# A COST-BENEFIT ANALYSIS OF THE DEZ MULTI-PURPOSE PROJECT

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Studies aimed at drawing up development projects for the Xuzestān Region began at the time of the 2nd Development Plan when two directors of the Development and Resources Corporation of New York visited Iran in the company of several experts on development. This group travelled to Xuzestān and, with the aid of rather scanty information, mostly based on miscellaneous studies made by government institutions, they recommended the implementation of large-scale development projects in that region. Later, in April 1956, the Plan Organization concluded an agreement with the same Corporation to carry out preliminary studies on the project. By July 1956 the Corporation had presented its preliminary report and was commissioned to draw up a comprehensive development plan for Xuzestān within the following two years. In accordance with an annex to a previous agreement concluded between the Plan Organization and the Development and Resources Corporation (signed in January 1956) the latter was to be vested with extensive powers with respect to the planning and implementation of projects approved for the region either independently or on a contract basis. The original agreement was, at this time, extended for three years (up till April 1961). In 1957 agreements related to four specific projects were signed. Three of these concerned uncompleted Plan Organization Projects in the region (the Gotund Project, the Karxeh irrigation project, and the expansion of facilities for the distribution of electric power in the Xuzestān region). The fourth project was for the production and refining of sugar cane. According to this agreement the Development Corporation was to assume responsibility for the planning and execution of future activities for all four projects and supervise current operations on existing projects made over to them by the Plan

Organization. In addition to these four projects, the Corporation continued its studies and in 1958 submitted a report to the Plan Organization entitled *The Unified Development of Natural Resources of the Khuzestan Region.*[1]

Despite its many defects, this report has been used as the basis upon which the development projects of Xuzestan have been drawn up. In it the Development and Resources Corporation proposed the construction of fourteen multi-purpose dams on the rivers Karxeh, Dez, Karun, Jarahi and Hendijan with the stated aim of producing 6,600,000 kilowatts of hydro-electric power and putting some several hundred thousand hectares of land to agricultural use.Table 1 shows the main characteristics of these multi-purpose projects.

*Projects included in the first stage of the Xuzestan Development Programme.* Agreements were made between the Plan Organization and the Development and Resources Corporation for seven projects to be carried out promptly in 1957. These were:

1. The Dez multi-purpose project including (a) The construction of the Dez dam, a power station and a transmission line; (b) A detailed programme for the use of water accumulated in the dam which, during the first stage, was to be used to irrigate 125,000 hectares.

2. A sugar-cane cultivation project.

3. A project aimed at creating and improving facilities for the distribution of electricity.

4. A four-year experimental project for chemical fertilizers which included training farmers in their use and expanding the creation of fertilized land.

5. A fixed programme for studying resources.

6. The Karxeh irrigation project.

7. A project for the establishment of a plastics factory which would use Xuzestan natural gas as its raw material.

Table 1. Irān: Basic features of the Xuzestān multi-purpose development projects proposed by the Development and Resources Corporation.

| River | Tributary | Project | Cachement area (sq. kms.) | Average annual flow(cu.metres per sec.) | Minimum natural flow (cu.metres per sec.) | Height of dam (metres) | Capacity of resevoir (million cu. metres) Total capacity | Useful capacity | Minimum regulated flow (cu. metres | regulated | Electricity production capacity (1,000 kwt) | Approx cost (million rls.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Karxeh | Karxeh | Karxeh 1 | 39000 | 170 | 25 | 170 | 6000 | 4500 | 150 | 140 | 240 | 6600 |
| | Simereh | Karxeh 2 | 36500 | 100 | 15 | 165 | 3550 | 2250 | 75 | 135 | 240 | 5400 |
| | Simereh | Karxeh 3 | 20000 | 80 | 10 | 170 | 1950 | 1380 | 40 | 140 | 240 | 7800 |
| Dez | Dez | Dez | 17000 | 305 | 50 | 190 | 3350 | 2550 | 190 | 152 | 520 | 6200 |
| | Baxtiāri | Baxtiāri | 6000 | 190 | 30 | 120 | 720 | 9630 | 60 | 270 | 180 | 4800 |
| Kārun | Kārun | Kārun 1 | 32000 | 465 | 115 | 180 | 9100 | 4400 | 425 | 150 | 600 | 10200 |
| | Kārun | Kārun 2 | 27500 | 355 | 90 | 195 | 8600 | 4600 | 325 | 220 | 900 | 15700 |
| | Kārun | Kārun 3 | 24500 | 340 | 80 | 150 | 4300 | 2050 | 250 | 125 | 750 | 9400 |
| | Kārun | Kārun 4 | 23500 | 330 | 80 | 160 | 1800 | 1150 | 225 | 140 | 1000 | 10200 |
| | Kārun | Kārun 5 | 15000 | 190 | 55 | 215 | 3000 | 1780 | 140 | 180 | 1200 | 16800 |
| | Kārun | Kārun 6 | 10500 | 135 | 30 | 160 | 1250 | 850 | 95 | 130 | 360 | 7000 |
| | Kārun | Kārun 7 | 7000 | 110 | 25 | 165 | 1050 | 870 | 70 | 280 | 200 | 6900 |
| Jarāhi | Mārun | Mārun | 3500 | 60 | 5 | 190 | 1200 | 800 | 30 | 155 | 100 | 3700 |
| Hendijān | Zoreh | Zohreh | 7000 | 55 | 10 | 150 | 1500 | 1000 | 35 | 120 | 70 | 2000 |
| | | | | | | | | | | | 6600 | 112700 |

Source: Development and Resources Corporation, *The Unified Development of the Natural Resources of the Xuzestān Region*. New York. March 1959. P.40.

In addition an aid programme for the implementation of these projects together with a costing of the necessary down-payments was made out. The Gotund project was, at the same time, abandoned. By 1959, the only projects that were actually being implemented by the Development and Resources Corporation were the sugar-cane project, the Dez dam, the electricity distribution programme and the chemical fertilizer programme. Responsibility for the plastics factory had been turned over to the Ministry of Industry and Mines (now the Ministry of the Economy). The Karxeh irrigation project was turned over to the Karxeh Dam Organization which was responsible to the Ministry of Agriculture.

In March 1958 the International Bank for Reconstruction and Development extended a loan for 38.2 million dollars (IRN 274) to the Iranian government whose repayment with interest meant a debt of some 42 million dollars. The purpose of this loan was to ensure the foreign exchange necessary for the Mohammad Reza Shah Pahlavi (Dez) dam, the power station, the transmission lines, the distribution network and the implementation of the first stage of the Dez irrigation project. Under the terms of this loan agreement, the first stage of the Dez irrigation project was to be confined to 20 thousand hectares which were called the Dez Pilot Irrigation Project (DPIP).

On the basis of recommendations made by the Development and Resources Corporation, a state regional development organization known as the Xuzestan Water and Power Authority was created in 1960. After a period of time, during which it was to be organized and manpower training programmes were to be undertaken, this authority was to assume full responsibility for the development projects. In 1961 a new agreement was concluded between the Plan Organization, the Xuzestan Water and Power Authority, and the Development and Resources Corporation under which the operations of the Corporation were to be extended to September/October 1962 (Mehr 1341). Up to this date, the terms of previous agreements were also to be in force. In March/April 1962 (Farvardin 1341) part of the responsibilites of the foreign corporation were transferred to the Xuzestan Water and Power Authority in accordance with principles outlined in 1956. However, in 1962 a further agreement was concluded between the Authority itself and the Development Corporation under which

the corporation would again extend its services to April 1965. The Corporation was to take responsibility for consulting and for the performance of all technical services required for the Authority's projects. In addition, the management of the Pahlavi (Dez) dam project, power production and installations, the construction of transfer lines, the DPIP and the sugar cane project were to remain in the hands of the Corporation until such time as the Xuzestān Water and Power Authority was capable of managing them itself. In any case the period was, on no condition, to last for longer than July 1963.

## An evaluation of the Mohammad Rezā Shāh Pahlavi (Dez) Dam Hydro-Electric Project

This is one of the fourteen dams recommended for the area by the Development and Resources Corporation and apparantly it received priority because of its proximity to the major roads of Xuzestān and the possibilities the site offers for an easy transfer of power to the major cities of the province. The Dez is a tributary of the Karun river and its basin is situated between the Karxeh and Kārun rivers. The area of the basin above the dam is about 17,000 square kilometres and the total area of the basin at the upper part of its junction with the Kārun is 22,500 square kilometres. The climate of the region is hot and dry with no rainfall between April and September. The annual precipitation is 150 mm. in the plains, and 1,200 mm. in the mountains. Before the construction of the dam, the average annual flow of the river was 220 cubic metres per second.

