The dez multi-purpose dam scheme, Khuzestan a socio-economic analysis

Ghazi, Iran

CHAPTER 17

ECONOMIC APPRAISAL OF THE MOHAMAD REZA SHAH PAHLAVI DAM SCHEME

The testing of economic feasibility by cost-benefit analysis of projects has not a long history. In the U.S.A. investment alternatives for water resources development are evaluated by examining costs of the expected benefits. The classical legislative description of benefit-cost analysis is in the Flood Control Act of 1936[1]. Since that date, the method has been extended to every water resource development project.

In Iran the application of such techniques for project economic appraisal and in particular for water resource development projects is a recent phenomenon[2]. Many water resource development schemes have been constructed over the last two decades, but very few attempts have been made to evaluate such schemes. The critical point of these few works is their inconsistency. In this analysis an attempt is made to produce an integrated and consistent economic evaluation. Since the Mohamad Reza Shah Pahlavi Dam scheme consists of a number of projects, each project was evaluated independently, and where necessary, in combination with others.

17-1 Benefit-Cost Categories

Because benefits and costs stem from so many kinds of effects, a systematic procedure is required to make sure each effect is considered and evaluated. Unfortunately even in the U.S.A. water resource planners and governmental agencies have not used consistent terminology to describe individual effects.

For the economic appraisal of the Mohamad Reza Shah Pahlavi Dam scheme, a cost-benefit category model was made based on two benefits namely:- tangible and intangible. The tangible benefits are those that have been earned from the sale of water and land leasing charges, hydro-electricity revenues, savings from flood control, tax revenues from the agro-business companies and revenues from the Haft-Tappeh sugar cane products. These are the direct benefits that were expected by the planners from the Pahlavi dam scheme since its conception.

The Haft-Tappeh Cane Sugar Project was analysed independently, and then was integrated with the DIP as a whole from the date that water was supplied to the Haft-Tappeh area through the modern irrigation system.

In the Iranian economy in which land, water resources, food and foreign exchange are scarce, but the supply of manpower is abundant, the central idea has been to increase yields. In such circumstances, preference was given to the projects that promised the greatest productivity from land and water resources. This productivity has been examined for the farming institutions of the DIP in preceding chapters (traditional farming of the DIP up to 1968, as well as the Farm Corporations, the Haft-Tappeh agro-industry and the agro-business enterprises.)

Examination of the productivity of capital, labour, foreign exchange, and the criteria of relative cost of investments, only provide a limited view of the total problem.

They are useful as preliminary techniques and are indispensible for calculations of profitability during the initial period when the project

is being established. Employment benefits and public benefits, such as the redistribution of income, regional development, etc. were considered as tangible effects and have already been examined.

The most important intangible effects are those of saving lives, through flood control, the development of health and sanitation conditions and improving housing in the DIP area. These benefits have also been investigated in the preceding chapters.

The costs of each project of the Mohamad Reza Shah Pahlavi Dam scheme includes construction costs, equipment, administrative and general costs, land compensation costs, resettlement expenditure, road building costs, research and resource investigation costs and operational and maintenance costs.

17-2 The Analytical Methods Employed in the Cost-Benefit Analysis

The criteria mentioned above for the calculation of profitability have the common disadvantage of creating a one-way relationship between revenues and certain elements of expenditure, or between investments and certain effects of the project without taking account of the whole. They do not show the return on the project and they also totally overlook the time needed to implement the plan which is a decisive factor, since clearly an investment made today is of much greater value than if the same investment was made in ten years time.

The Benefit-Cost analysis which has been the criterion widely used for a long time in the U.S.A. and other countries, consists of comparing all the advantages of the project with the total cost of investment during the life of the project. This is the technique which has been chosen by the author for the economic analysis of the projects of the Pahlavi Dam scheme.

The starting point of such an approach was to specify all the actual inputs and outputs of the projects, and to arrive at expenditures and revenues. These were spaced over the time from the inception of planning to the economic demise of the projects. Then the data were consolidated to arrive at a measure of profitability. The selected method for combining data is the "Discounted Cash Flow" method. The major reason for choosing the Discounted Cash Flow accounting method compared with normal commercial accounting is because of the following advantages:

a) In normal accounting, income and expenditure represent the values of goods delivered and received, not the cash received and paid out for them.

b) Normal accounting shows financial liabilities, with respect to interest and tax but not with regard to payments. There are sometimes large differences of timing here.

c) A financial allowance for depreciation and obsolescence of capital is made in normal accounting. In Cash Flow accounting there is no such provision, but anticipated renewals and replacements are included[3].

17-3 Cost-Benefit Analysis of the Pahlavi Dam Hydro-Power Project

By 1963 which is the commencement of the Pahlavi Dam hydro-power plant operation, the power installations consisted of two hydro-power generators and the Ahwaz-Abadan transmission line. Up to 1963, DRC from New York had the authority for planning and executing the project. KWPA, which was given authority in 1963 was funded through the Plan

Organization during the Third and the Fourth Development Plans to complete the second power house of the dam and to install the remaining six hydro-power generators. A further two generators had been installed in 1969 and all eight generators of the dam were in operation by 1971. From 1955 to 1963 the total allocated funds for the development of Khuzestan was 14,288.4 million rials (190.55 million dollars) of which 12,383.9 million rials (165.12 million dollars) had been the actual expenditure. The percentage distribution of expenditure is shown in Table 17-1. Over 75% of the total expenditure was paid for the construction of the dam, the hydro-power plant, the DPIP and the sugar cane project. By 1963 almost 55% of the total expenditure had been paid out for the hydro-electricity supply, transmission and distribution networks. A $42 million loan from the IBRD was secured to finance the construction of the Pahlavi Dam, its associated hydro-electric works and the DPIP. The remaining expenditure was financed through the development funds of Plan Organization. Almost all the IBRD loan went for the construction of hydro-power supply and transmission lines. Only 3.6% of the secured loan was used for development funds of the DPIP.

For the cost-benefit analysis of the hydro-power project of the dam the following model was made:

a) The capital cost of each part of the dam's installations was listed for the period 1956 to 1963. A further three capital cost groups were tabulated for the three periods of investment (1963-69, 1969-72 and 1972-77).

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Table 17-1

Allocated Funds and Expenditure of the Khuzestan Development Project

Years 1956-62 (million rials)

Projects	Allocated funds	Expenditures	Percentage of total expenditure
Dez dam: Power production and transfer units	5,325.9(1)	5,325.9(2)	43 006
Dez Pilot Irrigation Project	1,787.0	746.9	6.031
Abadan - Ahwaz transfer line	307.0	307.8	2.485
Power production operations	629.0	371.3	2.998
Sugar Cane Project	2,685.0	2,396.7	19.353
Plastics factory	77.0	77.7	0.537
Chemical fertilizer project	101.0	92.8	0.749
Karkheh irrigation project	383.0	379.5	3.064
Resources study project	362.0	307.9	2.486
General necessities	321.0	176.1	1.422
General and administrative expenses	1,278.0	1,278.0	10.319
Living quarters and services		9.0	0.072
Consultant engineers	134.0	134.0	1.082
Electricity distribution	62.7	62.7	0.506
Total	14,288.6		
Administrative expenditures of KWPA		618.2	4.991
Expenditures of DRC		99.4	0.802
Sub-total		12,383.9	99.900

Sources: (1) a: Plan Organization, Financial Affairs Division, Accounting Section, "Financial report of the Plan Organization, 1955-60", p.105.

b: Plan Organization, Financial Affairs Division, Accounting Section, "Financial report of the Plan Organization, 1955-61", p.16.

c: Plan Organization, Financial Affairs Division, Accounting Section, "Financial report of the Plan Organization, the first half of 1341 (1962) p.26.

d: Plan Organization, Financial Affairs Division, Accounting Section, "Financial report of the Plan Organization, one and a half years of the Third Plan", Mehr, 1341 (Oct. 1962); Farand, 1342 (Mar. 1963), p.16.

(2) DRC 1964, New York, Summary accounting of funds, Khuzestan Development Program, March 20th, 1956 - June 27th, 1963, a report to Khuzestan Water and Power Authority, Chapters 9 and 14.

b) The present value of the costs for the years 1963, 1969, 1973 and 1978 were calculated using the equation $T = \sum_{n=1}^{N} V_n$, in which T is the total value, N is the number of years of data and V is the present value in year n. V_n was obtained from the second equation: $V_n = D_n C_n$, where D_n is the cost data for year n and C_n is the multiplication factor for year n. The third equation, $C_n = (1 + I)^n$ was employed to compute the value of Cn. In this equation I is the discount rate.

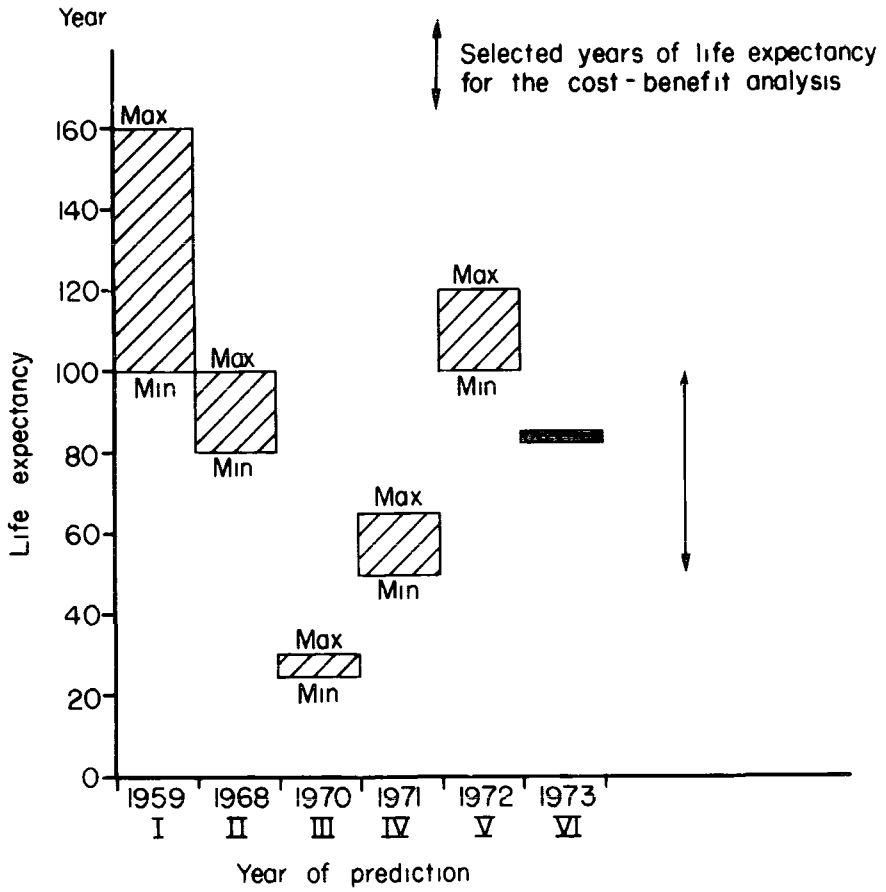
c) Choosing the discount rate did, of course, raise some difficult problems, since there were several possible rates, (the interest rate, the rate of investment in long-term bonds, the tax rate, the expected rate of growth of GNP etc.). Firstly, a 6.5 per cent rate (Alternative B) was applied, which is the interest rate of the borrowed money from the IBRD. This is the rate that has been accepted by KWPA itself[4]. Secondly a 9 per cent rate (Alternative A) was fixed as the discount rate, which is the average growth rate of the GNP of Iran over the period 1956 to 1974[5]. The interest rate was not used since the interest is the fee one producer pays to borrow the capital of another and is determined by the capital market. A discount rate is the expression of the time value of capital used in equivalence calculations comparing alternatives. The rate is essentially a value judgement based on a compromise between present consumption and future capital formation. Since water resources development is essentially a capital formation process, the question is how much sacrifice in current consumption should be made to increase

production of capital goods in the future. The ideal discount rate would achieve a rate of capital formation which maximises total social welfare. A low discount rate increases resource use, and also the capital intensity of investment within those sectors in which it is used. Moreover, it increases the risk that large amounts of capital will be tied to projects and that this capital would be unuseable by future generations. If this occurs to a large extent it defeats the whole purpose of capital formation. Nevertheless the lower the discount rate and the longer the anticipated project life, the more likely it is that the project benefits will exceed the costs. Indeed it is impossible to defend any exact discount rate for use in government planning, but too low a rate will definitely have serious adverse consequences on national economic growth[6].

d) It was difficult to estimate the precise useful life of the Pahlavi Dam. Different values have been estimated by various bodies over a period of about 17 years (1956-1973), (Fig. 17-1). Two values of 50 years and also one of 100 years were quoted in this analysis for the life expectancy of the dam. The useful life of the hydro-generators was estimated at a maximum of 50 years when the useful life of the dam was estimated at 100 years (Alternative B). However, the expected life of the generators is less than 50 years when the dam's life is only 50 years (Alternative A), as the generators were installed after the construction of the dam itself. This estimation is based on the assumption that thermal generators usually have a useful life of 25 to 30 years, whereas hydro-generators certainly

Fig 17-1

Predictions of the useful life of the Mohamad Reza Shah Pahlavi dam and the selected years of life expectancy for the cost-benefit analysis



Sources:

I - Plan Organization, 1959, "Dez Project, a proposal for power, flood control and irrigation", submitted to the Development Loan Fund, p.6.

II - KWPA. 1968. Feasibility Report $\frac{TV/2678}{1347.\ 12.17}$ Dez Irrigation Project, Project No. 4315. p.1.

III - Shah of Iran, 1970. "The address of the Shahanshah Aria Mehr and Amir Abbas Hoveida, the Prime Minister and Khoda Dad-i-Farmanfarmaian, the Managing Director of the Plan Organization on the historical occasion of 8.10.1349. p.33. (In this report a figure of 300 million tonnes/annum of siltation for the Pahlavi reservoir is quoted.)

IV - Ministry of Water and Power, KWPA, 1971. "Long-term operation and capabilities of the M.R.S. Pahlavi Dam and Reservoir on the Dez River in Khuzestan", Resource Investigations Project, Ahwaz, p.7.

V - KWPA, 1972. "A brief information on Khuzestan", in Tahqiqat-i-Eqtesadi, Department of Economics, University of Tehran, Nos. 29 & 30, Spring and Autumn, 1351. p.107.

VI - Ministry of Water and Power, KWPA, 1973. Resource Investigations Project, Reservoir Operation Unit, August 1973, Ahwaz, "Sedimentation Survey of M.R.S. Pahlavi Reservoir on the Dez River in Khuzestan", Winter, 1973. p.22.

have a longer useful life[7]. The useful life of the transmission lines was estimated at 50 years taking into consideration the fact that sand storms in Khuzestan damage them seriously.

e) Since the building costs of the body of the dam are shared between the hydro-electric and the irrigation and flood control projects, half of the construction costs of the dam were deducted from the total[8]. Also three quarters of the administrative and general costs, as well as the Consultant Engineers' costs were allocated to the hydro-electricity project costs.

f) The uniform annual costs were calculated through the application of the sinking-fund method and the capital recovery factor was calculated by the equation:-

$$E_m = \frac{I \times (1 + I)^M}{(1 + I)^M - 1}$$

in which E_m is the capital recovery factor, I is the discount rate, and M is the number of years of projection[9]. Thus the uniform annual costs were obtained through the equation $A_m = E_m \times T$, in which the values of T have already been calculated independently (Appendix L).

g) Present values of the capital costs by the end of each project period are shown in Tables 17-2-A to 17-10-A. In these, the discount rate is 9% and the useful life of the dam is 50 years (Alternative A). Tables 17-11-B to 17-19-B show the same values for Alternative B (6.5% discount rate and 100 years life expectancy of the dam).

h) Total annual capital costs and the operational costs are given in Tables 17-20-A and 17-21-B for Alternatives A and B. In these tables the annual costs were subtracted from the annual hydro-electricity revenues to obtain the benefit or loss of each year. All costs and benefits are estimated in terms of real money. Therefore no inflation rate correction factor has been used in the cost-benefit analysis.

Table 17-2-A

Construction Costs of the Dam and the Power Supply and Transmission Complex

(1,000 Rials) Alternative A

Year	Real Cost (a)	"Present Value" in 1963
1957	16,320.0	16,320.0 x 1.828 = 29,832.96
1958	356,010.0	356,010.0 x 1.677 = 597,028.77
1959	609,427.5	609,427.5 x 1.538 = 937,299.49
1960	662,482.5	662,482.5 x 1.411 = 934,762.80
1961	1,194,270.0	1,194,270.0 x 1.295 = 1,546,579.60
1962	1,548,097.5	1,548,097.5 x 1.188 = 1,839,139.80
1963	939,315.0	939,315.0 x 1.090 = 1,023,853.30
Total	5,321,923.0	6,908,496.70
Less shared cost for irrigation and flood control	697,440.0	908,002.00
Total	4,624,483.0	6,000,494.70

M = 50

$$Em = \frac{0.09(1 + 0.09)^{50}}{(1 + 0.09) - 1} = 0.09122$$

Am = 6,000,494.7 x 0.09122 - 547,365.12

Source: (a) D.R.C. New York. 1964. Summary accounting of funds, Khuzestan Development Programme, March 29, 1950 and June 21, 1963. pp.36-46.

Table 17-3-A

Ahwaz - Abadan Transmission Line Costs

(1,000 Rials) Alternative A

Year	Real Cost (a)	"Present Value" in 1963
1958	82,822.5	82,822.5 x 1.677 = 138,893.33
1959	207,600.0	207,600.0 x 1.538 = 319,288.80
1960	17,295.0	17,295.0 x 1.411 = 24,403.20
1961	3.5	3.5 x 1.295 = 4.53
1962	-	
1963	- -	
Total	307,721.0	481,589.86

Em = 0.09122

M = 50

Am = 481,589.86 x 0.09122 = 43,930.62

Source: (a) D.R.C. 1964. pp.46-59.

Table 17-4-A

Costs of Power Supply Installations

(1,000 Rials) Alternative A

Year	Real Cost (a)	"Present Value" in 1963
1957	3,240.0	3,240.0 x 1.677 = 5,433.48
1958	7,860.0	7,860.0 x 1.538 = 12,088.68
1959	96,735.0	96,735.0 x 1.411 = 136,493.08
1960	139,327.5	139,327.5 x 1.295 = 180,487.38
1961	56,572.5	56,572.5 x 1.188 = 67,208.13
1962	67,530.0	67,530.0 x 1.090 = 836,607.70
1963	-	
Total	371,310.0	1,238,318.45

M = 50

Am = 1,238,318.45 x 0.09122 = 112,959.4

Source: (a) D.R.C. 1964. pp.59-76.

