went bankrupt and its allocated land was expropriated by the state and become available for another agro-business company. The Ahwaz sugar refinery and the Hawaiian Agronomics Company joined together to constitute a single company under the title of International Agro-Business Corporation of Iran (IACI). (Table 11-4) At this time 67% of the DIP area was allocated to agro-business enterprises, 12.4% to Farm Corporations, 13.3% to the Haft-Tappeh Sugar Cane Project, 0.7% to KWPA headquarters and Trial farms and only 6.3% to traditional farming.[11] (Table 11-5)

TABLE 11-4

Land allocation to agro-business corporations of the DIP in 1974 (ha)

| Name of Company | Allocated Area |
|---|---|
| Iran-America | 20,267 |
| Iran-California | 10,539 |
| Iran-Shellcott | 14,736 |
| IACI | 16,680 |
| Total | 62,222 |
| Land available for agro-business | 5,772 |
| Sub-Total | 67,994 |

TABLE 11-5

Land use of the DIP in 1974 (ha)

| Name of user | Gross Area | % of the total area |
|---|---|---|
| Agro businesses | 68,000 | 67 |
| Farm Corporations | 12,951 | 12.4 |
| Traditional Farming | 6,450 | 6.3 |
| Haft-Tappeh Sugar Cane Project | 13,800 | 13.3 |
| KWPA headquarters and housing | 780 | 0.7 |
| Safiabad Trial Farms | 320 | 0.3 |
| Total | 101,427 | 100.0 |

By 1975/76 land use of the DIP area remained almost the same as in 1974 in terms of land allocation to agro-business companies. The number of companies increased to five with a total area of 67,550.9 ha. (Table 11-6) The traditional farming area which was 6.3% of the DIP was reduced to 5.27% and the area of the Haft-Tappeh Sugar Cane Project increased to 15.29% (Table 11-7) and ( Fig. 11-1)

TABLE 11-6

Land allocation to agro-business corporations of the DIP in 1975/76 (ha)

| Name of Company | Allocated Area |
|---|---|
| Iran-America | 20,263.2 |
| Iran-California | 10,796.7 |
| Iran-Shellcott | 15,796 |
| IACI | 16,690 |
| Galleh | 4,010 |
| Total | 67,550.9 |

Source: KWPA, DIP. Department of Agro-businesses and resettlement. Performance of the Department of Agro-business and resettlement by March 1975. P.14.

Ehlers commented that "11,620 ha or 14% of the DIP area is allocated to traditional farming, of which only 1,390 ha is located in the area of the second phase of the DIP. This is only 5% of the second phase of the DIP development area. In all, 70,130 ha or 85% of the DIP area is allocated to DIP agro-business enterprises. 27,350 ha out of 28,740 ha of the second phase of the DIP is allocated to agro-business corporations. This constituted 95% of the second phase of the DIP area".[12]

These comments seem to have been made based on recommended plans made by DRC of New York in 1971,[13] whereas Table 11-7 shows the actual situation by 1975/76.

TABLE 11-7

Land use of the DIP in 1975/76 (ha)

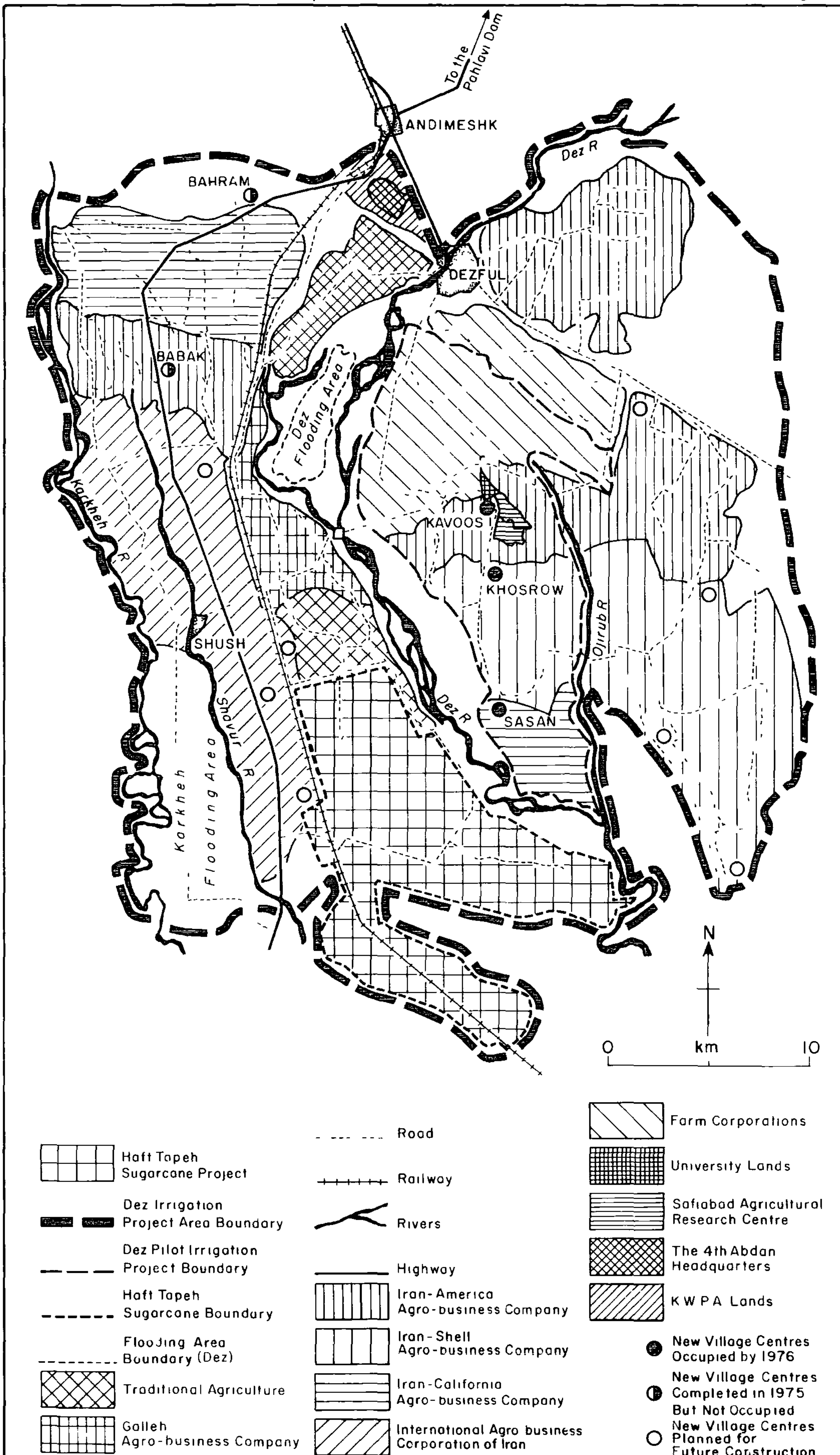
| Name of user | Gross Area | % of the total area |
|---|---|---|
| Agro business companies | 68,000 | 65.8 |
| Farm Corporations | 12,951 | 12.5 |
| Traditional agriculture | 5,450 | 5.27 |
| Haft-Tappeh Sugar Cane Project | 15,800 | 15.29 |
| KWPA headquarters and housing area | 780 | 0.75 |
| Safiabad Trial Farms | 326.5 | 0.3 |
| Total | 103,307.5 | |

Source KWPA, DIP. Department of Agro-businesses and resettlement. Performance of the Department of Agro-business and resettlement by March 1975. P. 14.

## 11-3 Transferring land to the Companies

KWPA has not been able to transfer lands to companies immediately after agreements made with them. This is because the conditions of the irrigation and drainage networks of the DIP have developed gradually with delays owing to one reason or another. Land transfer began in 1969. 5,778 ha of the DPIP which had already been developed was transferred to the H.N. Agro Industry of Iran and America. Two years later, in 1971, 11,7[illegible] ha had been transferred to companies of which 9,036 ha is located in the Pilot area. By 1974 the total area transferred

DEZ IRRIGATION PROJECT, LAND ASSIGNMENT 1976 Fig III 1



had increased to 26,626 ha and by 1976 it had reached almost twice that of 1974 (i.e. 53,992.2) (Table 11-8). 12,445 ha out of the total land transferred is located in the Pilot area and belongs to three companies.

## 11-4 Lease Agreement

It was agreed between the Ministry of Water and Power and the agro-business corporations that the construction of canals and headgates to bring water to the farming units of 100 ha should be the responsibility of KWPA.

In order to meet the peak water requirements of modern intensive agricultural production, the capacity of the canal was decided to be 2 lit/sec per hectare for the agro-business enterprises and 4 lit/sec per hectare for the Haft-Tappeh Sugar Cane Project.

Based on the intensive annual land use and much improved irrigation water efficiencies, the peak summer demand is estimated at 218 $m^3$/sec occurring in late July in the DIP area (Appendix D).

Large areas of land will be allotted to the cultivation of alfalfa, sugar beet, cotton, sunflowers and vegetables with the objective of gaining quick returns from the investment.

The water rate is 0.2 rials/$m^3$. The water rate will be revised by KWPA and the Ministry of Water and Power once in every five years. Companies are paying the water rate and land rental charge to KWPA in six monthly bills.

Companies have to pay 1,500 rials/ha as a land rental charge for lands of Class I and 1,200 rials/ha for Class II.[14] The criteria for the determination of the land rental charge is based on the gross value of the agricultural products. For the first three years no minimum limits for the gross value of

TABLE 11-8

DIP

The land assigned and transferred to Agro-business enterprises
1969 to 76

| Agro-business companies | Date of commencement | Assigned lands | TRANSFERRED LANDS 1969 (a) | 1970 (a) | 1971 (a) | 1974 (b) | 1975 (c) | 1976 (d) | DPIP Agro-business lands (e) |
|---|---|---|---|---|---|---|---|---|---|
| Iran-America | 1969 | 20,293.2 | 3,778 | 800 | 4,780 | 14,363.2 | 14,363.2 | 14,363 | 3,778 |
| Iran-California | 1970 | 10,796.7 | - | 3,066 | 2,201 | 4,316 | 10,796 | 10,796 | 3,291 |
| Iran-Shellcott | 1970 | 15,796 | - | - | 2,055 | 5,267 | 8,133 | 8,133 | 5,376 |
| International Agro-business Corporation of Iran. | 1972 | 16,690 | - | - | 2,680 | 2,680 | 9,076 | 16,690 | |
| Galleh | 1974 | 4,010 | - | - | | - | 1,916 | 4,010 | |
| Total | | 67,585.9 | 3,778 | 3,866 | 11,716 | 26,626 | 44,284.2 | 53,992.2 | 12,445 |

Sources:

a) KWPA 1972. "A brief information on Khuzestan" in Tahqiqat-i-Eqtesadi Nos. 29430 P.105

b) Jamaly, v. 1974 P.51

c) Faterifar 1975. Officer of the Department of Agro-industry and resettlement of the DIP. KWPA. Personal communication 1975.

d) KWPA , 1976. PP II

e) Gerami. Department of Agro-industry. Ministry of Water and Power, Tehran, Iran. Personal communication, February 1975.

products is set. In the two successive years a limit of 37,500 rials/ha and in the five successive years a gross value of products of 60,000 rials is expected.[15] Therefore 2 to 2.5% of the gross value of the products ranging from 1,200 rials/ha to 1,500 rials/ha is the rental charge.

The enterprise must invest a capital of $1,000 (80,000 rials) per hectare of land and attempt to increase the gross production of land.

The agreement will expire 30 years after the date when all sub-areas come into the possession of the enterprise. Also the enterprise has to develop 2,000 ha of land per year which includes land levelling, the installation of farm irrigation facilities and internal farm roads.

To maintain the labour force in the area, it is decided that 5,317 landholder peasants and 3,064 landless peasants of the DIP area will be resettled in 13 new village centres, (Fig. 11-1) which are to be built by KWPA. The companies have to employ 6,800 peasants of the DIP area on the basis of ten hectares per agricultural labourer.[16]

## 11-5 Capitalization and share distribution of the DIP agro-business enterprises

It is estimated that a total $68 million (5 billion rials) is needed for the development of the 68,000 ha of agro-business lands in the DIP area. This money has been raised from share holders as well as from foreign and domestic loans. By late 1975 1.5 billion rials were funded by corporations and a further 1 billion rials were invested through long-term loans.[17]

So far there are five agro-business companies involved in the DIP. The first company, Iran-America was established in

1969 for developing 3,778 ha of land around the Safiabad Trial Farms into a commercial agricultural operation in a developing programme of Hashem Naraghy Agro-Industry of America (H.N.A.I.A.). The major investor in this company was Mr. Hashem Naraghi (HN) who is a successful operator of an almond plantation in the Central Valley of California. The agreement between H.N. and the Ministry of Water and Power was signed on the 5th May 1969, and led to the formation of the Agro-industry of Iran and America. It was registered in Iran under the number 13,594 on 16th May, 1969.[18] The total land leased to the Company was 20,000 ha under a 30 years lease agreement. The total subscribed capital of the company was 114,375 shares of 1,000 rials each. The shareholders and the percentage distribution of shares were as follows:

| | Share Holders | % of share distribution |
|---|---|---|
| 1. | H.N. Development Co. | 51 |
| 2. | First National City Bank | 30 |
| 3. | Iranian Bank | 10 |
| 4. | Mr. Lester Heringer | 3 |
| 5. | Dr. Nosratolah Heravi | 3 |
| 6. | Mr. Hassan Alavi Kia | 2 |
| 7. | Mr. John Amas | 1 |
| | | 100 |

Source: Agricultural Development Fund of Iran. H.N. Iran and America Company Agro-industrial project, Project Dept., Project No. 49 December 1970. P2.

Mr. H.N., apart from being a major shareholder of the HNAIA, had been engaged in irrigated farming, poultry operation and associated agricultural industries such as feed mill processing using a dehydration plant.

By 1974 the Company went bankrupt and his shares were expropriated by the State. Hence in 1975 the shareholders were:[19]

| | Shareholders | % of share distribution |
|---|---|---|
| 1) | ADF of Iran | 40 |
| 2) | Mr. Alavi Kia | 30 |
| 3) | Others (mainly Iranian) | 30 |
| | Total | 100 |

At this time the allocated area to the Company was 20,263 ha and the Company's capital had been increased to 272,000,000 rials[20] of which 120,000,000 rials were borrowed from the ADF of Iran.[21]

The second company is Iran-Shellcott which was registered in mid-January 1970 with the initial capitalization of about 60,000,000 rials. This will ultimately be increased to 800,000,000 rials[22] of which 131,000,000 rials were borrowed from the Agricultural Development Fund of Iran.[23]

In 1976 the ultimate capital investment undertaking of the Company was 400,000,000 rials. The shareholders of this Company are:

| Shareholders | % of share distribution |
|---|---|
| Shell | 70.5% |
| Mitchell Cotts | 4.5 |
| Agricultural Development Fund of Iran | 15 |
| The Bank Omran | 10 |
| Total | 100 |

Source: Richard H. 1975. Land reform and agri-business in Iran, in Middle East Research and Information Project No. 43: December 1975. P.14.

This Company has great experience in different agro-business enterprises in African countries e.g. Ethiopia and Kenya.

The third company, Iran-California, was established in 1971 with an initial capitalization of 95,300,000 rials.[24] In 1975/76 the share capital was increased to 312,000,000 rials[25] of which 90,000,000 rials were borrowed from the ADF of Iran.[26] The performance of this company was not satisfactory therefore by 1975 ADFI and KWPA bought more shares from the foreigners and became the major shareholders. (Table 11-9)

TABLE 11-9

Share distribution of the Iran-California Co. in 1974 and 1976

| | Shareholders | % of share distribution 1974 (a) | % of share distribution 1976 (b) |
|---|---|---|---|
| 1) | ADFI | 18.9 | 31.67 |
| 2) | KWPA | 6.3 | 17.54 |
| 3) | Mr. Khalil Taleghani and partners | 12.5 | 9.51 |
| 4) | Transworld Agricultural Development Corporation | 30.0 | 18.2 |
| 5) | Bamerical International Finance Corporation | 24.2 | 9.51 |
| 6) | John Deer and Company | 7.1 | 4.14 |
| 7) | Dow Chemical Corporation | 10.0 | 9 25 |
| | Total | 100 | 100 |

Source:
(a) Jamaly, V. 1974 p.54
(b) Toosi, Department of Agro-industry, Ministry of Water and Power, Tehran. Personal communication. February 1975.

The fourth company, the International Agro-business Corporation of Iran (IACI) was established in May 1972. The share capital of the company is 610,000,000 rials. Sixty per cent of the shares are owned by foreigners and the remaining 40% by Iranians. (Table 11-10)

TABLE 11-10

Share distribution of IACI in 1974 and 1976

| Shareholders | % of share distribution | |
|---|---|---|
| | 1974 (a) | 1976 (b & c) |
| ADFI | 15 | 15 |
| Ahwaz sugar beet mill and refinery Co. Ltd. | 15 | 15 |
| KWPA | 5 | |
| Iranian investors | 5 | 10 |
| Chase International Investment Corporation | 15 | 15 |
| Diamond and Cattle Company | 15 | 15 |
| Hawaiian Agronomics Co. (International) | 15 | 15 |
| Mitsui and Co. Ltd. | 15 | 15 |
| Total | 100 | 100 |

Source:

a) Jamaly, v. 1974 P54-56.

b) Fatemifar, KWPA. 1975. Personal Communication.

c) Monajer, Bureau of Agro industry, Ministry of Water and Power, Tehran, Personal communication.

The fifth corporation, Galieh, was established in October 1974. The share capital of the company was initially 400,000,000 rials,[27] but increased to 700,000,000 rials in 1976. The owner of the company is Princess Ashraf.[28]

Table 11-11 shows the ownership pattern of the Agro-businesses at the beginning of their establishment and in 1975/76 in terms of foreign and Iranian partnerships.

In 1971 the ownership contribution of Iran had been only 29.45% whereas it increased to 55.93% in 1976. These percentages are only concerned with four Agro-businesses. If the fifth company i.e. Galleh is taken into account, the ownership contribution of the Iranian shareholders rises to 64.64% compared with only 29.45% at the early stage of the establishment of the agro-businesses.

TABLE 11-11

Ownership pattern in Agro-businesses at the time of their establishment and in 1975/76

| Company | Equity participation 1970/71 | | 1975/76 | |
|---|---|---|---|---|
| | Foreign | Iranian | Foreign | Iranian |
| Iran-America | 85 | 15 | - | 100 |
| Iran-Shellcott | 75 | 25 | 75 | 25 |
| Iran-California | 62.3 | 37.7 | 41.28 | 58.72 |
| International agro-business of Iran | 60 | 40 | 60 | 40 |
| Total | 282.3 | 117.7 | 176.28 | 223.72 |
| Average | 55.93 | 29.45 | 44.07 | 55.93 |
| Galleh Co. | - | | - | 100 |
| Sub-total | | | 176.28 | 323.72 |
| Average | | | 35.36 | 64.64 |

Source: Table was made based on the preceding data.

As far as the country of origin of foreign investors is con-concerned, as table 11-12 shows, the U.S. invested most with 48.1% and Japan the least with 3.75% while the U.K. held 18.75% of the total investment in 1971/72. The situation had been absolutely changed for the U.S. by 1975/76. The U.S. stood on a level with the U.K. since part of its share was replaced by Iran.

TABLE 11-12

Distribution of foreign equity participation in the Agro-businesses by country of origin

| Country | Percentage of Distribution 1970/71 | 1975/76 |
|---|---|---|
| U.S. | 48.1 | 19.67 |
| U.K. | 18.75 | 19.21 |
| Japan | 3.75 | 3.84 |
| Sub-total | 60.60 | 42.72 |
| Iran | 29.4 | 57.28 |
| Total | 100.00 | 100.00 |

Source: Table was made based on the preceding data.

Not all of the foreign companies which hold equity shares in agro-businesses have their main interests in agriculture. Shell International, for example, has its main interests in oil and chemicals and has little experience in farming business.[29] Some establishments e.g. Banks and financial corporations such as the First National City Bank and Chase International Investment Corporation do not have any previous experience in agriculture. They are mainly involved in financial transactions. Some other investors, such as John Deere, are related to agriculture, but only with regard to the production of agricultural machinery. Only four out of eleven foreign companies which hold interests in agro-businesses are directly involved in agriculture and, with one exception, are not holding substantial shares in the agro-businesses. These four companies are: Trans-world Agricultural Corporation with an 18.2% holding in Iran-California agro-business, Hawaiian Agronomics Co. with 15% of the shares in the International Agro-business Corporation of Iran and Mitchell Cotts with 4.5% interest in Iran Shellcott. The exception to the rule is the H.N. Agricultural Development Corporation with a holding in the Iran-America Agro-business.

11-6 Economic appraisal of the DIP Agro-business Corporations

In 1968 KWPA requested DRC to proceed with ten studies on the production, processing and marketing of alfalfa, fresh vegetables, grapes, oil seeds, onions and garlic, dairy produce, mixed farming produce (alfalfa, cotton, wheat), tomatoes, citrus fruit, grain and forage sorghum.[30] Between 1969 and 1971 ten reports were submitted in which the potentials of Iran's food and fibre demands as well as those of the Persian Gulf states and the eastern and western European Countries, were investigated. The potential of the DIP area for the production of different crops was also studied.

Based on these studies every agro-business company with the co-operation of KWPA and the Ministry of Water and Power prepared a feasibility report. In these reports the projects of the companies were technically and economically investigated and their farming programmes planned. When the reports were accepted by the Ministry of Water and Power and the agreement signed the Company had to carry out the plans presented covering land development, the area under cultivation, cropping patterns, crop yields, water charges and land rental fees. In the opinion of some officials who are involved with these companies, the evaluation of performance of the agro-business is illegal, because they are of a private nature. However, an evaluation of the performance of the companies is imperative because:

a) The development of agriculture in Iran is of vital importance given the high growth rate of the population and the rise in living standards

b) Iran's self-sufficiency in food is vital to national independence.

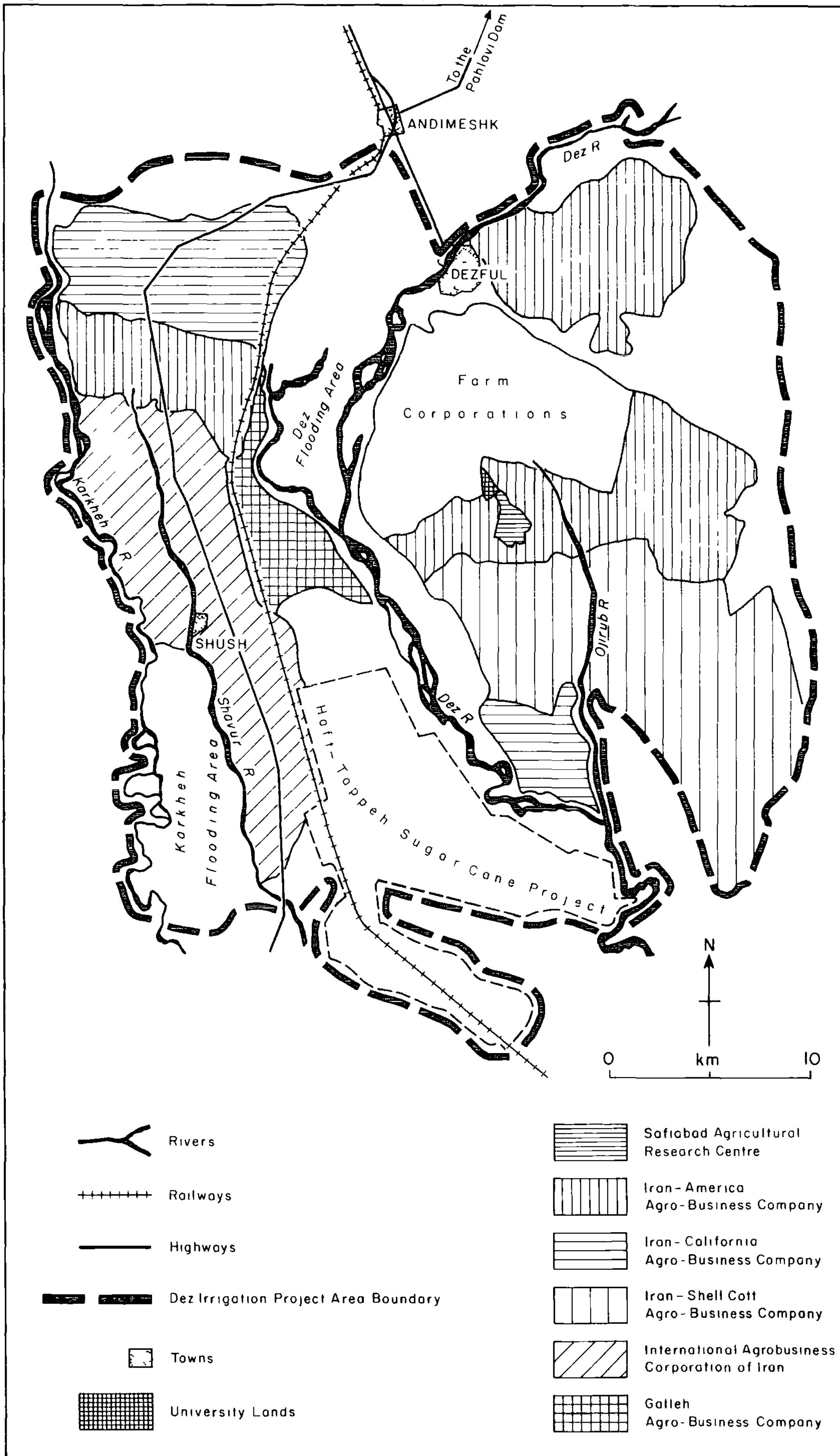
c) Great emphasis was given to the development of large scale capital intensive farming in the planned programme of 20 years food supply for Iran in December 1975.[31]

11-6-a <u>Iran-America Agro-business Company</u> (Fig. 11-2)

<u>Land development</u>

The H.N. Agro-industry of America began its activities in December 1970. Out of 20,293.2 ha which were allocated to it, 3,778 ha were transferred to the company in 1969. By 1974 the transferred land was increased to 14,363.2 ha. In two successive years (1974-76) no land was transferred to the company. (Table 11-13) It is estimated that based on a 30 year land lease and a 25 year period for capital return, each company will attempt to level the land in 5 to 7 years from the beginning of its activity. For Iran-America, which has a net area of 18,416 ha, 11,200 ha had been scheduled for levelling by 1975.[32] The levelled land did not exceed 3,666 ha. (Table 11-13) At the beginning of the creation of these new institutions Iranian officials and private investors were too optimistic about land development costs. It was estimated that an investment of 20,000 rials per hectare would be adequate for land levelling and on-field irrigation, drainage and road building.[33] Soon it was realised that the cost would be almost 4 times that which had been anticipated. The Iran-America Company

Fig II 2 DEZ IRRIGATION PROJECT, AGRO-BUSINESS COMPANIES 1976



should have financed an extra land development cost of 1.08 billion rials. Since the company could not afford more investment, it was far behind its scheduled land levelling programme by 1975.

TABLE 11-13

Land development of the Iran-America Agro-business Co. Planned and Actual (ha.)

| | Transferred land | Land development | |
|---|---|---|---|
| | | Planned | Actual |
| 1969 | a 3,778 | c 800 | - |
| 1970 | a 4,578 | c 3,400 | d 1,100 |
| 1971 | a 9,358 | c 8,700 | d 1,100 |
| 1972 | a 14,303 | c 10,260 | e 1,850 |
| 1973 | b 14,363.2 | c 11,000 | f 2,600 |
| 1974 | b 14,363.2 | c 11,200 | g 3,666 |
| 1975 | b 14,363.2 | | h 3,666 |
| 1976 | | | i 4,366 |

Source:

a) KWPA 1972. "A brief information on Khuzestan" in Tahqiqat-i-Eqtesadi. No. 29&30 Spring & Summer 1972. P. 105.

b) KWPA. Department of Agro-industry and resettlement 1976. PP10.

c) MWP KWPA 1971. Resource Investigation Project, Plate 7.

d) MWP KWPA 1971. Annual report of KWPA in 1970, P. 28.

e) MWP KWPA 1972. Annual report of KWPA in 1971, P. 30.

f) Agricultural Development Fund of Iran. H.N.I.A. Co. Agricultural report, 30, 3, 1352. P1.

g) MWP KWPA DIP Monthly report of March 1975, P 20.

h) Fatemifar, Dept. of Agro-industry (DIP) KWPA 1975. Personal communication.

i) KWPA. Dept. of Agro-industry, 1976 PP13.