The goals of the Dez project were outlined by the Development and Resources Corporation as follows:

1. The dam was to provide enough water for the development of the Xuzestān Plain and thus contribute to the development of industry and agriculture and a better standard of living for the people.

2. It was to be a 'huge and everlasting' source of water and electricity which, combined with thermal sources would make power plentiful and cheap.

3. It was to be used for flood control in the Dez basin.

However, although in theory these goals may look credible, in reality the dam cannot provide benefits of this kind. With respect to the first goal, the DRC had estimated that 125 thousand hectares of land lying below the dam could be irrigated for agricultural use. However, as we shall see later, after a lapse of some ten years (from 1962 to 1971), the Xuzestan Water and Power Authority has only succeeded in cultivating the lands included in the Dez Pilot Irrigation Project, a mere 22,000 hectares, and this at the cost of extremely heavy investment. Although the sugar cane project has been successfully implemented this is quite a separate matter and cannot be included in a cost-benefit analysis of the Dez project itself. Again it seems that the idea that the Dez will provide a huge and 'everlasting' source of electricity is devoid of any realistic content for, in the opinion of experts interviewed by this writer, it has a much shorter life than that expected. Apparently when the dam was being built necessary measures for the prevention of erosion were not taken with the result that there is a permanent flow of mud into the dam. It has been estimated that over the next twenty years the lower parts of the resevoir will be completely clogged up with mud and sediment and that, moreover, dredging will be uneconomical. This means that at the end of this period the water of the dam will not flow properly and irrigation and power-production operations will come to a complete halt.

The idea of enormous sources of cheap electricity is also in the question for one may well ask for what, or for whom? Xuzestan does not possess the industrial centres needed to create an adequate demand for the power of the Dez dam (except for the oil industry in Abadan which has, in any case, its own electricity station). Further, the electricity produced by the dam is by no means cheap.

The initial proposal for the construction of the Dez dam, which was to be built some 22 kilometres north-east of Andimeshk envisaged a dam with a height of 140 metres and a power station consisting of two 40 thousand kilowatt generators. The planners contemplated adding a further 50 metres

to its height at a later date and raising the capacity of its generators to 65,000 kilowatts. In 1958, the Development and Resources Corporation presented a further report entitled the *Dez Supplementary Report* which included a summary report by a Dutch firm, Nederlandsche Heidmaats Chappij of Arnhem. In this summary the Dutch firm stated as a result of the construction of the Dez Dam, 170 thousand hectares of land could be irrigated. On the basis of this optimistic estimate the Dez Irrigation Project was adopted as one of the uses of the dam. In the supplementary report,the Development and Resources Corporation introduced a number of changes into the initial project. Among these, the most important was revision of the height of the dam. According to the Corporation, if the height were to remain at the initial 140 metres, the electric power produced by the dam would be insufficient to meet the requirements of the area, even during the first years of operation. Consequently the height was set at 190 metres.

In the winter of 1957, a road was built between Andimeshk and the Dez plain by the Development and Resources Corporation and construction work on the first stage(living quarters, the provision of water and electricity, the digging of a diversion tunnel etc.) was begun in May 1958. The concrete shell of the dam was completed in September 1961 and the dam was inaugurated in October 1962. In February 1962 the power station began operations on an experimental basis and in May 1963 commercial operations commenced. The contractor for the first stage was Morrison Knudsen International Contractors Inc. and the contractor for the second stage was the Italian firm Impresit Girola Lodigiani(Impregilo). In addition, more than twenty other European and American companies have participated in the project.

On completion the dam became the largest in Irān, the highest in the Middle East, and the seventh or eighth highest in the world with a final height of 197 metres. Its resevoir has a capacity of 3,350 million cubic metres which is equal to the Norris lake, the greatest in the Tennessee Valley, and in October, November and December it has an extra capacity for storing 1,000 million cubic feet of water to help control winter floods. The underground power station will have a final capacity of 520 thousand kwts.

(generated by eight 65 thousand kwt. generators).

*The hydro-electric power operations of the Dam before its completion.* By the agreement concluded in 1957 between the Plan Organization and the Development and Resources Corporation, the latter was entrusted with the responsibility for drawing up all necessary projects for the development and distribution of electric power in Xuzestān. At the same time the DRC was to take over the responsibility for the execution of other agreements and projects for the development and operation of energy resources in the region. In August 1957 (Mordād 1336) a regional centre known as the Xuzestān Electricity *Bongāh* was founded by a decree of the Council of Ministers and was to operate under the aegis of the Plan Organization. The management of this *Bongāh* was handed over to the DRC and the *Bongāh* itself was eventually placed under the supervision of the Xuzestān Water and Power Authority. The functions of this organization were as follows:

1. To build a power-transfer network from the proposed dam site to Ābādān and Xorramshahr.

2. To assist the municipalities of Ābādān, Ahwāz, Andimeshk, Dezful and Xorramshahr in creating a power distribution network.

3. Responsibility for the delivery of electric power to various urban distribution networks.

4. Responsibility for the sale of electricity to large industrial consumers in Xuzestān.

In 1957 the functions of the DRC with respect to the development of electric power were turned over to the Xuzestān Water and Power Authority. Between 1957 and 1962 this Authority developed the distribution network in the urban areas of Xuzestān, purchased a power generating plant for Ahwāz (to be used prior to the completion of the Ābādān-Ahwāz transfer line), constructed the Golestān gas pipe-line, employed Dutch specialists to install transfer lines for 33,132 and 230 kwts, created substations and distribution centres, and repaired and supervised the operation of a

diesel power-generating plant.

By the time the generators were installed in the Dez dam power station (1963) the Dez power transfer unit included a power transfer line of 230 kwts. from the Pahlavi (Dez) dam to Ahwaz, a power transfer line of 132 kwts. from Andimeshk to Dezful, two 132 kwt. lines from the Ābādān sub station to the secondary distribution station of Abadan to Xorramshahr, a new sub-station in Admimeshk, high-pressure lines to the Ahwaz and Abadan sub-stations, and secondary distribution stations in Dezful, Andimeshk, Ahwaz, Abadan and Xorramshahr.

*Electric Power Operations after the completion of the dam.* From 1963 onwards the distribution network gradually spread over the whole of Xuzestan. The power-transfer network was continued through the creation of a 132 thousand volt line from Dezful to Masjed Suleiman. With a view to providing electricity for the Qasabeh region, Minoo island, Shush township and a number of villages, the power transfer lines were extended and a 33 thousand-volt power transfer line was installed between Ahwaz and Dasht Mishan. By December 1970, the total power transfer lines in the northern districts, in the south and the south-east of Xuzestan were as follows:[2]

| | |
|---|---|
| 230,000 volt power transfer line: | 428 kilometres |
| 132,000 volt power transfer line: | 658 kilometres |
| 33,000 volt power transfer line: | 228 kilometres |
| 11,000 volt power transfer line: | 639 kilometres |
| Low tension line | 1199 kilometres |

Up to the end of 1969 four main power stations, one in Andimeshk, two in Abadan and one in Ahwaz, and twenty- four sub-stations with a total capacity of 871,040 kilowatt amps had to be constructed. In the year 1970, the following seven stations and sub-stations with a total capacity of 327,000 kilowatt amps were under construction: the Reza Shah Dam Station, the Bid-Boland substation, the Chehel-Mil station, the Omidieh station, the Behbehan station, the Dogonbadan station and the substation of the Marun separation set.

With the installation of generators No.3 & No.4 of the

first power station of the dam was completed in 1969. Generators No.5 and No.6 were installed in 1969 and scheduled for operation in 1970. At present generators No.7 and No.8 are being installed and are scheduled to begin operations in March 1971. When the latter are completed, the second power station of the Pahlavi dam will be complete the final production capacity of 520 thousand kwts. will be reached. In addition to these, a 230,000 volt high-tension power transfer line between the Dez dam and Tehran has been constructed by the Tavānir Power Company. This is intended to meet the demand for electricity in Tehran and in other towns along the power-transfer line. Between March and December 1970 this Company purchased 138 kilowatt hours of electricity from the dam's power stations of which 62 kilowatt hours were wasted in the transfer.