Table 17-5-A

Electricity Distribution Costs in the Second Plan

(1,000 rials) Alternative A

Year	Real Cost (a)	"Present Value" in 1963
1961	58,246	58,246 x 1.188 = 69,196.25
1962	4,470	4,470 x 1.090 = 4,872.30
Total	62,716	74,068.55

M = 50

Am = 74,068.55 x 0.09122 = 6,756.53

Source: (a) Plan Organization, Department of Financial Affairs, Division of Accounting, "Financial Report", Mehr, 1334 to the end of Esfand, 1340, p.67.

Table 17-6-A

General and Administrative Costs

(1,000 Rials) Alternative A

Year	Real Cost (a)	"Present Value" in 1963
1956	3,762	3,762 x 1.992 = 7,494
1957	9,327	9,327 x 1.828 = 17,050
1958	16,926	16,926 x 1.677 = 28,385
1959	179,214	179,214 x 1.538 = 275,631
1960	113,022	113,022 x 1.411 = 159,474
1961	80,979	80,979 x 1.295 = 104,868
1962	497,493	497,493 x 1.188 = 591,022
1963	57,808	57,808 x 1.090 = 63,011
Total	958,531	1,246,935

M = 50

Am = 1,246,935 x 0.09122 = 113,745.41

Note: Three quarters of the total real cost was charged to electricity production and the remaining one quarter to the DIP.

Source: (a) DRC. 1964. pp.118-142.

Table 17-7-A

Consultant Engineers' Costs

(1,000 Rials) Alternative A

Year	Real Cost (a)	"Present Value" in 1963
1956	12,560	12,560 x 1.992 = 25,019
1957	12,560	12,560 x 1.828 = 22,960
1958	12,560	12,560 x 1.677 = 21,063
1959	12,560	12,560 x 1.538 = 19,317
1960	12,560	12,560 x 1.411 = 17,722
1961	12,560	12,560 x 1.295 = 16,265
1962	12,560	12,560 x 1.188 = 14,921
1963	12,560	12,560 x 1.090 = 13,690
Total	100,480	12,5 150,957
M = 50 Am = 150,957 x 0.09122 = 13,770.30		

Notes: (a) Three quarters of the costs were charged to electricity production and the remaining quarter to the DIP.

(b) Since the data on the annual distribution of the real costs were not available, the costs were spread over the time in uniform values.

Sources: (a) (i) Plan Organization. Department of Financial Affairs, Division of Accounting. "Financial Report of Plan Organization". From Mehr, 1334 to Esfand, 1339, p.105.

(ii) Plan Organization, Department of Financial Affairs, Division of Accounting. "Eighteen months financial report of the Third Plan, Mehr, 1341 to Esfand, 1342", p.16.

Note: The Consultant Engineers' costs are estimated at 134 million rials from 1956 to 1963. Three quarters of these costs were charged for hydro power project of the dam and the remaining quarter for the DIP. Also since the annual distribution costs were not available, the costs were equally spread over the time.

Table 17-8-A .

Supply, Transmission and Distribution of Electricity Costs in the Third Plan (1,000 rials) - Alternative A

Year	Real Cost					Total	"Present Value" in 1969
	Production and Transmission	Dez-Ahwaz Transmission	Electricity Operations	Electricity Distribution	Constructional Costs from KWPA's Revenues		
1963	(a) 801,500	(a) 156,110	(a) 208,839	(f) 4,470		1,170,919	1,170,919 x 1.828 = 2,140,439.9
1964	(b) 639,000	(b) 143,110	(b) 111,422	27,764	(j) 30,000	951,296	951,296 x 1.677 = 1,595,323.3
1965	(c) 545,400	(c) 157,110	(c) 124,017	27,764	60,000	914,291	914,291 x 1.538 = 1,406,179.5
1966	(d) 174,756	(d) 155,110	(d) 124,017	-	110,000	563,883	563,883 x 1.411 = 795,638.91
1967	(e) 493,609	(e) 154,110	(e) 124,017	-	160,000	931,736	931,736 x 1.295 = 1,206,598.1
*	Production	Transmission	Gachsaran-Shiraz electricity transmission	Rural Electricity	Construction Costs from KWPA's Revenues		
1968	(g) 376,450	(g) 134,153	(i) 5,000	17,034	(k) 103,800	636,437	636,437 x 1.188 = 756,087.15
1969	(h) 239,494	(h) 779,007	(i) 121,086	-	(k) 99,600	1,139,187	1,139,187 x 1.090 = 1,241,713.8
Total						6,307,749	9,141,980.5

* Since 1968, the costs of the production and transmission of electricity have been divided into two parts which are Production and Transmission.

M = 44

$$Em = \frac{0.09(1 + 0.09)^{44}}{(1 + 0.09) - 1} = 0.0920$$

Am = 9,141,980.5 x 0.092 = 841,062.2

Sources:

(a) Plan Organization, Department of Financial Affairs, Accounting Division, Eighteen months of Financial Report of Plan Organization in the Third Plan, Mehr, 1341, Esfand, 1342, pp.16 and 33.

(b) Plan Organization, "Financial report of 30 months of the Third Plan", Mehr, 1341; Esfand, 1343", pp.17 and 43.

(c) Plan Organization, "Financial Report of Mehr, 1341 - Esfand, 1344", pp.19 and 42-43.

(d) " " " " " " Mehr, 1341 - Esfand, 1345", p.44.

(e) " " " " " " Mehr, 1341 - Esfand, 1346", p.71.

(f) " " " " " " Mehr, 1341 - Esfand, 1344", p.46.

(g) " " Department of Financial Affairs, "Financed Funds of the Fourth Development Plan", Farvardin, 1347 - Esfand, 1347, pp.31-32.

(h) " " " " " " " " " " " " " " Farvardin, 1348 - Esfand, 1348, pp.22-23.

(i) " " " " " " " " " " " " " " Farvardin, 1347 - Esfand, 1347, pp.31-32.

(j) Rabani, 1971, "Cost-benefit Analysis of the Dez Multi-purpose Dam", in Tahqiqat-i-Eqtesade, Nos. 25 and 26, p.112.

(k) Ministry of Water and Power, Department of Projects and Investigations, 1971, Annual Report of 1349, pp.259-295.

Table 17-9-A

Supply, Transmission and Distribution of Electricity Costs in the Third Plan (1,000 rials) - Alternative A

Year	Real Cost					Total	"Present value" by the end of 1972
	Production	Transmission	Gachsaran-Shiraz electricity transmission	Rural electricity supply	Construction costs from KWPA's revenues		
1970	(a) 229,873	(a) 228,532	(a) 9,774	-	(e) 100,600	568,779	568,779 x 1.295 = 736,568.8
1971	(b) 91,362	(b) 194,825	(b) 1,000	(d) 29,999	149,600	466,785	466,786 x 1.188 = 554,541.76
1972	(c) 22,006	(c) 123,731	(c) 16,333	(d) 48,500	199,100	409,670	409,670 x 1.090 = 446,540.3
Total						1,445,235	1,737,650.8

M = 41

$$Em = \frac{0.09(1 + 0.09)^{41}}{(1 + 0.09) - 1} = 0.0927$$

Am = 1,737,650.8 x 0.0927 = 161,080.22

Sources: (a) Plan Organization, Department of Financial Affairs, Accounting Division, "Financial funds of the Fourth Development Plan", Final bulletin, Farvardin, 1347 - Esfand, 1349, pp.34-35.

(b) Plan Organization, Department of Financial Affairs, Accounting Division, "Financial Funds of the Fourth Development Plan", Final bulletin, Farvardin, 1347 - Esfand, 1350, pp.38-39.

(c) Plan Organization, Department of Financial Affairs, Accounting Division, "Financial Funds of the Fourth Development Plan", Final bulletin, Farvardin, 1347 - Esfand, 1351, pp.37-38.

(d) Plan Organization, Department of Financial Affairs, Accounting Division, "Financial Funds of the Fourth Development Plan", Final bulletin, Farvardin, 1347 - Esfand, 1351, p.64.

(e) See (κ) on Table 17-8-A.

Table 17-10-A

Transmission of Electricity Costs in the Fifth Plan

(1,000 Rials) Alternative A

Year	Real Cost		Total	"Present Value" by the end of 1977
	Power transmission	Construction costs from KWPA'S revenues		
	(a)	(b)		
1973	1,782,460	295,900	2,078,360	2,078,360 x 1.538 = 3,196,517.6
1974	1,782,460	300,000	2,082,460	2,082,460 x 1.411 = 2,938,351.0
1975	1,782,460	230,000	2,012,460	2,012,460 x 1.295 = 2,606,135.7
1976	1,782,460	275,300	2,057,760	2,057,760 x 1.188 = 2,444,618.8
1977	1,782,460	275,300	2,057,760	2,057,760 x 1.090 = 2,242,958.4
Total			10,288,800	13,428,581.0

Sources for (a) and (b):

Saqari, (Officer of the main financial Department of KWPA in Ahwaz). Personal Communication and Interview, April 1975.

$M = 34$

$$Em = \frac{0.09(1 + 0.09)^{34}}{(1 + 0.09) - 1} = 0.0942$$

$Am = 13,428,581 \times 0.0942 = 1,264,972.3$

Table 17-11-B

Construction Costs of the Dam and the Power Supply and Transmission complex

(1,000 Rials) Alternative B

Year	Real Cost	"Present value" in 1973
1957	16,320	16,320 x 1.55 = 25,361.1
1958	356,010	356,010 x 1.46 = 519,469.2
1959	609,428	609,428 x 1.37 = 834,968.5
1960	662,483	662,483 x 1.29 = 852,261.4
1961	1,194,270	1,194,270 x 1.21 = 1,442,618.0
1962	1,548,098	1,548,098 x 1.13 = 1,755,891.5
1963	939,315	939,315 x 1.06 = 996,110.5
Total	5,325,923	6,426,680.2
Less shared cost for irrigation and flood control	697,440	854,748.46
Total	4,624,483	5,571,931.8

M = 100

$$Em = \frac{0.06\ (1 + 0.06)^{100}}{(1 + 0.06) - 1} = 0.0651$$

Am = 5,571,931.8 x 0.0651 = 362,732.75

Table 17-12-B

Ahwaz - Abadan Transmission Line Costs

(1,000 Rials) Alternative B

Year	Real Cost	"Present value" in 1963
1958	82,823	82,823 x 1.46 = 120,849.8
1959	207,600	207,600 x 1.37 = 284,430.0
1960	17,295	17,295 x 1.29 = 22,249.4
1961	4	4 x 1.21 = 4.2
Total	307,721	427,533.5

M = 50

$$Em = \frac{0.06(1 + 0.06)^{50}}{(1 * 0.06) - 1} = 0.0679$$

Am = 427,533.5 x 0.0679 = 29,035.5

Table 17-13-B

Power Supply Installations Costs

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1963
1957	3,240	3,240 x 1.46 = 4,727.6
1958	7,860	7,860 x 1.37 = 10,768.9
1959	96,735	96,735 x 1.29 = 124,446.3
1960	139,373	139,373 x 1.21 = 168,355.0
1961	56,573	56,573 x 1.12 = 64,165.9
1962	67,530	67,530 x 1.06 = 71,919.4
Total	371,310	444,383.2

M = 100

Am = 444,383.2 x 0.0651 = 28,938.2

Table 17-14-B

Electricity Distribution Costs - The Second Plan

(1,000 Rials) Alternative B

Year	Real Cost	"Present Cost" in 1963
1961	58,246	58,246 x 1.13 = 66,064.1
1962	4,470	4,470 x 1.06 = 4,760.5
Total	62,716	70,824.6
M = 50		
Am = 70,824.6 x 0.0679 = 4,810.0		

Table 17-15-B

General and Administrative Costs

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1963
1956	3,762	3,762 x 1.65 = 6,207.3
1957	9,327	9,327 x 1.55 = 14,456.8
1958	16,926	16,926 x 1.46 = 24,711.9
1959	179,214	179,214 x 1.37 = 245,523.2
1960	113,022	113,022 x 1.29 = 145,798.4
1961	80,979	80,979 x 1.21 = 97,984.6
1962	497,493	497,493 x 1.13 = 562,167.0
1963	57,808	57,808 x 1.06 = 61,276.48
Total	958,531	1,158,125.6

M = 100

Am = 1,158,125.6 x 0.0651 = 75,394

Table 17-16-B

Consultant Engineers' Cost

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1963
1956	12,560	12,560 x 1.65 = 20,786.7
1957	12,560	12,560 x 1.55 = 19.518.1
1958	12,560	12,560 x 1.46 = 18,326.8
1959	12,560	12,560 x 1.37 = 17,208.3
1960	12,560	12,560 x 1.29 = 16,158.0
1961	12,560	12,560 x 1.21 = 15,171.8
1962	12,560	12,560 x 1.13 = 14,245.9
1963	12,560	12,560 x 1.06 = 13,376.4
Total	100,480	134,792.1

M = 100

Am = 134,792.1 x 0.0651 = 8,777.6

Table 17-17-B

Supply, Transmission and Distribution of Electricity Costs in the Third Plan

(1,000 Rials) Alternative B

YEAR	REAL COST					TOTAL	"PRESENT VALUE" in 1969
	Production and transmission	Dez-Ahwaz transmission	Electricity operations	Electricity distribution	Construction costs from KWPA's revenues		
1963	801,500	156,110	208,839	4,470	-	1,170,919	1,170,919 x 1.550 = 1,819,592.4
1964	639,000	143,110	111,422	27,764	30,000	951,296	1,951,296 x 1.460 = 1,388,076.2
1965	545,400	157,110	124,017	27,764	60,000	914,291	914,291 x 1.370 = 1,252,657.9
1966	174,756	155,110	124,017	-	110,000	563,883	563,883 x 1.290 = 725,416.5
1967	443,609	154,110	124,017	-	160,000	931,736	931,736 x 1.210 = 1,125,490.2
1968	376,450	134,153	5,000	17,034	103,800	636,437	636,437 x 1.130 = 721,862.8
1969	239,494	774,007	121,086	-	99,600	1,139,187	1,139,187 x 1.065 = 1,213,234.2
Total						6,307,749	8,346,330.1

M = 50

Am = 8,346,330.1 x 0.0679 = 559,925.81

* See Table 17-8-A

Table 17-18-B

Supply, Transmission and Distribution of Electricity Costs in the Fourth Plan

(1,000 Rials) Alternative B

YEAR	REAL COST					TOTAL	"PRESENT VALUE" BY 1973
	Production	Transmission	Gachsaran-Shiraz electricity transmission	Rural electricity supply	Construction costs from KWPA's revenues		
1970	229,873	228,532	9,774	-	100,600	568,779	568,779 x 1.21 = 687,0[illegible]6.4
1971	91,362	144,825	1,000	29,499	149,600	466,786	466,786 x 1.13 = 529,440.4
1972	22,006	123,731	16,333	48,500	199,100	409,670	469,670 x 1.065 = 436,298.5
Total						1,445,235	1,652,795.3

M = 50

Am = 1,652,795.3 x 0.0679 = 112,224.8

Table 17-19-B

Costs of Transmission of Electricity in the Fifth Plan

Year	Real Cost		Total	"Present value" in 1978
	Power transmission	Construction costs from KWPA's revenues		
1973	1,782,460	245,900	2,078,360	2,078,360 x 1.37 = 2,847,533.3
1974	1,782,460	300,000	2,082,460	2,082,460 x 1.29 = 2,679,014.7
1975	1,782,460	230,000	2,012,460	2,012,460 x 1.21 = 2,430,950.3
1976	1,782,460	275,300	2,057,760	2,057,760 x 1.13 = 2,333,962.8
1977	1,782,460	275,300	2,057,760	2,057,760 x 1.065 = 2,191,514.4
Total			10,288,800	12,482,975.6

M = 50

Am = 12,482,975.6 x 0.0679 = 847,594

Table 17-20-A

BENEFIT-LOSS OF THE PAHLAVI DAM HYDRO-POWER PROJECT

(1,000 Rials)

(Alternative A)

	C	O	S			T	S							
Year	Annual cost of the dam (1)	Annual cost of the Ahwaz-Abadan transmission line (2)	Annual cost of power productions installations (3)	Electricity distribution costs 2nd Plan (4)	Administrative and general costs (5)	Consultant Engineer's costs (6)		Production transmission and distribution cost of the 3rd Plan (7)	Production and transmission costs of the 4th Plan (8)	Transmission costs of the 5th Plan (9)	Selling costs (10)	Total annual costs (11)	Capital costs during the 6th Plan (12)	Electricity selling revenues (13)	Benefit-(Loss) (14)
1963	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3					(a) 300,000	1,138,527.3		(a) 96,552	(1,041,975.3)
1964	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3					(a) 310,000	1,148,527.3		(a) 200,168	(948,359.3)
1965	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3					(a) 320,000	1,158,527.3		(a) 269,851	(888,676.3)
1966	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3					(a) 315,000	1,153,527.3		(a) 323,120	(830,407.3)
1967	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3					(a) 325,000	1,163,527.3		(a) 405,241	(758,286.3)
1968	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3					(a) 320,000	1,158,527.3		(a) 480,857	(677,670.3)
1969	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3					(a) 321,000	1,159,527.3		(a) 650,917	(508,610.3)
1970	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2			(a) 350,000	2,029,589.5		(a) 893,370	(1,136,219.5)
1971	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2			(b) 772,030	2,451,619.5		(a) 1,089,490	(1,362,129.5)
1972	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2			(b) 844,025	2,523,614.5		(a) 1,390,626	(1,132,988.5)
1973	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2	161,080.22		(b) 1,001,307	2,841,976.7		(b) 1,653,869	(1,188,107.7)
1974	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2	161,080.22		(b) 1,616,124	3,456,793.7		(b) 2,110,000	(1,346,793.7)
1975	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2	161,080.22		(b) 1,797,269	3,637,938.7		(b) 2,123,000	(1,514,938.7)
1976	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2	161,080.22						
1977	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2	161,080.22						
1978	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2	161,080.22	1,264,972.3			3,105,642		
1979	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2	161,080.22	1,264,972.3			3,105,642		
1980	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2	161,080.22	1,264,972.3			3,105,642		
1986	547,365.12	43,930.62	112,959.4	6,756.53	113,745.4	13,770.3		841,062.2	161,080.22	1,264,972.3	1,797,269	*4,902,911.0	3,105,642	**5,200,000	297,089

* 4,902,911 = 3,105,642 + 1,797,269

** Estimation is made based on the assumption that all the elctricity produced by the dam will be consumed in Khuzestan.

Sources for Table 17-20-A:

(1) Table 17-2-A

(2) Table 17-3-A

(3) Table 17-4-A

(4) Table 17-5-A

(5) Table 17-6-A

(6) Table 17-7-A

(7) Table 17-8-A

(8) Table 17-9-A

(9) Table 17-10-A

(10) (a) Rabani, M., 1971. "Cost-benefit analysis of the Dez multi-purpose scheme", in Tahqiqat-i-Eqtesady. Nos. 25 and 26. 1350. Table 7.