Area under cultivation

The Iran-America Corporation began production on an area of 320 ha in 1970. After three years the area under cultivation was increased to 7,091.5 ha of which only half was mechanised. Since 1973 the area under cultivation has declined. In 1973 out of 14,363.2 ha of transferred land only 1,311 ha were cultivated with summer crops and 4,168 ha with winter crops. It was expected that by 1975/76 a total 17,150 ha would be cultivated whereas in practice it did not exceed 5,920 ha.(Table 11-14)

TABLE 11-14

The H.N. Agro-industries of Iran and America
Area under cultivation
1970-76

| | Year | Area under cultivation (ha) Summer crops | Winter crops | Total Area |
|---|---|---|---|---|
| (a) | 1970 | - | 320 | 320 |
| (a) | 1971 | 1411.5 | 4797 | 6208.5 |
| (a) | 1972 | 1346 | 5745.5 | 7091.5 |
| (b) | 1973 | 1311 | 4164 | 5479 |
| | 1974 | (d) 1879 | (c) 5116 | 6995 |
| (d) | 1975 | 1411 | 4519 | 5920 |
| (d) | 1976 | | 4619 | |

Source:-

a) Ehlers 1975 p.188.

b) KWPA Dept. of Agro-industry, Talebzadeh. Personal communication, April 1975.

c) KWPA. DIP Montaly report of March, 1975. P.19.

d) KWPA. DIP Dept. of Agro-industry, 1976. PP11.

Cropping pattern and crop yields

Wheat, cotton, oil seeds, alfalfa, vegetables and fruits were planned to be the major crops of H.N.A.I.A. The most important objective of this cropping pattern was to obtain the highest return per hectare of land. It was expected that after five or six years, when the full development of the land was achieved and a special cropping pattern had been applied (Table 11-15) a gross value of products of 78,840.2 rials/ha would be realised.[34] (at the price of 1969) Asparagus, sorghum, maize and alfalfa were the new crops of 1971/72. In addition to these, cotton and sugar beet have been cultivated since 1972/73. (Table 11-16) Oil seeds such as sunflower, sesame and soya beans have not been cultivated, but citrus fruits and stone fruits have been planted since 1971.

The yields of crops have been below those which had been planned for. The maximum yield of the irrigated wheat was 3.5 tonnes/ha and that of dry farmed wheat only 1 tonne/ha in 1974. The planned objective for the irrigated wheat was 4 tonnes/ha whereas that of the safiabad standard was 5 tonnes/ha

The planned goal for the sugar beet yield was almost realised in 1974. The sugar beet yield was 49 tonnes/ha against a target of 50 tonnes/ha but still it was below that of the safiabad standard of 70 tonnes/ha.

The maximum alfalfa yield was 15 tonnes/ha compared with the target of the company of 18 tonnes/ha. The cotton yield was 2 tonnes/ha against the planned goal of 3.5 tonnes/ha and the safiabad standard of 7 tonnes/ha. (Table 11-16)

# TABLE 11-15

## H.N. Agro-industries of Iran and America

### The projected yearly area under crops

| Crop | Area under cultivation (ha) |
|---|---|
| Sugar-beet (W) | 610 |
| Sesame | 1,010 |
| Wheat | 1,410 |
| Corn | 530 |
| Sorghum (F) | 1,360 |
| Blackeye beans | 150 |
| Vegetables (S & W) | 700 |
| Asparagus | 1,000 |
| Alfalfa | 2,520 |
| Citrus | 1,200 |
| Fruit | 500 |
| Sunflower | 2,040 |
| Sorghum (Spring) | 380 |
| Cotton | 1,380 |
| Soyabeans | 760 |
| Strawberries | 100 |
| Grapes | 1,500 |
| Total | 17,150 |

Source: MWPKWPA. Resource Investigation Project 1971

Table V - D

TABLE 11-16

**Area under Cultivation - Cropping Patterns and Crop Yield of the H.N. Agro-industries of Iran and America**

Planned and Actual

Area ha   Yield tonnes/ha

| Crops | 1971 Planned Area | 1971 Actual Area | 1971 Planned Yield | 1971 Actual Yield | 1972 Planned Area | 1972 Actual Area | 1972 Planned Yield | 1972 Actual Yield | 1973 Planned Area | 1973 Actual Area | 1973 Planned Yield | 1973 Actual Yield | 1974 Planned Area | 1974 Actual Area | 1974 Planned Yield | 1974 Actual Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (a) | | | | (a) | | | | (b) | (c) | (b) | | (b) | (c) | (b) |
| Sugar Beet | | | | | | 337 | | | | 300 | 45 | 16 | | 450 | 50 | 49 |
| Asparagus | | 270 | | | | 278 | | | | 131 | 6 | 6 | | 131 | 6 | 6 |
| " (nursery) | | 16 | | | | | | | | | | | | | | |
| Sorghum | | 500 | | | | 10 | | | | 470 | 5 | 2.5 | | 290 | 5 | 2 |
| Maize | | 31 | | | | 160 | | | | 10 | | 1 | | | | |
| Tomato | | 17 | | | | | | | | | | | | | | |
| Cucumber | | 15 | | | | | | | | | | | | | | |
| Aubergine | | 5 | | | | | | | | | | | | | | |
| Pepper | | 46.5 | | | | | | | | | | | | | | |
| Fruit/vegetables | | 604 | | | | 346.5 | | | | 438 | | | | 578 | | |
| Alfalfa | | 30 | | | | 1106 | | | | 550 | 17 | 13 | | 550 | 18 | 15 |
| Sudan grass | | | | | | 44 | | | | | | | | | | |
| Wheat (irrigated) | | | | | | 1950 | | | | 1300 | 3.5 | 2.5 | | 186 | 4 | 3.5 |
| " (non-irrigated) | | | | | | 2600 | | | | 1700 | | 0.7 | | 4000 | | 1 |
| Clover | | | | | | 23 | | | | | | | | | | |
| Onion | | | | | | | | | | | | | | | | |
| Cotton | | | | | | 140 | | | | 450 | 3 | 1.2 | | 750 | 3.5 | 2 |
| Beans | | | | | | 115 | | | | | | | | | | |
| Barley | | | | | | 112 | | | | 80 | | | | 60 | | 0.7 |

(a) Ehlers, 1975. P.189.

(b) Table is constructed based on data obtained from Talebzadeh, K.W.P.A., DIP Department of Agro-industry & Resettlement 1975.

(c) Agricultural Development Fund of Iran. Hashem Naraghi Iran-America Co. Agro-industrial project. Project Department, Project No. 49. Annex 6.

Economic prospects of the H.N. Agro-industrial Company

The low gross value of field crops was the outcome of the low crop yields. In 1974 after five years of operation the gross value of products did not exceed 43,582.6 rials/ha (Table 11-17), whereas it was expected to be 78,840.2 rials per hectare.

Based on six years of full land development and an ultimate area under cultivation of 17,500 ha per year, with concentration on cotton, alfalfa, oil seed, wheat, vegetable and fruit cultivation, a 20 per cent capital return had been expected. The realisation of this target was remote. In the first year of the project's operation the expenditure of Iran-America was approximately 94.5 million rials which was 38% of the total share capital of 234.4 million rials.[35] This was the amount which was used for the development of merely 5.5% of its allocated lands. In 1975 when the Company went bankrupt, 16,389 ha of land was still unlevelled. The properties of the Company were expropriated by the state. Still a further investment of 1,311 million rials for the full development to be made.

11-6-b The Iran-California Agro-Business Company (I.C.C.) (Fig. 11-2)

The development of the ICC began in 1965 with the formation of the Transworld Agricultural Development Corporation by fifteen Californian farmers. An intensive study of the DIP area began in 1968 and by February 1969 a feasibility report had been submitted. The Company was registered in March 1970. The project was planned over a five year period to level, develop and introduce

## TABLE 11-17

### H.N. Agro-Industries of Iran and America

### Annual gross value of production 1974

| Crop | Area under cultivation (ha) | Yield tonnes/ha | Total Production Tonnes | Price rial/tonne | Gross Value (rials) |
|---|---|---|---|---|---|
| Wheat (irrigated) | 186 | 3.5 | 651 | a 12,000 | 7,812,000 |
| Wheat (not irrigated) | 4,000 | 1 | 4,000 | a 12,000 | 48,000,000 |
| Sugar beet | 450 | 49 | 22,050 | a 2,300 | 50,715,000 |
| Alfalfa | 550 | 15 | 82,050 | b 3,652 | 30,129,000 |
| Cotton | 750 | 2 | 1,500 | a 30,000 | 45,000,000 |
| Sorghum | 290 | 2 | 580 | b 5,500 | 3,190,000 |
| Asparagus | 1,312 | 6 | 786 | c grade 1 (160+<br>" 2 ( 30<br>" 3 ( 20 | 94,320,000 |
| Barley | 60 | 0.7 | 42 | 12,000 | 504,000 |
| Total | 6417 | | | | 279,670,000 |

Gross value per hectare: 43,582. + 70% of asparagus products was regarded as grade 1, 20% as grade 2 and 10% as grade 3.

Source of prices: a) Shellcott Presentation December 1974 Chart 8 (wheat, sugarbeet and cotton)

b) Shellcott Managing Agents report. Report for quarter ended 31st March 1973, Schedule F (Alfalfa - Sorghum)

c) ADFI H.N. Agro-industrial Project. Project Dept. Project No. 49 December 1971. Annex 11 (Price of asparagus is based on 1971 Prices) modern methods of farming on 10,796.7 ha at a rate of development of 2,000 ha per year.[36]

After six years, i.e. in 1976, the Company had developed only 4,624 ha (Table 11-18) whereas the total assigned area had been transferred in 1975. According to the revised plan of the Company it was expected that full development of the land would be realised in 1976. This has not been achieved either.

TABLE 11-18

ICC

Land Development
Planned and Actual
(ha)

| Year | Transferred land | Land Development | |
|---|---|---|---|
| | | Planned | Actual |
| 1970 | a 3066 | | |
| 1971 | a 5267 | e 2,000 | f 1450 |
| 1972 | a 5267 | e 4,000 | g 2672.17 |
| 1973 | b 7380.35 | e 6,000 | h 3200 |
| 1974 | c 9493.7 | e 8,000 | i 4303 |
| 1975 | d 10796.7 | e 9,500 | j 4545 |
| 1976 | | | k 4624 |

Source:

a) KWPA. 1972 "A brief information on Khuzestan", in Tahqiqat-i-Eqtesadi. Nos. 29430 P.105.

b) Estimation.

c) Agricultural office of Khuzestan. The Geography of Khuzestan, 1975. P.115.

d) KWPA DIP. Dept. of Agro-industry, 1976. PP11.

e) A report on the problems of the Sherkate Iran California Sahami Khas, Iran-California Co.
H.V.A. International B.V. Bevenschot Bos Boom B.V.
I.L.A.C.O. R 6029/147. 1973 Table I-II.

f) MWP KWPA, 1971 Annual report of 1971 P.28

g) MWP KWPA, 1972 Annual report of 1972 P.30

h) I.C.C. 1973. P4

i) KWPA Dept. of Agro-industry, Personal communication with Mr. Fatemifar.

j) MWP KWPA DIP Monthly report of March 1975, P.22

k) KWPA DIP Dept. of Agro-industries & resettlement 1976. PP.11.

Area under Cultivation

When the ICC submitted its feasibility report it was planned that all the transferred area was to be cultivated by 1975. In practice the area under cultivation did not exceed 4,808 ha by 1974. (Table 11-19) In 1973, after three years of farming, the company changed its programme of cultivation. This meant that with a delay of five years the land would be completely under cultivation by 1980.[37] A figure of 6,958 ha is quoted by KWPA for the area under cultivation in 1975. (Table 11-19)

TABLE 11-19

ICC

Area under cultivation

| Year | Area under cultivation | | |
|---|---|---|---|
| | Summer crop | Winter crop | Total area |
| a 1971 | 320 | 2641 | 2961 |
| a 1972 | 579 | 2472 | 3051 |
| b 1973 | 648.45 | 3688 | 4336.45 |
| b 1974 | 201 | 4607 | 4808 |
| c 1975 | 1121 | 5837 | 6958 |

Source:

a) Ehlers 1975, P.189.

b) KWPA. Department of Agro-industries and resettlement Talebzadeh, Personal communication, April 1975.

c) KWPA. DTP. Department of Agro-industries and resettlement, 1976. P.5.

Cropping Pattern and Crop Yields

In the early years of activity, ICC planned to produce cotton on an area of 1500 ha, sugar beet on 2,000 ha, wheat on 2,500 ha, sorghum on 2,000 ha, alfalfa on 1,500 ha and winter vegetables on 500 ha.[38] This cropping pattern has been followed almost exactly since the beginning of the company's farming activities. (Table 11-20)

Since 1973 the Company has tended to change its cropping pattern to those crops that were traditionally cultivated i.e. wheat, beans, rice, sesame and vegetables because these crops adapt better and their yields are more certain.

The yields of wheat, sugar beet, alfalfa and cotton have been increased over three years of operation i.e. 1971 to 73, but still they were below those of the Safiabad standards and those planned by the Company. (Table 11-20) Only the yield of sugar beet which was 48 tonnes/ha was higher than the expected yield of 35 tonnes/ha in 1973. In 1973 the Company commented that its yields have been much lower than the standards of the Netherlands. The Netherlands standards for the past several years have been wheat 5.5 tonnes/ha, sugar beet up to 70 tonnes/ha and alfalfa 10 tonnes/ha (dry).[39]

The ICC economic prospects

So far the performance of the ICC has not been better than that of the Iran-America Company. Approximately half of the land is levelled and crop yields have been generally low. As a result the gross value of products which was expected to be 59,258 rials per hectare in 1975 [40] is not expected to reach this level even after ten years of cultivation. The company has predicted that a gross value of products of only 42,891.56 rials/ha will be achieved in 1980.[41] An accumulated loss of 243,531,000 rials is expected with an initial loss of 48,401,000 rials in 1973/74.[42] The accumulated funds of

TABLE 11-20

ICC

Area under cultivation, cropping patterns and crop yields

1971-74

| Crop | 1971 Area ha/ (1) | 1971 Planned Yield tonnes/ha | 1971 Actual Yield tonnes/ha (3) | 1972 Area ha/ (1) | 1972 Planned Yield tonnes/ha | 1972 Actual Yield tonnes/ha (3) | 1973 Area ha/ (3) | 1973 Planned Yield tonnes/ha (2) | 1973 Actual Yield tonnes/ha (3) | 1974 Area under cultivation (ha)(3) | 1974 Planned Yield tonnes/ha (2) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wheat (irrigated) | 1,900 | | 2.2 | 956.4 | | 2.38 | 2639 | 3.5 | 2.6 | 2,435 | 3.7 |
| Wheat (non-irrigated) | - | | - | - | | - | - | - | - | - | - |
| Sugar Beet | 500 | | 32 | 710.4 | | 34 | 667 | 35 | 48 | 1,500 | 38 |
| Alfalfa | 186 | | 4 | 175.9 | | 6 | 382 | 15 | 7 | 438 | 17 |
| Cotton | - | | 1.8 | 10 | | | 150 | | 2.5 | 156 | 3 |
| Sorghum | 86 | | 0.8 | - | | 0.3 | 124 | | 0.33 | 124 | 3 |
| Maize | 145 | | 0.7 | 81 | | 3.8 | 261 | | 2.2 | | |
| Sudan-grass | 45 | | | 20 | | | | | | | |
| Melon | 3 | | | - | | | | | | | |
| Onion | 2 | | | - | | | | | | | |
| Carrot | 2 | | | - | | | | | | | |
| Tomato | 1 | | | 8.7 | | 5 | | | | | |
| Broad Beans | - | | | 83 | | 0.6 | 11.45 | | 0.6 | 25 | 2 |
| Barley | - | | | 46.2 | | 2.5 | | | | | |
| Vegetables | - | | | 8 | | | | | | | |
| Clover | 91 | | | - | | | | | | | |
| Peanut | | | | | | | 25 | | | 20 | |
| Blackeye beans | | | | | | | 77 | | 1 | 110 | .2 |

(1) Ehlers 1975. P.191

(2) ICC 1973 Table IV I

(3) Data were obtained from KWPA DIP Department of Agro-Industry and Resettlement, 1975.

the Company will be 399,007,000 rials by 1979/80. The capital share of the Company which was 95,300,000 rials in 1970,[43] had to be increased to 232,300,000 rials.[44] This is mainly owing to the high cost of land improvement. The actual reported figure for land improvement was 77,000 rials per hectare in 1973[45] against the initial estimated cost of 20,000 rials/ha. In 1973/74 the Company's loan was 97,500,000 rials of which 90,000,000 rials came from ADFI. This must be repaid regularly at 6% interest. Under these circumstances the Company could not afford such a high cost of land development and large deficits. Therefore, in 1975/76, the state of Iran expropriated its properties and the ADFI and KWPA became the major shareholders of the Company.

11-6-c <u>The Iran-Shellcott Agro-business Company</u> (Fig. 11-2)

<u>Land development</u>

The Iran-Shellcott Agro-business Company was established in February 1970 (28.10.1349). The assigned land was 13500 ha initially.[46] ADFI quoted a figure of 18,000 ha in 1971 of which 4,300 ha was located in the DPIP.[47] At the time of writing the land allotted to the Company is 15,796 ha, of which 5,376 ha is located in the DPIP area and the remaining 10,420 ha in the East Dez area. In the original plan, the Company intended full development of a net area of 13,500 ha by 1976, but in 1974 the Company revised its land development programme. With a delay of two years, the full development of 13,400 ha will be realised in 1978. (Table 11-21) The land develop-

TABLE 11-21

Land development of Iran-Shellcott Agro-business Co.

(Planned and Actual)

| Year | Assigned Area (ha) | Transferred land (ha) | Land development: Original Plan of land development (ha) | Land development: Revised Plan of land Development (ha) | Land development: Actual land Development (ha) |
|---|---|---|---|---|---|
| 1970 | a 13,500 | d 1,360 | (i) 500 | j 550 | l 305 |
| 1971 | b 14,736 | e 2,055 | 1,500 | k 1,980 | k 1,980 |
| 1972 | | e 3,970 | 4,000 | k 4,000 | m 4,000 |
| 1973 | | f 5,376 | 5,000 | k 5,800 | k 5,400 |
| 1974 | c 15,796 | g 6,754.5 | 8,000 | k 7,000 | n 5,472 |
| 1975 | | h 8,133 | 11,000 | k 8,800 | o 5,494 |
| 1976 | | h 8,133 | 13,500 | k 10,200 | o 5,494 |
| 1977 | | | | k 12,000 | |
| 1978 | | | | k 13,400 | |

Source:

(a) KWPA 1971 "Agro industry venture". A publication of DIP of KWPA P.9

(b) KWPA 1972 "A brief information on Khuzestan" in Tahqiqat-i-Eqtesadi Nos 29 & 30, Spring and summer 1972. P.105

(c) KWPA 1976 A summary of Agro-business performance on the lands below the Mohamad Reza Shah Pahlavi Dam. Khuzestan. P. 6.

(d) KWPA 1972. Annual report of 1972, P.31.

(e) KWPA 1972. op cit P.105

(f) Ehlers P.181

(g) Estimation

(h) 1. KWPA. Bureau of Agro-industry in Dezful, Fatemifar, Personal communication 1975.
2. MWP Bureau of Agro-industry in Tehran, Mohajer, Personal communication 1975.

(i) KWPA, 1972.

(j) Report, managing agents report, period to July 31st, 1971. Dr. N. Ameri, Michell Cotts Services Limited, London September 16th P.3

(k) Iran-Shellcott Company, Report 1 - 1974 budget
2 - 5 year Plan 1974-78, January 1974 Appendix 20-1.

(l) KWPA 1971. Annual report of 1971 P.28

(m) Iran-Shellcott presentation 1974, London, December P.15

(n) KWPA Bureau of Agro-industry 1975. Report of March 1975. P.23

(o) KWPA, 1976. op cit P.5.

ment targets were achieved in 1970 to 74. Since then the performance of the Company has not been satisfactory. By January 1976 5,494 ha were levelled, against a target of over 10,000 ha. (Table 11-21) Therefore a further 7,906 ha or 59% of the total area is left to be levelled in only two years from 1976.

Area under Cultivation

In 1971 the Iran Shellcott Company cultivated 138 ha of land. In the following year the area under cultivation, which was 2,218.9 ha, exceeded the Company's planned area of 1,110.5 ha. (Table 11-22) Since 1973 the area under cultivation declined to almost half of that which had been planned, but in comparison with that of 1972 it increased. (Table 11-22) Against a planned area of 6,450 ha under cultivation for 1975 an actual figure of 7,301 ha is quoted by KWPA. Against a total area of 10,400 ha for 1976 KWPA quoted 5,090 ha as the area under winter crops.

Cropping pattern and crop yields

From the beginning the Iran-Shellcott Company was to produce oil seed to contribute to Iran's oil seed self-sufficiency. In the original plan it had been projected that 6,000 ha would be cultivated with sunflowers, 6,000 ha with soya beans and a further 13,500 ha with forage crops such as alfalfa, berseem clover and milo.[48] In practice cultivation of cotton replaced sunflowers, soya-beans and safflowers because the yields of these crops were too low. (Table 11-22) The cropping pattern programme of the Iran-Shellcott Company has focused on the cultivation

TABLE 11-22

Area under Cultivation, Cropping Pattern and Crop Yields of the Iran-Shellcott Agro-business Company

Planned and Actual area (ha) yield (tonnes/ha)

| Crops | 1971 Planned Area | 1971 Actual Area | 1971 Planned Yield | 1971 Actual Yield | 1972 Planned Area | 1972 Actual Area | 1972 Planned Yield | 1972 Actual Yield | 1973 Planned Area | 1973 Actual Area | 1973 Planned Yield | 1973 Actual Yield | 1974 Planned Area | 1974 Actual Area | 1974 Planned Yield | 1974 Actual Yield | 1975 Planned Area | 1975 Actual Area | 1975 Planned Yield | 1975 Actual Yield | 1976 Planned Area | 1976 Actual Area | 1976 Planned Yield | 1976 Actual Yield | Safiabad Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (a) | (b) | | | (a) | (b) | | | (a) | (c) | | (c) | (a) | (c) | (d) | (c) | (d) | (i) | (d) | | (d) | (j) | (d) | | |
| Alfalfa | 50 | 50 | | | 50 | 151.5 | | 4.2 | 561 | 150 | | 4.5 | 645 | 486 | 10 | 5.0 | 600 | 703 | 10 | | 500 | 273 | 10 | | 18.0 (c) |
| Berseem | 137 | 137 | | | 137 | 225 | | | 330 | 244 | | | 290 | - | | | | 67 | | | | | | | 5.0 (c) |
| Wheat | | | | | | 905 | | 3 | 309 | 905 | | 1.8 | 462 | 434 | 2.5 | 2.0 | 400 | 992 | 2.5 | | 1800 | 2500 | 2.5 | | 5.0 (e) |
| Barley | | | | | | 39 | | | 351 | 35 | | 2.2 | 703 | 123 | 2.5 | | 100 | 200 | 2.5 | | 200 | | 2.5 | | 2.5 (e) |
| Sorghum | | | | | 342 | 99.6 | | 1.5 | 736 | 678 | | 1.2 | 1292 | 475 | 3 | 2.3 | | 419 | 3 | | | 403 | 3 | | 4.0 (c) |
| Sunflower | | | | | 311 | 136.5 | | | 1277 | 123 | | | 1244 | - | | | | | | | | | | | 1.5 (c) |
| Maize | | | | | | 365.2 | | 0.8 | 330 | 510 | | 0.8 | 444 | 22 | | 1.0 | | 22 | | | | 15 | | | 8.0 (c) |
| Safflower | | | | | | | | | | 33 | | 0.5 | | 46 | 2 | 0.9 | | | | | | | | | 1.2 (c) |
| Soyabean | | | | | | 20 | | | 33 | 32 | | 0.4 | | | | | | | | | | | | | 2.2 (f) |
| Cotton (Mar.) | | | | | | 63.7 | | 0.2 | | 41 | | 1.7 | | 1715 | 2 | 1.2 | 2750 | 1940 | 2 | | 3500 | 1484 | 2 | | 6.7 (g) |
| Cotton (June/July) | | | | | | 41 | | | | 23 | | 0.9 | | 464 | 1.5 | 0.0 | 2000 | 585 | 1.5 | | 2700 | | 1.5 | | |
| Sugar Beet | | | | | | | | | | | | | 301 | 85 | 35 | 30.0 | 500 | 221 | 45 | | 2000 | 319 | 45 | | 78.1 (h) |
| Sudan grass | | | | | 108 | 55.2 | | | 153 | 122 | | | 14 | - | | | | 67 | | | | 67 | | | |
| Beans | | | | | 162 | 10 | | | 440 | | | | 679 | - | | | | | | | | | | | |
| Strawberry | | | | | ½ | 0.5 | | | 3 | | | | 5 | - | | | | | | | | | | | |
| Citrus | | | | | | 24 | | | | | | | | | | | | 29 | | | | 29 | | | |
| Vegetables | | | | | | 70.2 | | | | | | | | | | | | | | | | | | | |
| Others | | | | | | 13 | | | | | | | | | | | | | | | | | | | |
| Total | 187 | 187 | | | 1110½ | 2218.9 | | | 4523 | 2896 | | | 6079 | 3850 | | | 6350 | 5245 | | | | | | | |

Sources:-

(a) Iran-Shellcott Limited. 30th November 1971. Report Stage 1 Development Plan and Budget. Period January 1972 - December 1974.

(b) Ehlers, E. 1975. P. 192.

(c) Snellcott Presentation December 1974. London PP15.

(d) Shellcott January 1974. Report to the ADFI. 1 - 1974 Budget
2 - 5 year plan 1974-78. Appendix 4.1

(e) Shishehgar, M. 1971. MWP KWPA DIP Safiabad Agricultural Research Centre (SARC) Research on grains 1970-71, P3 and 17.

(f) Shishehgar, M. December 1972. MWP. KWPA. DIP. SARC Research on oilseeds. P.4.

(g) Fallah, M. 1973. MWP. KWPA. SARC. Cotton Crop Study. P. 39.

(h) Sepasi, A. 1973. MWP. KWPA. SARC Sugar Beet Study. P.2.

(i) Ministry of Water & Power, KWPA, DIP. Report of March 1975 P.22 also Personal communication with Fatemifar, KWPA, Dept. of Agro-industry. April 1975.

(j) KWPA Bureau of Agro-industry, 1976. A summary on the agro-business activities located on the lands below the Mohamad Reza Shah Pahlavi Dam, P.5.

of cotton, sugar beet, wheat and alfalfa in descending order since 1974. (Table 11-23) For 1976 the area allocated to the cultivation of cotton is 6,300 ha. In winter 1976 a total of 1,484 ha were cultivated with cotton. A further 2,500 ha were cultivated with wheat against a planned area of 1,800 ha. This is partly owing to an already fixed price for wheat in Iran and an almost certain yield at a relatively low production cost. Conversely the area under cultivation of sugar beet, which was planned to be 2,000 ha, did not exceed 319 ha. This was because of the difficulties of beet transportation to the Ahwaz Sugar Beet Plant and the shortage of a labour force for weeding.

The initial choice of crops was made on the basis of studies carried out at the U.S.-advised Safiabad research station. These tests were made on micro-plots, where all available variables (fertiliser, water, pests etc.) could be tightly controlled. The Safiabad studies could not give an accurate picture of what the true yields of the various crops would be when planted over thousands of hectares. None of the crops did very well (Table 11-22) and after several years of trial and error Shellcott arrived at a schedule of winter crops of sugar beet, alfalfa and wheat (marketed domestically) and a summer crop of cotton which was exported. The final selection of crops was made with the objective of securing a profit. With the exception of wheat, most of the crops variety used are not adapted to local environmental conditions.