Despite the low demand for electricity in the Xuzestān region and the fact that the generators of the power station have nearly always either been idle or working below capacity, the Xuzestan water and Power Authority has placed an order for one steam turbine unit with a capacity of 145 mega-watts for Ahwāz. This turbine is scheduled to start operations in 1973. One of the reasons for this order is that the Authority envisages using the power of the dam to meet the demand of the national grid and has, therefore, predicted a shortage for Ahwāz.

*The production of hydro-electric power.* In 1963, the first year of operation two generators with a total capacity of 130,000 kilowatts were ready to begin production. However, a low level of demand has meant that these have been working well under capacity. Table 2 shows the amount of production and the amount of electricity sold by the dam between 1342 (March 1963-March 1969) and 1349 (March 1969-March 1970).

The production figures shown in the Table indicate the low level of production.[3] If a 65,000 kilowatt generator works for one hour per day it can produce 23.7 million kwts. of power per year. This means that the two generators must each work a little more than an average of two hours per day in order to produce 97.4 million kilowatt hours (the 1346 [1962-63] production level) or, in other words, one of them

Table 2. Irān: 1342-49 (1963-64 - 1969-70)s production, demand, subscribers and sale of power from the Pahlavi Dam

| Year | Production (million kwt hours) | Demand (Kwts) | Subscribers | Total income (million rls.) |
|---|---|---|---|---|
| 1342 | 97.5 | 18000 | 27500 | 96.6 |
| 1343 | 158.1 | 38800 | 58339 | 219.3 |
| 1344 | 203.0 | 51900 | 66343 | 274.2 |
| 1345 | 257.2 | 59000 | 72067 | 322.2 |
| 1346 | 358.5 | 86000 | 80694 | 405.2 |
| 1347 | 435.3 | 89800 | 93412 | 459.8 |
| 1348 | 685.8 | 128000 | 99669 | 265.6 |
| 1349 | 1,220.0 | 200000 | 105000 | 750.0 |

Source: This table has been compiled from figures extracted from the archives of the Xuzestan Water and Power Authority(Electricity Sec-

worked for about $4\frac{1}{2}$ hours while the other remained idle. In 1343 (1963-64) the production level was 158 million kwt. hours which means that each generator worked for 3.5 hours or that one worked for 7 hours per day. The figures for the following years work out as follows:

1344 (production: 203 million kwt. hours) 4.5 hours each
1345 (production: 257 million kwt. hours) 5.5 hours each
1346 (production: 348 million kwt. hours) 8 hours each
1347 (production: 435 million kwt. hours) 8.5 hours each

In 1348 (1968-69) generators 3 and 4 were installedand the first power station of the dam was completed. If four 65,000 kwt. generators work for one hour a day they will produce a total of 95 million kwt. hours per year. In 1348 the demand for electricity was about 658 million kwt. hours which means that each of the four generators was used for 7.5 hours per day or that two of the generators were idle and the other two worked 15 hours each. In 1349 the power station sold electricity to the Tavānir Power Company for transfer to Tehrān and demand reached 1,220 million kwt. hours. This means that during this year two of the generators were in almost constant use while the other two remained almost constantly idle.[4] By 1350 two more generators had been installed (nos. 5&6) so, altogether we can conclude

that, out of six generators, two had been in almost permanent use and that a third had been operated for about two hours each day while the other three remained idle.

These other three generators could be used if the sale of power to the Tavanir Power Company for use in Tehran were increased. However, it is still not certain that the transfer of power in this way is economical. The low level of production in the years 1342-1347 can be attributed to the lack of demand in the Xuzestan region. The major institutions subscribing to the electricity of the dam are: the Pazargard Petro-Chemical Plant, the Iran Rolling Mill Company, the Ahwaz pipe-making factory, the Iranian Oil Exploration and Production Company in Masjed Suleiman and a few oil-pumping stations along the pipe-line. The Abadan oil refinery has its own power plant and not only does it not need the electricity of the Dez dam, but it has also, over the past years actually sold electricity to the Xuzestan Water and Power Authority. In 1346 (1967/68) the Authority purchased 1,489,000 kwt. hours from the Refinery,[5] in 1347 961,000 kwt. hours,[6] in 1348 65,000 kwt. hours.[7] Probably, in the preceeding years it purchased even more. Before the installation of the dam generators, the oil refinery produced 140 thousand kilowatt hours of electricity, enough to meet its own needs as well as those of Abadan, Xorramshahr, Ahwaz and other townships in the area. Indeed the power plant of the Refinery has, from an economic point of view, many advantages over the dam. Some of those which have been cited by experts on this problem are as follows:[8]

1. Gas which is not utilized by the refinery and was previously burned as a waste product is converted into electric power at the refinery power station.

2. The Aqajari-Abadan pipe-line is amortized and 50 million cubic metres of gas are transferred to Abadan by this means almost free of charge.

3. The cost of electricity produced at the Refinery is a little less than 5.9 dollars per 1,000 kwts. or about 9 shahis (a little less than 5 rials) per kwt.

4. The generators of the Refinery power station are already amortized and the production of power by this means

entails almost no capital costs.

5. The major consuming centres of the Refinery's powers are not far distant from the power station so that the cost of distribution is much lower.

Although Xuzestān has, without any doubt, great potential as an industrial centre, especially if plentiful, cheap electricity is available, the day when demand rises to a very high level is still distant. In this situation, the installation of eight 65,000 kwt. generators at the Dez dam cannot be considered an economically justifiable act for one power station with four such generators can meet all the present demand of the province. Moreover, in addition to the power plants at the Mohammad Rezā Pahlavi dam, a new power station with a final capacity of 1 million watts is at present being built at the Reza Shah Kabir Dam on the Karun river and this is scheduled to begin operations in 1975. This brings the total sources of electric power in Xuzestān to four: the Dez dam, the Ābadān refinery, the Reza Shah Kabir dam and the Ahwāz steam power station (scheduled to begin production in 1973). Why the last project was approved and is being implemented is somewhat unclear for it is quite obviously economically unfeasible. Perhaps the reason is that planners are thinking of eventually transferring the whole of the power of the Dez dam to Tehrān in a effort to justify the heavy investments made in that project. But even this plan is not necessarily viable from an economic point of view for the transfer is costly and a good deal of power is lost on the way. A new thermal power plant in Tehrān would have met that city's needs at a much lower cost.

*The price of electricity in Xuzestān.* One other reason for the low demand for electricity in Xuzestān is its price. The regulations of the electricity service show this to be as follows:[9]

1. Household electricity service (Tariff No.11). This concerns electricity sold to households but does not include clubs, schools, mosques and other public buildings of this type. The rate for two months electricity is: first 60 kwts. 150 rials (2.5 rials per kwt. hour); next 140 kwts., 2 rials per kwt. hour; next 600 kwt. hours, 1.60 rials per kwt. hour; over 800 kwt. hours, 1.2 rials per kwt. hour. Minimum

bi-monthly statement of account: 150 rials.

2. Service for small establishments (Tariff No. 21). This applies to all commercial, industrial or government units whose demand is less than 40 kwts. The rate for two months electricity: first 600 kwt. hours, 2.5 rials per kwt. hour; next 1,400 kwt. hours, 2 rials per kwt. hour; next 40,000 kwt. hours, 1.60 rials per kwt. hour; over 6,000 kwt. hours, 1.20 rials per kwt. hour. Minimum bi-monthly statement of account: 200 rials plus 200 rials per kilowatt.

3. Service for establishments consuming 40 to 5,000 kwts. The rate for each kilowatt demanded: 140 rials. Electricity rate: first 2,500 kwt. hours, 0.90 rials per kwt. hour; next 97,500 kwt. hours; 0.70 rials per kwt. hour; over one million kwt. hours, p.50 rials per kwt. hour. For each kwt. hour over and above 365 kilowatt hours consumed there is a discount of 0.10 rials on the above rates. The minimum on the monthly statement of account consists of 60 per cent of the demand rate multiplied by either of the following two figures, whichever is greater: (a) the largest figure of demand for the subscribers statement of account in the last twelve months (ending in the current month) or, (b) the demand inserted in the subscribers agreement (if this exists).