(b) Data were obtained from Saqari, officer of the Department of Financial Affairs, KWPA, Ahwaz, April 1975.

(11) = (1) + (2) + (3) + (4) + (5) + (6) + (7) + (8) + (9) + (10).

(12) = (1) + (2) + (3) + (4) + (5) + (6) + (7) + (8) + (9).

(13) (a) KWPA, Department of Electricity, "A report of ten years of activity", 1342-1351 (1963-1972), p.23.

(b) Data were obtained from Saqari, Officer of the Department of Financial Affairs, KWPA, Ahwaz, April 1975.

(14) = (13) - (11)

Table 17-21-B

BENEFIT-LOSS OF THE PAHLAVI DAM HYDRO-POWER PROJECT

(1,000 Rials)

Alternative B

	C O S T						S						REVENUES	
Year	Annual cost of the dam (1)	Annual cost of the Ahwaz-Abadan transmission line (2)	Annual cost of power production installations (3)	Electricity distribution costs 2nd Plan (4)	Administrative and general costs (5)	Consultant Engineer's costs (6)	Production transmission and distribution cost of the 3rd Plan (7)	Production and transmission costs of the 4th Plan (8)	Transmission costs of the 5th Plan (9)	Selling costs (10)	Total annual costs (11)	Capital costs during the 6th Plan (12)	Electricity selling revenues (13)	Benefit (Loss) (14)
1963	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6				300,000	809,688.05		96,552	(713,136.05)
1964	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6				310,000	819,688.05		200,168	(619,520.05)
1965	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6				320,000	829,688.05		269,851	(559,837.05)
1966	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6				315,000	824,688.05		323,120	(501,568.05)
1967	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6				325,000	334,688.05		405,241	(429,447.05)
1968	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6				320,000	829,688.05		480,857	(404,831.05)
1969	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6				321,000	830,688.85		650,917	(235,771.05)
1970	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81			350,000	1,419,613.80		893,370	(526,243.80)
1971	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81			772,030	1,841,643.80		1,089,490	(752,153.80)
1972	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81			844,025	1,913,638.80		1,390,626	(523,012.80)
1973	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81	112,224.8		1,001,307	2,183,145.60		1,653,869	(529,276.60)
1974	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81	112,224.8		1,616,124	2,797,962.60		2,110,000	(687,962.60)
1975	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81	112,224.8		1,797,269	2,979,107.60		2,123,000	(856,107.60)
1976	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81	112,224.8						
1977	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81	112,224.8						
1978	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81	112,224.8	847,594			2,029,432.6		
1979	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81	112,224.8	847,594			2,029,432.6		
1980	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81	112,224.8	847,594			2,029,432.6		
1986	362,732.75	29,035.5	28,938.2	4,810.0	75,394	8,777.6	559,925.81	112,224.8	847,594	1,797,269	*3,826,701.60	2,029,432.6	**5,200,000	1,373,298.40

Sources: For (1) to (9) see Tables 17-11-B to 17-19-B.
For (10) see Sources on Table 17-20-A.
For (11) see Sources on Table 17-20-A.
(12) = (1) + (2) + (3) + (4) + (5) + (6) + (7) + (8) + (9).
For (13) see Sources on Table 17-20-A.
(14) = (13) - (11).

* 3,826,701.6 = 2,029,432.6 + 1,797.269.

** Estimation is made based on the assumption that all the electricity produced by the dam will be consumed in Khuzestan.

In both analyses the hydro-power project of the Pahlavi dam has not reached the break-even point yet (Fig.17-2). Losses tend to be lowest in 1969 and 1972. These are the years when further generators were installed. The major factor contributing to the losses is that the Khuzestan region has not had a high electricity demand to make the hydro-power supply of the dam profitable. Even today almost half of the electricity is transferred to Tehran at the very low price of 0.35 rials/Kwh. However, the cost of electricity supply has never been lower than 0.7 rials/Kwh, which occurred in 1972. This is only used in Alternative B (Table 17-22).

It is unlikely that Khuzestan's electricity consumption will exceed the Pahlavi dam electricity supply potential of 2,400,000 mwh (maximum value) before the 1980's. By the mid-1980's the project begins to provide benefits if the trend of electricity demand in Khuzestan follows the rate of growth of the past 14 years (Fig. 17-2). However, the economic advantage of the hydro-power supply of the dam has been doubtful so far. The total losses of the Mohamad Reza Shah Pahlavi Dam scheme could be reduced at least for the power supply project, if a correct cost comparison of alternative power system developments had been made for electricity supply in Khuzestan and other cities as well[10]. This is stressed because electricity could have been produced through gas-fuelled turbines, using the gas which is currently being supplied to the U.S.S.R. via Bid-e Boland, Ahwaz, Kashan, Qom, Tehran, Qazvin, Rasht and Astara. This is not only a critical matter of dispute for the Pahlavi dam, but also for other dams such as the Shahbanoo Farah dam on the Sefid River in Gilan, and the Amir Kabir dam on the

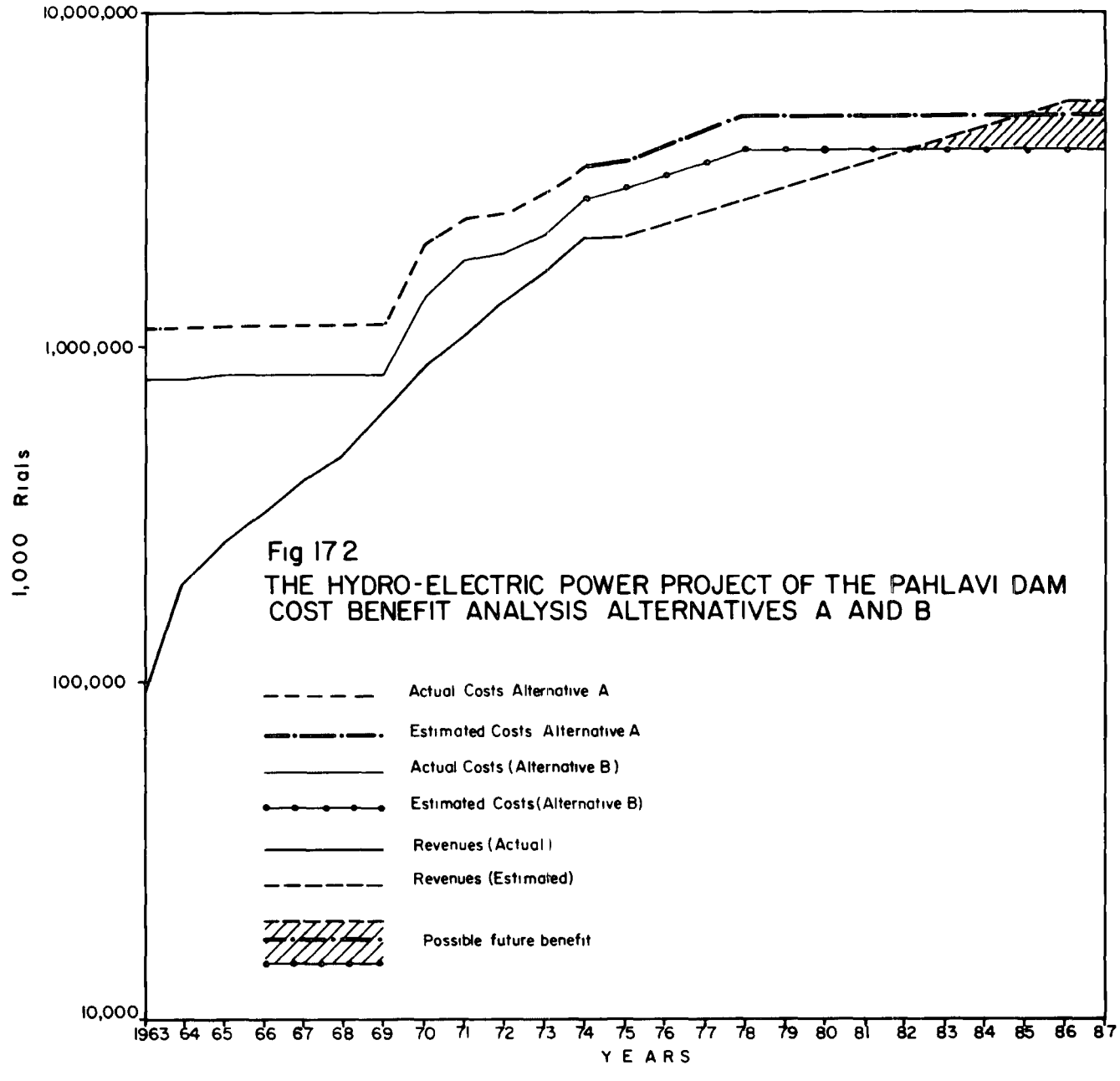


Fig 172

THE HYDRO-ELECTRIC POWER PROJECT OF THE PAHLAVI DAM
COST BENEFIT ANALYSIS ALTERNATIVES A AND B

Table 17-22

Cost of Electricity

Year	Production of electricity mwh (a)	Annual Cost Alternative A (1,000 rial) (b)	Annual Cost Alternative B (1,000 rial) (c)	Cost Alternative A (rial/Kwh) d = b ÷ a	Cost Alternative B (rial/Kwh) e = c ÷ a
1963	86,128	1,138,527.3	809,688.05	13.2	9.4
1964	155.650	1,148,527.3	819,688.05	7.4	5.3
1965	202,995	1,158,527.3	829,688.05	4.6	4.1
1966	256,190	1,153,527.3	824,688.05	4.5	3.2
1967	358,541	1,163,527.3	834,688.05	3.2	2.3
1968	435,341	1,158,527.3	829,688.05	2.7	1.9
1969	685,761	1,159,527.3	830,688.85	1.7	1.2
1970	1,187,250	2,029,589.5	1,419,613.80	1.7	1.2
1971	1,998,083	2,451,619.5	1,841,643.80	1.2	0.9
1972	2,569,582	2,523,614.5	1,913,638.80	0.9	0.7
1973	1,923,373	2,841,976.7	2,183,145.6	1.5	1.1
1974	2,508,135	3,456,793.7	2.797,962.6	1.4	1.1
1975	2,600,000	3,637,938.7	2,979,107.6	1.4	1.1

Sources: (a) Table 16-3

(b) Table 17-20-A

(c) Table 17-21 B

Karaj River in Tehran. A study made in 1969 shows an annual loss of 105 million rials for the Karaj hydro-electric power project[11], (the cost of the dam and its associated hydro-electric power installation is estimated at 5,524,000,000 rials)[12]. In the same study the cost of one kilowatt of hydro-electricity from the Shahbanoo-Farah Dam is estimated at 1 rials for Gilan province and 1.16 rials for the Tehran and the Qazvin regions. (The total cost of the dam and its associated hydro-electricity installation is estimated at 5,041,593,000 rials)[13]. The electricity produced is sold to Tavanir by the North Water and Power Authority to be resold in Gilan province and the Tehran and Qazvin regions. The price of electricity for Gilan is 0.8 rials/Kwh. The corresponding figure for Tehran is 0.9 Rials/Kwh for the first 30 million Kwh of electricity transmitted, and 0.25 rials/Kwh for the next 20 million Kwh and over[14]. The electricity pricing mechanism emphasises the fact that the Shahbanoo Farah dam hydro-electric power project is economically non viable since the major part of electricity is sold at such low rates in Tehran compared with the cost of production. For example, between March 1974 and March 1975 from a total of 479 million Kwh of electricity, 238,298,000 Kwh were transferred to Tehran and 199,093,000 Kwh to Gilan[15]. (The Potential capacity of the five electricity generators at the dam is estimated at 765,500,000 Kwh per annum, therefore the efficiency of the generators is estimated at 62.3% between March 1974 and March 1975.) The Trans-Iranian gas pipeline, with a length of 1,100 kilometres, transports 10×10^9 m^3 of gas per annum to the U.S.S.R. The pipeline has an extra capacity of 6×10^9 m^3. Tehran's domestic gas demand is estimated at 30×10^6 m^3 and the urban demand of the populated centres along the pipeline is estimated at 90×10^6 m^3 per annum[16].

Therefore the remaining capacity (5.880×10^6 m^3) of gas could be used to supply electricity for the nearby cities. This electricity would not be costly since no amortization cost would have to be accounted for with regard to the transporting gas pipeline.

17-4 Benefit-Cost Analysis of the Haft-Tappeh Sugar Cane Project

For computing the benefit-cost of the Haft-Tappeh Sugar Cane Project, the technique employed is exactly the same as the one used for benefit-cost analysis of the hydro-electric power project of the dam. The useful life of the irrigation and drainage works was estimated at 50 years and that of the sugar plantat 25 years for both alternatives, (Tables 17-23-A to 17-26-A and 17-27-B to 17-30-B). Revenues of the Haft-Tappeh Project are shown in Table 17-31. In Alternative A, benefit began to be realized in 1972. Since then losses have occurred and will continue even by the time of full development of the 12,000 ha of the cultivated area (1978) (Tables 17-32-A, 17-33-B and Fig. 17-3). At that stage the project will make a profit provided that the yield increases from 10 to 12 tonnes of sugar per hectare. Based on the 1974 operational costs the break even point will be realised in 1977/78 (Fig.17-3). The achievement of yield at 1968 and 1969 levels is hard to match since the cultivation of cane sugar on a larger scale of 12,000 ha requires a high level of management competence which might be lacking at present. If the yield remains at 10 tonnes of sugar per ha, then the management and administrative costs must be reduced. This is somewhat difficult to establish, considering the highly bureaucratic nature of government projects in Iran.

Table 17-23-A

Capital Costs of the Irrigation and Drainage Networks of the Haft-Tappeh Sugar Cane Project

1956 - 62

(1,000 rials) Alternative A

Year	Real Cost	"Present Value" in 1963
1956	(a) 67	67 x 1.828 = 122.47
1957	(a) 1,380	1,380 x 1.677 = 2,314.26
1958	(a) 1,419	1,419 x 1.538 = 2,182.42
1959	-	
1960	-	
1961	(b) 7,500	7,500 x 1.188 = 8,910.00
1962	(b) 94,000	94,000 x 1.090 = 102,460.00
Total	104,366	115,988.73

M = 50

Am = 115,988.73 x 0.09122 = 10,580.5

Sources: (a) Plan Organization, Dept. of Financial Affairs, "Receipts and payments of Plan Organization from the commencement of the 2nd Seven Year Plan to Mehr (October) 1339." p.12.

(b) Plan Organization, Dept. of Financial Affairs, "A financial report of the eighteen months of the Third Plan," Mehr 1341 - Esfand 1342. p.25.

Table 17-24-A

Capital Costs of the Irrigation and Drainage Networks of the Haft-Tappeh Sugar Cane Project

1963 - 74

(1,000 rials) Alternative A

Year	Real Cost	Uniform annual cost, M = 50
1963	(a) 183,000	183,000 x 0.0912 = 16,653.000
1964	(a) 108,477	108,477 x 0.0912 = 9,871.400
1965	(b) 76,385	76,385 x 0.0912 = 6,951.000
1966	(c) 50,000	50,000 x 0.0912 = 4,550.000
1967	(d) 36,641	36,641 x 0.0912 = 3,334.000
1968	(e) 46,000	46,000 x 0.0912 = 4,186.000
1969	(e) 140,287	140,287 x 0.0912 = 12,766.117
1970	(e) 146,635	146,635 x 0.0912 = 13,197.150
1971	(f) 264,028	264,028 x 0.0912 = 24,026.548
1972	(f) 137,102	137,102 x 0.0912 = 12.476.300
1973	(f) 147,248	147,248 x 0.0912 = 13,399.600

Sources: (a) Plan Organization. Dept. of Financial Affairs. "A financial report of 18 months of the Third Plan" Mehr 1341 - Esfand 1342, p.25.

(b) Plan Organization. Dept. of Financial Affairs, "Final financial report" Mehr 1341 - Esfand 1344. p.29.

(c) Plan Organization. Dept. of Financial Affairs, "Final financial report" Mehr 1341 - Esfand 1345. p.34.

Sources: (cont...)

(d) Plan Organization, Dept. of Financial Affairs, "Final financial report" Mehr 1341 - Esfand 1346. p.47.

(e) Plan Organization, Dept. of Financial Affairs, "Payments of the development projects of the Fourth Plan" Farvardin 1347 - Esfand 1349, p.6.

(f) Plan organization, Dept. of Financial Affairs, "Payments of the Development Projects of the Fourth Plan" Farvardin 1341 - Esfand 1351. p.6.

Table 17-25-A

Capital Costs of the Haft-Tappeh Sugar Plant

(First phase of development. 1958-62)

(1,000 rials) Alternative A

Year	Real Cost	"Present value" in 1963
1958	(a) 97,545	97,545 x 1.538 = 150,024.21
1959	(a) 509,971	509,971 x 1.411 = 719,569.08
1960	(a) 359,338	359,338 x 1.245 = 465,342.71
1961	(b) 303,431	303,431 x 1.188 = 360,476.02
1962	(b) 1,022,117	1,022,117 x 1.090 = 1,114,107.50
Total	2,292,402	2,809,519.52

M = 25

Am = 2,809,519.52 x 0.103 = 289,380.5

Sources: (a) Plan organization, Dept. of Financial Affairs, Accounting Section, "Receipts and payments of Plan Organization from the commencement of the 2nd Seven year Plan to Mehr (October) 1339 (1950). p.50.

(b) Plan Organization, Dept. of Financial Affairs, Financial Report. Mehr 1334 - Esfand 1339. p.105.

Table 17-25-A

Capital Costs of the Haft-Tappeh Sugar Plant

(Second phase of development. 1969 - 73)

(1,000 rials) Alternative A

Year	Real Cost	"Present value" in 1974
1969	(a) 107,187	107,187 x 1.538 = 164 853.60
1970	(b) 299,458	299,458 x 1.411 = 422,535.23
1971	(b) 550,003	550,003 x 1.295 = 712,253.88
1972	(b) 550,696	550,696 x 1.188 = 654,226.84
1973	(c) 326,716	326,716 x 1.090 = 356,120.44
Total	1,834,060	2,309,989.80

M = 25

Am = 2,309,989.8 x 0.103 = 237,928.94

Sources: (a) Ministry of Water and Power, Department of Projects and Investigations (1971). Annual Report of 1349. p.208.

(b) Plan Organization, Department of Financial Affairs, "Payments of the Development Projects of the Fourth Plan", Farvardin 1347 - Esfand 1351, p.16.

(c) Gregorian, KWPA. Haft-Tappeh Sugar Cane Project Department of Accounting, Personal communication, April 1975.