## TABLE 11-23

### Cropping pattern and area under cultivation of the Iran-Shellcott Agro-business Company

Planned

1974-1978

| Year | Cotton | | Sugarbeet | | Wheat | | Alfalfa | | Total area under cultivation |
|---|---|---|---|---|---|---|---|---|---|
| | Area | Percentage | Area | Percentage | Area | Percentage | Area | Percentage | |
| | | % | | % | | % | | % | |
| 1974 | 2179 | 56.77 | 83 | 2.16 | 405 | 10.55 | 486 | 12.16 | 3838 |
| 1975 | 4750 | 73.46 | 500 | 7.75 | 400 | 6.20 | 600 | 9.3 | 6450 |
| 1976 | 6300 | 60.57 | 2000 | 19.23 | 1800 | 17.30 | 500 | 4.8 | 10400 |
| 1977 | 7000 | 60.86 | 1500 | 13.04 | 1800 | 15.65 | 500 | 4.34 | 11500 |
| 1978 | 8800 | 61.53 | 2000 | 13.98 | 1800 | 12.58 | 1000 | 6.99 | 14300 |

Source: Shellcott Company, January 1974. Report to the ADFI 1 - 1974 budget
2 - 5 year Plan 1974-78

Annexes 24 and 25

Economic Prospects

So far, Iran Shellcott has been a losing proposition financially. The initial wave of optimism about the venture was soon overwhelmed by a host of problems. The company found out it could not double-crop. The land was in much worse condition than expected. In 1974 the cost of land development had increased to 79,832 rials[49] against an estimated figure of 20,000 rials/ha. More earth than anticipated had to be moved in order to level massive tracts of land for precise methods of irrigation. These massive movements of earth resulted in changes in the soil structures which have resulted in relatively low yields so far. KWPA fell behind the agreed schedule for the construction of irrigation works. This reduced by half the area the Company had originally promised to develop and produced low yield of crops. Iran-Shellcott has already overspent the budget which it calculated on only a small part of the total area. (Table 11-24) A figure of 19,200,000 is quoted by the Iran-Shellcott Company as overbudgeting having been spent above the budgeted figure for 1972. In 1973 the expected crop sales did not exceed 21,379,000 rials against 81,840,000 rials which had been budgeted for. The figures for the total farming products were 71,070,000 rials against an anticipated figure of 106,072,000 rials.[50] Taking into account the 131 million rials loan from the ADFI at a 9½% interest rate which Iran-Shellcott is burdened with, it is difficult for the Company to make a profit. The Company hopes to break even by 1977, to pay off the loans by the early

TABLE 11-24

Iran-Shellcott's Budget

Planned and Actual

(1,000,000 rials)

| Year | Land development | | Investment assets (c) | | Accumulated (loss) benefit (d) | | Total Capital Employed | |
|---|---|---|---|---|---|---|---|---|
| | Planned (a) ha | Actual (b) | Planned | Actual | Planned | Actual | Planned (e) | Actual (f) |
| 1971 | 500 | 305 | 114 | 121 | (16) | (74) | 130 | 195 |
| 1972 | 1,500 | 1,980 | 249 | 303 | (46) | (172) | 295 | 475 |
| 1973 | 4,000 | 4,000 | 382 | 435 | 95 | (309) | . 477 | 744 |
| 1974 | 5.000 | 5,472 | 535 | 634+ | 139 | | 674 | |
| 1975 | 8,000 | 5,494 | 599 | | 161 | | 760 | |
| 1976 | 11,000 | | 579 | | 133 | | 712 | |
| 1977 | | | 549 | | 101 | | 650 | |
| 1978 | | | 542 | | 46 | | 588 | |
| 1979 | | | 542 | | | | 542 | |

\+ In 1971, it was anticipated that the tangible fixed assets would be 439 million rials by the end of 1974 (1); whereas in practice this had been increased to 634 million rials.

(1) Iran-Shellcott Limited, Report Stage 1 Development Plan and budget. period January 1972-December 1974. Managing agents, Michell Cotts Services Limited. Cotts House, Camomile Street, London EC3, 30th November 1971. P.7

(a) Iran-Shellcott, Feasibility study cited in Shellcott Presentation, London, December 1974. P.1.

(b) Table 11-21.

(c) -Shellcott Presentation, London, December 1974. Charts 3 & 4.

(d) Ibid.

(e) Iran-Shellcott. Feasibility study cited in Shellcott Presentation, London, December 1974.

(f) c + d (actual).

eighties and to operate subsequently at a profit.

Fig. 11-3 shows the economic performance of the Company (original and actual). The lease of the Iran-Shellcott company is for 25 years. Unlike the Iran-America and Iran-California companies, Iran-Shellcott does not intend to pull out even if this requires more capital investment. Iran-Shellcott made a small mistake. They considered the Khuzestan situation similar to that of Africa, where agricultural labour is forthcoming at very low wages. In Khuzestan the peasants did not want to work for the agro-businesses, and were able to pick and choose. Therefore it was necessary to introduce capital intensive production.[51]

11-6-d The International Agro-business Company of Iran (IACI)(Fig. 11-2)

Land development

The IACI was established in 1972 and was registered on 22.1.1973. The total assigned area was 16,451 ha, with a net area of 13,600 ha. According to the land development schedule, the land levelling programme is to be completed by 1978. By 1976 4,562 ha had been levelled against a target of 8,600 ha. (Table 11-25) This is only 27.33% of the total transferred area. By 1973 the performance of the IACI was more hopeful than the other companies in terms of land development costs. The cost of land development was 17,980 rials against a budgeted figure of 22,873 rials.[52] The other three companies' costs were over 70,000 rials.

Fig II 3

# IRAN-SHELLCOTT AGRO-BUSINESS COMPANY

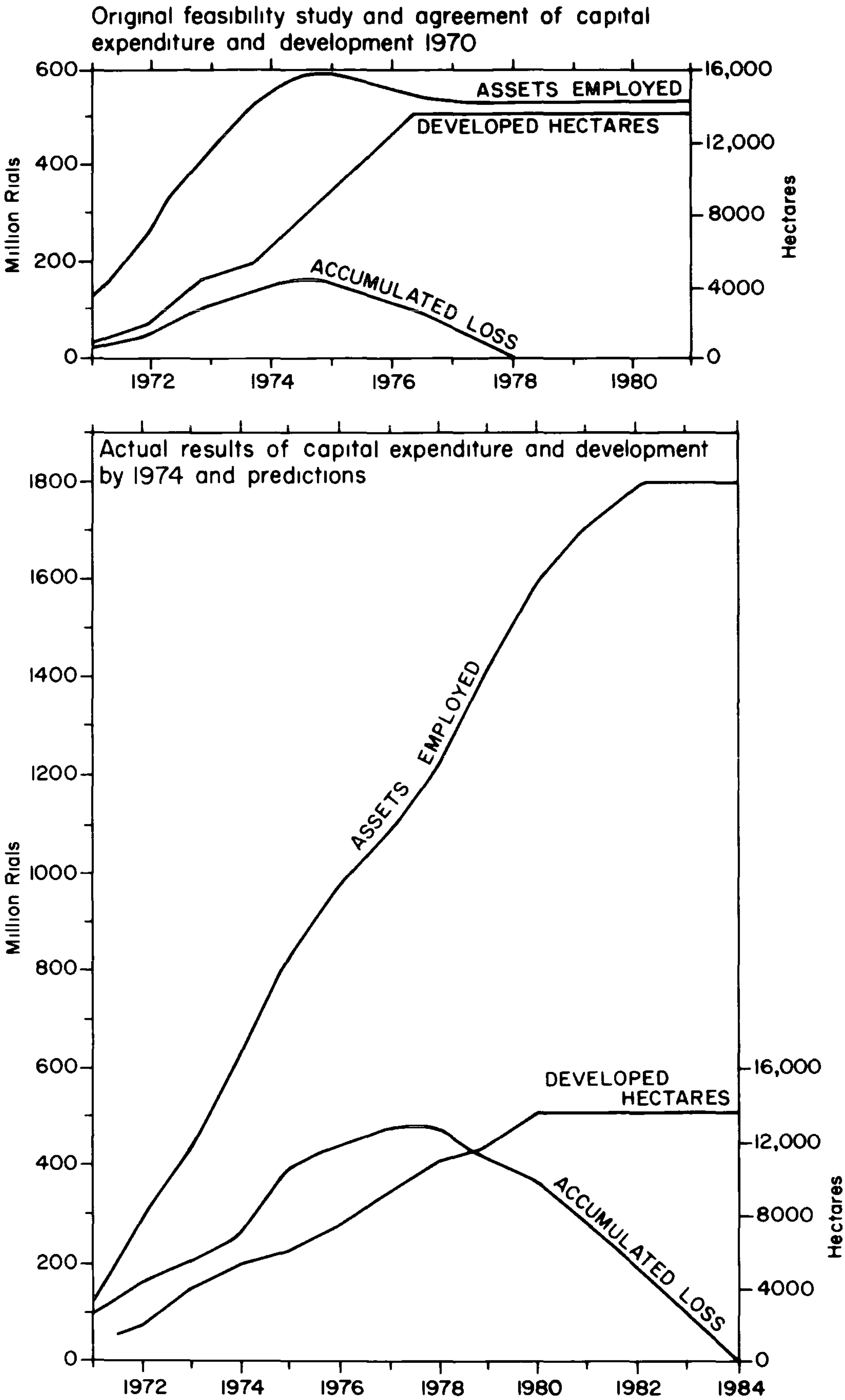


TABLE 11-25

Land Development of IACI

Planned and Actual

(ha)

| Year | Transferred land | Land Development | |
|---|---|---|---|
| | | planned | actual |
| 1972 | a 2,680 | (e) | - |
| 1973 | b 4,904 | 1,100 | - |
| 1974 | c 7,129 | 3,600 | f 2,768.6 |
| 1975 | c 9,076 | 6,100 | f 3,384.6 |
| 1976 | d 16,690 | 8,600 | d 4,562 |
| 1977 | | 11,100 | |
| 1978 | | 13,600 | |

(a) KWPA 1972 "A brief information on Khuzestan" in Tahqiqat-i-Eqtesadi Nos. 29 and 30. Spring and Summer 1972. P.105.

(b) Estimation.

(c) Mohajer. MWP Dept. of Agro-industries, Tehran. Personal communication 1975.

(d) KWPA DIP Dept. of Agro-industries, 1976. P.6

(e) Agricultural Development Fund Of Iran. International Agro-business Corporation of Iran. Projects Department. Project No. 180. January 1973. Annex 3.

(f) MWP KWPA. DIP. Monthly report of March 1975. P.24.

## Area under cultivation

IACI has not been able to cultivate the land according to its original plan. In 1974 the total area under cultivation was 2,041 ha against a target of 3,600. In the following year the total cultivated area, which was previously 57% of the planned area, was increased to 67.02% i.e. 4,826 ha against 7,200 ha. For 1976 the area under cultivation of winter crops was 4,910 ha out of the total planned area of 9,800 ha. (Table 11-26) KWPA officials are more optimistic about the future performance of the IACI than that of the other companies.

Cropping pattern and crop yields

So far IACI has focused on the cultivation of wheat and sugar beet despite the fact that in the planned cropping pattern cultivation of milo and/or sorghum, alfalfa and sugar beet had been given priority (in that order). Wheat and cotton are expected to be the 4th and the 5th most important crops which will be cultivated by 1979. (Table 11-27) In addition to these five major crops a limited area of 200 ha will be cultivated with grapes, because it is predicted that there is a great market for early grapes in Iran as well as Europe.[53] IACI has not planted any grapes yet. The actual crop yield was not satisfactory in 1973 (Table 11-26). The next year the yield of sugar beet exceeded that which had been planned for, namely 53.7 tonnes/ha against an expected value of 35 tonnes/ha. Also the yield of sorghum was higher than had been anticipated and very close to that of the Safiabad standard of 4 tonnes per hectare. (Table 11-26) The yield of irrigated wheat was below the Safiabad standard of 5 tonnes/ha. Data for 1975 and 1976 are not available. The future objectives of the company are 4 tonnes/ha for wheat by 1977, 60 tonnes/ha for sugar beet by 1979, 3 tonnes/ha for cotton by 1980 and 750 tonnes of meat per year by 1980.[54] Milo and alfalfa production will feed the cattle. The objectives for the production of these crops are 17 tonnes/ha

TABLE 11-26

Area under Cultivation - Cropping Pattern and Crop Yields of the IACI
1973-1975

Area ha Yield tonnes/ha

| Crop | 1973 Planned Area (1) | 1973 Actual Area (3) | 1973 Planned Yield (2) | 1973 Actual Yield (3) | 1974 Planned Area (1) | 1974 Actual Area (3) | 1974 Planned Yield (2) | 1974 Actual Yield (3) | 1975 Planned Area (1) | 1975 Actual Area (3) | 1975 Planned Yield (2) | 1975 Actual Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sugar Beet | 250 | 250 | 30 | 27.5 | 600 | 469 | 35 | 53.7 | 1,400 | 1,500 | 40 | - |
| Wheat | 600 | 600 | 1.5 | 1.9 | 1,400 | 1,245 (irri.)<br>264 (non-irri.) | 2.5 | 1.5 | 1,600 | 2,453 | - | - |
| Alfalfa | - | - | - | - | - | - | - | - | 1,200 | 438 | - | - |
| Milo | - | - | - | - | 1,400 | 41 | 3 | 3.9 | 2,000 | 124 | 4 | - |
| Cotton | - | - | - | - | 200 | 12 | - | - | 800 | 156 | 2.5 | - |
| Grapes | - | - | - | - | - | - | - | - | - | 20 | - | - |
| Groundnut | - | - | - | - | - | - | - | - | - | 110 | - | - |
| Black-eye Beans | - | - | - | - | - | - | - | - | - | - | - | - |
| Broad beans or | - | - | - | - | - | - | - | - | - | 25 | - | - |
| Peas | - | - | - | - | - | - | - | - | - | - | - | - |
| Barley | - | - | - | - | - | 10 | - | - | - | - | - | - |
| Sudan Grass | - | - | - | - | - | - | - | - | - | - | - | - |
| Total | 850 | 850 | | | 3,600 | 2,041 | | | 7,200 | 4,826 | | |

(1) Agricultural Development Fund of Iran. International Agro-business Corporation of Iran. Projects Department, Project No. 180. Annex 4.

(2) Agricultural Development Fund of Iran. International Agro-business Corporation of Iran. Projects Department, Project No. 180. Annex 5.

(3) Data obtained from Talebzadeh. KWPA DIP Department of Agro-industries and Resettlement, 1975.

TABLE 11-27

Cropping Pattern and the Planned Area under Cultivation of the JACI

1976-81

| Year | Milo | Alfalfa | Sugar Beet | Cotton | Wheat | Grapes | Total |
|---|---|---|---|---|---|---|---|
| 1976 | 3400 | 1200 | 1400 | 1000 | 2600 | 200 | 9800 |
| 1977 | 3400 | 3000 | 1600 | 1800 | 2000 | 200 | 12000 |
| 1978 | 5000 | 3800 | 2000 | 2000 | 3200 | 200 | 16200 |
| 1979 | 6400 | 4000 | 2800 | 1600 | 2000 | 200 | 17000 |
| 1980 | 5600 | 4000 | 2800 | 2200 | 2200 | 200 | 17000 |
| 1981 | 5600 | 4000 | 2800 | 2200 | 2200 | 200 | 17000 |

Source:- Agricultural Development Fund of Iran, International Agro-Business Corporation of Iran, Projects Department, Project No. 180. Annex 4.

for alfalfa by 1979 and 6 tonnes/ha for milo by 1977.

Economic prospects

Although the IACI has made a better performance than the other companies its actual loss was 22,213,477 rials. In the following year the anticipated loss was 44.92 million rials, whereas in practice it had increased to 60,953,200 rials.[55] The company hopes to break even by 1976 and to gain a profit of 240 million rials by 1981. Because of the losses in the early years, no payment of dividend is projected until 1979. The registered stock of the company is 610 million rials. The IACI has borrowed 194,337,401 rials in long term loans. 74 million rials came from ADFI and the remaining 120,337,401 rials from Exim-Chase.[56] Loans will not be repaid until 1979. By September 1974 a total 62,656,811 rials had been spent by the company. This constitutes 10.27% of the registered stock of the company which was spent for the development of a net area of 3,385 ha by 1974. The latter figure forms 25.83% of the total net area of 13,100 ha. Therefore for the development of the remaining area of 74.17% the Company had about 89.73% of stock at its disposal.

The Galleh Agro-business Corporation (Fig. 11-2)

Land Development

The Galleh Corporation was registered in October 1974. The allocated land was 4,010 ha. By November 1974 1,916 ha out of a total 4,010 had been transferred to the Company and by December 1975 all 4,010 ha had been transferred. It is predicted that 2,650 ha of traditional farmland in the north and 2,800 ha in the south will be added to the assigned land. By March 1975 the land survey undertakings were set up on 700 ha.[57] By December 1975 900 ha out of 4,010 ha had been developed[58] and by June 1976 a further 300 ha had been levelled.[59] It is hoped that the land development will be completed by 1979. Originally it had been planned to complete the work by 1976.

Area under cultivation

The Galleh Company began production on an area of 1,010 ha of unlevelled land in 1974/75. This was increased to 1,190 ha in 1975 and to 2,100 ha in 1976. The planned figure for 1976 was 3,315 ha. 1,900 ha out of 2,100 ha of cultivated land were unlevelled in 1976.

Cropping pattern and crop yields

The Galleh Company began production of wheat on 1,090 ha in 1974. A further 10 ha were planted with citrus fruits. One year later, in addition to the cultivation of wheat and citrus fruits, 50 ha were under the cultivation of alfalfa. Four crops were cultivated in 1976, with sugar beet being added to the cropping pattern. Therefore the cultivation of maize and milo, which had been planned, has not yet been set up. (Table 11-28) Cultivation of wheat in both the year 1974 and 1975 was carried out on unlevelled land. In these years the yield of wheat was 2 tonnes/ha and 3 tonnes/ha respectively. These yields are lower than the Safiabad standard. No data are available on the planned or actual yields of alfalfa and sugar beet.

TABLE 11-28

Area under Cultivation, Cropping Pattern and Crop Yield of the Galleh Company.

1974-76

(Area ha) (Yield tonnes/ha)

| Crop | 1974 | | 1975 | | 1976 | | |
|---|---|---|---|---|---|---|---|
| | Area | Yield | Area | Yield | Area Planned | Area Actual | Yield |
| | (1) | (1) | (1) | (1) | (2) | (2) | |
| Wheat | 1000 | 2 | 1100 | 3 | 1020 | 1000 | |
| Sugar Beet | - | - | | | 1020 | 500 | |
| Alfalfa | - | - | 50 | | 340 | 500 | |
| Maize | - | - | | | - | - | |
| Milo | - | - | | | - | - | |
| Barley | - | - | | | - | - | |
| Citrus fruits | 10 | | 40 | | - | 100 | |

Source:-

(1) Mazandarani, 1976. Personal correspondence.

(2) Data were obtained from Manzandary (Deputy Managing Director of the Galleh Co.) Andimeshk, Khuzestan 1975, also personal correspondence 1976.

Economic Prospects

The initial registered stock of the Company was 400 million rials. By June 1976 a total of 150 million rials had been spent for the development of 1,200 ha. At the present time it is estimated that 700 million rials is needed for full development[60] against the original estimate of 400 million rials. The future development schedule of the company is not definite as yet. It is anticipated that 350million rials out of 700 million rials will be provided by a 15 year loan at 6% interest by ADFI. Gross farm income of the Company was 20,000 rials per hectare in 1974, which is very low by any standards.

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# CHAPTER 12

# ANIMAL HUSBANDRY

## 12-1 Problems incurred with meat and animal protein products in Iran

Iran is a protein deficient nation. Human diets lack the necessary high protein foods, especially meat. Survey data compiled by the FAO show that the average per capita daily meat consumption of 41 gr (protein consumption of 30 gr) is below that of any other nation in the Near East with similar cultural and environmental characteristics.[1] Until the development of large scale irrigation projects, insufficient feed has been available to guarantee livestock feeding. To keep pace with the increasing demand for meat, the Central Bank of Iran has calculated that the income elasticity for meat is 0.75, but only 0.51 for all food purchased by urban families.[2]

The consumption of animal products in the urban areas is estimated at 1,382,320 tonnes out of the country's total consumption of 2,727,280 tonnes. In addition to the plan for increasing the livestock production by 25.4% for cattle and 63.6% for sheep during the fourth development plan period (1968-72), to satisfy the livestock production demand Iran has had to resort to the importing of meat, both live and chilled. This has caused a considerable drain on foreign exchange reserves, which amounted to over 200 million rials in 1969-70.[3]

## 12-2 Production potentials of Khuzestan for livestock feed

In Khuzestan the livestock industry is beset by a number of problems such as poor genetic stock, low rate of productivity, high mortality rates,[4] disease and, above all, lack of sufficient nutritional feed particularly during certain seasons of the year.

Irrigation in Khuzestan will allow the production of livestock feed stuffs, which can be greatly increased. Modern mechanised alfalfa production is characterised by both high yields and high quality. When the DIP is completed and assuming an average annual yield of 20 tonnes per ha, a total annual production of approximately 150,000 tonnes of alfalfa (from 7,900 ha) would be realised. This amount would account for only 9% of the increase in alfalfa production established as one of the goals for the fourth plan.[5] Barley is another animal foodstuff but rust can reduce yields to zero. The overall cropping pattern of the Agro-business Companies does not come out in favour of the cultivation of barley. Only 425 ha of land is to be allocated to the cultivation of barley by the Galleh Company. Grain Sorghum has only recently been introduced to the DIP area and 809 ha were cultivated by the Companies in 1973-74. By early 1980, the DIP will produce approximately 37,000 tonnes of sorghum which is expected to be the chief grain feed.

Supplementary feedstuffs

The present large quantity of molasses available from the sugar mill at Haft-Tappeh can not be consumed entirely in Khuzestan, so much is exported or simply wasted.[6] Sugar beet pulp can be obtained from the beet factory in Dezful. Ultimately 12,000 ha of the DIP is to be cultivated with sugar beet, which will give 650,000 tonnes of sugar beet per year, assuming a yield of 54 tonnes per ha. In addition to the sugar beet mill in Ahwaz, with a capacity of 2,500 tonnes per day, the establishment of a 500,000 tonnes/annum sugar beet mill in Dezful will guarantee beef feed by 1979.[7] (In 1976 the area under sugar beet cultivation was 5,000 ha and the production of sugar beet was estimated at 200,000 tonnes).

Increasing the production of oil seeds such as soya beans and sunflower seed in the DIP would have a profound effect upon the fattening programme. Iran Shellcott was the only company which was assigned to produce soya beans on 6,000 ha and sunflowers on a further 6,000 ha to contribute to Iran's self sufficiency in both vegetable oil and animal feed. The Company's cropping pattern for these oil seeds has instead been transferred to cotton cultivation. In comparison, the cotton seed oil content is less than that of sunflowers and more than that of soya beans. The crude protein element of cotton is less than that of soya beans and more than that of sunflowers.[8] When a total 15,140 ha is cultivated with cotton in the 1980s in the DIP area cotton seed meal will replace part of the livestock feed supply which has been imported from Tehran so far.

12-3 Local Sources of Livestock

The traditional livestock population in the DIP area is relatively small (Table 12-1) The remainder of the livestock of the province belongs to other village areas and to nomadic people whose herds roam the vast public ranges.

Although sheep and goats outnumber cattle in the project area, the Khuzestan Province had approximately equal numbers of both animals (based on the estimated number of 1,900,000 cattle by DRC)[9]. Certain supplementary feeding is afforded such as straw, bran and some grain. The manure is saved to be used as fuel and fertiliser. The available grazing consists of annual grasses, weeds, shrubs, crop residue, ditch bank and roadside growths.

TABLE 12-1

Number of livestock in the DIP area,
Khuzestan province and Iran

| | Cattle | Sheep | Goats | Buffalo |
|---|---|---|---|---|
| Designated Farm-Corporation lands (a) | 3,566 | 10,194 | 299 | 1,116 |
| Agribusiness lands (b) | 5,060 | 20,064 | 1,829 | 1,316 |
| Total pilot area | 8,626 | 30,258 | 2,128 | 2,432 |
| Dez Irrigation Project (b) | 22,759 | 85,000 | 6,757 | 5,053 |
| Khuzestan Province (c) | 310,000 | 1,250,000 | 570,000 | 60,000 |
| Total Iran (d) | 5,515,793 | 24,292,680 | 13,950,054 | 179,216 |

Sources:-

(a) DRC: 1970? Farm Corporations for the Dez Irrigation Project, P. 77.

(b) DRC: 1971 Agribusiness opportunities, prospectus series number 9. P.13.

(c) Plan and budget organisation, Statistical Centre of Iran. Statistical yearbook 1352. Serial No. 394 March 1975. P.345.

(d) NOVISAD, Yugoslavia, August 1973, Agro-industriya, A five year period development programme of agriculture and food industry in Iran. 1973-78. Agro-industrija, Novi Sad, Yogoslavi, pp 28-31.

On an annual basis both quantity and quality of the forage are inadequate for reasonable nutritional levels. On average, a low percentage of the existing herds is available for slaughter each year. The figure is estimated at 15%.[10] Cattle and sheep prices (carcase basis) in the Dezful area were 60 rials/kg for beef and 80 rials/kg for mutton in 1971. The corresponding figures for 1972/73 were 67 and 92 rials/kg.[11]

The prices of livestock and meat in the DIP area have not been permitted to fluctuate significantly by the municipal government of Dezful. This fact, combined with the low purchasing power and volume demand, does not make the DIP area an attractive market for fat cattle. In view of that the future livestock market for agro-business companies is likely to be Tehran.[12]

It is estimated that a feedlot enterprise involving 15,000 sheep and 3,000 cattle per year would require the purchase of 13% of the available DIP area cattle and 17% of its sheep.

12-4 Livestock production of agro-business corporations

12-4-a Iran-America Company

The Iran-America Company had a flock-building programme to increase its animal members to 11,285 in its eighth year of production.[13] ADFI quoted a figure of 50,000 sheep as the ultimate size of livestock production[14] for the Iran-America Company. The Agro-business of Iran-America has built up its livestock since March 1970 with the purchase of 2,500 of the DIP sheep.[15] The animals come in part from the sale of peasant herds, whose farmer owners had to give them up following removal from the villages to the new midpoint settlements. By March 1975 the animals of the Company had increased to 17,000[16] but it declined to 15,518 in December 1975.[17] The animals are looked after in herds of about 2,000 by five to six shepherds. With the new organisation has come new feeding systems. Traditional pastures are used, but especially in the area of the uplands of Andimeshk and the Dezful plateau (bench), stronger and stronger conflicts are occurring as to the traditional pasture rights of the nomads. The wide use of arable land is also made possible by the improved use of the harvested fields and the harvest left-overs. In addition to stubble, cereal and bean straw, leaves can also be fed to animals. Fodder plants produced by the company are also used as a fattening feed. Despite the farmer lack of selective breeding, giving low quality animals, a considerable proportion of the meat is marketed today.

12-4-b The Iran-Shellcott Company

The Iran-Shellcott Company likewise has at its disposal a small herd, which is in the process of being built up from 1,100 animals (1973).[18] By December 1975 the total number of animals of the Iran-Shellcott Company had increased to 1,939 against a total planned number of 8,000.[19] Here too it is a matter in the main of animals which have been bought from people moving away. Assuming an annual selling quota of 50% of the herd stocks, a building up of the sheep herds is certainly considered possible, but not high priority. At present the animals are sold for slaughter to Tehran.

12-4-c The Iran-California Company

In the original agreement of the ICC no undertaking was given for the building up of any livestock herds. The company renounced cattle holding as part of the total undertaking. The reasons for this are of general relevance and also are mentioned frequently by the managements of the other companies: These are:-

(a) Lack of an obligatory quality control and standardisation for animal produce as the basis of a differentiated price level.

(b) Lack of slaughterhouses, manufacturing and cooling installations.

(c) The adherence until now to the principle "Quantity before quality".