4. Tarrif for demand exceeding 5,000 kwts. The rate laid down in this tarrif applies especially to subscribers who consume electricity at a single voltage and through a single meter. The service for such subscribers consists of an alternating current with a frequency of 50 cycles per second, 3 phases with a nominal voltage of 11 or 33 kilowatts according to the capabilities of the Xuzestan Water and Power Authority. The price of electricity according to demand is 225 rials per month per kilowatt applied for. The total electric energy consumed in excess of 225 kwt. hours against each kilowatt of demand is charged at 0.3 rials per kwt. hour. The minimum monthly account consists of the cost of the energy supplied.

5. Tarrif for the lighting of thoroughfares (Tarrif No. 31). This relates to the work of municipalities and there is no special rate.

The tarrifs for the fourth category do not, at present, really concern Xuzestan because there are no industrial units consuming this level of electricity except the refinery which supplies its own power. There is no set tarrif for the lighting of thoroughfares so what remains are the tarrifs concerning household subscribers, small establishments and industrial units which have a demand of 40 to 5,000 kilowatts.

The first group, that is household subscribers, consists of some 80,000 units. The minimum rate of 75 rials per month is at least for rural households, rather high,for such people generally have low purchasing power. Moreover, they rarely consume more than 30 kwt. hours per month, the minimum monthly consumption. This makes the rate at which they must pay even higher so the villagers are often unwilling to use electricity in their homes. There have even been cases in which the people have used street lamps, an action which motivated the Xuzestan Water and Power Organisation to remove public lighting from the streets of such districts.[10]

By 1968 only a few of the households in 26 villages made use of electricity. However, it is obvious that electric power were made available in the rural areas at a low cost, many more households would subscribe and this would contribute considerable to the modernization of these areas. The Xuzestan Water and Power Organization should,therefore, follow up its programme for encouraging the use of electricity in the villages very seriously, and it should lower the price of the electricity supplied to them.

In the case of the second group, urban households, who comprise the majority of the household subscribers, we can say that although the electricity rate in Xuzestan area is somewhat cheaper than in other areas of Iran, it is still expensive. This is indicated by the fact that, out of 281,986 urban households living in the region, only 70,000 are subscribers to the electricity service. This small proportion could, of course, be explained with reference to the luxury nature of household electricity consumption in Iran, but I think that this factor cannot be said to apply to Xuzestan which has a very hot, even unbearable climate,

and where the use of coolers and other air-conditioning devices run by electricity is a necessity.

In the case of small industries and commercial institutions of which there are some 20,000 in Xuzestan, the price (1.8 rials) is also too high. But perhaps the most important group, from the economic point of view at any rate, are the larger industrial units with a consumption of 40 to 5,000 kilowatts and for whom the price of electricity is 0.9 rials. (There are at present no units large enough to make use of the 0.5 rial rate). There are 250 such units, a very limited number in view of the existence of water, electricity, roads, access to markets, proximity to gas and oil resources, all of which should make industrial investment in Xuzestan an attractive prospective. Indeed, the excellent situation of Xuzestan as a potential industrial centre means that the encouragement of industrial investment should be a major task of the Xuzestan Water and Power Organization, at task which that Organization has, alas, so far neglected. But despite the easy availablity of all these resources the problem of the price of electricity for large industrial concerns still remains. Perhaps the high price of electricity for industry in this region can be better highlighted by comparing it with the average rate for industrial electricity in the United States which is 0.37 rials per kwt. hour.[11]

Even though there is little doubt that industrial development would be greatly encouraged if a lower rate were to be introduced, the Xuzestan Water and Power Authority does not envisage making such a move because it argues that even the present rates are a loss. This is not, perhaps, the correct logic to use for the costs of production and investment in hydro-electric projects in Iran, especially the costs of the Pahlavi dam, which are so great that in any case there is little hope of recovering them over the useful life of the dam.

*The cost of electricity produced at the Pahlavi (Dez) Dam.* The total funds spent by the Development and Resources Corporation for all operations relating to the development of Xuzestan between 1957 and 1963 amount to 164.5 million dollars or 12,338 million rials. Of this 71 million dollars

or 5325.9 million rials have been spent on the construction of the Pahlavi (Dez) dam and power production installations; 9.96 million dollars or 746.9 million rials (6.1 per cent) on the Dez Pilot Irrigation Project; 4.1 million dollars or 308.7 million rials (2.5 per cent) on power production operations; 17 million dollars or 1,278 million rials(10.4 per cent) on administrative and general expenses; 34 million dollars or 2,574 million rials (20.7 per cent)on the sugarcane project; 1 million dollars or 77.7 million rials (0.6 per cent) on the plastics factory; 0.5 million dollars or 92.7 million rials (0.8 per cent) on the chemical fertilizer plant; 5 million dollars or 379.4 million rials(3.1 per cent) for the Karxeh Irrigation Project; 4.1 million dollars or 307.9 million rials (2.5 per cent) on the survey of resources project; and 2.3 million dollars or 176 million rials (1.4 per cent) on the purchase of general necessities. Of these funds, the Plan Organization (in the 2nd Development Plan) provided 129.3 million dollars and the International Bank for Reconstruction and Development provided 38.2 million dollars. Details of the sources of funds and the costs of the projects are provided in Table 3.

Out of the loan of 2,865.3 million rials extended by the International Bank for Reconstruction and Development which in Irānian currency comes to 2,425.2 million rials, (84.6 per cent) have been spent on the Pahlavi (Dez) dam and the transmission line; 335.8 million rials (11.7 per cent) on power production and operation; and 104.2 million rials (3.6 per cent) on the Dez Pilot Irrigation Project. As shown in Table 3, over 55 per cent of the expenses incurred up to the year 1963 were spent on production installations and the transmission and operation of the Pahlavi dam hydro-electric power project. Table 4 shows the construction costs of the primary hydro-electric power installations of the Pahlavi dam and the present value of the expenses in the last year of its construction (1963).

In the first column of Table 4 we have listed the construction expenses for each part of the dam's installations separately. In the second column we have calculated the present value of the costs for the year 1342 (1963) assuming an interest rate of 8 per cent the usual interest rate for hydro-electric power and irrigation projects in developing countries. The length of the useful life of the dam, the

Table 3. 1336-1342 (1957-1963):Summary of the receipts and remmitances of the Development and Resources Corporation for contracts made for the development of Xuzestan with the Plan Organization and the Xuzestan Water and Power Authority.

| | Dollars (thousands) | Rials (Millions) | Per cent |
|---|---|---|---|
| RECEIPTS | | | |
| Cash from Plan Organization | 128436.7 | 9632.8 | |
| | 942.2 | 70.7 | |
| | 5.2 | 0.4 | |
| | 129384.1 | 90703.8 | |
| From the IMBRD | | | |
| Paid to DRC | 9305.6 | 679.9 | |
| Paid to contractors | 28898.9 | 2167.4 | |
| Total | 38204.5 | 2865.3 | |
| ASSETS | | | |
| Property made over by the Plan Organization | 1174.1 | 88.1 | |
| Total Receipts | 168762.6 | 12657.2 | |
| REMMITANCES | | | |
| Dez dam; power production & transfer units | 71012.4 | 5325.9 | 43.2 |
| Dez Pilot Irrigation Project | 99580.6 | 746.9 | 6.1 |
| Abadan-Ahwāz transfer line | 4104.0 | 307.8 | 2.5 |
| Power production operations | 4950.8 | 371.3 | 3.0 |
| Sugar cane project | 33978.4 | 2548.4 | 20.7 |
| Plastics factory | 1036.1 | 77.7 | 0.6 |
| Chemical fertilizer project | 1236.9 | 92.8 | 0.8 |
| Karxeh irrigation project | 5059.3 | 379.5 | 3.1 |
| Resources study project | 4105.8 | 307.9 | 2.5 |
| General necessities | 2348.0 | 176.1 | 1.4 |
| General & administrative expenses | 17040.4 | 1278.0 | 10.4 |
| Living quarters & services | 119.4 | 9.0 | 0.1 |
| Total | 154950.1 | 11621.3 | 94.2 |
| REMMITANCES OF OFFICES OF THE XPWA | | | |
| | 8243.3 | 618.2 | 5.0 |
| Remmitances of the RDC | 1325.0 | 99.4 | 0.8 |
| Total remmitances | 164518.5 | 12338.9 | 100 |
| | 168762.6 | 12657.2 | |
| | 164518.5 | 12338.9 | |

* Figures are for the Iranian year which begins on March 21st. 1335 is therefore equivalent to March 21st 1956 to March 20th 1957; 1342 is equivalent to March 21st. 1963-March 20th. 1964.