Table 17-27-B

Capital Costs of the Irrigation and Drainage Network of the Haft-Tappeh Sugar Cane Project

1956 - 62

(1,000 rials) Alternative B

Year	Real Cost	"Present value" in 1963
1956	67	67 x 1.55 = 104.1
1957	1,380	1,380 x 1.46 = 2,013.6
1958	1,419	1,419 x 1.37 = 1,944.2
1959	-	
1960	-	
1961	7,500	7,500 x 1.13 = 8,506.7
1962	94,000	94,000 x 1.06 = 100,110.0
Total	104,366	112,678.6

M = 50

Am = 112,678.6 x 0.679 = 7,650.8

Table 17-28-B

Capital Costs of the Irrigation and Drainage Network of the Haft-Tappeh Sugar Cane Project

1963 - 74

(1,000 rials) Alternative B

Year	Real Cost	Uniform Annual Costs, M = 50
1963	183,000	183,000 x 0.0679 = 12,425.70
1964	108,477	108,477 x 0.0679 = 7,365.58
1965	76,385	76,385 x 0.0679 = 5,186.50
1966	50,000	50,000 x 0.0679 = 3,395.00
1967	36,641	36,641 x 0.0679 = 2,487.90
1968	46,000	46,000 x 0.0679 = 3,123.40
1969	140,287	140,287 x 0.0679 = 9,525.40
1970	146,635	146,635 x 0.0679 = 9,956.50
1971	246,028	246,028 x 0.0679 = 16,705.30
1972	137,102	137,102 x 0.0679 = 9,309.20
1973	147,248	147,248 x 0.0679 = 9,998.10

Table 17-29-B

Capital Costs of the Haft-Tappeh Sugar Plant

First phase of development. 1958-62.

(1,000 rials) Alternative B

Year	Real Cost	"Present value" in 1963
1958	97,545	97,535 x 1.37 = 133,645.1
1959	509,971	509,971 x 1.29 = 656,060.5
1960	359,338	359,338 x 1.21 = 434,062.2
1961	303,431	303,431 x 1.13 = 344,159.0
1962	1,022,117	1,022,117 x 1.06 = 1,083,444.0
Total	2,292,402	2,651,370.6

M = 25

Am = 2,651,370.6 x 0.0819 = 217,147.25

Table 17-30-B

Capital Costs of the Haft-Tappeh Sugar Plant

Second phase of development. 1969-73

(1,000 rials) Alternative B

Year	Real Cost	"Present value" in 1974
1969	107,187	107,187 x 1.37 = 146,855.5
1970	299,458	299,458 x 1.29 = 385,242.6
1971	550,003	550,003 x 1.21 = 664,375.9
1972	550,696	550,696 x 1.13 = 624,613.2
1973	326,716	326,716 x 1.06 = 347,952.5
Total	1,834,060	2,169,039.7

M = 25

Am = 2,169,039.7 x 0.0819 = 177,644.3

Table 17-31

Revenues of the Haft-Tappeh Sugar Cane Project

1962 - 1974 (1,000 rials)

Year	Sugar	Molasses (a)	Bagass (a)	Total
1962	(a) 235			235
1963	(a) 204			204
1964	(a) 337,506	539		338,045
1965	(a) 502,653	4,376		507,029
1966	(a) 532,944	15,592		548,536
1967	(b) 587,896	10,406		598,302
1968	(b) 731,759	1,748		733,507
1969	(b) 838,159	10,260		848,419
1970	(b) 849,857	7,439		857,296
1971	(b) 784,711	17,141	17,580	819,432
1972	(b) 1,095,888	115,202	5,573	1,216,163
1973	(b) 1,814,989	25,159	4,829	1,844,977
1974	(b) 2,002,935	-	22,714	2,025,649

Sources: (a) Data are obtained from Gregoorian, KWPA. Haft-Tappeh Sugar Cane Project, Department of Accounting, April 1975.

(b) KWPA. Haft-Tappeh Sugar Cane Project, Department of Administrative and Industrial Communication, Annual Report, 1974. p.14

TABLE 17-32-A

COST-BENEFIT OF THE HAFT-TAPPEH SUGAR CANEEPROJECT

(1,000 Rials)

Alternative A

YEAR	ANNUAL COSTS																		
	IRRIGATION AND DRAINAGE YEAR OF INVESTMENT												SUGAR PLANT 1958-62 (3)	EXTENSION OF THE SUGAR PLANT (4)	TOTAL CAPITAL COSTS (5)	OPERATIONAL COSTS (6)	TOTAL COSTS (7)	REVENUES (8)	BENEFIT (LOSS) (9)
	1956-62 (1)	1963 (2)	1964 (2)	1965 (2)	1966 (2)	1967 (2)	1968 (2)	1969 (2)	1970 (2)	1971 (2)	1972 (2)	1973 (2)							
1962	10,580.48												289,380.5		229,960.98	(a) 496,914.0	796,874.98	235	(796,639.98)
1963	10,580.48	16,653											289,380.5		316,613.98	(a) 413,671	730,284.98	204	(730,080.98)
1964	10,580.48	16,653	9,871.4										289,380.5		326,485.38	(a) 435,710	762,195.38	338,045	(324,150.38)
1965	10,580.48	16,653	9,871.4	6,951									289,380.5		333,439.42	(a) 444,470	777,909.42	507,029	(270,880.42)
1966	10,580.48	16,653	9,871.4	6,951	4,550								289,380.5		337,986.39	(a) 471,542	809,528.39	548,536	(260,992.39)
1967	10,580.48	16,653	9,871.4	6,951	4,550	3,334							289,380.5		341,320.75	(a) 492,012	833,332.75	598,302	(235,030.75)
1968	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186						289,380.5		345,506.75	(a) 535,450	880,956.75	733,507	(147,449.75)
1969	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117					289,380.5		358,272.87	(a) 557,691	915,963.87	848,419	(67,544.87)
1970	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117	13,197.15				289,380.5		371,470.02	(a) 553,848	925,318.02	857,296	(68,022.02)
1971	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117	13,197.15	24,026.548			289,380.5		395,496.56	(a) 597,359	992,855.56	819,432	(173,423.56)
1972	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117	13,197.15	24,026.548	12,476.3		289,380.5		407,972.84	(a) 766,943	1,174,915.80	1,216,163	41,247.16
1973	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117	13,197.15	24,026.548	12,476.3	13,399.6	289,380.5	237,928.94	659,301.44	(a) 1,275,871	1,935,172.2	1,844,977	(90,195.24)
1974	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117	13,197.15	24,026.548	12,476.3	13,399.6	289,380.5	237,928.94	659,301.44	(b) 1,739,136	2,398,437.4	2,025,649	(372,789.44)
1975	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117	13,197.15	24,026.548	12,476.3	13,399.6	289,380.5	237,928.94	659,301.44	(c) 1,838,758	2,498,059.4	2,167,672	(330,387.4)
1976	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117	13,197.15	24,026.548	12,476.3	13,399.6	289,380.5	237,928.94	659,301.44	(c) 1,938,389	2,597,690.4	2,285,115	(312,575.4)
1977	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117	13,197.15	24,026.548	12,476.3	13,399.6	289,380.5	237,928.94	659,301.44	(c) 2,038,016	2,697,317.4	2,402,557	(294,760.4)
1978	10,580.48	16,653	9,871.4	6,951	4,550	3,334	4,186	12,766.117	13,197.15	24,026.548	12,476.3	13,399.6	289,380.5	237,928.94	659,301.44	(c) 2,137,405*	2,796,707.2	{2,500,000** / 3,024,000***}	(296,707.2) / 227,292.8

Sources: (1) Table 17-23-A

(2) Table 17-24-A

(3) Table 17-25-A

(4) Table 17-26-A

(5) = (1) + (2) + (3) + (4)

(6) (a) KWPA, Department of the Haft-Tappeh Sugar Cane Project, "Annual report of 1352", Division of Administrative Affairs and Industrial Relations, p.14.

(b) Ministry of Agriculture and Natural Resources, Haft-Tappeh Sugar Cane Project, Gregorian, Officer of the Department of Monetary Affairs, personal communication, 1975.

(c) Estimation.

(7) = (5) + (6)

(8) Table 17-3.

(9) = (8) - (7)

* Estimation based on the operational costs of 1974 for 12,000 ha.

** Estimation based on 12,000 ha., 10 tonnes/ha of sugar yield and 21 rials/Kg for the produced sugar.

*** Estimation based on 12,000 ha., 12 tonnes/ha of sugar yield and 21 rials/Kg for the produced sugar.

Table 7-33-B

COST-BENEFIT OF THE HAFT-TAPPEH SUGAR CANE PROJECT

(1,000 Rials)

Alternative B

YEAR	ANNUAL IRRIGATION AND DRAINAGE YEAR OF INVESTMENT										COSTS							REVENUES	BENEFIT (LOSS)
	1956-62 (1)	1963 (2)	1964 (2)	1965 (2)	1966 (2)	1967 (2)	1968 (2)	1969 (2)	1970 (2)	1971 (2)	1972 (2)	1973 (2)	SUGAR PLANT 1958-62 (3)	EXTENSION OF THE SUGAR PLANT 1969 - 1973 (4)	TOTAL CAPITAL COSTS (5)	OPERATIONAL COSTS (6)	TOTAL COSTS (7)	(8)	(9)
1962	7,650.8												217,147.3		224,798.0	(a) 496,914.0	721,712.0	235	(721,477.0)
1963	7,650.8	12,425.7											217,147.3		237,223.8	(a) 413,671.0	650,894.8	204	(650,690.8)
1964	7,650.8	12,425.7	7,365.6										217,147.3		244,589.4	(a) 435,710.0	680,299.4	338,045	(342,254.4)
1965	7,650.8	12,425.7	7,365.6	5,186.5									217,147.3		249,775.9	(a) 444,470.0	694,245.9	507,029	(187,216.9)
1966	7,650.8	12,425.7	7,365.6	5,186.5	3,395								217,147.3		253,170.9	(a) 471,542.0	724,712.9	548,536	(176,176.9)
1967	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9							217,147.3		255,658.8	(a) 492,012.0	747,670.8	598,302	(149,368.8)
1968	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4						217,147.3		258,782.2	(a) 535,450.0	794,232.2	733,507	(60,725.2)
1969	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4					217,147.3		268,307.6	(a) 557,691.0	825,998.6	848,419	22,420.4
1970	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4	9,956.5				217,147.3		278,264.1	(a) 553,848.0	832,112.1	857,296	25,183.9
1971	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4	9,956.5	16,705.3			217,147.3		294,969.4	(a) 597,359.0	892,328.4	819,432	(72,896.4)
1972	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4	9,956.5	16,705.3	9,309.2		217,147.3		304,278.6	(a) 766,943.0	1,104,221.6	1,216,163	111,941.4
1973	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4	9,956.5	16,705.3	9,309.2	9,998.1	217,147.3	177,644.3	491,921.2	(a) 1,275,871.0	1,767,792.0	1,844,977	77,185.0
1974	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4	9,956.5	16,705.3	9,309.2	9,998.1	217,147.3	177,644.3	491,921.2	(b) 1,739,136.0	2,231,057.0	2,025,649	(205,408.0)
1975	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4	9,956.5	16,705.3	9,309.2	9,998.1	217,147.3	177,644.3	491,921.2	(c) 1,838,750.0	2,330,671.0	2,167,672	(162,999.0)
1976	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4	9,956.5	16,705.3	9,309.2	9,998.1	217,147.3	177,644.3	491,921.2	(c) 1,938,389.0	2,430,309.0	2,285,115	(145,194.0)
1977	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4	9,956.5	16,705.3	9,309.2	9,998.1	217,147.3	177,644.3	491,921.2	(c) 2,038,016.0	2,529,937.0	2,402,557	(127,380.0)
1978	7,650.8	12,425.7	7,365.6	5,186.5	3,395	2,487.9	3,123.4	9,525.4	9,956.5	16,705.3	9,309.2	9,998.1	217,147.3	177,644.3	491,921.2	(c) 2,137,405.8*	2,629,327.0	{2,500,000** 3,024,000***}	(129,327.0) (394,673.0)

Sources:
(1) Table 17-27-B
(2) Table 17-28-B
(3) Table 17-29-B
(4) Table 17-30-B
(5) = (1) + (2) + (3) + (4)
(6) (a) & (b) - see Table 17-32-A
(6) (c) Estimation
(7) = (5) + (6)
(8) Table 17-31.
(9) = (8) - (7)

* Estimation based on the operational costs of 1974 for 12,000 ha.

** Estimation based on 12,000 ha, 10 tonnes/ha of sugar yield, and 21 rials/Kg for the produced sugar.

*** Estimation based on 12,000 ha, 12 tonnes/ha of sugar yield, and 21 rials/Kg for the produced sugar.

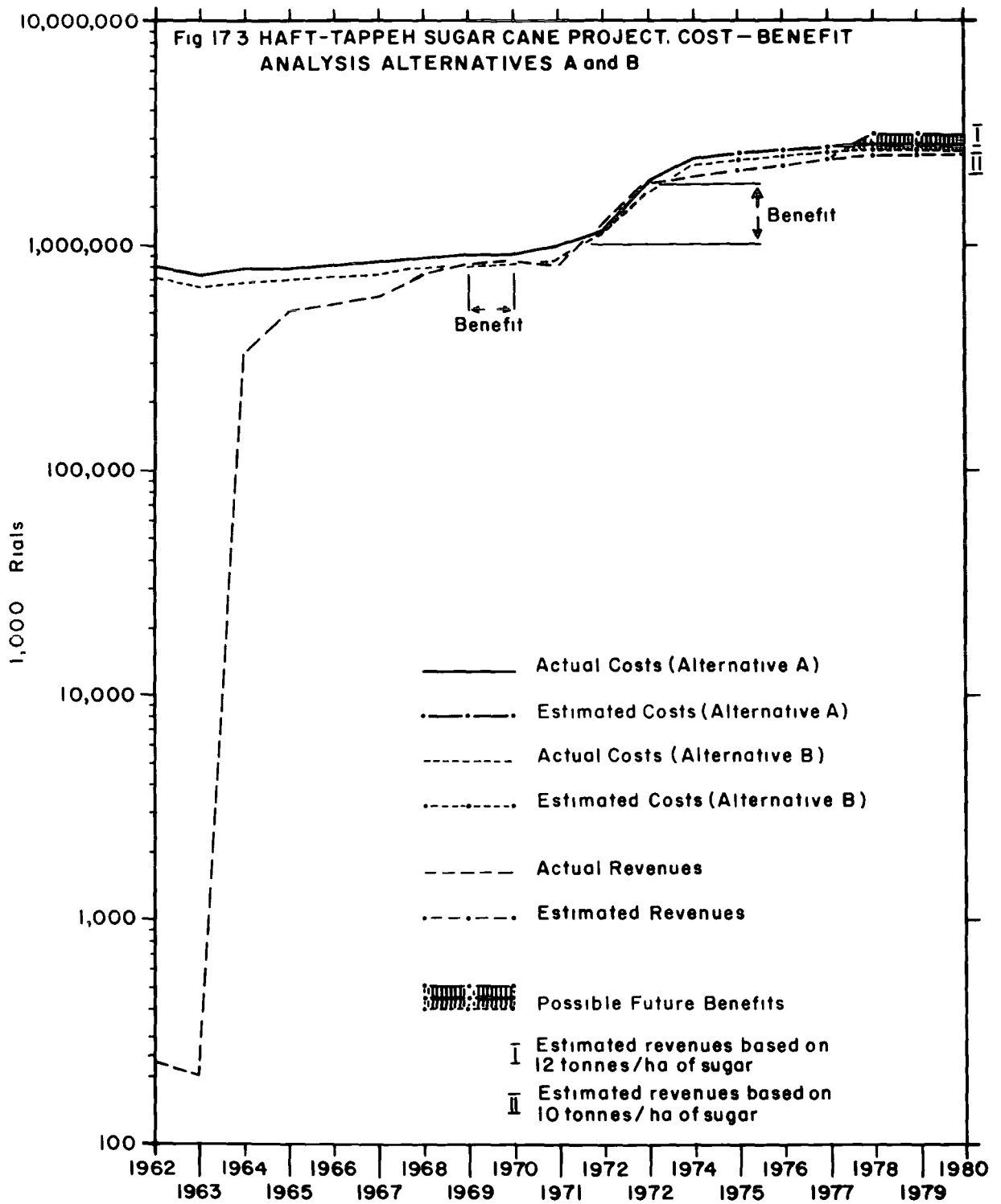


Fig 17 3 HAFT-TAPPEH SUGAR CANE PROJECT. COST – BENEFIT ANALYSIS ALTERNATIVES A and B
10,000,000
1,000,000
100,000
10,000
1,000
100
1,000 Rials
Benefit
Benefit
Actual Costs (Alternative A)
Estimated Costs (Alternative A)
Actual Costs (Alternative B)
Estimated Costs (Alternative B)
Actual Revenues
Estimated Revenues
Possible Future Benefits
I Estimated revenues based on 12 tonnes/ha of sugar
II Estimated revenues based on 10 tonnes/ha of sugar
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1972
1974
1975
1976
1977
1978
1979
1980

In Alternative B the Haft-Tappeh Sugar Cane Project began to show a profit in 1969, (Table 17-33-B and Fig. 17-3). The loss in 1971 was owing to the exceptional conditions of rainfall and freezing[17] that reduced the total sugar produced[18]. The loss in 1974 was owing to the impossibility of exporting molasses.

These losses will continue unless the loading facilities of the southern ports of Iran increase[19]. By 1978, the Haft-Tappeh Sugar Cane Project will continue to make a loss if the operational costs continue to be the same as the 1974 operational cost levels. In addition such a status will occur if the yield of sugar is 10 tonnes/ha and the price of sugar 21 rials/Kg.

Assuming a productivity of 12 tonnes/ha for sugar, the project is beneficial. KWPA claims that the Haft-Tappeh Project has made a profit since 1965. This is because KWPA's estimation is based upon two sets of variables, which are the operational costs and revenues, It disregards the capital costs. Normally in cost-benefit analysis all the costs and revenues must be taken into account[20]. Although the Haft-Tappeh Sugar Cane Project has been the most efficient farming unit in the DIP in terms of land productivity and employment, the cost of sugar is high in comparison with other countries (Appendix G). These high costs have remained a critical question for this project since its conception.

17-5 Benefit-Cost of the DIP

Besides the Dez dam itself, the DIP costs include those of the irrigation and drainage network and many other items. The DIP was

completed by 1965 and the DIP, which had been anticipated to be completed by 1972 is now expected to be finished by 1977. The Haft-Tappeh Sugar Cane Project was included in the cost-benefit analysis of the DIP from 1972 onwards.

From 1963 until 1969 water charges and savings from flood control were the revenues of the DIP. Since then the DIP revenues have bee as follows:

a) Water charges (Tables 17-56 to 17-59)

b) Land leasing to agro-businesses (Table 17-60)

c) Sugar production from the Haft-Tappeh project (Table 17-31)

d) House sales to the resettled farmers (Table 17-61)

e) Income taxes (143,000,000 rials per annum)

f) Savings from flood control (Tables 17-62 and 17-63)

The present values of the capital costs were computed for every cost item independently, Tables 17-34-A to 17-44-A and 17-45-B to 17-55-B and the uniform annual costs were established afterwards (Tables 17-64-A and 17-65-B).