Since the Company was taken over by the Iranian government, livestock holding and meat production have begun to be established as a component of the agro-industrial undertaking. By March 1975 the Company had 1,358 sheep at its disposal,[20] and this had increased to 6,400 by December 1975.[21]

12-4-d The International Agrobusiness Corporation of Iran (IACI)

The IACI, a big business in the DIP, began most ambitiously with the building up of a market-oriented cattle-sheep holding. The company's objective was the building up of a cattle flock of 1,690 by 1974 and a sheep flock of 60,000 by 1979.[22] Starting with

370 imported fat cattle they had succeeded in building (by the end of 1973) a cattle herd which in the future would satisfy a large part of the home demand for high-quality beef. The cattle herd was reported to be 378 in April 1975[23] against a planned target of 1,690 and sheep numbers to be 5,971 by December 1975 against the planned flocks of 23,089.

12-4-e The Galleh Company

The youngest of the big businesses in the DIP had focused on an ultimate building up of a cattle-sheep-holding of 3,000 cattle and 10,000 sheep.[24] By December 1975 the Company had 400 sheep at its disposal.

Recently the Company's objective has shifted from an oriented livestock producing enterprise to a field crop and citrus producer, combined with the manufacturing of agricultural tools and machinery.[25] KWPA officials believe that the conditions for the amplification of animal holding are not good. Ehlers disagrees and comments that "Productivity is seen in comparison with the marketing quota of the big businesses. With a yearly turnover of 50% of the herds, 20-25,000 sheep were sufficient to satisfy a market similar to that which was formerly supplied by a 15% marketing quota of 85,000 peasant sheep. In addition, the amount and quality of the meat is estimated as higher than the traditional farmer's herds."

Despite the natural harsh conditions, the development possibilities of the livestock economy is favourable in the light of the production of treacle from sugar cane in Haft-Tappeh and sugar beet in Ahwaz for cattle food. Full development will only be realised with the building of hygienic technical installations for processing meat and the setting up of a quality-based price structure for meat products. Although the establishment of Agrobusiness enterprises is just beginning, various trends are emerging with regard to the economics of their undertakings.

To encourage the development of livestock products the Agricultural Bank of the Ministry of Land Reform (now the Ministry of Co-operation and Rural Affairs) offers livestock loans of up to 4 million rials. The ADFI finances longer term loans at six percent previously and 9% currently. The Department of Animal Husbandry of the Ministry of Agriculture and Natural Resources offers special loans to encourage livestock fattening. These programmes, lasting up to eight years, allow 3,000 rials per sheep on a 1,000 head per year minimum basis. To support animal feedstuff development a free grant of 2,000 rials/ha has been offered for Sorghum cultivation by the Ministry of Agriculture. In addition to that 50% of the seed costs and 20% of the fertiliser costs are paid for by the same source.[26] Large animal improvement programmes are longer term. There are natural limitations on increases in numbers. The livestock sector will be seriously handicapped in maintaining pace with other developments in the light of the rapidly emerging irrigated agriculture of the DIP.

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# CHAPTER 13

## THE SOCIAL CONSEQUENCES OF THE ESTABLISHMENT OF THE AGROBUSINESS

### 13-1 Employment

The often-mentioned preference for economic as against social considerations becomes especially manifest in the social consequences, which the new big companies have brought for the traditional farming population of the DIP area.

Amongst the countless benefits which were hoped to be gained by the establishment of private economy-orientated companies, has been the increase of job opportunities and the standard of living in and around the DIP area.[1] As far as the labour demand is concerned powered machinery reduces the use of routine hand methods and calls for workers with greater technical skills.

The sources of employment in the DIP are: KWPA and the project companies. According to the lease agreement, companies ought to provide 7,000 permanent jobs, according to the standard of employing one worker for every 10 ha.

The total number of DIP peasant farmers is estimated at 6,550. Proportioned on the basis of total net irrigable area, 5,650 farmers would be available for agrobusiness corporations and 900 farmers for Farm-Corporations. The total population in the Project area, including unemployed and those employed in occupations other than farming, is estimated at 9,250 families of which 7,900 families are on agrobusiness lands.[2]

KWPA quoted a figure of 5,317 for the landholder peasants of agrobusiness lands and a further 3,064 as landless agricultural labourers.[3]

The only figure obtained on the potential job situation in the estates of the second phase of the DIP is 2,130 farming families. After the change of social structures, 1,800 permanent and 1,215 seasonal jobs will be available.

The agro-social changes and the problems of the traditional farming population must be seen in the light of these figures.

With the take-over of farming by Agrobusinesses, frequently, and often without known grounds, farmers were expelled from their land and, at the same time, there was a considerable shrinking of their traditional pasture rights. On the other hand, the new employment cited again and again which would be created by the new big businesses, was not forthcoming.

This discrepancy was confirmed by the companies' reports and by answers to questions put to various big businesses. Neither in the building-up phase nor in the final stage, would the employment quota of 10 ha DIP to one worker be achieved. Much more realistic would be 50-75 ha to one worker.[4]

So far the development of employment figures seem to bear this out. Iran-America has been allocated a total area of over 20,000 ha which includes 24 villages and 1,069 peasant farmers. In 1973 the temporary and permanently employed labourers numbered 250. By April 1975 a total of 204 permanent workers with a further 750 seasonal workers were employed. The ultimate labour requirement of the company will not exceed 405.

Similar figures hold true for a further concern. The Iran-Shellcott region will serve as an example, comprising of estates in the pilot area and also in the second phase of the DIP. On its area of 16,000 ha, there were originally 31 villages containing at least 1,349 people employed in traditional agriculture.[5] With a total dependent population of over 8,000, the present and the expected final employment structure is causing great concern. Ultimately, 320 permanent employees would be able to manage fully the mechanical and technical businesses. Posts as foremen, irrigators and other agricultural labourers have been filled by casual labourers. For example, in 1973 Shellcott employed 260 permanent and temporary labourers. The corresponding figure for 1975 was 394. The nature of the employment provided by Shellcott follows a casual pattern and this simply means that some 75% of the work-force formerly bound to their own land will become unemployed. The work is seasonal & the labour freely available with no other work alternative so far in the DIP. This is a problem inherent in the development of the big businesses. The releasing of a human work-force is a dear consequence seen through a comparison of the traditional farming economies, the social structure and the present situation in the light of the development of the new big businesses.

Iran-California was composed of estates of the pilot area and also the first phase of the DIP. On its area of 10,700 ha, 21 villages originally were found containing at least 915 people employed in traditional agriculture.[6] In early 1972, Iran-California employed approximately 200 agricultural workers, part of them as casual or seasonal employees, of whom some 15 were in management and administration, 35 were mechanics and technicians maintaining and repairing machines, and 35 were permanently in agricultural occupations. The ultimate required labour force of the company is 200-500 of which 232 were employed permanently in late 1975.

16,700 ha of the land of the IACI containing 26 villages of 895 traditional farmers.[7] By the end of 1973 the Company employed 152 permanent labourers and a further 148 casual workers.[8]

By March 1975 the number of permanent workers had increased to 265 and that of casual labourers to 628.[9] Under the premise that some 50 ha of the DIP area require one worker, 340 permanent employees would be able to manage fully the mechanical and technical businesses.

The Galleh Company has been allocated a total area of 4,010 ha, located on the West Dez area and this includes 8 villages with 281 peasant farmers. Employing one worker for every 50 ha the ultimate labour demand of the company will be 80, of which 40 had been employed by June 1975 with further 50 as casual labourers.

Offering either temporary or permanent jobs is to be confined to the farmers who already owned land and not to the landless agricultural labourers. The latter cannot get any job unless they have some knowledge of farming activities. Therefore the problem with the landless agricultural proletariat is their great reliance upon seasonal work. This is further aggravated by the previous strict application of the prohibition of keeping one's cattle on land belonging to agro-businesses. Thus a large part of the rural population are poorer today than ever before. In view of this misery, which the government also recognises, the state in recent years has had to set itself up as an employer in the DIP region. Accordingly, every head of household has a right to work, which he is provided with by the KWPA, so long as it is not in agriculture. Table 13-1 shows the number of man days of labour which was required by KWPA in 1971 to 1974. Taking into account 300 work days per labourer per year, the total number of KWPA employees ranges between 962 in 1971 and 551 in 1972.

TABLE 13-1

Labour requirement of KWPA
1971-74

| Year | Work Days | Number of Employees |
|---|---|---|
| 1971 | 288,619 | 962 |
| 1972 | 165,526 | 551 |
| 1973 | 235,364 | 784 |
| 1974 | 216,558 | 721 |

Source: KWPA DIP 1976, "A summary on the performance of Agro-businesses on the lands below the Mohamad Reza Shah Pahlavi dam." P.10.

To estimate the ultimate employment created by big businesses, the figures were derived from an assumption made on the cropping pattern and hours of labour requirement for each crop. Some 18,717,150 work hours are needed to cultivate 9,700 ha of alfalfa, 15,140 ha of cotton, 9,190 ha of sugar beet, 10,155 ha of sorghum, 9,730 ha of wheat and 2,830 ha of vegetables. (Table 13-2 A to C) With the assumption of 10 work hours per day and 300 work days per year a total of 6,239 full-time workers are needed. Therefore the number of unemployed DIP peasant farmers and landless rural proletariat is estimated at 2,475. (Table 13-2 D)

The actual employment situation of the five agrobusiness enterprises of the DIP in 1973/74 is shown in Table 13-3. The total number of permanent and temporary workers was 1,115 in that year. In addition to this, KWPA employed a further

TABLE 13-2

Ultimate labour force requirement of the DIP agro-businesses

(A)

| Crop | Labour requirement hour/ha | Yield Basis kg/ha* |
|---|---|---|
| Alfalfa | 43.6 | 18,000 |
| " | 34.62 | 10,000 |
| Sorghum | 50.1 | 8,000 |
| Cotton | 970.1 | 3,000 |
| Milo | 50.1 | 5,000 |
| Sugar Beet | 246.7 | 60,000 |
| Wheat | 29.9 | 4,000 |
| Vegetables & Miscellaneous Crops | 218.4 | |

* Ultimate planned and expected yields on the agro-business lands.
Source. DRC 1968. Dez Irrigation Project, Stage 1 Feasibility Report. New York, PP 106 - 133.

(B)

| Crop | Area under Cultivation ha | Labour requirement hour/ha | Total labour requirement hrs/year |
|---|---|---|---|
| Alfalfa | 9,700 | 34.62 | 335,814 |
| Cotton | 15,140 | 970.7 | 14,696,398 |
| Sugar Beet | 9,190 | 246.7 | 2,267,173 |
| Sorghum | 10,155 | 50.1 | 508,765.5 |
| Wheat | 9,730 | 29.9 | 290,927 |
| Total | 53,915 | | 18,099,078 |

(C)

| Area of Agro-business lands ha | Percentage allocation of gross area for canals and road buildings* | Total land allocation for structures |
|---|---|---|
| 67,554 | 16 | 10,808.6 |

67 554 - 10,808.6 = 56,745.4 Net area of Agro-business lands.

56,745 - 53,915 = 2,830 (ha) Land of Agro businesses which is allocated to the cultivation of vegetables or miscellaneous crops.

* 16% is the quoted figure by ICC in its report of 1973 to the ADFI.

| Area under cultivation of vegetables or miscellaneous crops | Labour requirement hour/ha | Total labour requirement |
|---|---|---|
| 2,830 | 218.4 | 618,072 |

| Labour requirement for all crops other than vegetables and miscellaneous crops | Labour requirement for vegetables and miscellaneous crop | Total labour requirement of 56,745 ha net area of agro-businesses lands |
|---|---|---|
| 18,099,078 | 618,072 | 18,717,150 |

(D)

18,717,150 ÷ 3,000 = 6,239 Ultimate number of the DIP ex-peasant who will be employed*

* Calculation is made based on 300 days/yr at 10 hr/day.

Available labour force in the agro-business lands of the DIP and the unemployed labour force

| Ex-peasant farmers | Landless peasants | Total Labour Force | Total number of the DIP ex-peasants who will be employed ultimately | Unemployed Labour Force |
|---|---|---|---|---|
| 5,650 | 3,064 | 8,714 | 6,239 | 2,475 |

TABLE 13-3

Employed labourers by Agro-businesses of the DIP in 1973/74

| Company | Number of employed workers Permanent and temporary |
|---|---|
| H.N.A.I. | 250 |
| I.C.C. | 255 |
| I. Sh. | 260 |
| I.A.C.I. | 310 |
| G | 40 |
| Total | 1,115 |

784 as temporary workers. Thus the total number of permanent and temporary labourers of the agro-businesses was 1,899 in 1973/74. In the same year the number of peasants whose land was purchased and transferred to the agro-business companies was 3,583 (Table 13-4). Therefore some 1,684 were unemployed and left without any alternative jobs. In addition to that a further 2,065 were landless agricultural labourers with no right to work in agro-business companies or KWPA either.

TABLE 13-4

Ex-landholder peasants of the areas of the agro-businesses of the DIP 1969-70 to 1974-75

| Year | Area of Transferred Land (ha) | No. of Ex-landholder peasants* |
|---|---|---|
| 1969/70 | 3,778 | 315 |
| 1970/71 | 7,644 | 637 |
| 1971/72 | 19,360 | 1,613.3 |
| 1972/73 | 26,225 | 2,185.4 |
| 1973/74 | 43,000 | 3,583.3 |
| 1974/75 | 46,378 | 3,865 |

* The average land holding size was estimated at 12 ha, since the total 67,554 ha of land was owned by 5,650 farmers.

So far the strong correcting influence of the state as employer has been inevitable.

Undoubtedly companies would not provide work for all the people. The villagers, on being asked to add their own evaluation of the situation, replied that "unemployment was sometimes due to the fact that workers were too old, partially disabled or unable to obtain more work". This is true since companies employ those in the age group 15 to 40 years old. Also it is worth noting that employment in the big businesses is in part only a matter of temporary jobs in the context of agricultural development or harvest peaks. Secondly these requirements stand against a supply of at least 8,400 jobs which need to be created.

13-2 Wages and Salaries

At the present time the most serious problem in the area of the businesses is that the people who were formerly supported by their own agricultural products and sales of them are not able to maintain and provide for their own subsistence. They have been displaced and are jobless. George Wilson, a former head of the California Farm Bureau, who is involved with the Transworld Agro-Development Company in the DIP commented that "All the villagers got progressively further into debt as Khuzestan was modernised. They were so badly in debt that when KWPA came to buy their lands the net gain for the villagers was almost nothing."[10] For those peasants who were actually paid something for their land the situation was not much better. They soon realised that more or less the same sum was demanded of them to pay for their house in Shahrak, (village centres) or was to be added to their household budget since they were so poorly paid. The presence of the Farm Corporations and agro-businesses has done nothing to raise the welfare of seasonal unskilled labourers. Apart from heavy equipment operators, the wages are very low. In 1971 the daily wage of a male worker was 78 rials and that of a female worker 48 rials. One year later these had been increased to 87 rials and 52 rials respectively.[11]

In 1972 only 6 men were employed from the village of Upper Dailam (Pilot area) with a wage of 100 rials per day, whereas in 1973 a permanent worker in Haft-Tappeh was paid 120 rials or 15 rials per hour. In the same year 18 ex-peasants from the village of Azizabad were employed by KWPA at 80 rials per day.[12] In early 1975 Agricultural Labour legislation determined a minimum wage of 188 rials per day for an unskilled agricultural worker subjected to 10 work-hours per day based on 300 days of work per year. By mid-1975 the Iran-America Company's wages ranged from 65 rials per day for a female worker to 80 rials per day for a male worker. At the same time the Iran-Shellcott Company paid an irrigator 100 rials for 8 hours work and a further 50 rials for an extra 8 hours.[13] In other words, he was paid 150 rials for 16 work hours per day. By late 1975 the unskilled worker's wage ranged from 95 rials per day for a female worker to 120 rials per day for a male worker.[14] The Gallcb Company paid 120 rials for 12 work hours per day and IACI 105 rials for 8 work hours per day in mid-1975.[15] In contrast there are men earning as much as approximately four times the income of an unskilled labourer. They include foremen, supervisors, heavy equipment operators etc. An Iranian work supervisor at H.N. Agro-Industry of Iran in 1973 earning

130,000 to 150,000 rials per year. This contrast was even more marked higher up the occupational ladder. The Iranian head of the accounting office of the Iran-California Company was earning 915,000 rials annually. The Managing Directors (either Iranian or foreign) of the agrobusinesses earn roughly twice this amount or 1.8 million rials.[16] At the top of the agro-technocratic pyramid stands the project manager, almost always a foreigner. In 1970 Hashem Naraghi, the Managing Director of the Iran-America Company, received 3.2 million rials tax-free. This is certainly higher now due to inflation.

Agro-businesses do not give any training and do not have so much need for workers. The primary jobs are for unskilled people. Unskilled workers are irrigators, watchmen and pickers. Women weed and pick. There are bursts of employment during the short period of the sugar beet harvest, asparagus packing etc., but these are brief. The highest skills that they require from the ex-peasants are driving the alfalfa binders and assisting in the repair shop in various ways, e.g. helping the land levelling crew. All the skilled jobs as top mechanics, drivers, clerks in the offices, bulldozer drivers and supervisors of specialised agricultural tasks (cotton gin, spraying etc.) are given to townsmen who have no claim on the land and water rights. Consequently agro-businesses will not absorb more than 50% of the ex-peasant labour force simply because the whole point of mechanised farming is to economise on labour. In support of this figure it is estimated that the input of labour in the gross farm product in Iran fell from 61.5% in traditional agriculture to 22.7% in modernised agriculture.[17] Ordinarily a low wage implies a higher share of labour. The decline in the labour share in developed countries such as the U.S.A. could be related to the increase in wage rates. But in Iran such a paradoxical situation may arise as a result of the high cost of "imported management and skilled labour and personnel." The annual salary of a foreign senior consulting engineer in the DIP was $37,600, as opposed to $5,900 for his Iranian colleague in 1970.[18]

Dezful has high unemployment amongst the unskilled. There are countless porters always sitting around the warehouses. But there may be a scarcity of semi-skilled and skilled labour. There are jobs available for peasants and the urban lower class which require acquaintances, above all in government positions which everyone wants. There is no rational allocation of labour at any level in these ranks or in any industry. Haft-Tappeh now has a remarkably stable labour force although this cannot be applied to the cane cutters who are seasonally employed. In the big businesses of the DIP there always exists an uncertainty about the job and the source of livelihood, since even those who are young are not contracted or tied by the companies. A continuous rise in prices combined with high household numbers (ranging from 3 to 8 and even more) make the low income very inadequate, and thus the household must cut down on expenditure. This often leads to lack of protein and malnutrition in the family.

13-3 Resettlement

Among the most pressing and potentially costly of the secondary results of the construction of the Pahlavi reservoir dam and its associated irrigation project are those which concern the people who must be evacuated from the areas to be allocated to Agro businesses and who must subsequently be resettled.

The DIP resettlement programme began in 1969. Financially the programme was funded by the allocation of 1,377,560,000 rials of the development funds for the purchasing of the peasants' properties (i.e. 68,000 ha of the DIP lands)[19] and a further 819,563,000 rials for the construction of 13 new village centres (Shahraks).[20]

The initial centres consist of 500 family units, with provisions for expansion to 750 units. At the present time, there are 332 out of 900 units in Khosrow Shahrak (rural town), 450 out of 810 in Kavoos, 450 out of 750 in Sasan, 250 out of 810 in Bahram and 250 units out of 750 in Baback. The first three centres are located in the Pilot Area and the remaining ten outside the DPIP. (Fig. 11-1)

The original plan aimed at completing 13 shahraks within a seven-year period at the rate of 2 shahraks each year from 1969. KWPA expects to complete the first five shahraks by 1980 and the remaining 8 within the next three years (i.e. by 1983). By January 1976 the number of house units built in five shahraks was 1,732 of which 1,163 units were occupied in three shahraks of the DPIP. (Fig. 11-1)

A total of 26 traditional villages are located in the DPIP Agro-businesses lands, which are to be levelled. These villages have 1,860 inhabitants of which 1,156 are the ex-peasant families. Twenty villages out of the 26 had been levelled by January 1976.[21] A further 90 villages are to be levelled to make a total of 110 villages which have to be resettled in the Agro-businesses area.

## 13-5 Compensation for the property of the peasants

When the "Law for Utilisation of the Lands Downstream of Dams" came into effect in May 1968, the first job of the Ministry of Water and Power was to create a favourable climate for investors to invest in large-scale commercial farming enterprises. The prospective investors, either local or foreign, were not in a position to negotiate with a large number of farmers to buy or rent their lands to establish agro-businesses. Government intervention was imperative. The government acted as a powerful intermediary to purchase the land from cultivators and subsequently either to sell or to lease it to the investors. In the event, sales were not made because it was against the establishment policy of the government in the implementation of the land reform programmes which aimed to break up large private estates. Besides, owing to the huge investment in building the Pahlavi dam and later, its associated irrigation network, it was not in the interests of the nation to sell the lands to private companies, particularly where the investor was a foreign corporation. Therefore, a leasing policy was followed and it was decided to lease the lands to the companies on a long-term basis.

The government, through the Ministry of Water and Power, was authorised, as provided by Article 4 of the law, to purchase farmers' lands as the circumstances may require in terms prescribed by the provisions of Article 8 of the Supplementary Eight Articles to the Land Reform law passed on June 12, 1967.[22] Article 8 states that in areas where the government plans to implement water and soil development projects or other projects such as the building of dams or the digging of deep wells, the government has the right to purchase the farmers' land and to compensate them with land of equal value in the project area.[23] What happened in practice, in Khuzestan was that instead of being provided with an equal amount of land, money was instead paid to the farmers. A Committee consisting of representatives of the Water and Power Authority, The Land Reform Department, the Justice Department, the Land Registration Board and representatives of the Plan and Budget Organisation in the Project area, was authorised to decide upon the value of land which was to be purchased from the farmers. When determining the price of the land, factors such as the price of land which the farmers paid (or were supposed to have paid) under land reform, the land situation in terms of access to water, and the return per hectare were considered most important. As a rule it was decided to price the land, at least approximately equal to ten times its annual net return. On that basis, the price of one ha of irrigated land was set in the range of 10,000 to 28,000 rials and one ha of dry farming land between 2,000 and 5,000 rials. The approximate median price for one ha of irrigated land was 18,000 rials and one ha of dry farming land was 4,000 rials. It is certain that the free market price of the land was not taken into account. Had a market price been considered, the prices would have been considerably higher and the cost of buying the land would have become a heavy burden on the government. Where the price set by the committee was not acceptable to the farmer he could make a formal complaint. His complaint was considered by a superior committee made up by the heads of the same organisations which were represented in the valuation committee in the region. Their verdict was final and had to be accepted by the farmer. If a farmer refused to accept the verdict and to sign the documents, the Ministry of Co-operation and Rural Affairs took the necessary action and signed the concerned documents according to Note 3 of the Article 8 of the Law.[24] Whatever the price of the land there was subtracted from the total sum the amount that the farmer was supposed to pay to the previous landlord through the government as a part of the price of land under land reform. Ehlers pointed out that "the procedure which was employed for the valuation of the peasants' properties is not uniform but flexible. The hectare as a unit of measurement is not applied. The joft is considered to be a measurement of the land." The area of a joft varies from one village to another. An average figure of 8 ha per joft is quoted by KWPA. The majority of peasants owned one joft or less of the land. (Table 13-5) (Approximately 89 to 90% of peasants fell in this category)

TABLE 13-5

Percentage distribution of jofts in the lands of the Agro-business companies
1975

| Company \ Joft | 1/16 | ¼ | ½ | ¾ | 1 | 3 | 5 | 10 |
|---|---|---|---|---|---|---|---|---|
| Iran-America | - | - | 15 | - | 79 | - | 6 | - |
| Iran-California | - | - | - | 7 | 82 | - | - | 1 |
| Iran-Shellcott | 8 | - | - | - | 87 | 5 | - | - |
| IACI | - | 28 | - | - | 63 | 9 | - | - |
| Galleh | - | - | 35 | - | 63 | 9 | - | - |

Source: Table is constructed based on data obtained from Bozorgmehri, April 1975.
KWPA. DIP. Dezful Dept. of Agro-industry and Resettlement, Division of land purchasing.

In Daylam Olya (DPIP) 100,000 rials were paid for each joft of farm land and 110,000 rials for $\frac{3}{4}$ of a joft of orchards. In Daylam Sofla (DPIP) the compensation rate was 120,000 rials per joft, whereas that of Azizabad was 90,000 rials.[28] In 1971 the estimated purchasing prices for a family unit (usually one joft) ranged from 19,000 to 45,000 rials.[29] In 1972-73 a total 41,269.36 ha had been purchased at a total cost of 536,972,626 rials.[30] It indicates an average figure of 13,011.41 rials per hectare. By April 1975, when KWPA had completed the DIP land purchasing programme, the total compensation which had been paid was 1,159,370,775 rials for 68,000 ha. This means an average compensation rate of 17,050 rials/ha.[31] Najafi (1975) quoted a figure of 15,208 rials/ha.[32] Against this average figure stands a figure of 23,670 rials/ha which was the allocated money for purchasing the peasants' properties in 1970.[33] Two years later (i.e. in 1972) the allocated fund had been reduced to 20,258 rials/ha[34]. However, with the compensation money it was impossible for the farmer to buy a new peice of land in other areas or to start a new business. Under these circumstances the farmer became unemployed, he migrated to the nearby cities or became an agricultural labourer in the agro-businesses or was employed in other construction projects in the area.

Because the intention was to complete the evacuation of the lands and the villages in the area occupied by the farmers by the time of delivering the land to the agro-businesses, the government decided to purchase the houses of the villagers as well. Here, the decision not only affected the cultivators but also other village dwellers (i.e. Khoshneshins (land-less villagers who are not farm workers)). The Committee found the valuation of houses much easier than the land owing to a uniformity among house types which was used by villagers. In general, one room frequently served as the living quarters for a whole family in the villages. But there were some villagers who had slightly better houses with more rooms. The prices of villagers' houses set by the Committee was in the range of 5,000 to 50,000 rials with the majority of houses bought at the price between 20,000 and 30,000 rials. Therefore, on average, each villager received 25,000 rials for the sale of his house to the government. Although the peasants received compensation in cash, more or less at the same time they were asked if they wanted to buy a house in the new Shahrak. The cost of building each house to the government was 90,000 rials, of which only 45,000 rials would be paid by the villagers and the other half came from the government special fund for rural development. The way that villagers had to pay the price of houses depended on the sum of money which they received when they sold their previous houses. As Table 13-6 reveals, if it was low they could buy their houses on hire purchase with a first instalment which varied from 21,000 to 37,000 rials and the rest would be paid in ten years. If the sum they had received was relatively high the whole price of houses was to be paid for at the time of purchase. In 1972-73 a total 20,970,000 rials was paid by 713 ex-peasants. One year later the corresponding figures were 31,839,000 rials and 1,074 persons. These figures give an average house price of the order of 29,411 to 29,645 rials. KWPA intends to raise the price of houses by 7,000 to 7,500 rials because the building costs have increased substantially compared with the previous figure of 90,000 rials.[32]

TABLE 13-6

The first instalment for buying new houses in relation to the price of old ones

| Price of the old house (rials) | First instalment |
|---|---|
| Less than 20,000 | 21,000 |
| 20,000 - 30,000 | 29,000 |
| 30,001 - 40,000 | 37,000 |
| More than 40,000 | 45,000 |

Source: KWPA. DIP. Department of Agro-Industries and Resettlement. (Personal communication April 1975)

## 13-6 Problems of Resettlement

### 13-6-a The question of the house unit size

One matter of dispute is whether the Shahrak houses have enough land around them for each family to have a garden. Many foreigners thought that Shahrak residents would have a plot to farm so that they could supplement their meagre incomes with food grown by their own labours. KWPA has recently begun to think about the allocation of 2 hectares to every family. This would be very good but impossible. For one thing, the people of the Shahraks have no spare time to manage the small plot of land around their houses, so they would have no time to farm a larger plot. Furthermore, KWPA is so strict about supplying even the minimum water needs of the Shahrak that they would be unlikely ever to give the residents enough water to maintain family plots of land. There is a shortage of water as it is. Finally, it is self-evident that the companies ought to pay their employees enough money so they can eat properly on their wages, rather than expecting them to work for 10 hours or more a day for insufficient wages and then go home and work on a plot of land to earn enough food to keep the family alive.