Source: Source of figures for production costs is *Summary Accounting of Funds* Xuzestan Development Program, March 29, 1950-June 21, 1963, Development and Resources Corporation, New York, December 1964. Chapter 7, Chapter 8, Chapter 9 & Chapter 14.

Table 4. Irān 1335-1342: Construction cost of the main installations of the Mohammad Reza Shāh Pahlavi Dam (Dez dam)*

| Year | Real costs ($1,000) | Present value in 1342 with 8 per cent interest |
|---|---|---|
| 1. Production costs of dam, power-production unit and transfer equipment | | |
| 1335 | - | |
| 1336 | 217.6 | 217.6 x 1.714 = 373 |
| 1337 | 4746.8 | 4746.8 x 1.578 = 5159.8 |
| 1338 | 8125.7 | 8125.7 x 1.469 = 11956.6 |
| 1339 | 8833.1 | 8833.1 x 1.360 = 12013 |
| 1340 | 15923.6 | 15923.6 x 1.260 = 20063.7 |
| 1341 | 20641.3 | 20641.3 x 1.166 = 14067.8 |
| 1342 | 12524.2 | 12524.2 x 1.080 = 13526.2 |
| Total | 71012.4 | 87140.1 |
| Less shared cost of dam for irrigation and flood control | 9330 | 7661.6 |
| Total ($1000) | 61682.3 | 7661.5 |
| Total (Rls.1,000,000) | 4625.9 | 5749.5 |
| 2. Production and installation cost of Ābādān-Ahwaz transmission line | | |
| 1335 | - | - |
| 1336 | - | - |
| 1337 | 1104.7 | 1104.7 x 1.587 = 1753.1 |
| 1338 | 2768.0 | 2768.0 x 1.469 = 4066.2 |
| 1339 | 230.6 | 230.6 x 1.360 = 313.7 |
| 1340 | 0.7 | 0.7 x 1.260 = 0.9 |
| 1341 | - | - |
| 1342 | - | - |
| Total ($1,000) | 4104 | 6133.8 |
| Total (Rls.1,000,000) | 308 | 460.0 |
| 3. Production cost of power production and operation installations | | |
| 1335 | - | - |
| 1336 | 43.2 | 43.2 x 1.587 = 68.5 |
| 1337 | 104.8 | 104.8 x 1.469 = 154 |
| 1338 | 1289.8 | 1289.8 x 1.360 = 1754.1 |
| 1339 | 1858.3 | 1858.3 x 1.260 = 2341.5 |
| 1340 | 754.3 | 754.3 x 1.166 = 879.6 |
| 1341 | 900.4 | 900.4 x 1.080 = 972.5 |
| Total ($1,000) | 4950.8 | 6170.1 |
| Total (Rls.1,000,000) | 371.3 | 462.8 |
| 4. Administration and general costs for the whole project | | |
| 1335 | 66.9 | 66.9 x 1.851 = 123.8 |
| 1336 | 165.8 | 115.8 x 1.714 = 284.2 |
| 1337 | 300.9 | 300.9 x 1.587 = 477.6 |
| 1338 | 3186.0 | 3186.0 x 1.469 = 4680.2 |
| 1339 | 2009.3 | 2009.3 x 1.360 = 2732.7 |
| 1340 | 1439.6 | 1439.6 x 1.260 = 1814.0 |
| 1341 | 8844.3 | 8844.3 x 1.166 =10312.4 |
| 1342 | 1027.5 | 1027.5 x 1.080 = 1109.7 |
| Total ($1,000) | 17040 | 21534.6 |
| Total (Rls.1,000,000) | 1278 | 1615 |

For production operations we can allocate only 50 per cent of administrative and general expenses.

Dollars 17040 x 0.50 = 8520.2 or 21534.6 x 0.50 = 10767.3
Rials (millions) 1278 x 0.50 = 639 or 1615 x 0.50 = 807.5

5. Grand total

| | | |
|---|---|---|
| ($1,000) | 79257.4 | 99733.7 |
| (Rls.1,000,000) | 5944 | 7480 |

Source of costs: *Summary Accounting of Funds, Khuzestān Development Program; March 29, 1950 to June 21, 1963.* Development and Resources Corporation. New York. December 1964.

the power stations, generators and transfer lines has been put at fifty years. This conflicts with the conventional assumption that the shell of the dam has a useful life of 100 years, the generators 25-30 years, and the power transfer lines 50 years. However it should be noted that, firstly, the dam's shell was not in itself a large item of expense (about 1,453 million rials)[12] and, secondly that it is subject to silting and technical experts believe that it will not have a useful life of more than fifty years. The useful life of the power-stations and generators have been overestimated. Since the construction cost of the shell of the dam is a cost common to both the hydro-electric and the irrigation and flood-control projects, we have deducted half of the construction cost of the dam from the costs of the hydro-electric power project. Likewise we have only included half of the administrative and general costs.

Table 5 shows the annual balanced cost of the hydro-electric power project and other supplementary installations incurred during the periods of the Third and Fourth Development Plans. Annual balanced costs have been calculated by the formula:

$$R = P \left[\frac{i(1+i)^n}{(i+i)^n-1}\right] = P(c.r.f.)$$

In this formula R represents a series of annual payments; n the period of capital return, i the rate of interest, and c.r.f. the capital return factor.

Column I shows the annual balanced costs incurred up to the completion of the construction of the dam in 1963 in terms of its 50 years useful life. The figure has been calculated from part 5 of Table 6 as follows:

$$7,480 \times 0.08174 = 611.4$$

The annual balanced costs incurred during the two Plan periods which ends in 1972 have been calculated by dividing the funds allocated by the number of years of the Plan. The average obtained for capital costs, under the income or reserves of the project itself, were then added and a balanced cost up to the end of the useful life of the project itself was obtained. Columns 2 to 6 show the equal annual balanced

Table 5. Irān: 1342-1391 (1963-64 - 2012-13) Costs and benefits of the hydro-electric power operations of the Mohammad Rezā Shāh Pahlavī Dam (Dez Dam)
(all figures in million rials)

$R = P \frac{i(1+i)^n}{(1+i)^n-1}$ = P(c.vof) Annual Balanced cost during the 50 year useful life of the project

| Year | (1) | 1342 (2) | 1343 (3) | 1344 (4) | 1345 (5) | 1346 (6) | 1347 (7) | 1348 (8) | 1349 (9) | 1350 (10) | 1351 (11) | (12) | (13) | (14) | (15) | (16) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1342 | 611.4 | 37 | | | | | | | | | | 648.4 | 300 | 948.4 | 69.6 | - 851.8 | |
| 1343 | 611.4 | 37 | 40.1 | | | | | | | | | 688.5 | 310 | 998.5 | 219.3 | - 779.2 | |
| 1344 | 611.4 | 37 | 40.1 | 42.6 | | | | | | | | 731.1 | 320 | 1051.1 | 274.2 | - 776.9 | |
| 1345 | 611.4 | 37 | 40.1 | 42.6 | 46.9 | | | | | | | 775.0 | 315 | 1083.0 | 322.2 | - 770.0 | |
| 1346 | 611.4 | 37 | 40.1 | 42.6 | 46.9 | 51.1 | | | | | | 829.1 | 325 | 1154.0 | 305.2 | - 748.8 | |
| 1347 | 611.4 | 37 | 40.1 | 42.6 | 46.9 | 51.1 | 68.0 | | | | | 897.1 | 320 | 1117.1 | 459.7 | - 657.4 | |
| 1348 | 611.4 | 37 | 40.1 | 42.6 | 46.9 | 51.1 | 68.0 | 68.0 | | | | 965.1 | 321 | 1286.1 | 625.6 | - 660.5 | |
| 1349 | 611.4 | 37 | 40.1 | 42.6 | 46.9 | 51.1 | 68.0 | 68.0 | 68.0 | | | 1033.1 | 350 | 1383.1 | 850.0 | - 533.1 | |
| 1350 | 611.4 | 37 | 40.1 | 42.6 | 46.9 | 51.1 | 68.0 | 68.0 | 68.0 | 68.0 | | 1101.1 | 380 | 1481.1 | | | Total-5777.7 |
| 1351 | | | | | | | | | | 68.0 | 68.1 | 1169.2 | 400 | 1569.2 | | | |
| 1391 | 611.4 | 37 | 40.1 | 42.6 | 46.9 | 51.1 | 68.0 | 68.0 | 68.0 | 68.0 | 68.1 | 1169.2 | | | | | |

Column 1 Based on present value of costs
Columns 2-6 Based on installation costs in 3rd development plan
Columns 7-11 Based on installation costs in 4th development plan
Column 12 Total annual balanced costs
Column 13 Costs of production, administration, sales and distribution
Column 14 Total production costs
Column 15 Income from electricity
Column 16 Performance (profit, loss)

costs on the basis of the installation cost incurred by the Third Development Plan as well as the capital costs of selling electricity each year, or the Xuzestan Water and Power Authority's reserves. During the period of the Third Development Plan 2,291 million rials were spent on the installations of the Pahlavi dam. The amount invested in the electric power installations out of the proceeds from the sale of electricity and the reserves of the Xuzestan Water and Power Authority have been estimated as follows: 30 million rials; 1344 (60 million rials); 1345 (110 million rials); 1346 (160 million rials). The installation costs incurred during the period of the Third Plan have been divided over the number of years and the average for each year has been added to the installation expenses for each year. Based on the total figure for each year, the equal annual balanced costs' have been calculated.