In Alternative A the DIP produced benefits only in the three years 1963-65 but losses thereafter (Fig. 17-4). The losses were least in 1967 and 1972. They then increased again, because of the increase in capital investment. which was financed through the second IBRD loan of $30 million and the development funds of the Third and the Fourth Development Plans.

In Alternative B the DIP produced benefits in the three years 1963-65. Losses occurred from 1967 to 1974 (Fig. 17-5) and will

Table 17-34-A

Construction Cost of the DPIP - 1959-65

(1,000 Rials) Alternative A

Year	Real Cost	"Present value" in 1966
1959	(a) 28,965	28,965 x 1.828 = 52,948.02
1960	(a) 75,877	75,877 x 1.677 = 127.245.72
1961	(a) 90,127	90,127 x 1.538 = 146,305.32
1962	(b) 425,803	425,803 x 1.411 = 600,808.03
1963	(c) 661,036	661,036 x 1.295 = 856,041.62
1964	(d) 346,148	346,148 x 1.188 = 411,223.82
1965	(e) 179,180	179,180 x 1.090 = 195,306.20
Total	1,807,136	2,389,878.70

M = 50

Am = 2,389,878.7 x 0.09122 = 218,004.73

Sources: (a) DRC. 1964. Summary accounting of funds, Khuzestan Development Programme, March, 29th 1956 to June 1963, pp.59-89.

(b) (i) Plan Organization, Department of Financial Affairs, Financial Report on the first six months of 1341, p.26.

(ii) Plan Organization, Department of Financial Affairs, Financial Report on the first eighteen months of the Third Plan, Mehr 1341 - Esfand 1342. p.16

(c) Plan Organization, Department of Financial Affairs, Financial Report on eighteen months of the Third Plan, Mehr 1341 - Esfand 1342, p.16.

(d) Plan Organization, Department of Financial Affairs, Financial report on eighteen months of the Third Plan, Mehr 1341 - Esfand 1343, p.17.

(e) Plan Organization, Department of Financial Affairs, Financial Report, Mehr 1341 - Esfand 1344. p.19.

Table 17-35-A

Construction Costs of the DIP - 1966-72

(1,000 Rials) Alternative A

Year	Real Cost	"Present Value" in 1973
1966	(a) 152,605	152,605 x 1.828 = 278,504.12
1967	(b) 334,087	334,087 x 1.677 = 560,263.89
1968	(c) 529,962	529,962 x 1.538 = 815,081.55
1969	(d) 625,088	625,088 x 1.411 = 881,999.16
1970	(e) 705,863	705,863 x 1.295 = 914,092.58
1971	(e) 1,126,105	1,126,105 x 1.188 = 1,337,812.70
1972	(f) 1,059,266	1,059,266 x 1.090 = 1,154,599.90
Total	4,532,976	5,942,353.60

M = 50

Am = 5,942,353.6 x 0.09122 = 542,061.49

Sources: (a) Plan Organization, Department of Financial Affairs, Financial Report, Mehr 1341 - Esfand 1345. p.24.

(b) Plan Organization, Department of Financial Affairs, Financial Report, Mehr 1341 - Esfand 1346. p.35.

(c) Plan Organization, Department of Financial Affairs, Financial Report, Farvardin 1347 - Esfand 1347. p.28.

(d) Plan Organization, Department of Financial Affairs, Financed funds of the Fourth Development Plan. Farvardin 1348 - Esfand 1348. p.29.

(e) Plan Organization, Department of Financial Affairs, Financed funds of the Fourth Development Plan. Farvardin 1347 - Esfand 1350. p.30.

(f) Plan Organization, Department of Financial Affairs, Financed funds of the Fourth Development Plan, Farvardin 1347 - Esfand 1351. pp.33-34.

Table 17-36-A

Construction Costs of the DIP - 1973-77

(1,000 Rials) Alternative A

Year	Real Cost (1)	"Present Value" in 1978
1973	*650,000	650,000 x 1.538 = 999,700.00
1974	x1,025,000	1,025,000 x 1.411 = 1,446,275.00
1975	*800,000	800,000 x 1.295 = 1,036,000.00
1976	**533,544	533,544 x 1.188 = 62,197.27
1977	**326,337	326,337 x 1.090 = 355,707.33
Total	3,324,881	4,459,652.50

M = 50

Am = 4,459,652.5 x 0.09122 = 406,809.5

x Actual

** Projected and proposed by KWPA to Plan Organization.

Source: (1) Data were obtained from Alavi, Officer of KWPA, DIP. Department of Financial Affairs, Desful, April 1975.

Table 17-37-A

General Necesssity Costs of the DIP - 1957-65

(1,000 Rials) Alternative A

Year	Real Cost	"Present Value" in 1966
1957	(a) 13,357	13,357 x 2.127 = 28,410.339
1958	(a) 78,442	78,442 x 1.992 = 156,256.460
1959	(a) 69,045	69,045 x 1.828 = 126,214.260
1960	(a) 9,517	9,517 x 1.677 = 15,960.009
1961	(a) 1,972	1,972 x 1.538 = 3,032.936
1962	(a) 3,765	3,765 x 1.411 = 5,312.415
1963	(b) 99,949	99,949 x 1.295 = 129,433.950
1964	(c) 142,562	142,562 x 1.188 = 268,016.560
1965	(d) 86,000	86,000 x 1.090 = 93,740.000
Total	504,609	826,376.900

M = 47

Am = 826,376.9 x 0.09159 = 75,687.86

Sources: (a) DRC. 1964. pp.115-118.

(b) Plan Organization, Department of Financial Affairs, Financial Report on eighteen months of the Third Plan. Mehr 1341 - Esfand 1342. p.16.

(c) Plan Organization, Department of Financial Affairs, Financial Report on eighteen months of the Third Plan. Mehr 1341 - Esfand 1343. p.17.

(d) Plan Organization, Department of Financial Affairs, Financial Report on eighteen months of the Third Plan. Mehr 1341 - Esfand 1344. p.19.

Table 17-38-A

Administrative and General Costs of the DIP - 1956-67

(1,000 Rials) Alternative A

Year	Real Cost	"Present value" in 1968
1956	(a) 1,254	1,254 x 2.812 = 3,526.248
1957	(a) 3,109	3,109 x 2,580 = 8,021.220
1958	(a) 5,642	5,642 x 2.367 = 13,354.614
1959	(a) 59,738	59,738 x 2.127 = 127,062.720
1960	(a) 37,674	37,674 x 1.992 = 75,046.608
1961	(a) 26,993	26,993 x 1.828 = 49,343.204
1962	(a) 165,831	165,831 x 1.677 = 278,098.580
1963	(a) 321,189	321,189 x 1.538 = 493,988.680
1964	(b) 226,551	226,551 x 1.411 = 319,633.346
1965	(c) 198,247	198,247 x 1.295 = 256,729.860
1966	(d) 183,168	183,168 x 1.188 = 217,603.580
1967	(e) 195,617	195,617 x 1.090 = 213,222.530
Total	1,425,013	2,055,663.000

M = 45

Am = 2,055,663 x 0.0919 = 188,915.42

Note: One quarter of the total administrative and general costs of the Pahlavi dam scheme was charged to the irrigation project. (See Tables 17-6-A and 17-15-B on cost benefit analysis of the hydro-power project).

Sources: (a) DRC. 1964. pp.118-142.

(b) Plan Organization, Department of Financial Affairs, "Financial report of thirty months of the Third Plan", Mehr 1341 - Esfand 1343. p.17.

(c) Plan Organization. Department of Financial Affairs, "Final financial report" Mehr 1341 - Esfand 1344, p.19.

(d) Plan Organization, Department of Financial Affairs, "Final financial report" Mehr 1341 - Esfand 1345, p.34.

(e) Plan Organization, Department of Financial Affairs, "Final financial report" Mehr 1341 - Esfand 1346. p.35.

Table 17-39-A

Resource Investigation Costs of the DIP - 1956-65

(1,000 Rials) Alternative A

Year	Real Cost	"Present value" in 1966
1956	(a) 2,265.00	2,265.00 x 2.367 = 5,361.255
1957	(a) 48,202.50	48,202.50 x 2.127 = 102,527.780
1958	(a) 61,815.00	61,815.00 x 1.992 = 123,135.480
1959	(a) 62.602.50	62,602.50 x 1.828 = 114,438.280
1960	(a) 105,240.00	105,240.00 x 1.677 = 176,487.480
1961	(a) 14,212.50	14,212.50 x 1.538 = 21,859.590
1962	(a) 2.430.00	2,430.00 x 1.411 = 3,428.730
1963	(b) 22,491.00	22,491.00 x 1.295 = 29,125.845
1964	(c) 24,000.00	24,000.00 x 1.188 = 28,512.000
1965	(d) 39,000.00	39,000.00 x 1.090 = 42,510.000
Total	382,257.00	647,386.000

M = 47

Am = 647.386 x 0.09159 = 59,294.083

Sources: (a) DRC. 1964. Summary accounting of funds, Khuzestan Development Programme, March 29, 1956 to June 1963, pp.103-115.

(b) Plan Organization, Department of Financial Affairs, Financial report on eighteen months of the Third Plan, Mehr 1341 - Esfand 1342. p.16.

(c) Plan Organization, Department of Financial Affairs, Financial report on eithteen months of the Third Plan, Mehr 1341 - Esfand 1343. p.17.

(d) Plan Organization, Department of Financial Affairs, Financial report on eighteen months of the Third Plan, Mehr 1341 - Esfand 1344. p.19.

Table 17-40-A

Consultant Engineers' Costs of the DIP - 1956-65

(1,000 Rials) Alternative A

Year	Read Cost	"Present Value" in 1966
1956	* (a) 4,800	4,800 x 2.367 = 11,361.60
1957	* (a) 4,800	4,800 x 2.127 = 10,209.60
1958	* (a) 4,800	4,800 x 1.992 = 9,561.60
1959	* (a) 4,800	4,800 x 1.828 = 8,774.40
1960	* (a) 4,800	4,800 x 1.677 = 8,049.60
1961	* (a) 4,800	4,800 x 1.538 = 7,382.40
1962	* (a) 4,800	4,800 x 1.411 = 6,772.80
1963	* (b) 16,292	16,292 x 1.295 = 21,098.14
1964	* (c) 15,300	15,300 x 1.188 = 18,176.40
1965	* (d) 9,728	9,728 x 1.090 = 10,603.52
Total	74,920	111,990.06

M = 47

Am = 111,990.06 x 0.09159 = 10,257.169

* A quarter of the cost was charged to the irrigation project. (See cost-benefit analysis of the Pahlavi dam hydro-power project. Tables 17-7-A and 17-16-B).

Sources: (a) (1) Plan Organization, Department of Financial Affairs, Division of Accounting, Financial report of Plan Organization, Mehr 1334 to Esfand 1339. p.105.

(2) Plan Organization, Department of Financial Affairs, Division of Accounting, Financial report of the Third Plan, Mehr 1341 - Esfand 1342. p.16.

(b) Plan Organization, Department of Financial Affairs, Division of Accounting, Financial Report of the Third Plan. Mehr 1341 - Esfand 1342. p.16.

(c) Plan Organization, Department of Financial Affairs, Division of Accounting, Financial Report of the Third Plan. Mehr 1341 - Esfand 1343. p.17.

(d) Plan Organization, Department of Financial Affairs, Financial Report of the Third Plan. Mehr 1341 - Esfand 1344. p.19.

Table 17-41-A

Construction Costs of the Shush-Shushtar Road of the DIP

(1.000 rials) Alternative A

Year	Real Cost	"Present value" in 1975
1971	(a) 8,871	8,871 x 1.411 = 12,516.98
1972	(b) 80,977	80,997 x 1.295 = 104,865.21
1973	(a) 46,458	46,458 x 1.188 = 55,192.10
1974	(a) 38,041	38,041 x 1.090 = 41,464.69
Total	174,347	214,038.98

M = 50

Am = 214,038.98 x 0.09122 = 19,524.635

Sources: (a) Al-i-yasin, A. October 1974. "Executional report and the progress of the construction of the DIP". Ministry of Water and Power. KWPA. Annex 4 and p.42.

(b) Ministry of Water and Power, Department of Projects and Investigations, Bureau of Supervision and Investigations, Annual report 1351. pp.178-181.

Table 17-42-A

Costs of Agricultural Development of Safiabad - 1968-77

(1,000 Rials) Alternative A

Year	Real Cost	"Present value" in 1978
1968	(a) 159,962	159,962 x 2.367 = 378,630.050
1969	(b) 155,323	155,323 x 2.127 = 330,372.020
1970	* (b) 167,322	167,322 x 1.992 = 333,305.420
1971	* (b) 178,009	178,009 x 1.828 = 325,400.450
1972	(c) 177,200	177,200 x 1.677 = 297,164.400
1973	(d) 212,362	212,362 x 1.538 = 32,854.756
1974	(d) 115,000	115,000 x 1.411 = 162,265.000
1975	(d) 90,000	90,000 x 1.295 = 116,550.000
1976	(d) 303	303 x 1.188 = 359.960
1977	(d) 303	303 x 1.090 = 330.270
Total	1,255,784	1,977,232.000

M = 35

Am = 1,977,232 x 0.0946 = 187,105.46

Sources: (a) Plan Organization, Department of Financial Affairs, "Financed funds of the Fourth Development Plan". Farvardin 1347 - Esfand 1348. p.6.

(b) Plan Organization, Department of Financial Affairs, "Financed funds of the Fourth Development Plan". Farvardin 1347 - Esfand 1350. pp.6-8.

* The capital costs in 1970 and 1971 are 76,073,615 rials and 127,323,153 rials respectively. Two figures of 91,248,000 rials in 1970 and 50,686,000 rials in 1971 which are the capital investment of project number 110,107 under the titel of Research were added to the cost of agricultural development of Safiabad.

(c) Ministry of Water and Power, Department of Projects and Investigations, Bureau of Supervision and Investigations. "Annual report of 1351". p.77.

(d) Data were obtained from Sagari, KWPA. Department of Financial Affairs in Ahwaz, April 1975.

Table 17-43-A

Costs of Purchasing 68,000 ha of Land for DIP - 1969-74

(1,000 Rials) Alternative A

Year	Real Cost	"Present value" in 1975
1969	(a) 134,187	134,187 x 1.677 = 225,031.59
1970	(b) 92,500	92,500 x 1.538 = 142,265.00
1971	(a) 342,878	342,878 x 1.411 = 483,800.85
1972	(c) 348,000	348,000 x 1.295 = 450,660.00
1973	(d) 240,000	240,000 x 1.188 = 285,120.00
1974	(d) 127	127 x 1.090 = 130.43
Total	1,157,692	1,587,015.80

M = 38

Am = 1,587,015.8 x 0.09353 = 148,433.58

Sources: (a) Plan Organization, Department of Financial Affairs, "Financed funds of the Fourth Development Plan", Farvardin 1347 - Esfand 1350. pp.6-8.

(b) Plan Organization, Department of Financial Affairs, "Financed funds of the Fourth Development Plan", Farvardin 1347 - Esfand 1349. p.6.

(c) Plan Organization, Department of Financial Affairs, "Financed funds of the Fourth Development Plan". Farvardin 1347 - Esfand 1351. p.6.

(d) Data were obtained from Saqari, the officer of KWPA, Department of Financial Affairs, Ahwaz, April 1975.

Table 17-44-A

Costs of Building the Rural Towns of the DIP - 1970-76

(1,000 Rials) Alternative A

Year	Real Cost	"Present value" in 1977
1970	(a) 58,015	58,015 x 1.828 = 106,051.420
1971	(a) 92,096	92,096 x 1.677 = 154,444.990
1972	(b) 95,576	95,576 x 1.538 = 146,995.880
1973	(c) 157,628	157,628 x 1.411 = 222,398.990
1974	(c) 79,459.	79,459 x 1.295 = 102,899.400
1975	(c) 37,389	37,389 x 1.188 = 44,418.132
1976	(c) 39,359	39,359 x 1.090 = 42,901.310
Total	544,522	820,110.120

M = 36

Am = 820,110.12 x 0.0942 = 77,279

Sources: (a) Plan Organization, Department of Financial Affairs, "Financed funds of the Fourth Development Plan Projects". Farvardin 1347 - Esfand 1350. pp.6-8.

(b) Plan Organization. Department of Financial Affairs, "Financed funds of the Fourth Development Plan Projects". Farvardin 1347 - Esfand 1351. p.6.

(c) Data were obtained from Saqari, the officer of KWPA. Department of Financial Affairs, Ahwaz. April 1975.

Table 17-45-B

Construction Costs of the DPIP - 1959-65

(1,000 Rials) Alternative B

Year	Real Cost	" Present Value " in 1966
1959	28,965	28,965 x 1.55 = 45,011.20
1960	75,877	75,877 x 1.46 = 110,715.30
1961	90,127	90,127 x 1.37 = 123,431.80
1962	425,803	425,803 x 1.24 = 547.781.20
1963	661,036	661,036 x 1.21 = 798,498.20
1964	346,148	346,148 x 1.13 = 391,147.94
1965	179,180	179,180 x 1.06 = 190,826.70
Total	1,807,136	2,207,462.30

M = 50

Am = 2,207,462.3 x 0.0679 = 149,886.69

Table 17-46-B

Construction Costs of the DIP - 1966-72

(1,000 Rials) Alternative B

Year	Real Cost	"Present value" in 1973
1966	152,605	152,605 x 1.55 = 237,146.1
1967	334,087	334,087 x 1.46 = 487,480.5
1968	529,962	529,962 x 1.37 = 726,093.9
1969	625,088	625,088 x 1.29 = 804,154.7
1970	705,863	705,863 x 1.21 = 852,646.9
1971	1,126,105	1,126,105 x 1.13 = 1,277,256.4
1972	1,059,266	1,059,266 x 1.06 = 1,128,118.3
Total	4,532,976	5,512,896.8

M = 50

Am = 5,512,896,8 x 0.0679 = 374,402.5

Table 17-47-B

Construction Costs of the DIP - 1973-77

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1978
1973	650,000	650,000 x 1.37 = 890,556.3
1974	1,025,000	1,025,000 x 1.29 = 1,318,628.6
1975	800,000	800,000 x 1.21 = 966,359.7
1976	533,544	533,544 x 1.13 = 593,816.7
1977	326,337	326,337 x 1.06 = 347,548.9
Total	3,324,881	4,116,909.6

M = 50

Am = 4,116,909.6 x 0.0679 = 279,595.5

Table 17-48-B

Administrative and General Costs of the DIP - 1956-67

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1968
1956	1,254	1,254 x 2.13 = 2,669.9
1957	3,109	3,109 x 2.00 = 6,215.4
1958	5,642	5,642 x 1.88 = 10,590.8
1959	59,738	59,738 x 1.76 = 105,292.4
1960	37,674	37,674 x 1.65 = 62,350.3
1961	26,993	26,993 x 1.55 = 41,946.8
1962	165,831	165,831 x 1.46 = 241,971.0
1963	321,189	321,189 x 1.37 = 440,056.8
1964	226,551	226,551 x 1.29 = 291,450.2
1965	198,247	198,247 x 1.21 = 239,472.4
1966	183,168	183,168 x 1.13 = 207,753.7
1967	195,617	195,617 x 1.06 = 208,332.1
Total	1,425,013	1,858,101.8

M = 95

Am = 1,858,101.8 x 0.0651 = 121,082.