The size of housing units is 750 $m^2$ of which 40$m^2$ is built upon. Each house consists of two rooms, a kitchen and an outside toilet. There is no bathroom. People can extend their buildings, but the extension plan must be drawn up by KWPA. One of the restrictions in the expansion plan is that kiln-bricks, concrete-bricks and iron must be used and not mud and semi-dried bricks. This is to preserve the Shahrak's appearance. The cost of expansion is estimated to be the same as that of purchasing the house. As far as the ex-peasant is concerned this price is beyond his means, without the aid of loans. Extending the housing units is impossible, at least at the present time as a result of the poor employment situation.

With regard to the family size, when the number exceeds five persons, and especially when there is more than one wife (usually amongst the Arabs) a house of two rooms is too small and makes circumstances very difficult for the people. KWPA has to revise the housing plan and change its classification to a higher grade.

13-6-b <u>Problems of subsistence between the time of resettlement and re-employment</u>

Peasants are moved in one or two days. Their land will have been expropriated years before they themselves are resettled. There are people living in old villages now who have not had any land of their own to work for 3-5 years. The land is taken first and then the people are moved whenever houses are available. After the rice or wheat harvest a peasant family has enough food for the coming year which is set aside at harvest time.[33] In this case the family has something to live on between the end of farming and the time the family finds a job. However, in some cases the companies have been in a hurry to level the land (having hired the equipment and wanting to use it continually) and so they have taken the land from the peasants even a week or so before harvest. It is not only excruciating for any farmer to see a field that he has tended and is just about to harvest, ploughed under before his eyes, but it also causes economic hardship. However, the companies pay the peasants for the harvest in these cases.

Animal husbandry, which could be considered as a means of subsistence, has been restricted to one cow and two sheep or goats for each peasant family. It was planned to remove water buffalo herds from the project area and the remaining cattle, sheep and goats were to be sold to Agro-businesses, Farm Corporations or to livestock producers outside the project area. The maximum number of cattle and sheep which ex-peasants are allowed to own is estimated at 1,200 cattle (out of 5,050) and 2,400 sheep or goats (out of 21,893) in the Pilot area. Since thousands of the peasants' cows and water buffaloes were lost and these were the major sources of meat and dairy supplies, today the shahraks cannot buy milk or yoghurt because none is available.

With losing the land and livestock, the ex-peasant has lost his credit in the city market (Dezful and Andimeshk). In the past, farmers used to buy their whole year's supplies from the shops on credit and pay their bill at harvest time whereas now they have to purchase daily or weekly with cash. Because of this, expenditure is now greatly increased, and as a result the immediate problem caused by resettlement is malnutrition. No data is available on nutrition in the shahraks. Undoubtedly the nutritional level in the Shahraks is much lower than in the period 1964-1969, since there is no milk, few chickens, very little rice, no eggs etc. Far more important than these things, though, is that the initiative and rugged self-reliance that the Iranian peasantry has always had in the villages and it was especially encouraged and gained in the post-land reform period, is almost becoming weak in the shahraks. They have somewhat become helpless people waiting for the state to do everything for them. The negative impact of this situation seems great at the national scale.

13-6-c Social services in Shahraks

Every Shahrak was to be supplied with clinics, schools, vocational schools, bath houses, drinking water, electricity and slaughter houses.

In Kavoos there are two bath houses, a small hospital and ambulance centre, a technical school and a butchering centre. In the next new town along the road (Khosrow) there is a clinic. In Sasan there is a gendermerie post. A mosque was built by the people in the Kavoos shahrak and also in the next (Khosrow). There are primary schools in all shahraks. KWPA has an office in Kavoos just for the workers employed by it. There are no official stores, shops or services. UNESCO had built some 5 to 10 rural clinics and had begun to staff them (small buildings to regulate check-ups, vaccinations etc.) but some of these have fallen into disuse, so health provisions in the countryside itself have not improved sufficiently. The peasants both traditionally and in the Shahraks go to the town to the doctor in most cases. These urban doctors charge very high prices. While the Red Lion and Sun make a good attempt at a public clinic, they too have sometimes inadequate resources to deal with health problems.

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# CHAPTER 14

# CANALIZATION AND DEVELOPMENT OF SCHISTOSOMIASIS IN THE DIP

## 14-1 The Bilharziasis Control Project

The Iranian effort to expand agricultural development through increased water availability illustrates problems faced by all developing areas where schistosomiasis is endemic or a possible threat. From the standpoint of disease transmission, the major impact of the irrigation project in Iran (Khuzestan) was to increase the length of accessible snail habitats. The first series of surveys for schistosomiasis in Khuzestan were set up in 1953. The surveys concluded that "unless immediate attention was paid to the disease it would become a major problem."[1]

As a result of this survey and because of the proposed irrigation scheme in the Dez area, the Ministry of Health, along with the Plan Organisation of Iran, asked the Institute of Public Health Research to organise a research and control station in Dezful with the assistance of the School of Public Health of the University of Tehran. The World Health Organisation (WHO) contributed advisors. In 1961 the Near East Foundation was asked to assist with the administration of the project and to provide a sanitation advisor. The Project was called the Bilharziasis Pilot Control Project and its objectives were as follows:

a) Identifying the exact locations of Schistosomiasis in Khuzestan, snail vectors and their habitats, rates of transmission and mapping the villages.

b) Identifying the most effective and economical way of controlling schistosomiasis.

c) To implement control measures in an attempt to bring the disease to low levels of prevalence.[2]

The area of the Bilharziasis Experimental Control Project was 1,646 $km^2$ in Khuzestan as a whole and encompassed 250 $km^2$ of the DPIP.

By 1965, of the 930 infected persons examined, one third had one or more symptoms of disease.[3] The survey also disclosed that infection rapidly approached a peak in the 11-15 year olds, then an increase also appeared in the 50-60 age group. High levels of infection (17%) were found in the 0-2 year olds because mothers washed them in snail-infested pits and ponds around the villages. _Bulinus truncatus_ was found to be the only snail vector for _schistosomiasis haematobium_. Surveys carried out from 1958 through 1961 noted that the major breeding places for the snails were closely connected with human activities, essentially with irrigation. Excess irrigation waters or waters coming from leakages or overflowing of irrigation canals became breeding places when the water became stagnant or could not reach their natural drains.[4]

The effects of the DPIP helped to create the kind of stagnant water favourable to the production of _Bulini_. The post-DPIP survey suggested that:

> From 1963 to 1965, the types of habitats were similar to those of 1962. They included ponds, some old canals, drains, swamps and springs.
>
> From 1965 onwards, an increased number of habitats was found in swamps and in sidepools along new canals and new highways.
>
> The flow of water in the old canals was much slower than it had been previously, thus more canals became infested with _B. truncatus_ during 1966.[5]

Since 1968 with the introduction of big businesses into the DIP, the health and education undertakings of KWPA in the DIP area were handed over to other authorities completely. The DIP Bilharziasis control programme was undertaken by the Public Health Office of Khuzestan. The Bilharziasis control programme followed the same approaches as before but over a larger area. The area of survey included Dezful, Shushtar, Haft-Tappeh, Susangerd and the Karoon dam site and its associated irrigation project area. The number of villages taken for the identification of snail habitats and the rates of transmission increased to 673 in 1973. The Karoon dam site and its associated irrigation project area were added to the Bilharziasis control areas.

14-2 Impact of the DIP on the Transmission of Schistosomiasis

Since the beginning of the DIP, concentrated efforts have been made to control the spread of the bilharziasis disease. Different methods have been employed to control the infection and to decrease the prevalence of the disease. Among them three methods are most important. These methods are molluscididing. engineering measures and chemotherapy. Various molluscicides such as copper sulphate, sodium pentachlorophenate and Bayluscide were tried. Since 1967 Bayloscide only has been used. This is the most common method, and is used all over the DIP area and in the Haft-Tappeh Sugar Cane Project area after 1970. Because of the extension of furrow irrigation and the existence of 14 night water reservoirs the snail was common there. Although this method is an easy one, practically, it affects wildlife seriously. (Personal communication with Hazraty 1975) On the other hand a complete kill of B. truncatus in a habitat after molluscicidal treatments is demonstrated by the fact that no snails were found in monthly tests for a period of one year or longer. (This covers at least two potential snail population peaks.) Failure is detected when one or more live snails is collected within one year of treatment.[6] Continuous effort is impossible because of the shortage of staff and equipment in the Public Health Office.[7] Also the immigrant workers carry and spread the disease in the project area. To check and control these daily immigrant workers is beyond the present capability of the Public Health Office.

Chemotherapy is another method which is employed but is only administered after transmission has been eliminated through snail control and where prevalence is greater than 10 per cent.[8] Miracil-D, Astiban, Ambilhar and now Hycanthone injections are methods which were chosen for treating people. Because of the difficulties in administration and countless dangers and/or unpleasant side-effects, the use of chemotherapy has been considered as an unnecessary method especially when the de-infestation is highly efficient.[9]

Engineering measures such as drying up the small ponds, large swamps around villages, repairing the banks of canals and cleaning canals have been employed as methods for snail control.

Although controls were established, the impact of increased snail habitats resulting from increased water on the landscape has been clearly identified in the DPIP area. The prevalence of infection among humans which was 22.0% in 1961 declined during the time of the construction of the irrigation canals to 7.0% in 1966. When all the villages of the DPIP began receiving irrigation water in 1967 the percentage of infection increased to 27.3%.[10] The development of bilharziasis infection in the

DPIP area is not a newly-discovered phenomenon. From the beginning, the Dez Irrigation Project planners realised the impact that the project would have on the spread of schistosomiasis. DRC pointed out that:[11]

> "The extensive projects which are a part of the Seven Year Plan and which will make possible the growing of more than one crop per year could, unless precautions are taken, spread the infection (schistosomiasis) out of its present pockets with more extensive transmission. More water on the land could result in heavier infection....."

Since the establishment of agrobusiness enterprises no data have been available on the Bilharziasis situation of the DPIP area. The Public Health Office of Khuzestan, which has undertaken the Bilharziasis Control Programme has recorded data on the identified infected villages and the number of tested and infected people. (Table 14-1)

In these data, the area under control is changed every year, therefore an appraisal of Bilharziasis control is impossible, but in general it declined from 8.77% in 1970 to 1.2% five years later. (Table 14-1) What is obvious is that with the development of the irrigation and drainage networks of the DIP the infection became more widespread with more extensive transmission. (Appendix F). Canal lining is usually referred to as an effective engineering control measure for schistosomiasis. In the West Dez Irrigation Project all of the canals are being lined for reasons of disease control as well as to decrease water losses because of seepage. In 1973, schistosomiasis appeared in previously uninfected areas in the new west project's lined canal areas. (Appendix F). Snails have been found in both the newly lined canals and in the newly created swamp areas near those canals.

TABLE 14-1

Bilharziasis Prevalence in the Control Areas of the Public Health Office

1970-74

| | Tested Population | | | Infected Population | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | Male | Female | Total | Male | Female | Total | Number of Controlled Villages | % of Prevalence |
| 1970 | 13,143 | 8,130 | 21,273 | 1,076 | 791 | 1,867 | 129 | 8.77 |
| 1971 | 14,118 | 8,549 | 22,667 | 601 | 325 | 926 | 168 | 4.8 |
| 1972 | 24,279 | 13,090 | 37,307 | 921 | 521 | 1,442 | 332 | 3.9 |
| 1973 | 46,426 | 33,822 | 80.248 | 1,309 | 951 | 2,257 | 673 | 2.81 |
| 1974 | 44,031 | 29,293 | 73,324 | 737 | 345 | 882 | 512 | 1.2 |

Source: Table is constructed based on data obtained from Hazrati, The Office of Health, Ahwaz, Khuzestan, 1975.

Sanitary and health education measures are further tools for combating the transmission of schistosomiasis. The Bilharziasis Control Project was relatively successful in its sanitary and health education programme (Personal communication with Setayesn, April 1975). With the movement and relocation of the project population in Shahraks (new rural towns) parasitic diseases have thrived in these new towns, where no domestic water is supplied except for a single tap serving two blocks of families. Similarly no waste disposal facilities are provided except for Jubs (open drains) which encircle the blocks, and little time or money is spent on health education. Today in addition to Cholera and Malaria which have recently been reported in the shahraks, schistosomiosis is increasing again after years of concentrated effort to control its spread.

Extensive land levelling by agro-businesses should be an effective limitation on the transmission of schistosomiasis. However, two drawbacks could affect any advantages. One is that those who work for the agro-businesses, both male and female, must be between 18-40 years old and healthy. Thus, many villagers with still high levels of parasitic and other diseases, are not employed. Such people do not generally seek out health facilities, nor are they treated by the agro-businesses and unless government agencies find them, they remain active in the transmission cycle. A second related disease problem arises because of strict health qualifications governing the employment of local people by the agro-businesses, which results in their dependence upon migrant workers. While these workers are also examined for health they come from areas where schistosomiasis is widespread, such as Iraq, and can easily bring the disease with them through vector snails clinging to their clothing or possessions. This problem was intensified when approximately forty thousand Iraqi refugees were accommodated in the newly-built rural towns of Baback and Bahram (in the west DIP area). Many of these people had been employed by agrobusinesses. (Personal observations during field trips, also personal communication with Colonel Naraghi who was in charge of the Iraqi camps in the DIP, April 1975). In many parts of the world migrant labourers are active transmission agents.[12] However as long as irrigation systems are expanded and armies, refugees, migrant workers and others criss-cross borders, schistosomiasis must continue to be considered a problem. Control requires a long, expensive effort involving dedicated work, over a long period of at least over 15 years. It costs 5 rials per metre of accessible snail habitats for mollusciciding, 17 rials per metre of accessible snail habitats for engineering measures and 10,000 rials per chemotherapy treatment (at 1974 prices).[13] The scale of expenditure and human effort for the control of Bilharzisis disease becomes even greater when one considers that 14 dams and irrigation networks are planned for the five rivers of Khuzestan.

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# CHAPTER 15

## THE FLOOD CONTROL PROJECT OF THE PAHLAVI DAM SCHEME

The Dez river periodically floods an area to the south of a point halfway between Dezful and Band-i-Qir, where the Dez flows into the Karoon River. The Dez river also contributes, together with the Karoon, to the periodic flooding of the areas further south from Ahwaz to the Shatt-el-Arab (Arvand rood). The lands located between the Dez and the Karkheh rivers are usually flooded by the Karkheh river.

Floods cause great damage to villages, crops, livestock, highways, railroads, post and telegraph facilities and the city of Ahwaz.

The damage caused by floods in Khuzestan ranges from 30 million rials for a normal flood (expected on the average every two years) to about 440 million rials for a large flood, having a recurrence of 30 years. The average annual damages are estimated at 80 million rials.

The impact of the Dez dam scheme on these floods has been to reduce flood damages. Damages owing to normal floods are expected to be practically eliminated and damages owing to the 30 year flood are to be reduced from about 440 million rials to 50 - 90 million rials. Average annual damages were expected to drop from 80 million rials to 5- 10 million rials. The average annual savings resulting from the reduction in floods would amount to about 70 - 75 million rials.[1]

### 15-1 The Flood of January and of March - April 1969

#### 15-1-a Precipitation

As a result of intense precipitation during January and snow melt runoff during March and April

1969, the Khuzestan rivers flooded in late January and also in late March-early April 1969. The most intense precipitation occurred at Haft-Tappeh recording station on January 22-23 with a total of 150 mm, at a rate of 21.5 mm per hour.[2]

15-1-b Flood damages in Khuzestan

Both the January and the March-April floods were high on the Dez, the Karkheh and the Karoon rivers and were relatively less intense on the Jarahi and Hendijan rivers. At Godar Landar gauging station, the Karoon river rose as high as 17.40 metres during 6 days. The peak discharge at Ahwaz was 6,704 $m^3$/sec.[3] The loss of 28 lives was attributed to the storm and floods and the total damages amounted to 1,440 million rials. The only assistance which was given to the people was a 6% loan of 15,278,000 rials granted to 201 homeless people in the city of Ahwaz, by the Mortgage Bank of Iran.[4]

15-1-c Flood of the Dez river in January and March-April 1969

In the Dez river basin, during the flood of January 1969 the peak inflow to the Pahlavi Dam Reservoir was 4,070 $m^3$/sec. The peak outflow from the reservoir was regulated at about 1,800 $m^3$/sec. The total stored water was 678 x $10^6$ $m^3$ and resulted in a rise of reservoir elevation of 12.71 metres.[5] During the flood of March 1969, the peak inflow to the reservoir was 3,880 $m^3$/sec, while the peak outflow from the reservoir was regulated to about 2,000 $m^3$/sec. The total stored water of this flood was 262.5 x $10^6$ $m^3$ which resulted in a rise of reservoir elevation of 4.72 metres. Figure 15-1 shows the operation curve of the Pahlavi Dam Reservoir during the floods of January and of March 1969.

In April 1969 the peak inflow to the Pahlavi reservoir was 2,700 $m^3$/sec while the peak outflow from the reservoir was 1,700 $m^3$/sec.

15-1-d <u>Flood damages of the Dez River in 1969</u>

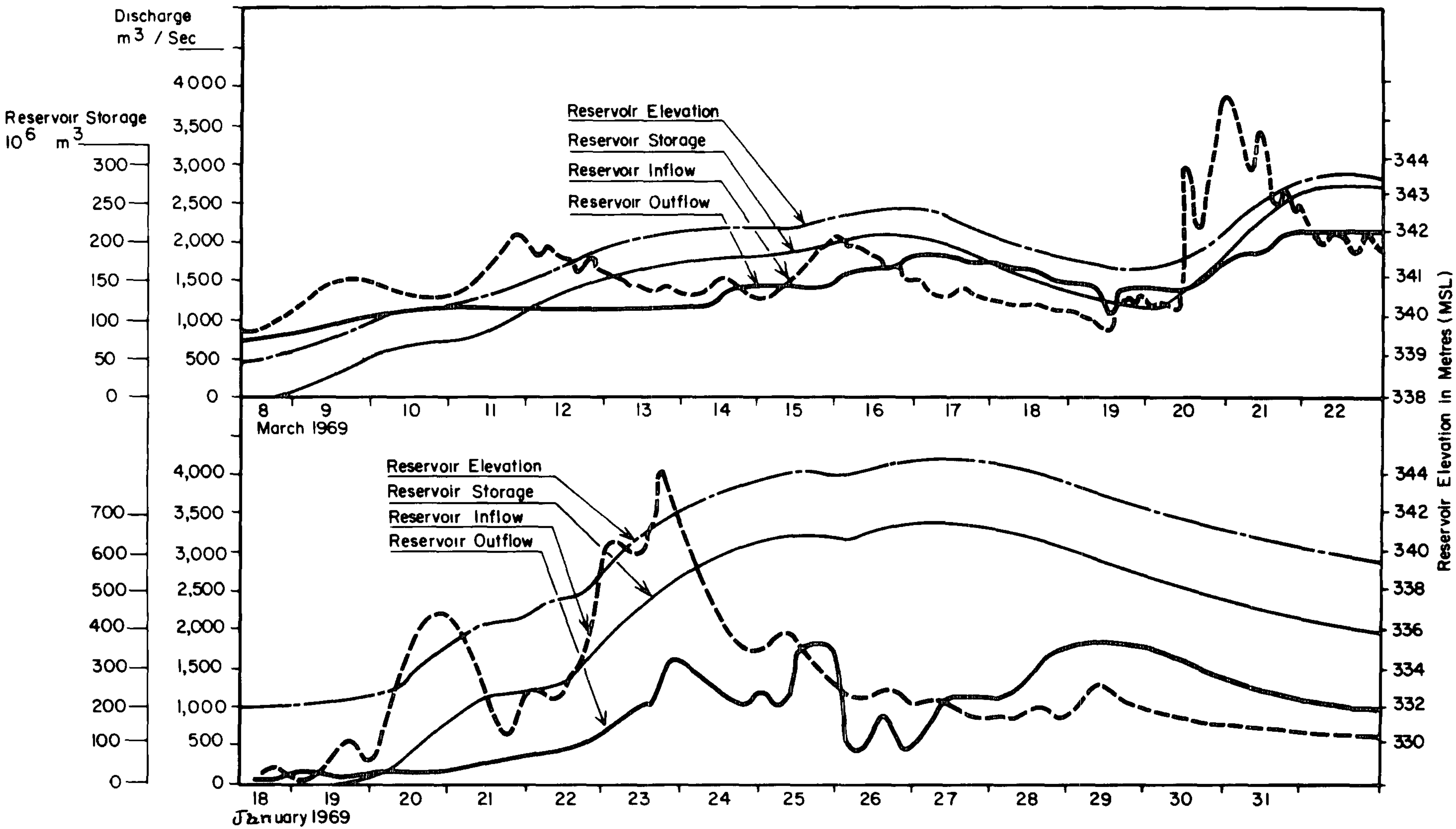
According to the survey carried out by the Resource Investigations Project of KWPA, damages caused by the floods on the Dez river in 1969 were estimated at 151,850, 000 rials. (Table 15-1)

During the flood heavy damage occurred in the basin upstream from the Pahlavi reservoir. The city of Dorood was flooded severely and the Dorood-Andimeshk railroad was closed for a short period, because of storm-induced landslides. No data are available on damages caused by floods in the basin upstream from the Pahlavi reservoir.

Damages in the lower Dez river basin were not considerable, and were confined mostly to lowland agricultural areas. The total damages to crops and livestock were estimated at 120,619,000 rials which is 79.35% of the total damages of 152 million rials caused by the Dez river.

The contribution of the Dez river damages to the total damages of Khuzestan caused by floods in 1969 is 10.53%. The inundated agricultural land was 25,514 ha. The farmers lost 1,814 animals and 56 villages

Fig 15·1 MOHAMAD REZA SHAH PAHLAVI DAM OPERATION CURVES
FLOODS OF JANUARY AND MARCH 1969



out of 197 villages of the DIP area were damaged. (Table 15-1).

TABLE 15-1

FLOODED AREA AND FLOOD DAMAGES IN THE LOWER DEZ RIVER BASIN
JANUARY 1969

| Type of damage | | Value in 1000 rials |
|---|---|---|
| CROPS | | |
| Wheat | 21,105 ha | 42,210 |
| Barley | 20,108 " | 3,794 |
| Vegetables | 2,299 " | 68,970 |
| Forage | 2 " | 12 |
| TOTAL CROPS | 25,514 ha | 114,986 |
| LIVESTOCK | | |
| Sheep & Goats | 1,567 head | 2,821 |
| Cows and calves | 164 " | 1,640 |
| Buffalos | 52 " | 1,092 |
| Camels & Horses | 6 " | 42 |
| Donkeys | 25 " | 38 |
| TOTAL LIVESTOCK | 1,814 head | 5,633 |
| OTHERS | | |
| Equipment | -- | 20,505 |
| Houses & bridges | 563 units | 7,882 |
| Foodstuffs | 545 tonnes | 2,180 |
| Personal effects | -- | 620 |
| Seeds | 11 tonnes | 44 |
| TOTAL | | 81,231 |
| Total Cultivated Area inundated | 25,514 ha | |
| Total Damages | | 151,850 |

Total No. of Villages Damaged = 56
Total No. of Existing Villages = 197

Source: Alavi, M. 1969.

## 15-2 Floods of March 1972

### 15-2-a Precipitation

Frontal storms moved into Khuzestan on 26 Esfand 1350 (16th March 1972) and heavy precipitation continued intermittently until 5 Farvardin 1351 (26th March 1972). The total storm exceeded 10 days in duration. The maximum precipitation of 301.0 mm was recorded at pol-e-zal and the minimum of 70.0 was recorded at Ahwaz. The total precipitation of seven days is estimated at 200 mm at the Jelogir station, 158 mm at Tal-e-Zang and 150 mm at the Godar Landar station.[6] At the Pahlavi Dam precipitation reached a maximum of 25.0 mm per hour or 3 mm per hour more than that of the 1347/48 (1969) storm.[7]

### 15-2-b Flood damages in 1972

In the floods of 1972 rainfall in early spring combined with variable amounts of snow pack melting in the mountains resulted in a non-uniform magnitude of floods in the lowlands of Khuzestan. On the lower Karoon maximum stages did not reach those of the 1347/48 (1969) floods. The Karoon river discharge was 620 $m^3$/sec at Godar Landar on the 25th of Esfand (16th March). It increased to its maximum value of 3800 $m^3$/sec on the 3rd of Farvardin (23rd March). The river discharge at Ahwaz reached 4,600 $m^3$/sec on the 6th of Farvardin (26th March).[8]

On the lower Karkheh river, the maximum stages generally exceeded those recorded during the 1347/48 (1969) floods. The mean discharge which was 304 $m^3$/sec at Gelogir station on the 25th of Esfand (16th March) increased to 2200 $m^3$/sec on the 3rd of Farvardin (23rd March). At the Hamidieh river gauging station the maximum river discharge of 1500 $m^3$/sec occurred on the 6th of Farvardin (26th March). During the period 26.12.1350 - 10.1.1351, 4,857 million $m^3$ of water flowed to the Persian Gulf.[9] The total direct damages caused by the floods of 1972 were estimated at 485 million rials in Khuzestan. 285 million rials or 53.39% of the total occurred in the lower Karkheh river basin between Pay-e-Pol and the Hoor-Al-Azim swamp. The intangible damages were small during the 1972 floods. There was no loss of human life nor was there a noticeable increase in the recorded number of diseases, injuries etc., as a result of the flood.

15-2-c The Flood of the Dez river in 1972

The maximum discharge of the Dez river of 3400 $m^3$/sec occurred on the 3rd Farvardin 1351 (23rd March 1972) compared with its mean daily discharge of 537 $m^3$/sec, on the 26th of Esfand (17th March).[10]

According to the original design criteria, the Pahlavi Reservoir should have provided 850 million $m^3$ of storage space reserved for flood control.

On the 26th Esfand (17th March) the reservoir was at an elevation of 335.50 m above the sea level, thus providing about 824 million $m^3$ of storage space for the control of downstream flow.

On the 3rd Farvardin 1351 (23rd March 1972), to reduce the super position of the peak flows of the Dez and the Karoon rivers below their confluence (near the Molla Sani station), the total outflow from the Pahlavi dam was reduced from over 1700 $m^3$/sec to less than 1,100 $m^3$/sec for a 12 hour period (Fig. 15-2). The operation coincided with a peak flow of the Karoon river in Ahwaz and helped to reduce the maximum stage in Ahwaz by about 0.5 metre.

15-2-d Flood damages on the Dez river in 1972

Flood damages caused by the Dez river were estimated at 10.11% of the total flood damages of Khuzestan in 1972. The largest losses were due to the inundation of agricultural lands under cultivation. Out of a total of 49,034,000 rials of damages along the Dez river, 38,435,000 rials were crop damages. (Table 15-2) No livestock loss occurred. The flood damages of 1972 were 32.2% of those of 1969. The damaged villages which numbered 56 out of 197 in 1969 had been reduced to 46 in 1972.