Columns 7 to 11 record the equal annual balanced costs for the period of the Fourth Development Plan obtained on the basis of the installation costs incurred by the Plan and the investment from the proceeds of electricity sales. During the Fourth Development Plan, the electricity project was divided into two separate projects (power production and power transfer) the one being fixed at 1,250 million rials and the other at 2,348 million rials making a total of 3,598 million rials. Investment in the power production and transfer installations out of the funds from the sale of electricity by the Xuzestan Water and Power Authority was as follows: 1347 (103.8 million rials); 1348 (99.6 million rials); 1349-51 (100 million rials) per year. As with the Third Development Plan period, an average for each year was obtained and added to the capital expenditure for each year to obtain the equal annual balanced costs up to the end of the useful life of the project. Column 12 shows the total of equal annual balanced costs.

Column 13 records administrative expenses and the costs of operation, sale and distribution for each year. Some of the figures are actual, while others have been calculated on the basis of criteria currently used by the Xuzestan Water and Power Authority. That is to say, in the cases for which no accurate data was available, the figure was extracted from the budget of the Xuzestan Water and

Power Organization on the basis of the one-third of its appropriations which are normally devoted to the power production and distribution operations, the one-third devoted to the Dez Irrigation Project and the one-third the one-third to the Sugar Cane Project. The administrative expenses for the years preceeding 1968 were rather large, one of the reasons for this being the employment of a number of foreign nationals who received very high salaries.

Column 14 records the total of columns 12 and 13 together with the total annual production expenses in the power-generating installations. Column 15 shows the income from the sale of electricity and the figures recorded have been obtained from the accounts of the Xuzestan Water and Power Authority. Column 16 shows performance using a + sign for profit and a - sign for loss.

As can be seen from the Table, the Xuzestan Water and Power Authority has, during the eight-year lifetime of the project, sustained heavy losses from its production, transfer and distribution of electricity. The total losses for the eight years in question amount to 5,777 million rials and are distributed over the years as follows:1962, 852 million rials; 1963, 779 million rials; 1965, 777 million rials; 1966, 770 million rials; 1967, 749 million rials; 1968, 657 million rials; 1969, 660.5 million rials; 1970, 533 million rials.[13] From 1972 onwards, when the electric power installations of the Dez Dam can be operated at full capacity, the volume of losses is expected to shrink gradually. However, even though the costs of electricity per kilowatt hour will gradually become less, we still cannot expect any substantial profits since there is no prospect, in the forseeable future at any rate, of demand for more than one-third of the total power production capacity in Xuzestan itself. The surplus electricity produced is sold at a low rate to the Iran Power Production and Transfer Company (TAVANIR) to meet shortages in other provinces.

Table 6 shows the production cost of 1 kwt. hour of electricity generated by the Pahlavi dam since its first year of operation on the basis of figures shown in Tables 3 and 5.

From Table 6 it can be seen that even in recent years,

Table 6. Iran: 1342-46 (1963/64-1967/68) Cost of production of one kilowatt-hour of electricity at the Mohammad Reza Pahlavi (Dez) dam

| Year | Total production (million kwt. hrs.) | Cost of Production (million rials) | Cost of 1 kwt. hr. |
|---|---|---|---|
| 1342 | 97.5 | 948.4 | 9.7 |
| 1343 | 158.1 | 998.5 | 6.3 |
| 1344 | 203.0 | 1051.1 | 5.2 |
| 1345 | 257.2 | 1093.0 | 4.2 |
| 1346 | 358.5 | 1154.0 | 3.2 |
| 1347 | 435.3 | 1117.1 | 2.6 |
| 1348 | 685.8 | 1286.1 | 1.9 |
| 1349 | 1220.0 | 1383.1 | 1.1 |

when the costs of production have been lower, the cost of electricity produced by the dam is still too high. This is, as has already been emphasised, due to the high cost of the power production installations and transmission lines. The latter especially involve heavy costs because of the distances involved (by 1970 1,141 kilometres of high-tension lines carried electricity from the dam to the cities of Abadan, Ahwaz, Xorramshahr and Masjed Suleiman and the costs of 1 kilometre of 230 thousand kilowatts line and one kilometre of 132 thousand kilowatts line are 12 thousand and 10 thousand dollars respectively). Moreover, since the heaviest costs of this and other similar projects are in installations and the purchase of specialized foreign skills, the construction process itself has little effect on the national economy especially from the point of view of employment.

We can therefore conclude that, although the construction of dams over the rivers of Xuzestan is in itself a useful project which might yield great social benefits (in flood control and irrigation), the economy of hydro- electric power installations is much in doubt. This point is underlined by the fact that, as far as the provision of electric power is concerned, there are a multitude of alternatives especially in Xuzestan which has an absolute of natural resources. In this case a good substitute project could have used natural gas, for the gas pipeline takes the same route as the power transmission lines of

both the Dez and the Sefid Rud dams, which means that turbines using gas could be installed along the route thus cutting the costs of transferring power.[14] The final capacity of the gas trunkline is 1,650 million cubic metres per day of which (as from 1974) some 1,050 cubic metres are to be exported to the Soviet Union. Of the remaining 600 million cubic metres 32 million cubic metres will be used for household consumption in Tehrān and 90 million cubic metres for household and commercial consumption along the trunk-line. There will therefore be a daily surplus of 48 million cubic metres for which there is no demand and which could easily be converted into electric power. Moreover, since such power production would be an indirect benefit of the trunkline no depreciation costs would have to be counted and the price of electricity would be fixed at a low level.

## A cost-benefit analysis of the irrigation operations of the Dez project

The irrigation operations of the Dez project consist of two separate programmes: the Dez Pilot Irrigation Project which includes 22 thousand hectares of the lands under the Dez dam, and the Greater Irrigation Project which includes a further 90 thousand hectares.[15] The pilot project originated in conditions set out by the World Bank in its talks with Irān in 1338 (1959/60) on the possibilities of a loan for the irrigation project. At that time the Bank specified that the loan of 38.2 million dollars would be extended on condition that an initial project covering 22 thousand hectares was undertaken with the hope that during the first three years of implementation, the farmers of the region would acquire knowledge of modern agricultural methods and show their ability to participate in developing the area. It was arranged that the Bank should itself inspect the progress of the operations after the initial period of three years and only then authorize payment of the loan.[16] In the summer of 1340 (1961) after an educational programme had been carried out among the farmers of the region and the World Bank declared itself satisfied, arrangements for payment were finalized.[17]

The Dez Pilot Irrigation project includes land which

has always been famous for its relative fertility and covers some 58 villages with a population of 13,000 and 21,600 hectares of cultivable land. Prior to the implementation of the project the winter crops of the region were wheat, barley, cereals, vegetables and fruits and the summer crops rice, . However, despite this variety because of the lack of water summer crops and market gardening, which could have been very profitable, were in a state of decay. The digging of canals and installation of equipment began in the summer of 1340 (1961) and was more or less completed by the summer of 1965. The Greater Dez Irrigation Project was begun in 1345 (1966/67) but has not yet been completed.[18] Responsibility for the supervision and implementation of the project lay with the Development and Resources Corporation, even after the formation of the Xuzestan Water and Power Authority and the allocation of a further loan of 30 million dollars by the IBRD in 1348 (1969/70)[19]

The basic aim of those who conceived this massive irrigation project was to provide a regular and constant supply of water for the native farmers of the region (those who had become the owners of their own plots during the land reform), to acquiant them with modern methods of farming, the use of chemical fertilizers and the use of better seeds. Such a programme, it was thought, would increase the area of cultivated land, facilitate the introduction of more profitable crops and raise productivity per hectare.