Table 17-49-B

Resource Investigation Costs of the DIP - 1956-65

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1966
1956	2,265.00	2,265.00 x 1.88 = 4,251.7
1957	48,202.50	48,202.50 x 1.76 = 84,959.4
1958	61,815.00	61,815.00 x 1.65 = 102,303.6
1959	62,602.50	62,602.50 x 1.55 = 97,282.7
1960	105,240.00	105,240.00 x 1.46 = 153,560.1
1961	14,212.50	14,212.50 x 1.37 = 19,471.7
1962	2,430.00	2,430.00 x 1.29 = 3,126.1
1963	22,491.00	22,491.00 x 1.21 = 27,168.0
1964	24,000.00	24,000.00 x 1.13 = 27,221.4
1965	39,000.00	39,000.00 x 1.06 = 41,535.0
Total	382,257.00	560,879.7

M = 97

Am = 560,879,7 x 0.0651 = 36,538.4

Table 17-50-B

General Necessity Costs of the DIP - 1957-65

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1966
1957	13,357	13,357 x 1.76 = 23,542.7
1958	78,442	78,442 x 1.65 = 129,821.2
1959	69,045	69,045 x 1.55 = 107,295.0
1960	9,517	9,517 x 1.46 = 13,886.7
1961	1,972	1,972 x 1.37 = 2,701.8
1962	3,765	3,765 x 1.29 = 4,843.5
1963	99,949	99,949 x 1.21 = 120,733.4
1964	142,562	142,562 x 1.13 = 161,697.4
1965	86,000	86,000 x 1.06 = 91,590.0
Total	504,609	656,111.6

M = 97

Am = 656,111.6 x 0.0651 = 42,742.3

Table 17-51-B

Costs of the Consultant Engineers of the DIP - 1956-65

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1966
1956	4,800	4,800 x 1.88 = 9,010.3
1957	4,800	4,800 x 1.76 = 8,460.3
1958	4,800	4,800 x 1.65 = 7,944.0
1959	4,800	4,800 x 1.55 = 7,459.1
1960	4,800	4,800 x 1.46 = 7,003.9
1961	4,800	4,800 x 1.37 = 6,576.4
1962	4,800	4,800 x 1.29 = 6,175.0
1963	16,292	16,292 x 1.21 = 19,679.9
1964	15,300	15,300 x 1.13 = 17,353.6
1965	9,728	9,728 x 1.06 = 10,360.3
Total	74,920	100,022.9

M = 97

Am = 100,022.9 x 0.0651 = 6,516.

Table 17-52-B

Construction Costs of the Shush-Shushtar Road of the DIP

1971 - 74

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1975
1971	8,871	8,871 x 1.29 = 11,412.2
1972	80,977	80,977 x 1.21 = 97,816.1
1973	46,458	46,458 x 1.13 = 52,693.8
1974	38,041	38,041 x 1.06 = 40,513.7
Total	174,347	202,435.9

M = 50

Am = 202,435.9 x 0.0679 = 13,748.2

Table 17-53-B

Costs of Agricultural Development of Safiabad - 1968-77

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1978
1968	159,962	159,962 x 1.88 = 300,728.56
1969	155,323	155,323 x 1.76 = 273,368.48
1970	167,322	167,322 x 1.65 = 276,081.30
1971	178,009	178,009 x 1.55 = 275,913.90
1972	177,200	177,200 x 1.46 = 258,712.00
1973	212,362,	212,362 x 1.37 = 290,935.94
1974	115,000	115,000 x 1.29 = 148,350.00
1975	90,000	90,000 x 1.21 = 108,900.00
1976	303	303 x 1.13 = 342.39
1977	303	303 x 1.065 = 321.18
Total	1,255,784	1.933,653.50

M = 85

Am = 1,933,653.5 x 0.0653 = 126,267.57

Table 17-54-B

Costs of the Purchase of 68.000 ha of Land for the DIP

1969 - 74

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1975
1969	134,187	134,187 x 1.46 = 195,913.02
1970	92,500	92,500 x 1.37 = 126,725.00
1971	342,878	342,878 x 1.29 = 442,312.62
1972	348,000	348,000 x 1.21 = 421,080.00
1973	240.000	240,000 x 1.13 = 271,200.00
1974	127	127 x 1.065 = 135.60
Total	1,157.692	1,457,366.20

M = 87

Am = 1,457,366.2 x 0.0652 = 95,020.3

Table 17-55-B

Costs of Building the Rural Towns of the DIP - 1970-76

(1,000 Rials) Alternative B

Year	Real Cost	"Present Value" in 1977
1970	58,015	58,015 x 1.55 = 89,923.25
1971	92,096	92,096 x 1.46 = 134,460.16
1972	95,576	95,576 x 1.37 = 130,939.12
1973	157,628	157,628 x 1.29 = 203,340.12
1974	79,459	79,459 x 1.21 = 96,145.39
1975	37,389	37,389 x 1.13 = 42,814.57
1976	39,359	39,359 x 1.065 = 41,720.54
Total	554,522	739,343.15

M = 86

Am = 739,343.15 x 0.0652 = 48,057.304

Table 17-56

Water Revenues of KWPA

Resulting from a Base Charge of 750 rials/ha[1]

1963 - 74

Year	Area under traditional farming (ha)	Total water revenues (rial)
1963	3,440	2,580,000
1964	11,568	8,676,000
1965	19,920	14,940,000
1966	19,920	14,940,000
1967	19,920	14,940,000
1968	19,920	14,940,000
1969	16,142	12,106,500
1970	12,276	9,207,000
1971	2,410	1,807,500
1972	10,345	7,758,750
1973	10,345	7,758,750
1974	10,345	7,758,750

1. For the mechanism of water pricing see the chapter on water pricing and irrigation efficiency of theD.I.P. (Chapter 18).

Table 17-57

Water Revenues of KWPA resulting from a 0.2 rials/m^3 base charge for Agro-businesses and 0.05 rials/m^3 for the Haft-Tappeh Sugar Cane Project - 1969-74

WATER CONSUMPTION BY AGRO-BUSINESS CORPORATIONS AND WATER CHARGES													
YEAR	Iran-America Company		Iran-California Company		Iran-Shellcott Company		International Agro-business Corporation of Iran		Galleh Agro-business Company		Haft-Tappeh Sugar Cane Project		Total Revenues (1,000 rials)
	Water consumed (m^3)	Water revenues (1,000 rials)	Water consumed (m^3)	Water revenues (1,000 rials	Water consumed (m^3)	Water revenues (1,000 rials)	Water consumed (m^3)	Water revenues (1,000 rials)	Water consumed (m^3)	Water revenues (1,000 rials)	Water consumed (m^3)	Water revenues (1,000 rials)	
	(a)		(a)		(a)		(a)				(a)		
1969	1,026,108	205											205
1970	49,268,219	9,854	10,169,336	2,034									11,888
1971	44,867,106	8,973	22,018,976	4,404	1,311,451	262					1,842,912	92	13,731
1972	36,527,596	7,306	27,048,085	5,410	19,214,009	3,843	6,210,000	1,242			13,621,284	681	18,482
1973	62,078,530	12,416	37,696,506	7,539	44,623,751	8,925	2,168,245	434			21,176,904	1,059	30,373
1974	90,053,632	18,011	59,079,805	11,816	91,598,174	18,320	28,970,586	5,794			23,459,652	1,173	55,114

Source for (a): Data were obtained from Khosrowshahi, K., the Officer of Department of Irrigation Affairs, KWPA, Andimeshk, Khuzestan, April 1975.

Table 17-58

Water Revenues of KWPA Based on a Two-part Tariff - 1963-74

(1,000 Rials)

Year	Revenues resulting from 750 rials/ha	Revenues resulting from 0.2 & 0.05 rials/m^3	Total water revenues
1963	2,580	-	2,580
1964	8,676	-	8,670
1965	14,940	-	14,940
1966	14,940	-	14,940
1967	14,940	-	14,940
1968	14,940	-	14,940
1969	12,107	205	12,312
1970	9,207	11,889	21,096
1971	1,808	13,731	15,539
1972	7,758	18,482	26,240
1973	7,758	30,373	38,131
1974	7,758	55,114	62,872

Table 17-59

Estimation of Water Revenues of KWPA - 1977

Farming Organizations	Area under cultivation (ha)	Water supply l/ha/sec	Total water supply (m^3)	Water charge (rials/m^3)	Total water revenues (rials)
	(1)				
Agro-business lands	68,000	2	4,230,144,000	0.20	846,028,800
Farm Corporations	6,200	2	385,689,600	0.20	77,137,920
Haft-Tappeh Sugar Cane Project	12,000	4	1,492,992,000	0.05	7,464,960
Total					930,631,680

(1) See chapters on agro-business enterprises, farm corporations and the Haft-Tappeh Sugar Cane Project. (Chapters 11, 10 and 9 respectively).

Table 17-60

Revenues of KWPA derived from the Leasing of Land to the Agro-businesses

Year	Leased Area (ha)	Charge of leasing (rial/ha)	Total revenues (rials)
		(1)	
1969	3,778.0	1,350	5,100,300
1970	7,644.0	1,350	10,319,400
1971	19,360.0	1,350	26,136,000
1972	26,225.0	1.350	35,403.750
1973	43,000.0	1,350	58,050,000
1974	46,378.0	1,350	62,610,300
1975	*53,585.0	1,350	72,339,750
1976	*60,792.6	1,350	82,070,010
1977	*68,000	1,350	91,800,000

* Estimation

(1) The charges for land leasing are based on a two-part tariff which charges 1,500 and 1,200 rials per hectare. An average figure of 1,350 rials is quoted for the estimation of land leasing revenues (see Chapter 11).

Table 17-61

Revenues of KWPA from Resettlement Project

Year	Number of houses sold to the Ex-peasants within the DJP area (1)	Value per house (rials) (1)	Total value of houses (rials)
1972	713	30,000	21,390,000
1973	361	30,000	10,830,000
1974	30	30,000	900,000
1975	30	30,000	900,000
1976	29	30,000	870,000

(1) See Chapter 13.

Table 17-62

Savings from Flood Control

(1,000 Rials) Alternative A

Year	Real value				"Present value" in each year
	(1)				
1960	-				-
1961	-				-
1962	-				-
1963	72,500	x	1.440	=	104,400
1964	72,500	x	1.538	=	111,505
1965	72,500	x	1.677	=	121,582
1966	72,500	x	1.828	=	132,530
1967	72,500	x	1.992	=	144,420
1968	72,500	x	2.178	=	157,905
1969	72,500	x	2.367	=	171,607
1970	72,500	x	2.580	=	187,050
1971	72,500	x	2.812	=	203,870
1972	72,500	x	3.065	=	222,212
1973	72,500	x	3.341	=	242,222
1974	72,500	x	3.642	=	264,045
1975	72,500	x	3.970	=	287,825
1976	72,500	x	4.326	=	313,635
1977	72,500	x	4.716	=	341,910
1978	72,500	x	5.140	=	372,650
1979	72,500	x	5.603	=	406,217
1980	72,500	x	6.107	=	442,757
1981	72,500	x	6.657	=	482,605
1982	72,500	x	7.256	=	526,069
1983	72,500	x	7.909	=	573,405

(1) See Chapter 15.

Table 17-63

Savings from Flood Control

(1,000 Rials) Alternative B

Year	Real value	"Present Value" in each year
1960	-	-
1961	-	-
1962	-	-
1963	72,500 x 1.29 =	93,525
1964	72,500 x 1.37 =	99,325
1965	72,500 x 1.46 =	105,850
1966	72,500 x 1.55 =	112,375
1967	72,500 x 1.68 =	121,800
1968	72,500 x 1.79 =	129,775
1969	72,500 x 1.89 =	137,025
1970	72,500 x 2.01 =	145,725
1971	72,500 x 2.19 =	158,775
1972	72,500 x 2.39 =	173,275
1973	72,500 x 2.60 =	188,500
1974	72,500 x 2.84 =	205,900
1975	72,500 x 3.09 =	224,025
1976	72,500 x 3.37 =	244,325
1977	72,500 x 3.57 =	258,825
1978	72,500 x 3.78 =	274,050
1979	72,500 x 4.00 =	290,000
1980	72,500 x 4.36 =	316,100
1981	72,500 x 4.62 =	335,066
1982	72,500 x 4.89 =	355,047
1983	72,500 x 5.18 =	375,796

Table 17-64-A

Cost-Benefit of the Irrigation Project and Flood Control of the Pahlavi

(1,000 Rials)

Alternative A

Year	COSTS: Dam costs (1)	Irrigation network costs 1966 (2)	Irrigation network costs 1973 (3)	Irrigation network costs 1978 (4)	General necessity costs (5)	Administration and general expenditures (6)	Resource investigation costs (7)	Cost of Consultant Engineers (8)	TOTAL COSTS: Costs of agricultural development of Sofiabad (9)	Shush-Shushtar road costs (10)	Costs of purchase of 68,000 ha (11)	Costs of building of rural towns (12)	Total Capital costs	Operational and administration costs (13)	Total DIP costs excluding Haft-Tappeh (14)	Haft-Tappeh sugar cane costs (15)	Total DIP costs including Haft-Tappeh Sugar Cane costs from 1972 (16)	REVENUES: Water charges (17)	Land leasing revenues (18	Sugar revenues (19)	Rural house selling revenues (20)	Savings from flood control (21)	Tax revenue (22)	Total revenue (23)	Benefit (Loss) (24)
1962	82,827.9												82,827.9		82,827.9		82,827.9							(82,827.9)
1963	82,827.9												82,827.9	3,437	86,264.9		86,264.9	2,580				104,400		107,250	20,985.1
1964	82,827.9												82,827.9	3,437	86,264.9		86,264.9	8,676				111,505		120,181	33,916.1
1965	82,827.9												82,827.9	3,437	86,264.9		86,264.9	14,940				121,582		136,522	50,257.1
1966	82,827.9	218,004.7			75,687.9		59,294	10,257.2					446,071.7	18,512	464,583.7		464,583.7	14,940				132,530		147,470	(317,113.7)
1967	82,827.9	218,004.7			75,687.9		59,294	10,257.2					446,071.7	18,512	464,583.7		464,583.7	14,940				144,420		159,360	(305,223.7)
1968	82,827.9	218,004.7			75,687.9	188,915.4	59,294	10,257.2					634,987.1	26,352	661,339.1		661,339.1	14,940				157,905		172,845	(488,494.1)
1969	82,827.9	218,004.7			75,687.9	188,915.4	59,294	10,257.2					634,987.1	26,352	661,339.1		661,339.1	12,312	5,100			171,607		189,019	(472,320.1)
1970	82,827.9	218,004.7			75,687.9	188,915.4	59,294	10,257.2					634,987.1	26,352	661,339.1		661,339.1	21,096	10,319			187,050		218,464	(442,875.1)
1971	82,827.9	218,004.7			75,687.9	188,915.4	59,294	10,257.2					634,987.1	26,352	661,339.1		661,339.1	15,539	26,136			203,870		245,545	(415,794.1)
1972	82,827.9	218,004.7			75,687.9	188,915.4	59,294	10,257.2					634,987.1	26,352	661,339.1	1,174,915.8	1,836,254.9	26,240	35,404	1,216,163	21,390	222,212		1,521,409	(314,845.9)
1973	82,827.9	218,004.7	542,061.5		75,687.9	188,915.4	59,294	10,257.2					1,177,048.6	48,848	1,225,896.6	1,935,172.2	3,161,068.8	38,131	58,050	1,844,977	10,830	242,222		2,194,210	(966,858.8)
1974	82,827.9	218,004.7	542,061.5		75,687.9	188,915.4	59,294	10,257.2					1,177,048.6	48,848	1,225,896.6	2,398,437.4	3,624,334	62,872	62,610	2,025,649	900	264,045		2,416,076	(1,208,258.0)
1975	82,827.9	218,004.7	542,061.5		75,687.9	188,915.4	59,294	10,257.2		19,525	148,434		1,345,007.6	55,818	1,400,825.6	2,498,059.4	3,898,885	279,812	72,300	2,167,672	900	287,825		2,808,509	(1,090,376.0)
1976	82,827.9	218,004.7	542,061.5		75,687.9	188,915.4	59,294	10,257.2		19,525	148,434		1,345,007.6	55,818	1,400,825.6	2,597,769.4	3,998,516	496,752	82,070	2,285,115	870	313,635		3,178,422	(820,094.0)
1977	82,827.9	218,004.7	542,061.5		75,687.9	188,915.4	59,294	10,257.2		19,525	148,434	77,279	1,422,286.6	59,025	1,481,311.6	2,697,319.4	4,178,629	713,692	91,800	2,402,557	900	341,910		3,550,859	(627,770.0)
1978	82,827.9	218,004.7	542,061.5	406,809.5	75,687.9	188,915.4	59,294	10,257.2	187,105.5	19,525	148,434	77,279	2,016,201.6	83,672	2,099,873.6	2,796,707.2	4,896,580.8	930,632	91,800	{2,500,000 / 3,024,000}	900	372,650	143,000	{4,038,982 / 4,562,982}	{(857,598.8) / (333,598.8)}
1979	82,827.9	218,004.7	542,061.5	406,809.5	75,687.9	188,915.4	59,294	10,257.2	187,105.5	19,525	148,434	77,279	2,016,201.6	83,672	2,099,873.6	2,796,707.2	4,896,580.8	930,632	91,800	{2,500,000 / 3,024,000}	900	406,217	143,000	{4,072,549 / 4,596,549}	{(824,031.8) / (300,031.8)}
1980	82,827.9	218,004.7	542,061.5	406,809.5	75,687.9	188,915.4	59,294	10,257.2	187,105.5	19,525	148,434	77,279	2,016,201.6	83,672	2,099,873.6	2,796,707.2	4,896,580.8	930,632	91,800	{2,500,000 / 3,024,000}	900	442,757	143,000	{4,109,084 / 4,633,089}	{(787,496.8) / (263,491.8)}
1981	82,827.9	218,004.7	542,061.5	406,809.5	75,687.9	188,915.4	59,294	10,257.2	187,105.5	19,525	148,434	77,279	2,016,201.6	83,672	2,099,873.6	2,796,707.2	4,896,580.8	930,632	91,800	{2,500,000 / 3,024,000}	900	482,605	143,000	{4,148,932 / 4,672,932}	{(747,648.8) / (223,648.8)}
1982	82,827.9	218,004.7	542,061.5	406,809.5	75,687.9	188,915.4	59,294	10,257.2	187,105.5	19,525	148,434	77,279	2,016,201.6	83,672	2,099,873.6	2,796,707.2	4,896,580.8	930,632	91,800	{2,500,000 / 3,024,000}	900	526,069	143,000	{4,192,396 / 4,716,401}	{(704,179.8) / (180,179.8)}