## 15-3 The floods of April 1974 and of February 1976

In late January 1974 severe snow storms occurred on the upland areas around Masjid Solaiman, Laly and Izeh. The rains of mid-March were accompanied by snow melt on the upland areas of the catchments of the Karoon, the Karkheh and the Dez rivers in Khuzestan. The Gharasoo river flooded on 28.12.1352 (19th March 1974).[11] On the following day (20th March) the Karkheh river flooded and a maximum discharge of 2,680 $m^3$/sec was gauged at the Hamidieh station.[12] The floods of the Karkheh river in 1974 were of greater magnitude than the floods of 1969 and 1972. In these years the maximum discharges of the

Fig 15 2 MOHAMAD REZA SHAH PAHLAVI DAM OPERATION CURVES FLOOD OF FARVARDIN 1351 (MARCH 1972)

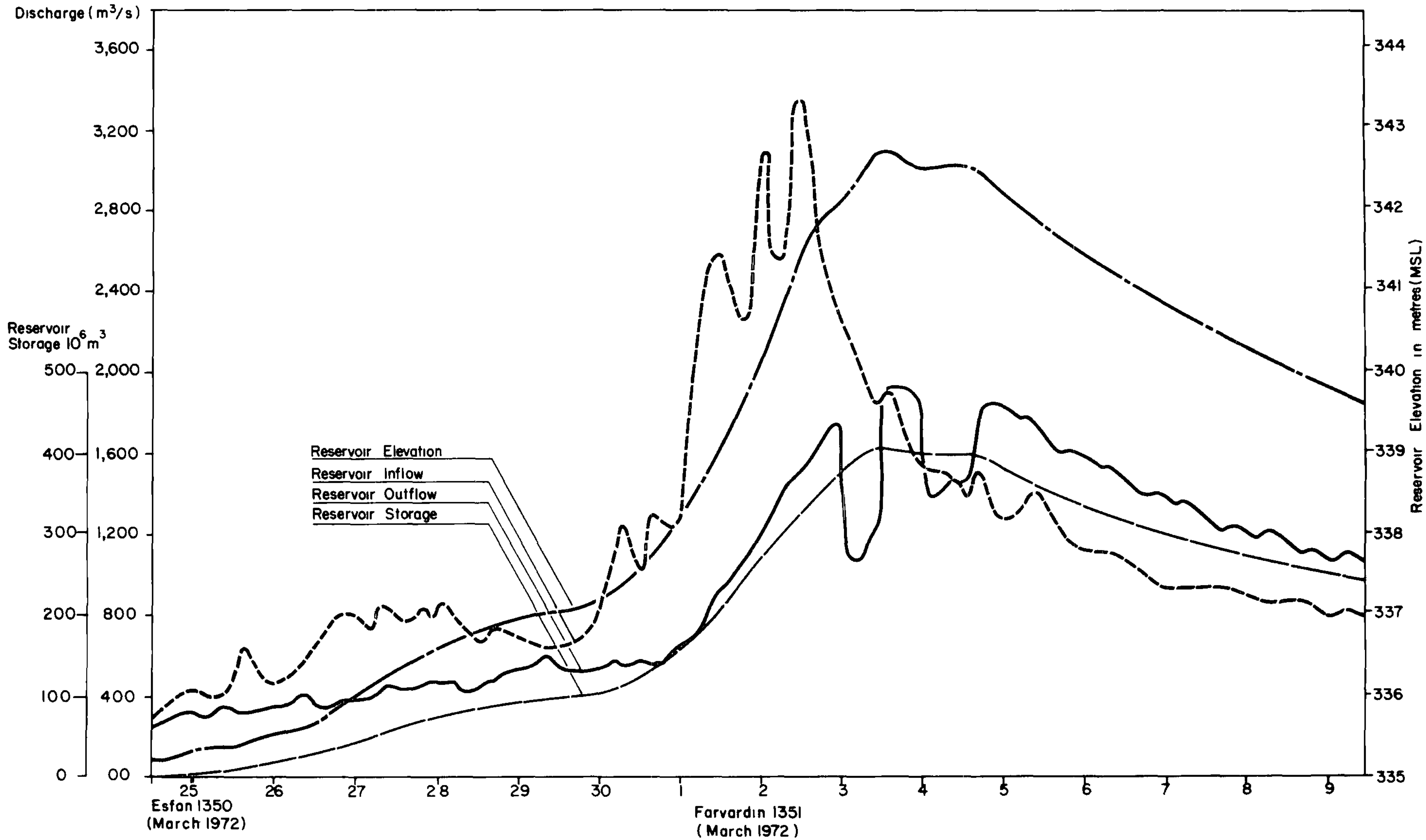


TABLE 15-2

THE FLOOD AREA AND FLOOD DAMAGES IN THE LOWER DEZ RIVER BASIN

MARCH 1972

| TYPE OF DAMAGE | EXTENT/UNIT | VALUE IN 1,000 RIALS |
|---|---|---|
| CROPS: | | |
| Wheat | 7,365 ha | 14,730 |
| Barley | 436 " | 785 |
| Vegetables | 764 " | 22,920 |
| Forage Crops | - | - |
| Total Crops | 8,565 ha | 38,435 |
| LIVESTOCK: | | |
| Sheep & goats | - | - |
| Cows & Calves | - | - |
| Buffalos | - | - |
| Camels & Horses | - | - |
| Donkeys | - | - |
| Total Livestock | - | - |
| OTHERS: | | |
| Equipment | - | 8,925 |
| Houses and Bridges | 124 units | 1,674 |
| Foodstuff | - | - |
| Personal effects | - | - |
| Seed | - | - |
| Total | - | 10,599 |
| Total cultivated Area inundated | 8,565 ha. | |
| Total damage | | 49,034 |

Total no. of villages damaged = 46
Total no. of existing villages = 197

Source: Ministry of Water and Power, KWPA Resource Investigation Project, 1973. P.66.

river were 1532 $m^3$/sec and 1863 $m^3$/sec respectively. As a result of the 1974 flood the Shush township and its villages were inundated. The flood on the Karoon river was not as serious as it was in 1969 and 1972. The maximum discharge of the river was 2,386 $m^3$/sec at the Ahwaz station in 1974[13] compared with 4600 $m^3$/sec in 1972 and 6704 $m^3$/sec in 1969. The stage of the Karoon river reached 13.50 metres above sea level at Ahwaz. The floods of theDez river too were not as great as those which had occurred in 1969 and 1972. The maximum discharge of the river was 1324.7 $m^3$/sec at the Tal-e-Zang station (1974)[14] compared with two values of 4070 $m^3$/sec and 3400 $m^3$/sec for 1969 and 1972 respectively. As a result of the 1974 floods on the Karoon and the Dez rivers, the Ahwaz-Andimeshk highway was inundated and 12,000 ha of agricultural lands were damaged. In addition 2,000 housing units were destroyed. After ten days of flooding, the level of the rivers decreased. No detailed data are available on the damages caused by floods of 1974 but many animals were known to have been killed.[15]

The floods of 1976 began on the 12th February. After heavy rains, the Bahmanshir river in Abadan flooded. As a result the roads connecting Abadan, Ahwaz and Khorramshahr were inundated. At the same time, the Zohreh river in Southern Khuzestan flooded. As a result of this flood the administrative centre of the Hendijan District was inundated. On the following day (13th February) the Karoon river flooded. At 6 p.m. the height of the river at Ahwaz was 14.83 metres above sea level compared with a height of 13.50 metres of which had been recorded in the 1974 flood. As a result of the floods on the Karoon river the east bank of the river in Ahwaz was submerged and the farmlands of many villages, such as Kut-i-Saleh and Aboo Obais were damaged. The storms which had begun on the 11th February in the Haft-Tappeh area and the floods of the Dez and the Karoon rivers caused heavy damages to the electricity transmission lines from the Dez dam to the central, southern and the south-eastern parts of Khuzestan.[16] As a result all cities and towns except Dezful, Andimeshk and Masjid-Solaiman were faced with a critical shortage of electricity. Because of this problem Ahwaz had no electricity and drinking water for five consecutive days. The Ahwaz water treatment plant and the Abadan meat freezing storage plant were out of operation because of cuts in their electricity supply owing to storms and flooding.[17]

The flood damages in Khuzestan have been a great problem facing KWPA and other authorities of Khuzestan. The Pahlavi dam operations and the flood control programmes began in 1963. 98% of the constructional works of the Reza Shah Kabir dam on the Karoon river were completed at the time that the dam was visited by the author in April 1975. Because of some technical problems it had been impossible to fill the reservoir at the time of the visit. Despite these efforts, flood damages still remain a serious problem in Khuzestan. KWPA and the other authorities hope that by the time the Reza Shah Kabir dam is in operation (possible date is April 1977),[18] the flood damages in the lower Karoon basin will be reduced considerably.

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    b) BAQAI, The Chief Officer of the Karoon scheme of KWPA, Ahwaz. Personal interview, April 1975.

# CHAPTER 16

## THE DEZ DAM MULTI-PURPOSE SCHEME

## THE HYDRO-ELECTRICITY SUPPLY

### 16-1 Problems of Electricity Supply and Demand in Khuzestan in 1959

Before the electricity supply from the Pahlavi dam, the supply and distribution of electricity in the Khuzestan region was limited to certain urban centres and areas where electricity was needed for industrial purposes, notably, for the Oil Consortium and NICO operations. Villages and rural areas, accounting for 65% of the region's population, received no electric power service. In the low land of Khuzestan from Abadan to Ahwaz 84% of the electricity which was generated (110 mw) was used by the oil industry[1].

The efficiency of the electricity service was generally low and the price of power usually high. The household use of electricity was a luxury. Retail rates were from 3.5 to 7 rials per kilowatt hour, compared with the average U.S.A. residential rate of about 1.9 rials (equivalent) per kwh, including the municipal tax of 1 rial per kwh applied to all domestic and commercial power consumption. There was too small a generating and distribution system capacity to meet the demand. The applicants of electricity had to provide local funds ranging from 2,500 to 10,000 rials for the extension of electricity services[2].

The estimated average electricity consumption for the Khuzestan urban population was 139 kwh per capita per year. This includes the

NICO consumption as well. The village and rural population of the region was estimated to consume a nominal average of less than 10 kwh per capita annually. The corresponding figure for the Dezful area was 33.6 kwh and that of Shush, 15 kwh. The combined average annual consumption for the population as a whole averaged less than 60 kwh . The oil industry was the only large scale power producer in the area. Its Abadan power plant supplied the energy requirements of the Abadan refinery, the Aghajari oil field and the oil port of Bandar Mashar as well as the municipal demand of Abadan and Khorramshahr. The total load of the Abadan plant was 73 mw. In addition, the consortium had a number of smaller, not inter-connected plants, at the various fields, and pumping stations with capacities of up to 20 mw.

There were two groups of small plants with a total capacity of about 6 mw serving the city of Ahwaz. There were also several small diesel plants (which served a few small towns and villages of the area) and a small hydro plant at Shushtar.

It was planned that the electricity supply from the Dez dam would be transferred to the cities of Abadan, Khorramshahr, Ahwaz, Dezful, Andimeshk, Shush, Dorood and Azna. The total 1957 peak load of these cities and towns was 12.101 mw and the expected load for 1962 was 36.300 mw[3]. Ahwaz was the first city scheduled to receive hydro power. In 1959 it was served by four power plants with 6,315 kw of installed generating capacity. About 7,500 consumers were being served in Ahwaz. This is the figure quoted by DRC, while KWPA quoted only 4,000[4].

Abadan and Khorramshahr received their electricity through wholesale purchases from the oil companies at the Abadan plant. Abadan with 18,000 utility customers, was the largest municipal electric power user in Khuzestan[5]. Per capita consumption of electricity was higher in Abadan than in any other town (277 kwh compared with 150 kwh in Ahwaz). Khorramshahr with only 2,600 consumers had a serious shortage of electric power (120 kwh per capita consumption)[6].

The installed capacity of the towns of Dezful, Andimeshk and Shush with a combined population of 100,000 was 3 mw. The combined load of these towns, plus the requirements of the Dez Project village, the Sugar Cane Project at Haft-Tappeh and the Iranian Air Force and Army stations near Andimeshk was expected to be 16 mw after the availability of the Dez hydro-power electricity in 1962.

## 16-2 Industrial electricity demand in 1959 and the forecasts for 1962 to 1973 in Khuzestan

Compared with the industrial demand of the oil industry in Khuzestan, other demands were small.

In Ahwaz, among the consumers of power in the industrial category, which were supplying their own power requirements, were the Kut Abdollah installations of the oil companies. The total power needs of these installations was 2,600 kw.

Other industrial establishments, which supplied their own requirements in the Ahwaz area included the Iranian State Railway with 600 kw and the Ahwaz Sugar Refinery with 900 kw capacity. The total new small industrial demand in Khuzestan was estimated at 5,000 kw and the large industrial demand 92,400 kw. The total energy requirements including industrial, domestic and commercial were estimated to be 132,000 kw for 1962 in addition to the 76,000 kw required by the Abadan oil industry. Against these requirements, definite power supplies in 1962 were to be 210,000 kw of which 130,000 kw would be supplied by the Dez hydro-electricity power system.

It was estimated that by 1965 the Khuzestan electricity demand would exceed this figure. This was the planned schedule for the installation of a further two hydro generators in the Pahlavi hydro-electric project with a capacity of 130,000 kw (65,000 x 2 = 130,000 kw). A further power demand of 130,000 kw was to be realized by 1971. By that time the Pahlavi dam would have six hydro generators with a total capacity of 390,000 kw. The ultimate industrial peak demand of 161,200 kw was expected to occur in 1973 against the full capacity of the Dez hydro generation plant of 520,000 kw[7].

## 16-3 Electricity Development in Khuzestan, 1957-62

In 1957 Plan Organization commissioned the Development and Resources Corporation (DRC) of New York to draw up projects for the development and distribution of electric power in Khuzestan. DRC was also given authority over the development projects of energy resources in the Khuzestan region.

In August 1957 the Khuzestan Electricity Bongah (Centre) was founded in Khuzestan under the management of a Plan Organization Agency. The management of the Bongah was handed over to the DRC, but was eventually placed under the supervision of KWPA.

The functions of the organization were as follows:[8]

a) To build a power transmission line from the Pahlavi dam to Abadan and Khorramshahr.

b) To assist the municipalities of Abadan, Ahwaz, Khorramshahr, Dezful and Andimeshk in the establishment of a power distribution network.

c) Electric power supply to various urban distribution networks.

d) The sale of electricity.

In five years (1957-62) DRC developed the distribution network in the urban areas of Khuzestan, purchased a power generating plant for Ahwaz, built the Golestan Gas Pipeline, employed Dutch specialists to install transmission lines of 33, 132 and 230 kv, established sub-stations and distribution centres and repaired and supervised the operation of a diesel-generating plant.

The first hydro-power generator was installed in May 1963 with a delay of seven months, and the second one in July 1963 with a delay of eight months[9]. At that time the Pahlavi dam transmission lines consisted of a 230 kv line from the Pahlavi dam to Ahwaz, a 132 kv line from Andimeshk to Dezful, two 132 Kv lines from the Abadan sub-station to the secondary distribution station of Abadan and Khorramshahr, a new sub-station in Andimeshk, high tension lines to the Ahwaz and Abadan sub-stations and secondary distribution stations in Dezful, Andimeshk, Ahwaz, Abadan and Khorramshahr.

## 16-4 Development of the Pahlavi Dam Hydro-power Generation, Transmission and Distribution Systems, 1962-75

### 16-4-a Development of electric power generation

The installation of generators 3 and 4 which had been planned to be completed by 1966/67[10], was completed in 1969.

The construction of the second power house of the Pahlavi dam began in 1965. A further four hydro-generators of the Pahlavi dam were installed in 1971 (Nos. 5 and 6 in July, No.7 in October and No.8 in December 1971). Therefore the completion of the hydro-power capacity of the Pahlavi dam hydro-power project which was 520,000 kw was realized in early 1972.

16-4-b Development of electric power transmission and distribution systems

Since 1963 the transmission and distribution networks have gradually been extended all over the Khuzestan region and outside the region as well. The power transmission line system was expanded through the establishment of a 132 Kv line from Dezful to Masjid Solaiman. To supply electricity to the Ghasabeh region, Minoo Island, the Shush township and 85 border villages on the Iran-Iraq frontier, the power transmission lines were extended and a 33 kv transmission line was installed between Ahwaz and Dusht-i-Mishan.

By mid-1975 the total power transmission lines in the northern, central, southern and south eastern service areas of Khuzestan were as follows:[11]

| | |
|---|---|
| 230 kv transmission line | 484 Km |
| 132 kv " " | 653 Km |
| 33 kv " " | 157 Km |
| Total | 1,294 Km |

The Khuzestan transmission lines are connected with a 550 Km 230 kv line to the Tehran area in the north. Also when the extension of the transmission line from Do-Gonbadan to Shiraz (Governing Centre of the Fars province) is completed the Khuzestan region will be connected with the National Grid (Fig. 16-1).

By April 1975 Khuzestan had 40 main stations and sub-stations with a total capacity of 1,476.9 MW , out of which seven stations were main ones with a total capacity of 889 MW (Table 16-1).

Table 16-1

Main Power Stations of Khuzestan

1975

| Station | Transformer Capacity MW |
|---|---|
| Ahwaz | 315 |
| Abadan | 37 |
| Andimeshk | 90 |
| Chehelmill | 90 |
| Omidieh | 180 |
| Do-Gonbadan | 27 |
| Naward | 150 |
| Total | 889 |

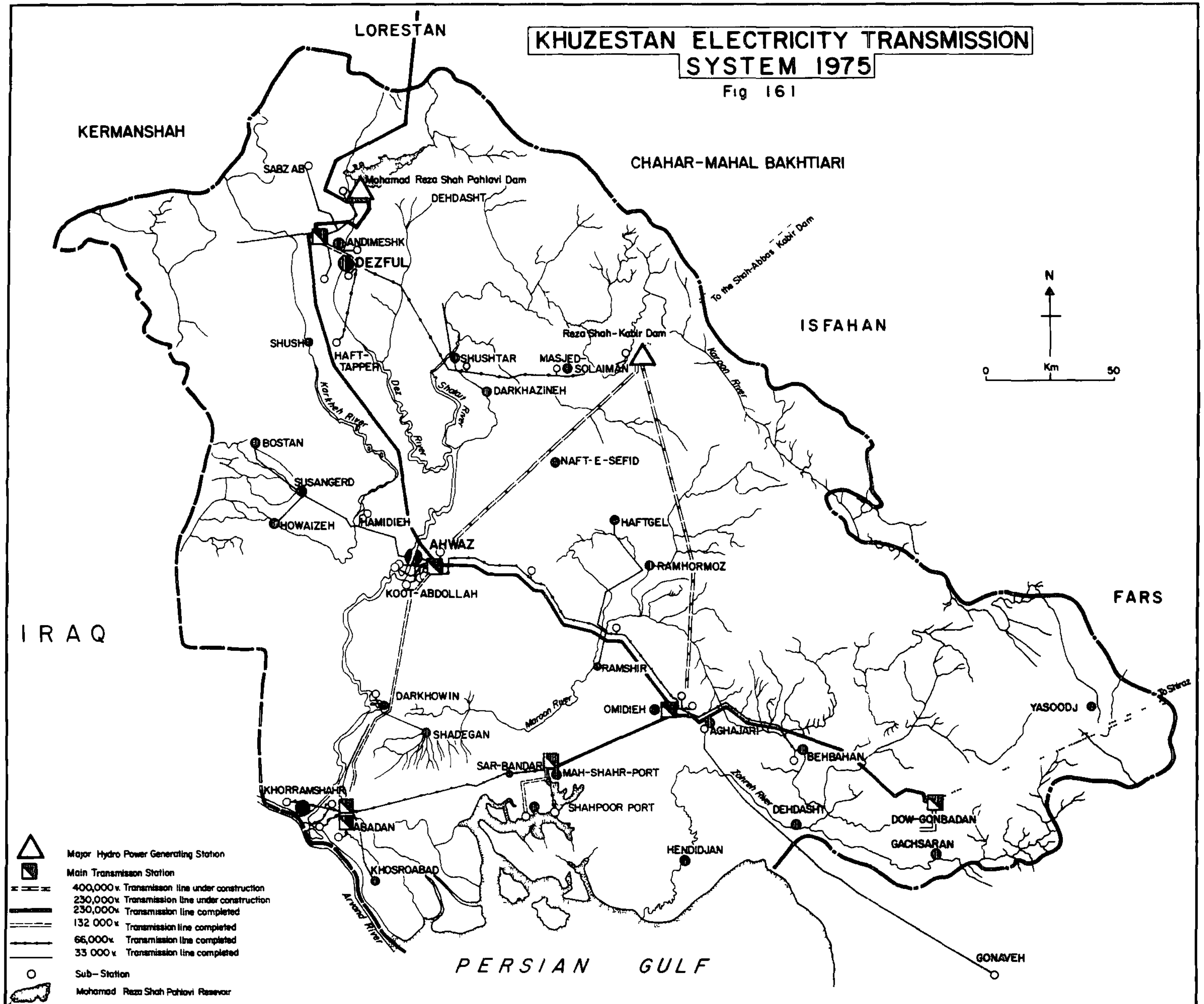
Source: KWPA, Electricity Department,
Bureau of Marketing and Economics.

The distribution of electricity in Khuzestan is achieved by 11 kv and 33 kv lines. The high tension distribution lines of 11 and 33 kv total approximately 1,925 Km and that of the low tension network of 230 and 400 volts, 1,957 Km. Fourteen districts (Shahrestan) and ten regions (Bakhsh) are served by the Pahlavi dam hydro-electricity system. The districts are: Abadan, Khorramshahr, Ahwaz, Andimeshk, Dezful, Shushtar, Masjid Solaiman, Behbahan, Aghajari, Mahshahr, Sarbandar, Bandar Shapoor, Ramhormoz and Dow-Gonbadan (Fig.16-1). The regions are: Arvand Kenar, Minoo Island, Bostan, Hovaizeh, Susangerd, Shush, Ramshir, Haftgel, Shadegan and Darkhovin.

Before the construction of the Pahlavi dam and its hydro-power plant, only seven villages had electricity. This increased to 202 villages by 1975[12] which is a small fraction of the total 3,804 inhabited villages of the Khuzestan region[13].

## 16-5 The Installed Electricity of the Pahlavi Dam and the Electricity Demand, 1962-76

When the installed electricity capacity of the Pahlavi dam power plant was 130 MW, electricity demand was only 18 MW in Khuzestan, which was only one seventh of the supply in 1962. After six years of operation of the Pahlavi dam power plant (i.e. in 1969/70) the Khuzestan demand equalled the initial installed capacity of 130 MW. At this time a further 130 MW was installed at the dam. In 1970/71 Khuzestan's total electricity demand (including the electricity demand from Tehran) had increased to 244 MW against a 260 MW installed capacity. The electricity demand of Khuzestan itself however was much lower than 244 MW, because the electricity from the dam was already being transferred to Tehran. In 1971/72, when the demand of Khuzestan itself had been increased to 220 MW a further 260 MW was supplied at the Pahlavi dam through the installation of a further four generators. The demand of 220 MW was even less than half of the installed total capacity of 520 MW of the Pahlavi hydro-electricity plant (Table 16-2 and Fig. 16-2).


KHUZESTAN ELECTRICITY TRANSMISSION SYSTEM 1975
Fig 161
LORESTAN
KERMANSHAH
CHAHAR-MAHAL BAKHTIARI
ISFAHAN
FARS
IRAQ
PERSIAN GULF
N
0 Km 50
SABZ AB
Mohamad Reza Shah Pahlavi Dam
DEHDASHT
ANDIMESHK
DEZFUL
To the Shah-Abbas Kabir Dam
SHUSH
HAFT-TAPPEH
SHUSHTAR
MASJED-SOLAIMAN
Reza Shah-Kabir Dam
DARKHAZINEH
Karkheh River
Dez River
Shatait River
Karoon River
BOSTAN
SUSANGERD
NAFT-E-SEFID
HOWAIZEH
HAMIDIEH
HAFTGEL
AHWAZ
RAMHORMOZ
KOOT-ABDOLLAH
RAMSHIR
DARKHOWIN
Maroon River
OMIDIEH
YASOODJ
To Shiraz
SHADEGAN
AGHAJARI
BEHBAHAN
SAR-BANDAR
MAH-SHAHR-PORT
KHORRAMSHAHR
SHAHPOOR PORT
Zohreh River
DEHDASHT
DOW-GONBADAN
ABADAN
GACHSARAN
HENDIDJAN
KHOSROABAD
Arvand River
GONAVEH
Major Hydro Power Generating Station
Main Transmission Station
400,000v. Transmission line under construction
230,000v. Transmission line under construction
230,000v. Transmission line completed
132 000v. Transmission line completed
66,000v. Transmission line completed
33 000v. Transmission line completed
Sub-Station
Mohamad Reza Shah Pahlavi Resevoir

The growth rate of electricity demand at the Pahlavi dam began to increase in 1964 and 1967. In these years it was 115% and 46.6% respectively. Between 1967 and 1969 the growth rate of electricity demand was slower. The growth rate was 3.8% in 1968/69 which was the minimum value in the ten years (1963-73). The high growth rates of electricity demand of 90.6% and 83.6% which occurred in 1970/71 and 1971/72 were partly due to the demand of Tehran which has been receiving electricity from the dam since 1970 (Table 16-2).

By 1973/74 the electricity demand at the Pahlavi dam exceeded its installed capacity. At this time the total demand was 530 MW, whereas that of Khuzestan was 344 MW. The estimated demand of Khuzestan of 361 MW, which would have been realized in 1973/74, has not yet been reached, and the planned demand of 976 MW for the end of the Fifth Development Plan (1978) is unlikely to be realized in Khuzestan in the near future (Table 16-2). This is emphasised when the low growth rates of demand in the period 1973 to 1976 at the dam, and even the negative growth rates of electricity demand in Khuzestan in 1974 to 1976, are taken into account.

The electricity demand of Khuzestan has never had a uniform growth rate. The highest growth rate of 115.5% was realized in 1967/68. Since 1969/70 there has been a gradual decline in the growth rate of demand. Negative values of 12% and 5% occurred in 1973/74 and 1974/75 respectively. Therefore, it is hard to believe that Khuzestan's electricity demand will be equal to the capacity of the Pahlavi dam power plan in the near future.

Table 16-2

Dez Hydro-power Project - Installed Capacity of the Plant and Electricity Demand

1962 - 1975/76

| Year | Installed Capacity (MW) (a) | Max Electricity Demand (MW) | | Khuzestan's Demand (MW) | | | Tehran's Demand (MW) | Industrial Demand (MW) | | Domestic Demand (MW) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Value | % of growth rate | Actual | % of growth rate | Planned Demand (MW) | | Value | % of growth rate | Value | % of growth rate |
| 1962/63 | - | (b) 14.4 | | (b) 14.4 | | | | | | 14 4 | |
| 1963/64 | 130 | (o) 18.0 | 25.0 | (b) 23.5 | 63.1 | (g) 40 | | | | 18 0 | 25.0 |
| 1964/65 | 130 | (b) 38.8 | 115.5 | (b) 38.8 | 115.5 | (g) 57 | | | | 39 0 | 115 5 |
| 1965/66 | 130 | (b) 52 0 | 34.0 | (b) 52 0 | 34.0 | (g) 95 | | | | 52 0 | 33 3 |
| 1966/67 | 130 | (b) 59 0 | 13.4 | (b) 59.0 | 13.4 | (g) 107 | | (k) 7.4 | | 51.6 | - 0 8 |
| 1967/68 | 130 | (c) 86.5 | 46.6 | (c) 86.5 | 46.6 | (g) 116 | | (k) 19.8 | 167.5 | 66.7 | 29.[illegible] |
| 1968/69 | 130 | (c) 89 8 | 3.8 | (f) 89.8 | 3.8 | | | (l) 32.8 | 65.6 | 57.0 | - 14 6 |
| 1969/70 | 260 | (c) 128.0 | 42 5 | (f) 128 0 | 42.5 | | | (m) 69 4 | 111.5 | 58.6 | 2 8 |
| 1970/71 | 260 | (c) 244.0 | 90.6 | (f) 169.0 | 32 0 | (h) 410 | (i) 260 0 | (n) 115.05 | 65 7 | 70 3 | 20 0 |
| 1971/72 | 520 | (c) 448.0 | 83.6 | (f) 220.0 | 30 0 | | (i) 269 0 | (n) 130.0 | 12.9 | 90 0 | 28 0 |
| 1972/73 | 520 | (c) 510 | 13 8 | (f) 280.0 | 27 0 | | (j) 266.2 | (n) 154.0 | 18.4 | 126 0 | 40.0 |
| 1973/74 | 520 | (d) 530.0 | 3.9 | (d) 344.0 | 22 8 | (f) 361 | (d) 276.0 | (n) 154.0 | 0.0 | 190.0 | 50.7 |
| 1974/75 | 520 | (d) 567 | 6 9 | (e) 304 0 | - 12 0 | (f) 447 | (e) 274.0 | (o) 161 0 | 4 5 | 229.0 | 20 5 |
| 1975/76 | 520 | (e) 587 | 3.5 | (e) 291 0 | - 5.0 | (f) 577 | (e) 290.0 | (o) 164.0 | 1.8 | | |
| 1976/77 | | | | | | (f) 859 | | | | | |
| 1977/78 | | | | | | (f) 979 | | | | | |

Sources: (a) KWPA, Department of Electricity, Bureau of Marketing and Economics,"Annual report of 1970". pp. 6-7.