Even though the Pilot project was extremely costly, it could, in the first instance, have been justified by its social benefits to the farmers of the region. However, in the year 1345 (1966/67) a new policy for the development of lands irrigated by the resevoirs of Iran was being debated and this came to fruition in 1347 (1968/69) with the passing of the law governing the formation of agro-industrial companies financed either by the state or local and foreign capital for the purpose of exploiting these regions. The area of land which came under the terms of this law was to be not less than 5,000 hectares for each dam. As a result, the greater part of the lands of the Dez dam, were put aside for the use of agro-industrial companies, leaving a mere 17,000 hectares (9 thousand hectares of the land of the Pilot project and 8 thousand hectares of the main project)

for the local farmers who were to work within the framework of the newly-founded agricultural corporations. The justification of the protagonists of agro-industry is this ".... the creation of the Dez Pilot irrigation network and the main irrigation network has gathered together the factors of water, soil and climatic conditions at the most favourable location for attaining maximum production. Around this pole, agricultural and industrial development should be encouraged."[20] Thus we can see that the emphasis has shifted from social to economic goals and that agro-industry is regarded as the optimum method for arriving at these.

Although it would be quite acceptable to create agro-industry in previously barren land on which there are no rights of *nasaq*, it does not seem to be such an acceptable project for the Dez lands where, at first, action was taken to create experimental farms in order to acquiant the local cultivators with modern methods. But despite these initial steps, agro-industry has taken over the land on the grounds that Iranian farmers are not capable of using modern methods or of setting up producers co-operatives.[21]

At present the following companies are engaged in agro-industry on the Dez lands:

1. Agro-Industry of Irān and America managed by Mr.Hashem Naraqi on 18,000 hectares of land of which 4,500 hectares are under the Dez Pilot Project and the rest under the Main Project.

2. The Irān-California Company managed with the help of the Trans-World Agricultural Development Corporation on 10,000 hectares. This Corporation is a joint venture of Iranian and American investors. Private Iranian investors own 10 per cent of the shares; the Xuzestān Water and Power Authority, 5 per cent; the Bank Keshavarzi (Agricultural Bank attached to the Ministry of Agriculture), 15 per cent; the Trans-World Agricultural Development Corporation, 30 per cent; the Bank of America, 20 per cent; and the Dow Chemical Company, 10 per cent.

3. The Ahwāz Sugar Refining Company managed by Mr.Abu-Nasr Azodi; 10,000 hectares.

4. The Classeh Agro-Industrial Company of Denmark.

5. The Shell-Mitchel Cotts Agro-Industrial Company which has been formed as a partnership between the Shell Oil Company and private investor.

In addition, the Yugoslavs are at present beginning operations on 12,000 hectares and negotiations for the formation of a German Agro-industrial company are under way. Thus a total of 12,500 hectares of the lands of the Dez Pilot Project have been purchased from the farmers and leased to these Companies. The price of land has been fixed at 4,000 rials per hectare and that of orchards at 250,000 rials per hectare. But this money is not really of very much use to a farmer who has one, two or even more hectares because, having sold his land to the government he has no further interests in the village and must move to urban centres with his family. In urban areas there is still not enough employment to ease the absorption of such individuals with the result that the social difficulties incurred by the creation of agro-industry exceed any tangible economic advantages it may have. Agro-industry cannot, itself, absorb all the former farmers for it needs only a small labour force and tends to gather this from the youngest and most active men who it has settled in the three modern villages built in the area by the Ministry of Water and Power.

It can therefore be seen that if the same measures are taken on the lands of the main project, which support a population of 138,000 of whom 46,500 are farmers and their families, further hardship will be encountered. Especially so because a great many of these are quite old, making it even more difficult to absorb them into the nascent industrial sector.

We can therefore see that, although the goal of modernizing the agricultural sector has been fulfilled in this plan, no effective remedy has been sought for the labour force released from the land and in general we can say that the irrigation projects (except for the sugar-cane project) has been a costly and unsuccessful one especially since its social benefits have been rather negative.

Table 7. Irān: Costs of the Dez Pilot Irrigation Project up to 1342(1963-64)[A]

| Year | | Real Costs ($1,000) | Present value in 1342 (1963/64) at 8 per cent interest ($1,000) | |
|---|---|---|---|---|
| 1. | Building Costs | | | |
| | 1335 | | | |
| | 1336 | | | |
| | 1337 | | | |
| | 1338 | 386.2 | 386.2 x 1.469 = | 567.3 |
| | 1339 | 1011.7 | 1011.7 x 1.360 = | 1376.0 |
| | 1340 | 1201.7 | 1201.7 x 1.260 = | 1514.2 |
| | 1341 | 2715.1 | 2715.1 x 1.166 = | 3165.8 |
| | 1342 | 4643.9 | 4643.9 x 1.080 = | 5015.4 |
| | Total | 9958.6 | | 11638.6 |
| | Total (million rls.) | 746.9 | | 873.0 |
| 2. | Purchase of general necessities | | | |
| | 1335 | | | |
| | 1336 | 178.1 | 178.1 x 1.587 = | 282.7 |
| | 1337 | 1045.9 | 1045.9 x 1.469 = | 1536.5 |
| | 1338 | 920.6 | 920.6 x 1. 36 = | 1252 |
| | 1339 | 126.9 | 126.9 x 1.260 = | 159.9 |
| | 1340 | 26.3 | 26.3 x 1.169 = | 26.3 |
| | 1341 | 50.2 | 50.2 x 1.080 = | 50.2 |
| | 1342 | | | |
| | Total | 2348.0 | | 3315.9 |
| | Total (million rls.) | 176.1 | | 248.7 |
| 3. | Survey of resources | | | |
| | 1335 | 30.2 | 30.2 x 1.851 = | 55.8 |
| | 1336 | 642.7 | 624.7 x 1.147 = | 1101.5 |
| | 1337 | 824.2 | 824.2 x 1.587 = | 1308 |
| | 1338 | 834.7 | 834.7 x 1.469 = | 1226.2 |
| | 1339 | 1403.2 | 1403.2 x 1.360 = | 1908.3 |
| | 1340 | 189.5 | 189.5 x 1.260 = | 238.8 |
| | 1341 | 124.8 | 124.8 x 1.166 = | 145.6 |
| | 1342 | 56.5 | 56.5 x 1.080 = | 61.0 |
| | Total | 4105.8 | | 6045.3 |
| | Total (million rls.) | 3.8 | | 453.4 |
| 4. | Administrative expenses[B] | | | |
| | Total (million rls.) | 317 | | 404 |
| 5. | Cost of shell of dam | | | |
| | Total (million rls.) | 700 | | 786[C] |
| 6. | Total costs (million rls.) | 2248 | | 765.1 |

Source: Development and Resources Corporation. *Summary Accounting of Funds Khuzestan Development Program March 29; 1956 to June 1963.* PP.76-89; 115-142; 103-115; 59-71.

A. Table re-translated from the Persian.

B. One quarter of the total administrative expenses of the Dez Project as a whole have been counted.

C. Half of the costs of the resevoirs shell have been counted.

Table 8: Costs of the Dez Pilot Irrigation Project covered by the Third Plan (million rials)

| No. | Name of Project | Payments |
|---|---|---|
| 1 | Dez Pilot Irrigation | 1537 |
| 2 | General equipment and project necessities | 506 |
| 3 | General expenses | 1436 |
| 4 | Fees of advisory engineers | 87 |
| 5 | Research and | 183 |
| Total | | 3749 |

Source: *Tarhā-ye Masub Sāzman Barnāmeh: Barnāmeh omrāni seevom-e keshvar ta pāyān-e Esfand 1343* (1961/62) Chapter One P.2.

Table 9: Costs of the Dez Irrigation Project 1345-1351 (1966/67-1972/73)

| | |
|---|---|
| 1. Greater Dez irrigation project | 399 |
| 2. Costs of equipment and irrigation operations 1345 & 1346 | 1721 |
| 3. Costs of general services 1345 & 1346 | 426 |
| 4. Payments from the Fourth Plan budget 1347-1349 | 1938 |
| 5. Loan of the IBRD for the year 1348 | 2250 |
| 6. Prediction of costs to end of fourth plan | 2062 |
| Total | 8796 |

Source: Statistics obtained from the Plan Organization of Irān and and the Xuzestān Water and Power Authority and the publications of the Project and Credits Office of the Plan Organization.