Sources:
(1) Table 17-2-A (M = 50 years and Am = 908,002 x 0.09122 = 82,327.9)
(2) Table 17-34-A
(3) Table 17-35-A
(4) Table 17-36-A
(5) Table 17-37-A
(6) Table 17-38-A
(7) Table 17-39-A
(8) Table 17-40-A

(9) Table 17-42-A
(10) Table 17-41-A
(11) Table 17-43-A
(12) Table 17-44-A
(13) Of the total capital costs in each year, 4.15% were charged as the operational costs (See Farzaneh, R. 1970).
(14) = (1) + (2) + (3) + (4) + (5) + (6) + (7) + (8) + (9) + (10) + (11) + (12) + (13)
(15) Table 17-32-A
(16) = (14) + (15)

(17) Tables 17-56, 17-57, 17-58 and 17-59
(18) Table 17-60
(19) Table 17-31
(20) Table 17-61
(21) Table 17-62
(22) Estimation
(23) = (17) + (18) + (19) + (20) + (21) + (22)
(24) = (23) - (16)

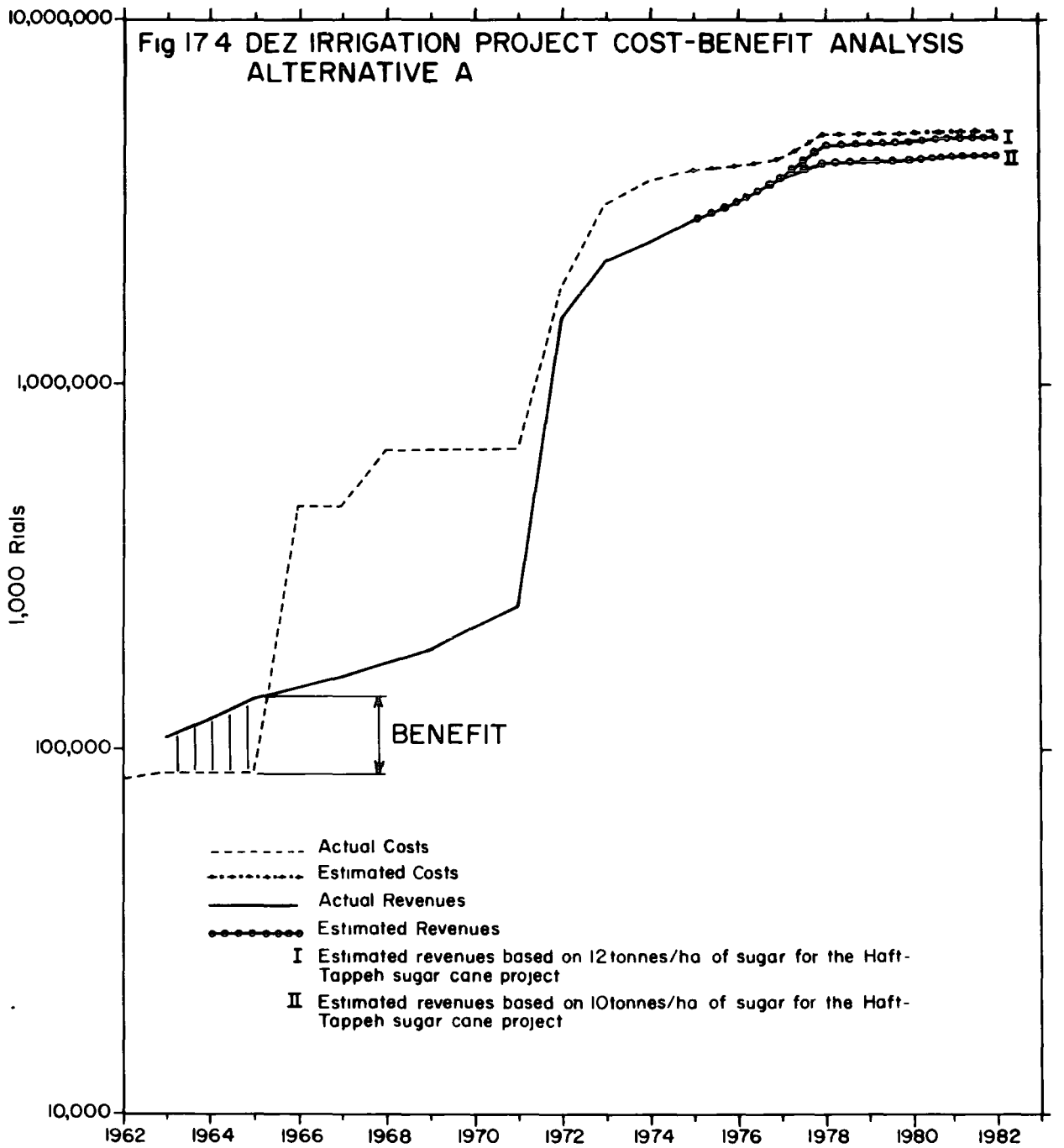


Fig 17 4 DEZ IRRIGATION PROJECT COST-BENEFIT ANALYSIS
ALTERNATIVE A
10,000,000
1,000,000
100,000
10,000
1,000 Rials
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
I
II
BENEFIT
Actual Costs
Estimated Costs
Actual Revenues
Estimated Revenues
I Estimated revenues based on 12 tonnes/ha of sugar for the Haft-Tappeh sugar cane project
II Estimated revenues based on 10 tonnes/ha of sugar for the Haft-Tappeh sugar cane project

continue until 1982, (Table 17-65-B). The achievement of benefits will be realized in 1978 and will continue to increase in amount (Fig. 17-5).

This will be the result of the following measures:

a) Minimizing the administrative and management costs of both the DIP and the Haft-Tappeh Sugar Cane project.

b) Maximizing the productivity of the agro-industrial unit of Haft-Tappeh.

c) Revising the water and land leasing charges within the DIP, and above all,

d) Creating an agricultural policy which can revitalize the initiative of the peasants. (Such a policy had been introduced through the implementation of the land reform law in 1962 to 1968). However since this time the confidence of the peasants has been weakened as the result of bureaucratic interference.

In the benefit-cost analysis of the DIP the costs of land levelling and the costs of the development of the on-field irrigation and drainage works were not taken into account, as they are matters concerning the individual private intensive farming undertakings. However these costs would increase the losses rather than the benefits as they have already been examined for the agro-businesses.

By 1967 the Dez farmers began to be better off financially. At the beginning of the Fourth Development Plan, the foreign and Iranian planners of the DIP hoped to achieve a 10 to 13% capital return after five years for the project as a whole. It was anticipated that the

Table 17-65-B

Cost-Benefit of the Irrigation Project and Flood Control of the Pahlavi Dam

(1,000 Rials)

Alternative B

		C O S T S															R E V E N U E S								
Year	Dam Costs	Irrigation networks costs 1966 (2)	Irrigation networks costs 1973 (3)	Irrigation networks costs 1978 (4)	General necessity costs (5)	Administration and general expenditures (6)	Resource investigation costs (7)	Costs of Consultant Engineers (8)	Costs of agricultural development of Sofiabad (9)	Shush-Shushtar road costs (10)	Costs of purchase of 68,000 ha (11)	Costs of building of rural towns (12)	Total capital costs	Operational and administration costs (13)	Total DIP costs excluding Haft-Tappeh (14)	Haft-Tappeh Sugar Cane costs (15)	Total DIP costs including Haft-Tappeh Sugar Cane costs from 1972 (16)	Water charges (17)	Land leasing revenues (18)	Sugar revenues (19)	Rural house selling revenues (20)	Savings from flood control (21)	Tax revenue (22)	Total revenue (23)	Benefit (Loss) (24)
1962	55,644												55,644.0				55,644								(55,644)
1963	55,644												55,644.0	2,309.0	57,953		57,953.0	2,580				93,525		96,375	38,422.0
1964	55,644												55,644.0	2,309.0	57,953		57,953.0	8,676				99,325		108,001	50,048.0
1965	55,644												55,644.0	2,309.0	57,953		57,953.0	14,940				105,850		120,790	62,837.0
1966	55,644	149,886.7			42,742.3		36,538.4	6,516					291,327.3	11,728.6	303,055.9		303,055.9	14,940				112,375		127,315	(175,740.9)
1967	55,644	149,886.7			42,742.3		36,538.4	6,516					291,327.3	11,728.6	303,055.9		303,055.9	14,940				121,800		136,740	(166,315.9)
1968	55,644	149,886.7			42,742.3	121,082	36,538.4	6,516					412,409.3	16,753.5	429,162.8		429,162.8	14,940				129,775		144,715	(284,447.8)
1969	55,644	149,886.7			42,742.3	121,082	36,538.4	6,516					412,409.3	16,753.5	429,162.8		429,162.8	12,312	5,100			137,025		154,437	(274,725.8)
1970	55,644	149,886.7			42,742.3	121,082	36,538.4	6,516					412,409.3	16,753.5	429,162.8		429,162.8	21,096	10,319			145,725		177,139	(252,023.8)
1971	55,644	149,886.7			42,742.3	121,082	36,538.4	6,516					412,409.3	16,753.5	429,162.8		429,162.8	15,539	26,136			158,775		200,450	(228,712.8)
1972	55,644	149,886.7			42,742.3	121,082	36,538.4	6,516					412,409.3	16,753.5	429,162.8	1,104,221.6	1,533,384.4	26,240	35,404	1,216,163	21,390	173,275		1,472,472	(60,912.4)
1973	55,644	149,886.7	374,402.5		42,742.3	121,082	36,538.4	6,516					786,811.8	32,291.0	819,102.8	1,767,792.0	2,586,894.8	38,131	58,050	1,844,977	10,830	188,500		2,140,488	(446,406.8)
1974	55,644	149,886.7	374,402.5		42,742.3	121,082	36,538.4	6,516					786,811.8	32,291.0	819,102.8	2,231,057.0	3,050,159.8	62,872	62,610	2,025,649	900	205,900		2,357,931	(692,228.8)
1975	55,644	149,886.7	374,402.5		42,742.3	121,082	36,538.4	6,516		13,748.2	95,020.3		895,580.27	36,545.7	932,125.97	2,330,671.0	3,262,796.9	279,812	72,340	2,167,672	900	224,025		2,744,749	(518,047.9)
1976	55,644	149,886.7	374,402.5		42,742.3	121,082	36,538,4	6,516		13,748.2	95,020.3		895,580.27	36,545.7	932,125.97	2,430,309.0	3,362,434.9	496,752	82,070	2,285,115	870	244,325		3,109,132	(253,302.9)
1977	55,644	149,886.7	374,402.5		42,742.3	121,082	36,538.4	6,516		13,748.2	95,020.3	48,057.3	943,637.57	38,540.0	982,177.57	2,529,937.0	3,512,114.5	713,692	91,800	2,402,557	900	258,825		3,467,774	(44,340.5)
1978	55,644	149,886.7	374,402.5	279,595.5	42,742.3	121,082	36,538.4	6,516	126,267.57	13,748.2	95,020.3	48,057.3	1,349,500.5	54,763.0	1,404,263.5	2,629,326.9	4,033,590.4	930,632	91,800	2,500,000 3,024,000	900	274,050	143,000	3,940,382 4,464,382	(93,208.4) 430,791.6
1979	55,644	149,886.7	374,402.5	279,595.5	42,742.3	121,082	36,538.4	6,516	126,267.57	13,748.2	95,020.3	48,057.3	1,349,500.5	54,763.0	1,404,263.5	2,629,326.9	4,033,590.4	930,632	91,800	2,500,000 3,024,000	900	290,000	143,000	3,956,332 4,480,332	(77,258.4) 446,741.6
1980	55,644	149,886.7	374,402.5	297,595.5	42,742.3	121,082	36,538.4	6,516	126,267.57	13,748.2	95,020.3	48,057.3	1,349,500.5	54,763.0	1,404,263.5	2,629,326.9	4,033,590.4	930,632	91,800	2,500,000 3,024,000	900	316,100	143,000	3,982,432 4,506,432	(51,158.4) 472,841.6
1981	55,644	149,886.7	374.402.5	297,595.5	42,742.3	121,082	36,538.4	6,516	126,267.57	13,748.2	95,020.3	48,057.3	1,349,500.5	54,763.0	1,404,263.5	2,629,326.9	4,033,590.4	930,632	91,000	2,500,000 3,024,000	900	335,066	143,000	4,001,398 4,525,398	(32,192.4) 491,807.6
1982	55,644	149,886.7	374,402.5	297,595.5	42,742.3	121,082	36,538.4	6,516	126,267.57	13,748.2	95,020.3	48,057.3	1,349,500.5	54,763.0	1,404,263.5	2,629,326.9	4,033,590.4	930,632	91,000	2,500,000 3,024,000	900	355,047	143,000	4,021,379 4,545,379	(12,211.4) 511,788.6

Sources:
(1) Table 17-11-B (M = 100 years and Am = 854,746.46 x 0.0651 = 55,644.1)
(2) Table 17-45-B
(3) Table 17-46-B
(4) Table 17-47-B
(5) Table 17-50-B
(6) Table 17-48-B
(7) Table 17-49-B
(8) Table 17-51-B
(9) Table 17-53-B
(10) Table 17-52-B
(11) Table 17-54-B
(12) Table 17-55-B
(13) See (13) on Table 17-64-A
(14) = (1) + (2) + (3) + (4) + (5) + (6) + (7) + (8) + (9) + (10) + (11) + (12) + (13)
(15) Table 17-33-B
(16) = (14) + (15)
(17) Tables 17-56, 17-57, 17-58 and 17-59.
(18) Table 17-60.
(19) Table 17-31
(20) Table 17-61
(21) Table 17-63
(22) Estimation
(23) = (17) + (18) + (19) + (20) + (21) + (22)
(24) = (23) - (16)

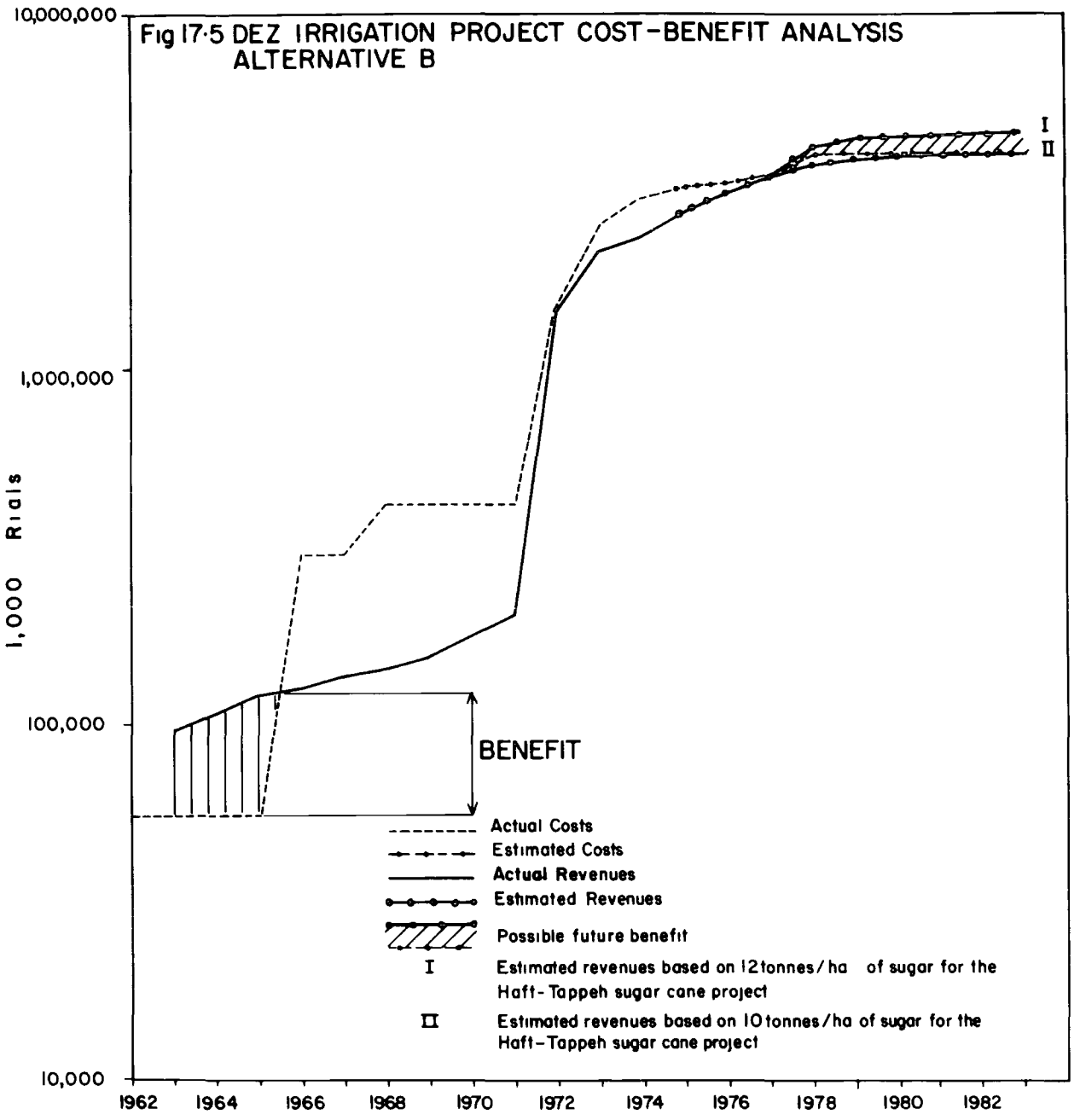


Fig 17·5 DEZ IRRIGATION PROJECT COST-BENEFIT ANALYSIS
ALTERNATIVE B
10,000,000
1,000,000
100,000
10,000
1,000 Rials
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
I
II
BENEFIT
Actual Costs
Estimated Costs
Actual Revenues
Estimated Revenues
Possible future benefit
I Estimated revenues based on 12tonnes/ha of sugar for the Haft-Tappeh sugar cane project
II Estimated revenues based on 10tonnes/ha of sugar for the Haft-Tappeh sugar cane project

DIP contribution to national agricultural products would be 14% for the oil seeds, 11% for fodder crops and 11% for sugar beet[21]. As shown in preceding chapters, the whole performance of the irrigated agriculture of the DIP has been somewhat behind that which had been anticipated. Farm Corporations in the DIP area and elsewhere in Iran will continue to exist only if they are heavily subsidized by the government, as they have been so far. By January 1976, eighty-five Farm Corporations had been established in Iran with 31,565 shareholders. It is planned that by the end of the Fifth Development Plan a total of 140 Farm Corporations will have been created on a total gross area of 420,000 hectares. Of this total only 280,000 hectares will be under cultivation[22]. The responsibility for the agricultural development of about 400,000 hectares of land below major dams has been transferred from individual farmers to the Ministry of Water and Power and it is now to be developed completely by Agro-industries and Farm Corporations.