(b) KWPA, 1967, "The Speech of the KWPA Managing Director in the Oil Council of Iran, Abadan, 11.7.1346, p.13.

(c) KWPA, Department of Electricity, "A Ten Years Report" from 1342 - 1351, p.23.

(d) KWPA, Department of Electricity, Annual Report of 1350-1353, p.2.

(e) KWPA, Department of Electricity, Division of Marketing and Economics. Farzaneh, personal correspondence, June 1976.

(f) Ministry of Water & Power, KWPA. Electricity Department, "Report of Moroad, 1351 (1972), p.2.

(g) KWPA, March 1963, "A Commemorative Booklet issued upon the occasion of the attendance of His Imperial Majesty, Shahamshah of Iran, Mohamad Reza Pahlavi, at the dedication of the Mohamad Reza Shah Pahlavi Dam", p.28.

(h) Ministry of Water and Power, Department of Projects and Investigation, 1350 (1971), Annual Report of 1349, p.289.

(i) Ministry of Water and Power, KWPA. Annual Report of 1350 (1971), p.47.

(j) Ministry of Water and Power, KWPA, Annual Report of 1351 (1972), p.45.

(k) KWPA. The speech of the KWPA Managing Director in the Oil Council of Iran, Abadan, 11.7 1346, p.20.

(l) KWPA. Department of Electricity. Actual report from the beginning of the establishment of KWPA until 1348, p 27.

(m) KWPA. Department of Electricity. "Electricity development during the eve of His Imperial Majesty, Shahanshah Aria mehr, p.10.

(n) KWPA. Department of Electricity. "Electricity development during the eve of His Imperial Majesty, Shahanshah Aria mehr, pp. 11-12, 13-14 & 20.

(o) Ministry of Water and Power, KWPA. Department of Electricity, Division of Marketing and Economics, December 1974. Required demand of industrial subscribers with demands exceeding 500 KW from 1353, end of the Sixth Development Plan, p.10.

A significant point which should be mentioned is that, according to a survey carried out by the Resource Investigation Projects of KWPA, the capability of the Pahlavi reservoir for electricity production is 1,750,000 mwh in a dry year and 2,400,000 mwh in a wet year[14]. Taking into account the average value of these two figures, i.e. 2,075,000 mwh, six generators each of 40,000 kwh generating capacity would have been sufficient for the hydro-electricity production at the Pahlavi dam (instead of the present eight generators each with a capacity of 65,000 kwh). Therefore at the beginning of the project, the generators and their capacities should have been planned and built according to the actual potential of the Dez river for hydro-electric power production.

The industrial demand of Khuzestan was almost nil during the first three years of the Pahlavi hydro-power plant operation (1963-66). In 1966 the largest industrial demand was that of the Masjid Solaiman oil exploration and production company with a demand of 5 MW. The remaining industrial demand of 7.470 MW was from the rolling mill of Ahwaz with 1.620 MW and the Abadan petrochemical industry with 0.850 MW demand[15]. The development of industrial demand was rapid between 1967 and 1971. The highest growth occurred in 1967/68 at a rate of 167.5% (Table 16-2). Since 1971/72 the industrial demand did not grow as fast as was planned. For instance, the planned industrial demand for 1974/75 was 326.3 MW[16], whereas it did not exceed 161.004 MW . Between 1969 and 1973 the industrial demand exceeded that of domestic, but since 1973/74 the household demand has exceeded that of the industrial as in the years prior to 1969 (Fig. 16-2).

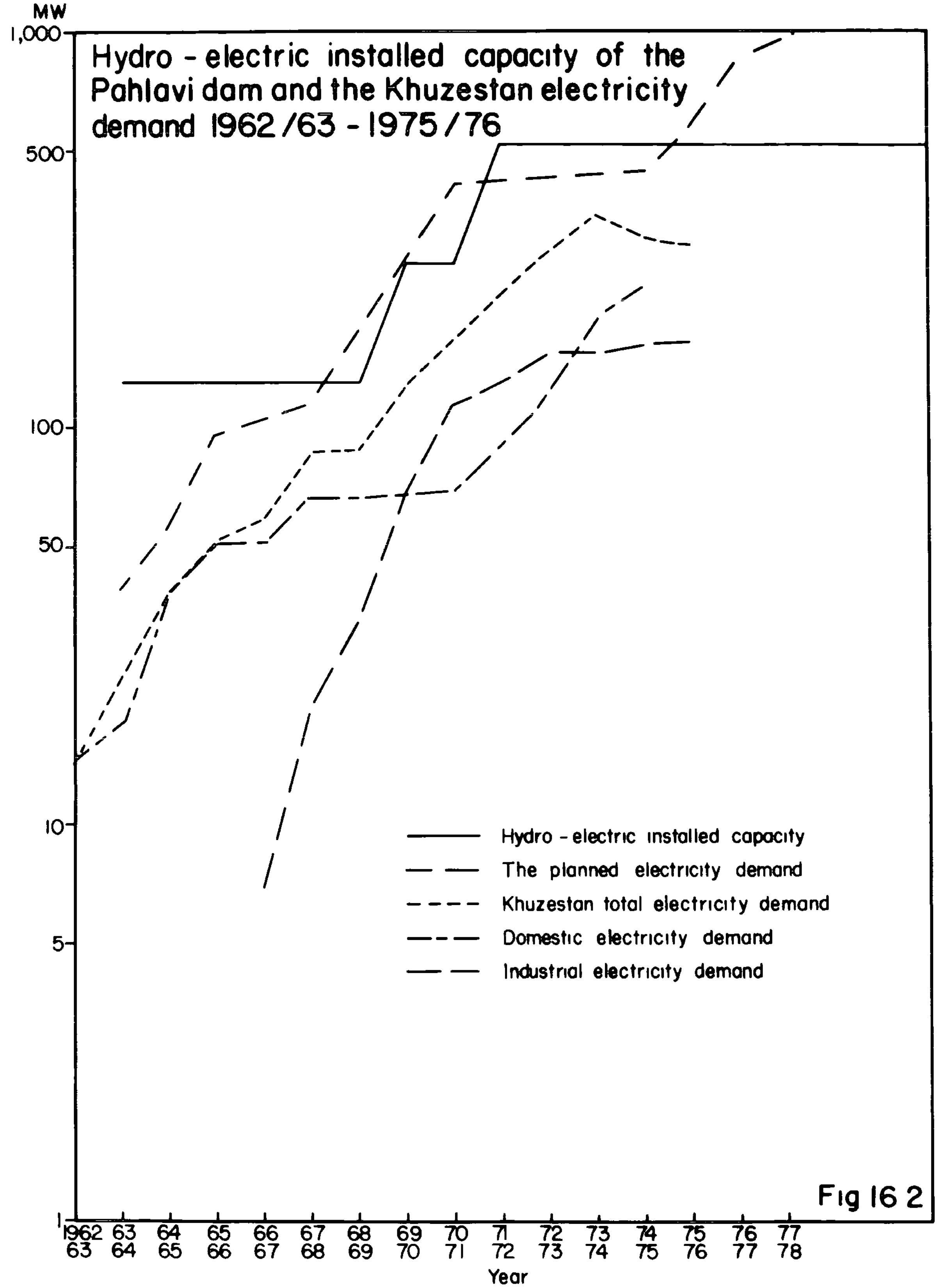

MW
1,000
500
100
50
10
5
1
Hydro - electric installed capacity of the Pahlavi dam and the Khuzestan electricity demand 1962/63 - 1975/76
Hydro - electric installed capacity
The planned electricity demand
Khuzestan total electricity demand
Domestic electricity demand
Industrial electricity demand
1962 63 63 64 64 65 65 66 66 67 67 68 68 69 69 70 70 71 71 72 72 73 73 74 74 75 75 76 76 77 77 78
Year

Fig 16 2

In 1974/75 an agreement was made between KWPA and a number of industrial enterprises whose electricity demands ranged between 1,200 and 21,000 Kw with a total demand of 391,000 Kw. The future industrial demand of Khuzestan is estimated to be 612,000 Kw by the end of the Sixth Development Plan (1982).

Against these demands the planned electricity supplies will be as follows:-

a) Utilization of the first Ahwaz thermal power plant unit of 145 MW in Spring 1975.[17]

b) Utilization of the second Ahwaz thermal power plant unit of 145 MW in Spring 1977.

c) Utilization of gas fuelled power generators with a total capacity of 125 MW in March 1976.[18]

d) Utilization of two units of thermal power plant with a total capacity of 600 MW in April 1978 and a further two of a total capacity of 600 MW in early 1979.

e) Utilization of four hydro power generators of the Reza Shah Kabir dam with a total capacity of 1,000 MW in April 1977.[19]

Therefore the total installed power capacity of KWPA which was 665 MW in Spring 1975, will increase to 3,160 MW in March 1978. By that time the contribution of the Pahlavi hydro-electric power plant to the total electric power supply of Khuzestan will be 16.45%.

## 16-6 Electricity Consumption in Khuzestan

The electricity consumption of Khuzestan was only 11,700 mwh in 1959. In 1963 when the Pahlavi dam hydro-power plant supplied 86,128 mwh, the consumption of Khuzestan had been increased to 85,011 mwh. After more than a decade, Khuzestan's electricity consumption increased to 1,924,219 mwh in 1974/75 (Table 16-3). In the first year the Pahlavi dam hydro-power contribution to the industrial electricity demand was less than that supplied to domestic consumers. The domestic consumption was 32,436 mwh against 23,196 mwh of industrial consumption. Since 1964/65 the industrial consumption of electricity has shown a steady increase and has always exceeded that of domestic use (Table 16-3 and Fig. 16-3). In 1974/75, 75.5% of the total electricity which was consumed was for industrial purposes whereas the domestic demand only accounted for 14.5%. The growth rate of industrial electricity use, which ranged between 190.4% in 1964/65 and 11.58% in 1974/75, was almost always greater than the growth rate of domestic use. Since 1972/73 the growth rate of domestic electricity consumption has exceeded that of the industrial demand (Table 16-3). The future trend of domestic electricity use is not definite. This is something which depends upon the electricity pricing policies and is a reflection of the general standard of living. Since it is expected that between 1980 - 1985 every household in Khuzestan will have a cooling system[20], the future household electricity consumption will therefore be much higher than in 1975/76.

Table 16-3

The Pahlavi Dam Hydro-electricity Production and Electricity Consumption in Khuzestan

| YEAR | Electricity generated mwh (1) | Household consumption mwh (total) | % growth | Industrial consumption mwh (total) | % growth | Commercial consumption mwh (total) | Street lighting consumption mwh (total) | Dam site consumption mwh (total) | Total electricity consumed mwh (total) (2) | Tavanir† electricity consumed mwh (total) | Total electricity sold mwh | Electricity bought from Tavanir† mwh | Electricity bought from NIOC m/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1963/64 | 86,128 | (a) 30,205 | | (a) 23,196 | | (a) 26,184 | (a) 3,195 | | 85,011 | | 85,011 | | |
| 1964/65 | 155,650 | (a) 35,659 | 18.0 | (a) 67,365 | 190.40 | (a) 24,778 | (a) 5,943 | (a) 610 | 134,355 | | 134,355 | | |
| 1965/66 | 202,995 | (a) 48,453 | 35.0 | (a) 76,991 | 14.20 | (a) 31,392 | (a) 10,944 | (a) 6,922 | 174,702 | | 174,702 | | (l) 1,334.2 |
| 1966/67 | 256 190 | (a) 56,910 | 17.4 | (a) 104,8[illegible]9 | 36.10 | (a) 33,538 | (a) 13,235 | (a) 14,913 | 223,414 | | 223,414 | | (m) 1,250.0 |
| 1967/68 | 385,541 | (a) 63,045 | 10.7 | (a) 181,446 | 73.10 | (a) 37,552 | (a) 14,007 | (a) 16,579 | 312,630 | | 312,630 | | (n) 1,459 0 |
| 1968/69 | 435,341 | (a) 74,576 | 18.2 | (a) 227,288 | 25.20 | (a) 44,285 | (a) 16,185 | (a) 10,948 | 376,283 | | 376,283 | | (o) 961.2 |
| 1969/70 | 685,761 | (b) 93,199 | 24.9 | (b) 393,704 | 73.2 | (b) 53,402 | (b) 20,289 | (b) 18,581 | 579,174 | | 579,174 | | (p) 65 0 |
| 1970/71 | 1,187,250 | (c) 109,692 | 17.6 | (c) 666,473 | 69.20 | (c) 57,610 | (c) 20,887 | (c) 22,401 | 877,063 | (h) 193,759 | 1,070,822 | (h) 11,236 | (q) 54.8 |
| 1971/72 | 1,998,083 | (d) 139,326 | 27.0 | (d) 935,937 | 40 40 | (d) 69,499 | (d) 25,110 | (d) 24,402 | (d) 1,194,284 | (i) 692,829 | 1,887,113 | (i) 2,179 | (q) 44.6 |
| 1972/73 | 2,569,582 | (e) 179,325 | 28.7 | (e) 1,056,267 | 12.80 | (e) 75,850 | (e) 26,367 | (e) 19,400 | (e) 1,357,209 | (j) 1,044,207 | 2,401,416 | (j) 6,945 | |
| 1973/74 | *1,923,373 | (f) 244,200 | 36.10 | (f) 1,267,850 | 20 00 | (f) 95,464 | (f) 38,283 | (f) 34,216 | (f) 1,680,012 | (k) 368,608 | 2,048,620 | (k)365.610 | |
| 1974/75 | **2,508,135 | (g) 279,135 | 14.30 | (g) 1,433,995 | 11.58 | | | | (g) 1,924,220 | (g) 550,462 | 2,474,682 | (g)177,848 | |
| 1975/76 | ***2,600,000 | | | | | | | | | | | | |

† The company for the production and transmission of power in Iran.

* KWPA, Department of Electricity, A ten years report from 1342-1351 (1963-1972) p 23

** " " " " Report of 1352. p 1

*** Kayhan April 1, 1976. No.9825. p 28.

Sources for:

(1) KWPA, Department of Electricity, A ten years report from 1342-1351 (1963-1972). p.23.

(a) Ministry of Water & Power, KWPA, Department of Electricity, Graphic bulletin of production, selling and subscribers in the fourth quarter of 1349. pp.13-18.

(b) Ministry of Water & Power, Department of Electricity, Division of projects, engineering and planning, "Statistical report of the electricity institutions. 1349, p.9.

(c) Ministry of Water & Power, Department of Electricity, Division of projects, engineering and planning, "Electricity industry in 1349 (1970). p.38.

(d) Ministry of Water & Power, Department of Electricity, Division of projects, engineering and planning, "Iran's electricity industry in 1350". p.29.

(e) Ministry of Water & Power, Department of Electricity, Division of projects, engineering, and planning, "Iran's electricity industry in the Fourth Development Plan". p.39.

(f) Ministry of Water & Power, Department of Electricity, Division of projects engineering and planning, "Iran's electricity industry in 1352". p.49.

(g) KWPA. Department of Electricity, Division of Marketing and Economics, Farzaneh, Personal correspondence, June 1976.

(h) Ministry of Water & Power, Department of Electricity, "Statistical bulletin, Electricity industry", No.38, 3rd year, Esfand 1349, p.13.

(i) Ditto - No.51, 4th year, Esfand 1350, p.13.

(j) Ditto - No.64, 5th year, Esfand 1351, p.13.

(k) Ditto - No.77, 7th year, Esfand 1352, p.13.

(l) KWPA, Department of Electricity, "A report from the commencement of the KWPA establishment to the end of 1348. p.13.

(m) Ibid. p.17.

(n) Ibid. p.19.

(o) Ministry of Water & Power, KWPA, Annual report of 1347. p.35.

(p) KWPA. Department of Electricity, Division of Marketing and Economics. "Statist cal report of 1348". p.1.

(q) Ministry of Water & Power, KWPA, Department of Electricity, Division of Marketing and Economics, Bureau of Research and Economic Investigation, "Cost of Energy", May 1974. p.3.

## 16-7 Electricity Tariffs in Khuzestan

The electricity tariff of Khuzestan was confirmed in 1963 and then revised and amended in 1968[21]. The following tariffs are currently in operation and fall into five categories:

1) Residential services (Tariff 11)

Tariff 11 deals only with the household electricity consumer and it does not include clubs, schools, mosques, and other public buildings. The monthly electricity charges are as follows:-

First 30 Kwh or less, 75 rials (2.5 rials per Kwh)

Next 70 Kwh, 2 rials/Kwh.

Next 300 Kwh, 1.6 rials/Kwh.

Over 800 Kwh, 1.2 rials/Kwh.

Minimum bill: Monthly statement of account 75 rials.

2) Small establishments (Tariff 21)

All commercial, industrial or government establishments whose demand is less than 40 Kw are categorized in Tariff 21. The monthly electricity charge for them is:-

First 300 Kwh, 2.5 rials/Kwh.

Next 700 Kwh, 2.0 rials/Kwh

Next 2000 Kwh, 1.6 rials/Kwh

Over 3000 Kwh, 1.2 rials/Kwh.

Minimum monthly bill statement of account 100 rials plus 100 rials per Kw which exceeds a maximum of 10 Kw.

3) <u>Establishments with electricity consumption of 40 Kwh to 5,000 Kwh (Tariff 31)</u>

The rate for each kilowatt demand is 140 rials.

The electricity rate is as follows:-

First 2,500 Kwh, 0.9 rials/Kwh.

Next 975,000 Kwh, 0.7 rials/Kwh.

Over 1,000,000 Kwh, 0.5 rials/Kwh.

The above energy rates are subject to a reduction of 0.10 rials for energy used in excess of 365 Kwh per kilowatt of billing demand. The minimum monthly bill consists of 60% of the demand charge multiplied by the larger of the two following figures:-

a) the customer's highest billing demand during the 12 months ending with the current month, or

b) the customer's contract demand, if any.

4) <u>Street lighting service (Tariff 41)</u>

Applicability of this tariff is to out-door electric lighting of publicly-owned streets, roads, highways, parks and bridges, from dawn to dusk throughout all seasons of the year.

Monthly rate:

For installing, re-lamping, operating, maintaining and supplying of the required electricity, this rate shall be made up of three distinct elements as follows:-

1) A monthly flat charge representing ½% of the investment by the authority in providing street lighting service.

2) 0.75 rials/Kwh of power consumption during the month.

3) Charges for labour, transportation and material of the authority required for the operation and maintenance

of street lighting facilities, including lamp replacement, cleaning glasswear and fixtures, testing lines and equipment and other expenses directly related to the street lighting system.

Minimum monthly bill shall be 60% of the highest bill issued to the customer within the last 12 months ending with the current month.

5) Demand exceeding 5,000 Kwh (Tariff 51)

This rate applies especially to electricity supply at a single voltage and through a single metering installation to customers requiring in excess of 5,000 Kwh of power.

The service consists of an alternating current with a frequency of 50 cycles per second, 3 phases with a nominal voltage of 11 or 33 kilovolts, as determined to be available by the authority.

The capacity charge is 225 rials/Kw of reserved capacity per month. This charge includes an energy equivalent of 225 Kwh per Kw of reserved capacity.

Energy used during the month in excess of 225 Kwh per Kw reserved capacity will be billed at a rate of 0.3 rials per Kwh.

The minimum monthly bill consists of the capacity charge.

## 16-8 Tariffs and Electricity Consumption in Khuzestan

### 16-8-a Domestic Electricity Consumption (Tariff No.11)

Urban Consumption

Domestic electricity consumers, who are considered to be household subscribers, numbered 140,176 in March 1975 (Table 16-4).

This figure represents only the urban areas of Khuzestan. According to the national census of 1966, the urban housing units of Khuzestan were 103,662, and the rural ones 107,927[22].

Considering that 1.48 families live in a housing unit[23], the total number of urban families is 153,420. Of this figure, 56,496 families, or 36.8% of the total, received electricity supplies in 1966-67 (Table 16-4). In 1972-73, out of 201,270 urban families in Khuzestan, 103,097 families or 51.22%, received an electricity supply[24]. The growth rate of the urban family size is 4.3%[25]. By April 1975, the urban families of Khuzestan numbered 228,366, of which 140,176, or 61.39%. had electricity (Table 16-4). In other words, 88,190 families or 493,864 of the urban population of Khuzestan (family size was 5.6) still had no electricity in 1975. The major reason for this is the high urban electricity tariff. Although the price of electricity in Khuzestan is somewhat cheaper than in the other regions of Iran (an average rate of 2 rials/Kwh in Khuzestan) it is still expensive.

The reason why only 61.39% of the urban population of Khuzestan are electricity subscribers could, of course, be explained by the fact that the household electricity consumption in Iran is a luxury rather than a necessity. It could be argued that this does not apply to Khuzestan which has a very hot, even unbearable climate.

The Pahlavi dam hydro-power scheme was set up to supply abundant and cheap electricity to everybody. Over the last decade or so (1963-75) there has been a significant growth in the number of households receiving electricity (approximately 5.2 times). At the same period per capita electricity consumption amongst the urban consumers increased by almost

Table 16-4

Electricity Subscribers of Khuzestan

1963/64 - 1974/75

| Year | Domestic | Industrial | Commercial | Others | Total |
|---|---|---|---|---|---|
| 1963/64 | (a) 27,163 | 86 | ? | ? | 33,916 |
| 1964/65 | (b) 44,458 | 107 | ? | ? | 57,085 |
| 1965/66 | (c) 50,885 | 131 | 13,700 | 342 | 65,058 |
| 1966/67 | (d) 56,496 | 175 | 15,000 | 396 | 72,067 |
| 1967/68 | (e) 62,500 | 220 | 17,000 | 974 | 80,694 |
| 1968/69 | (f) 73,700 | 250 | 17,800 | 1,250 | 93,000 |
| 1969/70 | (g) 79,720 | 320 | 18,679 | 909 | 99,628 |
| 1970/71 | (h) 84,335 | 366 | 19,715* | | 104,416 |
| 1971/72 | (i) 97,019 | 473 | 21,781* | | 119,273 |
| 1972/73 | (j) 103,097 | 516 | 22,614* | | 126,227 |
| 1973/74 | (k) 126,307 | 599 | 27,707* | | 154,671 |
| 1974/75 | (l) 140,176 | 682 | 29,417* | | 172,000 |

* Since 1970/71 the commercial subscribers and other subscribers are combined.

Sources: (a) KWPA, Dept. of Electricity, Division of Marketing and Economics. "A report from the commencement of the establishment of KWPA to the end of 1348, p.6.

(b) Ibid. p.10.

(c) KWPA, Department of Electricity, Division of Marketing and Economics, op.cit. p.13.

(d) -ditto- op.cit. p.17.

(e) -ditto- op.cit. p.20.

(f) Ministry of Water & Power, KWPA. Dept. of Electricity, Division of Economic Investigations. Graphic bulletin of production, selling and subscribers of the 4th Quarter, 1349, p.3.

(g) Ministry of Water & Power, Dept. of Electricity, Division of Engineering and Projects Planning Affairs. "Statistical Report of 1348", pp.22-23.

(h) Ministry of Water & Power, Dept. of Electricity, Division of Engineering & Projects Planning Affairs, "Electricity Industry in 1349", p.25.

(i) Ministry of Water & Power, Dept. of Electricity, Division of Engineering and Projects Planning Affairs, "Iran's electricity industry in 1350", p.38.

Sources: (cont..)

(j) Ministry of Water & Power, Dept. of Electricity, Division of Engineering and Projects, Planning Affairs. "Iran's electricity industry in the Fourth Development Plan", p.44.

(k) Ministry of Water & Power, Dept. of Electricity, Division of Electricity plans. "Iran's electricity industry in 1352", p.32.

(l) KWPA. Department of Electricity, Statistical Report of 1353, p.1.

79% (Table 16-5) and by 435% amongst all the urban population of Khuzestan (Table 16-6).

Per capita electricity consumption of 126 Kwh of an urban electricity consumer in 1967 in Khuzestan was much higher than the per capita electricity consumption of a developing country such as India with an average value of 81 Kwh. Per capita electricity consumption of the urban population of Khuzestan which was 68 Kwh in 1967 is lower than that of India. However per capita electricity consumption of both groups in Khuzestan is much less than the consumption of the advanced countries in 1967, (Table 16-7). By 1973/74, per capita electricity consumption of the urban population of Khuzestan had risen to almost 200 Kwh. No data are available on the per capita electricity consumption of the advanced countries in 1973. However, per capita electricity production of Turkey, a developing country, as well as that of the advanced countries was much higher than the per capita electricity consumption of urban Khuzestan in 1973 (Table 16-8).

This increase in per capita electricity consumption for the electricity consumers was achieved after a period of decline. This means that per capita electricity consumption which was 139 Kwh in 1963 declined to 99.8 Kwh in 1964, and then after a further six years it reached its initial 1963 level in 1971/72 (Fig. 16-3).

<u>Rural Electricity Consumption</u>

According to the National Census of 1966 Khuzestan has 4,097 villages of which 3,804 are inhabited[26]. In 1969, seven villages in Khuzestan had electricity. The policy of KWPA for electricity supply to the rural areas allowed the supply to be installed to a distance of

Table 16-5

Per capita electricity consumption of the urban electricity consumers in Khuzestan

1963/64 - 1974/75

| Year | Household electricity consumption (Kwh) (a) | Domestic electricity subscribers | Electricity consumption per subscriber (Kwh) | Per capita electricity consumption* (Kwh) |
|---|---|---|---|---|
| 1963/64 | 30,205,000 | 27,163 | 1,111.9 | 138.9 |
| 1964/65 | 35,659,000 | 44,650 | 798.6 | 99.8 |
| 1965/66 | 48,453,000 | 50,885 | 952.2 | 119.0 |
| 1966/67 | 56,910,000 | 56,496 | 1,007.3 | 125.9 |
| 1967/68 | 63,045,000 | 62,500 | 1,008.7 | 126.0 |
| 1968/69 | 74,576,000 | 73,700 | 1,011.8 | 126.4 |
| 1969/70 | 93,199,000 | 79,720 | 1,169.0 | 146.1 |
| 1970/71 | 109,692,000 | 84,335 | 1,300.6 | 162.6 |
| 1971/72 | 139,326,000 | 97,019 | 1,436.0 | 179.5 |
| 1972/73 | 179,326,000 | 103,097 | 1,739.4 | 217.4 |
| 1973/74 | 244,200,000 | 126,307 | 1,933.4 | 241.7 |
| 1974/75 | 279,135,000 | 140,176 | 1,991.3 | 248.9 |

Sources: (a) Table 16-3.

(b) Table 16-4.

* For the calculation of per capita electricity consumption, per subscriber, consumption was divided by 8, which is the number of residents in each housing unit. It was obtained through the multiplication of 5.7 (the average urban household size[1]) and 1.4 (which represents the average number of households living in a housing unit[2].)

Ref: 1. Plan organization, Statistical Centre of Iran, "Statistics of Khuzestan", May 1973, p.22.

2. Ministry of Water and Power, Dept. of Electricity, "Urban household in the urban centre with over 10,000 population electricity supply". Bureau of Statistics and predictions. Farvardin, 1348, p.19.

Table 16-6

Per capita electricity consumption of the urban population in Khuzestan

1963/64 - 1974/75

| Year | Electricity consumed (Kwh) (a) | Population* | Per capita electricity consumption (Kwh) |
|---|---|---|---|
| 1963/64 | 30,205,000 | (757,111) | 40.0 |
| 1964/65 | 35,659,000 | (796,959) | 44.7 |
| 1965/66 | 48,453,000 | (838,904) | 57.7 |
| 1966/67 | 56,910,000 | 883,057 | 64.4 |
| 1967/68 | 63,045,000 | (927,210) | 68.0 |
| 1968/69 | 74,576,000 | (973,570) | 76.6 |
| 1969/70 | 93,199,000 | (1,022,248) | 91.2 |
| 1970/71 | 109,692,000 | (1,073,360) | 102.2 |
| 1971/72 | 139,326,000 | (1,127,028) | 123.6 |
| 1972/73 | 179,325,000 | (1,183,379) | 151.5 |
| 1973/74 | 244,200,000 | (1,242,548) | 196.5 |
| 1974/75 | 279,135,000 | (1,304,675) | 213.9 |

Source: for (a) - Table 16-3.