Tables 7,8&9, summarize the costs of the Dez Pilot Irrigation project and the Dez Main project between 1342(1963-64) and 1351 (1972-73). Table 7 shows the costs of operations undertaken by the Development and Resources Corporation. Table 9 shows the payments of the Plan Organization for the Dez Pilot Irrigation Project during the period of the Third Plan ending in 1344 (1965-66) and Table 10 shows

total payments made for two projects by the Plan Organization from 1345-1351 (1966/67-1972/-73). The Tables show that altogether, up to the end of the Fourth Plan period, 15,310 million rials has been spent to irrigate an eventual 109 thousand hectares[22] although by the end of 1351 only 30 thousand hectares of the land of the Main Project will be ready for cultivation by the Angro-industrial companies.[23] Experts of the Xuzestan Water and Power Authority believe that it will take till the year 1354 (1975/76) to complete the rest of the project and this will necessitate further large payments. If we were to calculate the balanced annual costs up to the end of the useful life of the project we would see that the whole plan has been extremely expensive and that, in particular, a very large proportion of the total expenses have gone on administrative expenses and the costs of the Development and Resources Corporation.

To what extent will the expenses of this project be recovered? It is a well known fact that in irrigated areas in recent years the farmers have refused to pay any 'rent' for their water and the authorities have been compelled, after witholding water for some time, to reinstate the irrigation flow free of charge. The same thing has happened with respect to the local farmers in Xuzestan.[24] The arrangement with the Agro-industrial companies is that they should pay 750 rials per hectare per year for their water rights. But this sum is so tiny that it is impossible to regard it as being of any economic significance at all. If it were mainly villagers using the waters of the Dez dam then perhaps it would have been justifiable to disregard the question of a return on the capital invested in the irrigation equipment and channels, but since it is a number of commercial companies who are using the land, it seems ridiculous not to be concerned over the economics of the project.

## Notes

1. This report was printed in 1959 and runs for 200 pages. It cost a great deal of money and took a long time to complete. It consists of three chapters, on the general features of Xuzestan itself, on the integrated

project and on future possibilities, nine appendices and 23 tables. The passing of time shows that very many of its projections were faulty and unrealistic and we shall refer to some of these in the course of our report.

2. Figures taken from *Gozāresh-e Qesmat-e Barq* (Report from the Electricity Department) Xuzestan Water and Power Authority, Economics and Evaluation Section.
3. Dr. Cyrus Ebrahimzadeh has also analysed the level and costs of production of electricity at this dam (see *Tahqiqāt-e Eqtesādi* Nos. 15&16 1969). However, in his calculations he made a mistake which has affected all his figures. That is, although using the same figures of the Xuzestan Water and Power Authority he mistakenly took the production figures for Bahman 1342 as the figure for the whole of the year 1342 and the figure for Mordad 1343 as the figure for the whole of 1343.
4. In 1971 the writer visited the power station of the Dez dam and observed that the position was more-or less as has been calculated. Of the four generators installed two worked day and night while the others remained idle.
5. Unpublished report of the Xuzestan Water and Power Organization on the statistics of electricity production and sales in the year 1346. (1967/68).
6. Ministry of Water and Power, Xuzestan Water and Power Authority, *Kārnāmeh fa'āliathā-ye 1347* (Report on Activities in the Year March 1968 to March 1969).
7. Xuzestan Water and Power Organization, Economics and Evaluation Section, Statistics Group of the Electricity Section, *Gozāresh Āmāri Salyāneh 1348* (Statistical report for the year 1969/70).
8. Ebrahimzadeh, Cyrus, *Eqtesād-e Barq-e Hasteyi* (The economics of atomic electric power) P.132.
9. The figures for the price of electricity have been taken from the *Āyn-nāmeh va Moqararāt-e Servis-e Barq* (Statistics and Regulations of the Electricity Service) Xuzestan Water and Power Organization, Electricity Section.
10. *Tahqiqāt-e Eqtesādi* Nos. 15&16 1969.
11. Cyrus Ebrahimzādeh. *Op.Cit.*
12. Development and Resources Corporation. *Summary Accounting of Funds. Xuzestān Development Program March 29, 1956 to June 21, 1963.* A Report of the Xuzestan Water

and Power Authority, New York, December 1964.

13. In the records of the Xuzestān Water and Power Authority the figures indicate a total profit. This arises from the fact that the Authority does not use the conventional methods for evaluating its profits and losses.
14. The gas pipeline is 1,100 kilometres long. It begins at Bīd Boland and passes through Isfahān, Kāshān, Qom, Tehrān, Qazvīn, Rasht and Āstāra.
15. Some 4 thousand hectares of this 90 thousand hectares are uncultivable.
16. Development and Resources Corporation, *Op.Cit.* p.76.
17. *Ibid.* p.79.
18. For further comments on inconsistencies in the implementation of resource-development projects, particularly irrigation projects, see the publication: *Farmāyeshāt-e Ālāhazrat Homāyn Shāhanshāh Ārya - Mehr dar bāreh-ye xotut-e asli barnāmeh omrāni panjom-e keshvar dar Sāzmān-e Barnāmeh.* (Speech of his Imperial Majesty the Shāhanshāh to members of the Plan Organization on the basic features of the Fifth Plan) 8th Dey 1349 (31st December 1970) pp. 21, 22 & 23.
19. In 1967 and 1968 the Development and Resources Corporation published two long reports entitled the *Dez Irrigation Project* and the *Dez Irrigation Project Stage 1, Feasibility Report Supplement* respectively. These reports cost many millions of rials but contain nothing other than some scattered information on the history, geography, and native crops of Xuzestān, tables on the supposed costs of the various projects and some rather imaginitive figures on the probable benefits. We found these reports to be rather worthless and have therefore made no use of them in our work.
20. Mohandess Mansur Rouhāni, *Siāsat-e Towse-e ye Keshāvarzi dar qotbhā-ye manāb'e-ye āb va xāk* (Policy for agricultural development in resource-rich regions). Unpublished paper.
21. For a critical examination of the feasibility of projects for the development of some crops and livestock farming in Xuzestān refer to a report by Plan Organization experts on the proposed joint agro - industrial venture with Yugoslavia. Plan Organization of Irān, *Seminār-e barresi-e massā-el-e keshāvarzi-ye Irān*

(Study seminar on the agricultural problems of Irān) 30/10/48 - 5/11/48 (20/1/70 - 26/1/70). Cyclostyled. In this report the following views are expressed:

In the opinion of experts of the Plan Organization and Yugoslavian experts the project for co-operation with the Yugoslavs in Xuzestan cannot really be beneficial for the region nor can it ensure an optimum return to the inputs of capital, soil and water. The livestock development project included in this plan is one of those which can be regarded as unfeasible because of the hot weather of the region. In this project, emphasis been placed on livestock products, particularly meat.

Another product of this company is sterilized milk of which a production of 17 tons per day is envisaged. The price has been fixed at about 24 rials per packet which means that it will be sold to the consumer at about 30 rials per packet. However, the present price of milk produced at the state factory in Tehrān is around 15 rials. With respect to the orchards, the problems of water soil and climate have not been properly taken into account. For example, instead of planning the production of citrus fruits, peaches have been chosen.

The problem of markets for this massive investment has still not been solved indeed keeping in mind what has just been said, we can say that no complete social and economic study was undertaken before four thousand hectares of land was bought and now 7.5 thousand hectares more are in the process of being purchased. The investment of the government in this Company is approximately 750 million rials.

22. Of 125 thousand hectares 12 thousand are included in the Haft-Tappeh sugar cane project and 4 thousand hectares are barren, uncultivable lands.

23. See Plan Organization of Irān. *Barnāmeh-ye Omrāni -ye Chahārom-e Keshvar 1348-1351.* (The fourth development plan 1969/70 - 1972/73). Tehrān 1347 (1969/70) P.439.

24. For further information on this problem see Hushang Saedloo *Naqdi bar siāsat towse-e keshāvarzi dar qotbha -ye manābe'-ye āb va xāk* Tahqiqat-e Eqtesādi Nos.23&24 (Persian Edition).