* According to the National Census of 1956 and 1966 the urban population of Khuzestan in these years was 566,176 and 883,057 respectively. (Source: Plan and Budget Organization, Statistical Centre of Iran, May 1973. "Statistical book of the province of Khuzestan", p.15). The remaining figures are calculated based on these two figures.

Table 16-7

Per capita electricity consumption in the advanced countries, in India, and for the urban population of Khuzestan

1967

| Country | | Per capita electricity consumption (Kwh) |
|---|---|---|
| U.S.A. | | 6,614 |
| U.K. | | 3,796 |
| West Germany | | 3,205 |
| France | | 2,303 |
| Japan | | 2,377 |
| Australia | | 3,634 |
| India | | 81 |
| Khuzestan | ( urban consumers | 126 |
| | ( urban population | 68 |

Source: for the advanced countries and India - Vatanian, A., 1971, p.123.

Table 16-8

Per capita electricity production in the advanced countries and in Turkey

1973

| Country | Per capita electricity production (Kwh) |
|---|---|
| U.S.A. | 9,254 |
| U.K. | 5,044 |
| West Germany | 4,825 |
| France | 3,339 |
| Japan | 4,338.7 |
| Turkey | 324 |

Source: United Nations, Department of Economic and Social Affairs, Statistical Office, 1975, "Statistical Year Book", 1974, 26th Issue, pp.67-86 and 372-381.

Note: If a 10 or 15 per cent of electricity production is allocated for the electricity losses through the transmission, the remaining amounts are still much higher compared with the per capita electricity consumption in Khuzestan.

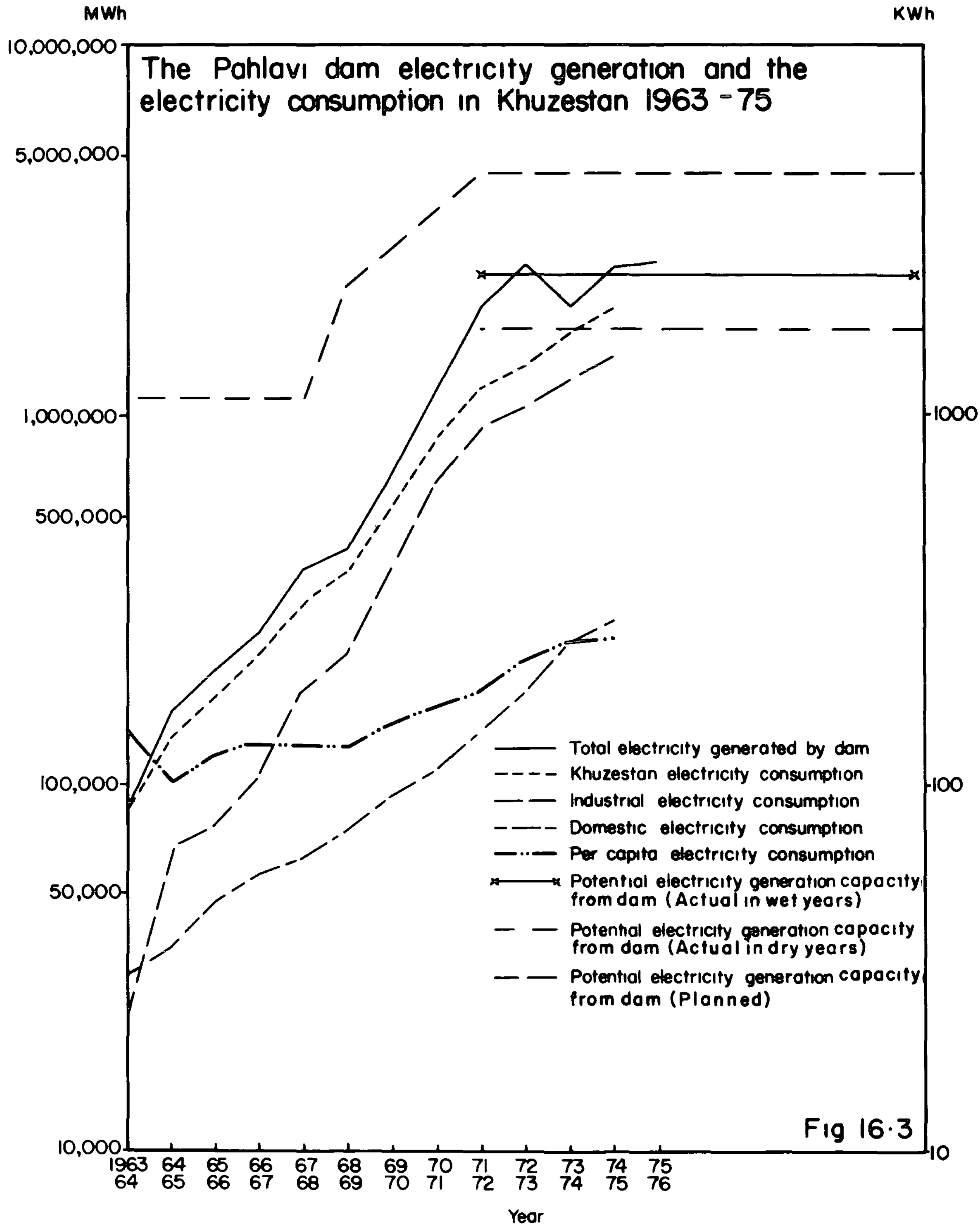

MWh
KWh
The Pahlavi dam electricity generation and the electricity consumption in Khuzestan 1963 - 75
10,000,000
5,000,000
1,000,000
500,000
100,000
50,000
10,000
1000
100
10
Total electricity generated by dam
Khuzestan electricity consumption
Industrial electricity consumption
Domestic electricity consumption
Per capita electricity consumption
Potential electricity generation capacity from dam (Actual in wet years)
Potential electricity generation capacity from dam (Actual in dry years)
Potential electricity generation capacity from dam (Planned)
1963 64
64 65
65 66
66 67
67 68
68 69
69 70
70 71
71 72
72 73
73 74
74 75
75 76
Year

Fig 16·3

30 Km from the power transmission line. Out of 211,589 housing units of Khuzestan in 1966, 107,927 are considered as the rural units. The number of rural housing units of Khuzestan which had electricity was 10,855 or 10.05% of the total in 1966[27]. There were 128,968 rural families and the average number of families living in a housing unit was 1.19[28]. Since the average rural family size was 5.4, the rural population that had electricity was 69,689 or 8.46% of the total rural population of Khuzestan in 1966. By 1967, KWPA supplied electricity to 85 villages[29]. This number increased to 165 villages in 1971 against a target of 207 villages for March 1971[30]. This further development was achieved at a cost of 102,034,000 rials which was provided by Plan Organization for the rural electricity development in Khuzestan during the Fourth Development Plan[31].

For the Fifth Development Plan (1973-78) 1,050 villages were surveyed by KWPA, Electricity Division, Department of Economic Research and Investigations. 358 villages with a population of 156,961 were chosen to be supplied with electricity at a cost of 441,141,206 rials[32]. By mid 1974 a further 27 villages had electricity[33], and the target of 208 villages, which had been planned to be supplied with electricity by mid 1971, was achieved after four years delay, by mid 1975 The major reason for this very slow progress in the rural electricity supply of Khuzestan can be sought in the high cost of electricity for rural Khuzestan. The minimum rate of 75 rials per month is rather high for people who live at subsistence level and have low purchasing power. They rarely consume more than 30 kwh per month which is the minimum monthly use. This means that they have to pay even higher rates than that for the actual electricity consumed. In these circumstances they have no incentive to use electricity in their homes. In some cases, people have used street lights. This stimulated KWPA to remove public lighting from streets of such rural areas[34]. With regard to the rural electricity consumption, at least the experience gained by others should be a lesson to Iran and other developing countries[35].

Since 1973 the policy of rural electricity supply in Khuzestan has been changed. Instead of the Ministry of Water and Power, the Ministry of Cooperation and Rural Affairs surveys the villages which must be supplied with electricity services. Certainly priority will be given to Farm Corporations. To carry out this strategy the number of traditional villages which would have been supplied with electricity services in Khuzestan was restricted to 208 of those previously served and a further 58 villages in the General Governing Centre of Kohkilooyeh. Therefore the rural population of Khuzestan which would have benefitted from the electricity services in the Fifth Development Plan, is to be reduced from 156,761 to 117,830, but a further 27,000 of the population of Kohkilooyeh is to be added[36]. The funds allocated for rural electricity supply in Khuzestan are $1.5 \times 10^9$ rials of which $165 \times 10^6$ rials are allocated to the Kohkilooyeh electricity supply . Four Farm Corporations and five Agro-businesses of the DIP area are given priority in electricity supply. Thirteen new rural towns (Shahraks) are to be furnished with all services such as electricity, water, roads, schools, shopping centres, clinics, etc.

So far KWPA has tried to keep electricity from the traditional villages, so that this will be one consolation for their moving to the Shahrak. In shahraks, electricity is not metered out individually, but in blocks.

Thus those who can afford to buy manufactured goods, such as a fan, refrigerators and even a television set and/or air conditioners benefit most and perhaps at the expense of the poor. This sytem of electricity supply to the Shahrak has caused many quarrels, since there is no way of determining the electricity consumption of each individual. The situation is even worse in a little row of poor rooms far on the edge of town. Some 15 poor people live there completely separated from the rest of the community. The rooms were built for them by the government but despite the millions of kilowatts produced by the Pahlavi dam, the poor receive none. The street lights of Shahraks are not replaced when they are burnt out, despite the continuous demand of the workers. At the present time no authority is in charge of the village centres, since they are neither considered to be towns to be run by a town council, nor as villages to be run by the village councils. In those circumstances no better conditions of electricity supply to the ex-peasants of Khuzestan is expected to be provided at least for the time being.

16-8-b <u>Small industrial establishments and commercial electricity consumption (Tariff No.21)</u>

This group of electricity consumers in Khuzestan numbered 29,417 in April 1975. The electricity tariff for this category is also high. An average figure of 2.086 rials/Kwh was quoted by KWPA in 1970[37]. Since the development of industry, even on a small scale, is one of the vital factors for the solution of unemployment, any reduction of electricity charges for this group has a profound encouraging impact on private industrial investors.

The growth rate of these subscribers ranged between 14.2% in 1967 and 3% in 1969. The percentage of electricity expenditure in the total expenditure of retailers is so high that it tends to discourage the development of business[38].

16-8-c <u>Industrial electricity consumption with electricity demands ranging between 40 and 5,000 and over 5,000 Kwh (Tariffs Nos. 31 & 51)</u>

Perhaps the most important group, from the point of view of economics at any rate, are the large industrial units with a demand of 40 to 5,000 Kwh (Tariff 31) and for whom the price of electricity is 0.9 rials/Kwh. Until 1970 no unit large enough to make use of the 0.5 rial rate existed. Although the industrial electricity subscribers increased from 86 in 1963 to 682 in 1975 (Table 16-4) and the industrial electricity consumption from 23,196 mwh to 1,433,995 mwh in 1974/75, very few of these subscribers were charged at the rate of 0.5 rials/Kwh. There were three in 1970 and five in 1975. The remaining industrial subscribers were charged at 0.9 rials/Kwh.

In 1974/75, 902,730 mwh or 64.2% of the total of 1,433,995 mwh of industrial electricity consumption in Khuzestan were used by those who paid 0.5 or/and 0.3 rial/Kwh (Table 16-3). So far the major industrial electricity consumers in Khuzestan have been the Shahriar Steel Mill, the oil refinery of Mahshahr, the paper plant at Haft-Tappeh, the steel rolling mill in Ahwaz and the Oil Exploration & Production Company of Aghajari. By the end of the Fifth Development Plan, the most important industrial consumers and their demands are predicted to be Iran's manufacturing industry corporation with 125 MW, the Industrial group and ironworks of Shahriar with 150 MW, the sugar agro-industry project of Karoon with 50 MW, and the Pars paper plant at Haft-Tappeh with 20 MW. Many other industries will have a total demand of 325 MW, with their demands ranging between 0.5 and 100 MW. These are expected to begin consumption from 1978. Projects of gas injection to the oil wells in Khuzestan are the most important electricity consumers in this group of which the Gachsaran field, with a demand of 100 MW, is the most important. In brief, KWPA expects some 8,000 MW of electricity demand in Khuzestan in 13 - 15 years time from 1975[39]. By that time, besides hydro and thermal power supply, three atomic power plants will supply electric energy for Khuzestan. They are to be installed at the Shahpoor Port and Khark Island[40]. Another prediction estimated that a total 12,424 MW of electricity will be installed by 1992 (at the end of the Eighth Development Plan). This objective is to be gradually achieved through four development plans; that is 1,256 MW by 1977, 2,999 MW by 1982, 6,283 MW by 1987 and 12,424 MW by 1992[41]. The agro-industrial units of Khuzestan that were hoped to be large electricity consumers, are entirely agro-business enterprises with low electricity demands, which have not exceeded 40 Kwh[42].

The agro-industrial unit of Haft-Tappeh has supplied its electricity needs through four diesel generators so far[43]. Some 5 MW was acquired by the Haft-Tappeh Sugar Cane Project from KWPA in 1975. Today, after almost one and a half decades of operation of the Pahlavi dam hydro-power plant, the large industrial units are very limited, despite the existence of abundant resources such as natural gas and oil and easy access to internal and international markets through the Trans-Iranian railway and the Persian Gulf. Since the availability of cheap electricity is a pre-requisite for the development of industries there is a great need for the revision of the electricity tariff in Khuzestan to achieve this end. This must be done in such a way as to encourage private investment for the development of industry and job creation. The urgency of such a revision of electricity tariffs is certainly realised when the problem of some 16,000 semi-skilled discharged labourers of the NIOC in Khuzestan is considered. They have been added to the unemployed rural population. The Ministry of Water and Power bureaucrats in Tehran believe that the reliability of the electricity service is much more important than the electricity cost contribution of manufactured goods[44].

According to a report of the Deputy Manager of the World Bank in 1965, the electricity cost of manufactured goods of Mexico was a mere 1.5% of their total cost[45]. This figure is 2% for 90% of all manufactured goods of the United States of America. Only for non-organic chemicals and the aluminium industries is the cost of electricity over 5% of the total cost[46].

A survey carried out by the Bureau of Economic Research and Investigation of the Ministry of Water and Power in Tehran in December 1971, using an average electricity price of 1.13 rials/Kwh, indicates that the percentage contribution of the electricity cost to the total cost of manufactured goods is usually lower than 2%. In the case of many other manufactured goods this percentage rises to over 21%. These percentages are much higher than those of the U.S.A. (Table 16-9). In addition to that, the higher industrial electricity tariffs of Khuzestan compared with those of the U.S.A. accentuates the need for electricity price revision in Khuzestan. For comparison, some electricity tariffs of the U.S.A. are quoted. For instance the electricity tariff of the Niagara Mohak Production Company of New York is 0.345 rials (26 cents)/Kwh for electricity consumption of over 350 Kwh/month, and that of the Electricity and Lighting Company of Arkansas is 0.277 rials/Kwh (37 cents) for consumption of over 360 Kwh/month. The Modster Irrigation Distribution Company has an electricity tariff of 0.375 rials/Kwh (50 cents) for electricity consumption of over 260 Kwh/month[47]. An average figure of 0.37 rials/Kwh is quoted by Ebrahimzadeh as the industrial electricity tariff in the U.S.A.[48] compared with that of 0.9 rials/Kwh in Khuzestan. The officials of the Ministry of Water and Power, both in Tehran as well as in Khuzestan, believe that to increase the reliability of electricity services a further 20% of capital investment over the total cost has been funded. If this is true it has not been confirmed in the case of Khuzestan. This is because electricity cuts in Khuzestan for both short and long periods are not unusual. In March and April 1975 when the multi-purpose Dez scheme was visited by the author, the electricity was frequently cut in Ahwaz, Andimeshk and even at the Pahlavi dam site, where the cuts lasted for half an hour and

Table 16-9

Contribution of the Electricity Cost to the Total Cost of Manufactured Goods in Iran and the U.S.A.

| Goods | Percentage Contribution of the Electricity Cost to the Total Cost: Iran (a) | U.S.A. (b) |
|---|---|---|
| Ice | 12.71 | 6.8 |
| Non-alcoholic drinks | 21.84 | 4.3 |
| Pasteboard (cardboard) | 6.79 | 1.2 |
| Plastic goods | 17.70 | 1.1 |
| Cement | 9.82 | 5.7 |
| Fire bricks | 10.95 | 2.5 |
| Tiles | 10.33 | 0.9 |
| Iron & aluminium brackets | 8.75 | N.A. |
| Water pumps | 25.73 | 0.5 |
| Agricultural machinery | 2.01 | 0.5 |
| Asbestos boxes | 3.54 | 0.9 |
| Matches | 2.77 | N.A. |
| Cotton & rubber shoes | 2.71 | 0.4 |
| Tissues | 2.63 | 0.3 |
| Fibreboard | 2.15 | 0.9 |
| Cotton & silk materials | 2.17 | 0.9 |
| Beer | 2.33 | 0.5 |
| Livestock food | 1.25 | 0.5 |
| Rice | 2.39 | 0.3 |
| Pasturized icecream | 2.78 | 0.9 |
| Meat products | 2.74 | 0.2 |

Sources: (a) Ministry of Water & Power, Dept. of Electricity, Division of Research and Economic Investigations. December 1971. "Percentage of electricity costs in the total costs of manufactured goods and retailing", pp.5-9.

(b) Ministry of Water & Power, Dept. of Electricity, Division of Research and Economic Investigations. March 1967. "The impact of the electricity cost in the total costs of the manufactured goods", Annex 1.

sometimes one hour. Even a long electricity cut of over five continuous days was experienced in all cities of Khuzestan except Dezful and Andimeshk in February 1976[49]. The standard period of the electricity cuts for the Japanese Aluminium industries is estimated at 20 minutes[50]. Certainly the industrial losses of Khuzestan, especially in the city of Ahwaz, must have been enormous in 1976. High electricity tariffs combined with unreliable services have kept the industrial development of Khuzestan almost static.

Agricultural electricity uses in Khuzestan are almost nil. A research group of the Institute of Social Studies at the University of Tehran quoted a figure of 1,000 to 1,500 diesel engine pumps installed on the Karoon river and commented that:

> KWPA hopes to find new electricity markets by encouraging water pump owners to change to electricity gradually. The owners complained about the high price of electricity and claimed that diesel engines are more economical. The group added that the tariffs of electricity for agricultural purposes ought to be revised.[51]

The number of installed diesel engine pumps on the five rivers of Khuzestan was 2,225 in 1972 (Table 16-10). Most of these pumps are privately owned. Only 7.28% of the pumps (162) are government owned and of these 44 are on the Dez river. Today almost all existing pumps are diesel engines and electrical motors are not used[52]. In general electricity tariffs for domestic, industrial, commercial and agricultural purposes are high in Khuzestan. This discourages economic and social development, whereas the Dez scheme was established to develop the economy and the social status of the region. Even though there is little doubt that industrial development would be greatly

## Table 16-10

## Water Pumps of the Rivers of Khuzestan

| Pumps | Dez River | | Karoon River | | Karkheh River | | Jarahi River | | Hendijan River | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1941 | 1972 | 1925 | 1972 | 1941 | 1972 | 1933 | 1971 | 1948 | 1972 | 1971/72 |
| Total water pumps | 1 | 261 | 9 | 1,072 | 1 | 322 | 1 | 174 | 1 | 396 | 2,225 |
| Government owned pumps | | 44 | | 93 | | | | 25 | | | 162 |

Source: Ministry of Water and Power, KWPA. Department of Water Supply, Bureau of the Khuzestan Water Resource Control and Supervision. "Survey of the statistics of water pump engines of the five rivers of Khuzestan." July, 1973, p.200.

encouraged if a lower rate was to be introduced. KWPA does not envisage making such a move because it claims that present rates are loss making. This claim is illogical because the cost of electric supply and investment in hydro-electric projects in Iran is so high, especially that of the Pahlavi dam, that in any case there is little hope of recovering the investment over the useful life of the dam. This is emphasised when we take into account the comments of the authorities involved that "all parts of the Dez scheme are costly and make losses. It is supposed that only the electricity supply should bear all the expenses of the scheme. The Haft-Tappeh Sugar Cane project is considered as a separate project in budgetary terms, otherwise it too could contribute to the cost recovery of the Pahlavi dam scheme".[53]

## 16-9 Efficiency of the Pahlavi Dam Hydro-electric Generators

From the previous discussions it may be seen that the Khuzestan electricity demand itself at the Pahlavi dam has not increased to the level of its full capacity yet. The low electricity consumption in Khuzestan simply indicates the fact that the generators of the Pahlavi dam have always been operated at a low rate of efficiency. To estimate this efficiency, the expected operating hours were calculated based on the assumption of a possible 24 hours of operation on 360 days per year. Since the commencement of their operation, a figure of 2 to 3 per cent of the total operating hours was subtracted to represent repair time[54] (Table 16-11(A)). The actual operating hours of each generator were subtracted from the expected operating hours after the time allowance for repair had been taken away (Table 16-11(B)). The results indicate that, since the installation of the generators, only the seventh generator has operated at its full capacity (Table 16-11(B)). The remaining generators were idle for a total 77,763.4 hours by the 21st March 1975. The efficiency rates range from 72.8% for the first generator to 91.1% for the sixth (Table 16-11(C)). However seven generators of the Pahlavi dam have been utilized at lower efficiency rates than their actual capacities. This again emphasises the lack of a market for electricity produced by the Pahlavi dam. Since 1969 with the installation of a further four generators, the additional electricity supply from the dam could be used only if it was transferred to Tehran[55]. In these circumstances it is surprising that the Harza consultant engineers from the U.S.A. commented that the installation of a 150 MW thermal power plant in Khuzestan was inevitable by the end of the Fourth Plan because Khuzestan would be short of electricity[56]. The transmission of electricity to Tehran has been done at a very high cost. (The capital cost of the Dez-Tehran transmission line is estimated at 3,475,309,000 rials[57].) The Pahlavi dam electricity is sold currently at 0.35 rials/Kwh to Tehran[58] and at the lower price of 0.32 rials/Kwh in 1971[59]. Although this low price encourages the development of industries in Tehran it is not reasonable to suggest that this is a realistic price for the recovery of the cost of the electricity supply from the dam and the transmission line costs. In Khuzestan itself the major institutions subscribing to the electricity supply from the Pahlavi dam are the Pazargad petro-chemical plant, the Ahwaz steel rolling mill company, the Ahwaz pipe-making company, the Iranian oil exploration and production company in Masjid-Solaiman and

Table 16-11

Efficiency of the Pahlavi Dam Hydro Generators (21 March 1975)

(A) Time Allowed for Repair

| Generators | Commencement of operation | Potential operating hours | Percentage of time allowed for repair | Total time allowance for repair | Expected hours of operation |
|---|---|---|---|---|---|
| 1 | 11.2.1342 | 104,040 | 0.030 | 3,121.20 | 100,918.8 |
| 2 | 10.4.1342 | 102,600 | 0.030 | 3,078.00 | 99,522 0 |
| 3 | 1.3.1348 | 50,760 | 0.025 | 1,269.00 | 49,491.0 |
| 4 | 8.4.1348 | 50,040 | 0.025 | 1,251.00 | 48,789.0 |
| 5 | 19.4.1350 | 32,280 | 0.020 | 645.60 | 31,634.4 |
| 6 | 5.4.1350 | 31,800 | 0.020 | 636.00 | 31,164.0 |
| 7 | 8.7.1350 | 29,640 | 0.020 | 592.80 | 29.047.2 |
| 8 | 16.9.1350 | 28,776 | 0.020 | 575.52 | 28,197.4 |

(B) Idle times of generators

| Generators | Expected hours of operation | Actual hours of operation (a) | Hours not in use |
|---|---|---|---|
| 1 | 100,918.8 | 72,929.0 | 27,990.0 |
| 2 | 99,522.0 | 76,067.0 | 23,455.0 |
| 3 | 49,491.0 | 42,581.0 | 6,910.0 |
| 4 | 48,789.0 | 42,971.0 | 5,818.0 |
| 5. | 31,634.4 | 27,525.0 | 4,109.0 |
| 6 | 31,164.0 | 28,347.0 | 2,817.0 |
| 7 | 29,047.2 | 29,047.2 | - - * |
| 8 | 28,197.4 | 21,533.0 | 6,664.4 |
| Total | | | 77,763.4 |

(C) Generator efficiency

| Generators | Total hours not in use | Total days not in use | Years of operation | Days not in use per year | Efficiency |
|---|---|---|---|---|---|
| 1 | 27,990.0 | 1,166.25 | 11.90 | 98.00 | 72.8% |
| 2. | 23,455.0 | 977.29 | 11.75 | 83.17 | 77.0% |
| 3 | 6,910.0 | 287.90 | 5.83 | 49.38 | 86.3% |
| 4 | 5,818.0 | 242.40 | 5.75 | 42.15 | 88.3% |
| 5 | 4,109.0 | 171.21 | 3.66 | 46.77 | 87.1% |
| 6 | 2,817.0 | 117.37 | 3.66 | 32.06 | 91.1% |
| 8 | 6,664.4 | 277.66 | 3.50 | 79.33 | 78.0% |

Source for (a): Taheri, KWPA. Pahlavi dam hydro-power plant operating control room at the dam site. Personal communication and interview, April 1975.

* The 7th generator has been operated at a rate of 100% efficiency.

a few oil pumping stations along the pipe-line. The Abadan oil refinery has its own power plants.

Although at the commencement of the Pahlavi dam scheme it was negotiated and agreed that the dam would supply the electricity demand of the oil industry, in fact it has been the oil industry which has sold electricity to KWPA over recent years. The installed electricity capacity of NIOC, which was 110 MW in the 1960's, increased to 394.7 MW in 1971[60]. In 1965, KWPA purchased 1,334,240 KWh from the refinery. This was reduced to 44,600 Kwh in 1971. Since then KWPA has bought electricity from Tavanir[61] (the company for the production and transmission of power in Iran).

With the support of the experts' views on the development of gas fuelled electricity supply in Khuzestan, it was more logical to delay the installation of the Pahlavi dam generators in the early stage of the development of electricity supply in Khuzestan at least for a few years in the early 1960's. This is emphasised since the hydro-electricity power systems are more costly in the early years of operation than alternative systems[62].

From the economic point of view the experts support the following advantages of the Abadan refinery power plant development:[63]

(a) Un-utilized and burnt gas in Abadan could be used as fuel for the power plant.

(b) The Aghajari-Abadan pipe-line which transferred 50 million cubic metres of gas for almost no cost to Abadan, was amortized.

(c) The cost of electricity at the refinery was approximately $5.9 per thousand kilowatts, or 0.43 rial/Kw.

(d) The generators of the refinery power station were already amortized, therefore production of power by this means required almost no further capital cost.

(e) Since the major consuming centres are not far from the refinery power station, the transmission and distribution costs would be much lower.

Undoubtedly Khuzestan has great potential for industrial development, especially if abundant and cheap electricity is available, but the day when demand will rise to a high level seems remote. In this situation, the installation of eight 65,000 Kw generators at the Pahlavi dam cannot be economically justified since six such generators could meet the present demand of the Khuzestan region. In addition there is the \$200 million Reza Shah Kabir Dam on the Karoon river, which will supply 1,000 mw of hydro-electricity by April 1977[64]. The original supply date for this dam was April 1975. The hydro-electricity supply from the Reza Shah Kabir Dam will be transferred to Tehran via the Shah Abbas Kabir Dam in Isfahan through a 230 KV transmission line. Also two 400 Kv transmission lines transfer hydro-electricity to Shiraz via Ahwaz and Aghagari. Some economists believe that it would be more feasible economically if Tehran's demand was met by the installation of thermal power plants in Tehran rather than by electricity transmission from Khuzestan. This has been emphasised especially when the electricity losses over long distances are taken into account. (In Bahman, 1350 (February 1971) the power transferred to Tehran was 51,456,000 Kwh with a loss of 5,414,800 Kwh or 10.52%)[65].

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