By 1973 Agro-business Companies and Farm Corporations cultivated 110,000 ha or 1.5% of the total cultivated area of Iran. They employed 0.3% of the agricultural labour force and produced something like 2% of the agricultural output. By the end of the Fifth Plan period, even if the 400,000 ha available for the establishment of Agro-business Companies are developed completely and if all of the 140 Farm Corporations are established, a reasonable estimate of the area of the modern agricultural sub-sector would be 620,000 ha or about 14% of the total irrigable area of Iran. The total number of agricultural workers employed would be of the order of 80,000 and the contribution of these organizations to the

total agricultural output of Iran would probably be between 7 and 8%.[23]

Published statistics concerning the performance of Farm Corporations indicate in general a marked increase in the income of members when compared to the years prior to the establishment of the Corporation.[24] Of course this is not common to all Farm Corporations. It was shown that the shareholder peasant family income of the Dez Farm Corporation of the DIP area declined in 1972/73. For the Reza Pahlavi Farm Corporation, a decline of 10,030 rials per farming family in 1969 was quoted by Azkia.[25] An average dividend of 306.5 rials on the value of a share of 1,000 rials is quoted by Shams Zanjani (1973 - p.214). This represents a rate of return of approximately 30% per annum on the share capital of the Corporations. However, this rate of return does not take into account the real costs of the investments, many of which are in the form of infrastructures such as those which were examined in the cost-benefit analysis of the Dez Irrigation Project (Tables 17-64-A and 17-65-B). In addition, it is not clear to what extent the provision of free technical and financial assistance to the farm corporations is reflected in the sums from which the returns on the share capital are derived. The government's free grant to the farm corporations ranged from 214 to 343 million rials for the years 1968 and 1971 respectively, (Appendix H) More significant is that, in addition to this free grant, the per capita government loan to the members of the Farm Corporations amounts to over three times the size of the loans granted to the members of the rural cooperative societies for the corresponding years (Appendix I). This discrepancy becomes more crucial given the fact that 8,500 rural cooperatives with 1.7 million farming families constituted 56.7% of the farming population of Iran in 1972-73.[26]

It should be mentioned that in addition to the 1.7 million rural cooperative farming population of Iran, there are at least one million people earning at the subsistence level, often in areas completely isolated from the sphere of government or private enterprise activity. (This is true especially on lands which have not been affected by water resource development projects such as the large reservoir dam schemes and their associated irrigation projects). The investment for the construction of infrastructures, all management personnel and subsidized interest on loans[27] to the Farm Corporations are supplied by the government[28]. In contrast the rural cooperative societies provide their own capital and pay for infrastructures and management personnel. All these facts emphasise one important point, namely that the rural cooperatives of Iran are under-capitalized both in terms of managerial personnel and also funds.

In the future, it seems likely that the Farm Corporations will be more fortunate than the rural cooperatives. Within a period of 15 to 20 years, four dairy and meat complexes will be established with some 50 to 65 thousand million dollars of capital. Foreign advisers to these complexes will come from Denmark[29].

The crop yields of lands managed by the Farm Corporations are better so far than the national average yields of most crops. In the case of wheat, the Dez and the Shamsabad Farm Corporations, which were visited by the author in April 1975 had yields of 1.5 to 2 tonnes per hectare. On almost all of the Farm Corporations visited by the International Labour Organization (ILO) in Iran the yields were 3 tonnes perhectare or more. These yields are in contrast to the national average, ranging from

750 to 1,000 Kg for dry-land and about 1,200 Kg for irrigated wheat.

In studying the performance of farm corporations to date, the common practice appears to have been a comparison of the difference in production before and after the creation of a Farm Corporation. This method of comparison leaves certain questions unanswered. For instance, it is not known whether the same objective could have been attained by alternative schemes. A study of the Dez Farm Corporation in the DIP may illustrate this point. The average production cost per hectare was 5,737.7 rials[30] before the establishment of the Corporation, whereas it had increased to 10,137.6 rials in 1972/73[31]. The corresponding figures for the net benefits per hectare were 2,691.2 rials and 521 rials respectively. Even the cash profit of a traditional village in the DIP excluding annual consumption of rice and wheat of the villagers was 8,844.75 rials in 1972/73[32]. This illustrates a far better situation for the traditional farmers than the members of the Farm Corporations. A positive aspect in the development of the Farm Corporations in Iran is the rise in agricultural productivity. There is no doubt that the consolidation of several villages into new business units makes possible the introduction and application of modern cultivation methods and practices. The rise of agricultural production associated with this, presupposes an efficient and trained management to make possible the increase in returns on an area. Another positive impact of the Farm Corporations is the instruction of the farming population in modern methods of farming. However, against these positive impacts stands a number of negative consequences. These consequences have already been examined by the author as well as by Poorafzal and Najafi, 1972; Frievales, J., 1972; Field, M., 1972; Ehlers, E., 1975; Richards, H., 1975 and Stoub, C A., 197

In contrast to other forms of business, there are two negative consequences associated with the establishment of Farm Corporations. First, as big businesses the Farm Corporations have to be heavily mechanized. The liberation of a large number of the people until now engaged in agriculture is inevitable. In the province of Fars, (southern Iran), a mechanized farm of 300 hectares was formerly operated by 60 share cropping farmers in the traditional way. Under full mechanization now, it is run by four full-time paid workers in addition to two drivers (tractors and combines). This means a releasing of 90% of the human labour[33]. Secondly, the separation of the Dez Farm Corporation's population from agricultural production processes, as AZkia has already said, "is in no way compensated by the possession of shares." As the investigations of the Farm Corporations in Iran indicate, 80% of the ex-farmer shareholders in Farm Corporations believe that as their lands have gone, they have lost all their social and economic values and power.[34] Of much importance is the fact that in the Farm Corporations about half of the people previously engaged in agriculture are left with no alternative farming or non-farming employment in the rural areas. The rule bound up with the conception of Farm Corporations leaves the population in their old villages non-affected by the new organization of the rural areas. In other words: if the members of the Farm Corporations do not wish to remain passive, as shareholders on the land, there is no alternative for them but to move to the urban centres. More employment will not be created in the rural areas as no plans to encourage this have been made as yet. The International Labour Organization (ILO) has strongly suggested the idea of the acceleration of rural migration to urban areas, because of the

establishment of large scale farming companies such as Farm Corporations and Agro-businesses. The organization quoted a figure of 150,000 to 200,000 persons who have moved to the towns from only 110,000 hectares of land which was operated by large businesses in 1973[35].

A more recent study which has been done on the agrarian change in western Iran (Olya sub-district, by Stobbs, C.A., 1976) commented that the Farm Corporation of Iran in the Khezel sub-district has had a disruptive impact on agrarian development, and adds "there is an intrinsic incompatability existing between the self-help principles of land reform, as conceived by Dr. Arsanjany and the economic intervention with an accompanying desire for quick results, underlying the Farm Corporations, as conceived by Dr. Valian. Imposing change is very different from encouraging change."[36]

Amongst all farming inputs, water has been considered as an enabling factor. Following the long-term water resources development programmes by means of the construction of a system of multi-purpose high dams and integrated irrigation systems, a crucial question has been raised. This is "who should benefit most from the actions and investments of the Government?" At first it was the farmer who benefited most. In the new set-up, the traditional farmer was expected to maximize returns from the DIP land and the water resources, and at the same time to replace the traditional subsistence agriculture with a market oriented farming system. In five years from the completion of the Pahlavi dam, the DIP farmers were able to increase their production by 2.6 times.[37]

A higher figure of 3 times is quoted by DRC.[38] It does not, of course, necessarily mean that their net income had risen three times.[39]

What is remarkable, none the less, is that the small farmers in the DIP area have responded to the increased availability of water in a way formerly thought impossible, despite the difficulties surrounding them with respect to the provision of other inputs and the marketing of their products. It is relevant here to record that the research activities of the Safiabad Trial Farm in the Dez Irrigation area are now concentrating on the needs of the agro-industrial enterprises. Small farmers have not received any assistance since 1968.

Up to now, although the performance of the agro-business companies is somewhat behind what was planned, it is common to see a rate of capital return ranging from 17 to 20% or even up to 35% quoted in the feasibility studies which preceded the establishment of the agro-business companies and farm corporations. It is clear, of course, that these returns on capital reflect none of the external and social costs imposed on the government[40], on the displaced farmers, and the rural families in particular, and on the farmers who are left out of favour and have to fend for themselves under more difficult conditions (see Chapter 13).

So far, large private capital oriented companies have been given the most assured supply of irrigation water, land, government protection and subsidies (both explicit and implicit, especially with regard to investment in infrastructure), most of which is denied to the smaller private individual entrepreneurs in agriculture. Cost-benefit analysis of the multi-purpose Dez dam scheme confirmed the most spectacular manifestation of this with regard to explicit and implicit government expenditure in water resource development for irrigation which Iran has ever made (Tables 17-64-A & 17-65-B). In addition to this high construction

cost of infrastructures, the production and subsidies of the government to agro-businesses are as follows:

a) Large sums of money as grants have been given to these enterprises. By April 1976, out of 624 large scale farming contracts of the Agricultural Development Fund of Iran, 87 or 13.9% were those dealing with agro-industries. These contracts, which were free grants given by the government, produced 557 million rials out of a total of 1,627 million rials.

b) In addition, agro-industries had been offered 72.9% of the total 5,214 million rials available for low rate loans to large scale farming projects[41].

Despite the high external and social costs of agro-businesses in Iran, the question of their future extension is somewhat problematic. The agricultural planners want to expand them further. This is irrespective of the high infrastructure and social costs of the agro-businesses and also regardless of the particular failures of the companies in Khuzestan and elsewhere in Iran[42]. The officials involved, as well as the research workers and the foreign consultants for irrigated agriculture in Iran, believe that the potential of the highly mechanized farms within the large irrigation projects in Iran has not yet been realized. This is especially the case where the Corporations are run by foreign private capitalists[43], or by the military forces of Iran[44], or by some of the state farming institutions[45]. Cordtz, O. (1972, pp.135-136, Fortune Journal) has analysed the failures of corporate farming in the U.S.A. and noted that "The executives of the financially oriented corporations did not understand

farming and also that the companies tried to grow too fast and did not have a chance to make little mistakes before making big ones."

It has been assumed that with modern economies of scale, corporate farms could grow crops much more efficiently than smaller, independent ones. But the American experience shows that because of the critical importance of close personal involvement, the most efficient producing unit is a farm that can be run directly by its owner(s).[46] Economies of scale end rather quickly. A report of the U.S. Department of Agriculture in 1967 revealed that for California peach growers, average costs were minimized in orchards of 90 - 110 acres (36 - 44 ha). Even for field crops such as cotton, alfalfa and barley, which lend themselves to almost total mechanization, producers in California's San Joaquin Valley, were found to incur the lowest average cost at about 640 acres. This is approximately 265 ha. The agro-business corporations of the DIP are cultivating similar crops on areas of thousands of hectares (see Tables 11-14. 11-19, 11-23, 11;26 and 11-28).

Farming, as Professor Sidney S. Hoos of the University of California (Berkeley) points out, "is saturated with uncertainties! Weather, soil, seed, yields." Such uncertainties call for countless important decisions that must be made in the field, not behind a distant desk which may be hundreds or even thousands of kilometres away.[47]

Agro-businesses in Iran generally, and in Khuzestan in particular, present the same problems in their extreme forms[48]. High overhead costs are a consequence of drastically increased extra layers of management. The requirements of large scale entrepreneurs demand higher salaries for

experienced supervisors with no direct personal stake in the enterprise.[49] The travelling costs of specialized advisers have also increased the risky nature of business companies.

In addition to these fundamental problems, which have always been recognised by the companies themselves as major problems, are:[50]

a) Delays on the part of the contractors constructing the main irrigation systems, which have prevented the delivery of water when needed.

b) The shortage of manpower, especially of unskilled labour. Agro-business companies must compete with each other in this respect in the DIP.[51]

c) Skilled labour is also in short supply as there are simply not enough skilled men to cope with all the development projects under way in Iran. Every attempt has been made to cope with the manpower shortage by mechanization, but this is hampered by the time-lag between ordering and delivery of equipment.

d) Delays in the delivery of equipment, particularly equipment ordered from overseas, and the lack of supplies of spare parts in Iran, have also caused difficulties.

Despite these problems, if agro-business corporations begin to perform successfully, the goods produced by them would greatly help towards the desired rise of productivity. Unfortunately, profits gained by their activities leave the country to a large extent. Experience shows that often in order to obtain the highest returns, the products are exported (for example, cotton and asparagus) and even products are imported from outside the country to the DIP, packed and sold to gain

high profits in the wealthy market of Tehran.[52] Therefore the country itself gains nothing. These are the most serious disadvantages of the private economy oriented big businesses of the agro-business type. These problems discourage the extension of such enterprises within the irrigation projects below the large dams in Iran.

Agro-businesses could produce associated industries to reduce their negative external effects and to lower their social costs of unemployment in the countryside. Since they are businesses which are involved only with agricultural activities, their negative impact of releasing human labour is too devastating. As was discussed previously the need for human workers in this business type runs to only 20 - 30% of the population formerly active on the same area. The negative effect of under-employment and unemployment increased even more with the removal of the population into Shahraks. This is becoming now, after only a few years, significant in the desolate economic and social situation of those land worker towns. Even more important, is the socio-economic uprooting of the population, till now rural dwellers, whose circumstances have been set out in detail in previous chapters. Indeed it is difficult to comment upon how these modern institutional structures in the DIP and elsewhere within the large irrigation projects in Iran, can solve the problems of output growth and employment, facing Iranian agriculture. However, some western scholars do not foresee the extension of agro-business enterprises in Iran in the future because of some socio-environmental constraints which exist on the irrigated lands[53]. Others have predicted a rapid development of agro-business companies because of some socio-political issues, regardless of the economic aspects.[54] The Iranian scholars have never agreed with the

strategy of the creation of large capital intensive commercial farms in Iran and specifically within the large irrigation projects (irrigated by either the surface water resources through dams or groundwater resources).[55]

The seriousness of the problem, which is partly caused by the commercial farming ventures, will be seen if food importing trends of Iran are reviewed. It is estimated that Iran will be in need of wheat, sugar beet, oil seeds, sugar and all meat and dairy products by 1975 and afterwards (Appendices I and J). Iran has already imported large amounts of grain. In 1971 Iran imported 1.2 million tonnes of wheat.[56] In 1973, in addition to 4.4 million tonnes of home grown wheat, Iran imported 800,000 tonnes of wheat.[57] The prediction of wheat imports for 1978 is 1.5 million tonnes.[58] A wheat shortage of 1.2 million tonnes occurred in 1975 since the wheat demand was predicted at 5.8 million tonnes and the wheat produced in Iran did not exceed 4.6 million tonnes.[59] In addition to wheat it is estimated that 0.25 million tonnes of rice and considerable amounts of maize, barley and tea were imported during 1975-76.[60] These imports of agricultural produce have drained Iran's foreign exchange (Table 17-66). The cost of food imports, which was 2,790 million rials in 1962/63, increased to 25,052 million rials in 1972/73. This is an increase of approximately nine times over a decade. A massive spending on food imports occurred in 1975. Iran spent 150,000 million rials ($2,255.6 million) on food imports in six months in late 1974 and early 1975. More than 500 agreements were made for the purchasing of food items from abroad. These items included 400,000 tonnes of rice, 300,000 tonnes of vegetables, 18,000 tonnes of eggs, 10,000 tones

Table 17-66

Food Stuff Import-Export of Iran

(1,000.000 rials)

	Import			Export		
	1962/63	1972/73	% of growth	1962/63	1972/73	% of growth
Agricultural products	1,916	19,109	897	4,610	13,030	182
Livestock products	876	5,943	578	1,027	3,487	239
Total	2,790	25,052	797	5,637	16,517	193

Source: Echo of Iran, 1975, Iran Almanac, Echo of Iran, p.217.

of cheese, 100,000 tonnes of flour, 50,000 tonnes of apples and 25,000 tonnes of bananas[61]. This situation began seriously to worry the officials concerned. Soon afterwards the U.S.A. assured the Iranian government that it would supply any grain imports which were necessary in the period 1975-1981[62]. However, this policy will enrich the farmers of the American mid-west rather than Iran's own agricultural population. The reason for this can be sought in the pricing mechanism of the agricultural products in Iran. Wheat for instance, has been bought from local farmers at about 70% of the price the government has had to pay for grain imported from the U.S.A.[63]

The agricultural policy of Iran has ignored one of the major factors concerned with the land reform law of 1962. This was to raise the living standards in the rural areas, where around 60% of the population is located. Plan Organization has estimated that the rural/urban per capita income differential is now at 1 to 6, whereas it was at a level of 1 to 5 about ten years ago. Little has taken place to reduce this differential. The top 10% of the population in terms of income, accounted for around 40% of total private consumption, and those with incomes in the bottom 30% accounted for only 8% of total private consumption[64]. The consequences of this inequality have been a rapid drift of population from the countryside to the towns. This has caused heavy pressure on urban welfare and, more importantly, on the employment situation. The out-migration from the villages has been welcomed by the Ministry of Agriculture since it concludes that "this rapid migration of the rural population helps to achieve the ideal economic farm size of

15 to 20 hectares for Iran[65]. The Ministry makes no comment on the question of the employment situation in the urban areas, nor on the more important problem of the skilled labour requirement of the urban industries.

Iran is already faced with a tricky employment situation. The government has planned to create some 2.1 million new jobs by the end of the Fifth Plan (1978). It is estimated that in addition to an already unemployed pool of 700,000 people at the beginning of the Fifth Development Plan (1973), a further 250,000 new labourers will be added to the unemployed labour force each year[66]. Now, however, industry is faced with an acute shortage of trained labour, which has led to the government calling for "the maximum use of machinery, which should replace human labour as much as possible." By May 1976 over 25,000 foreigners were employed in Iran. 3,500 of this total were doctors and other medical workers who came from India and the Philippines, and the rest were employed in industry, mining, transportation, management, etc.

The present situation of employment in the urban areas of Iran is as follows:-

> In June 1976, out of 300,000 school graduates who were University applicants, only 38,000 had been offered places by Universities. In addition to these, it was predicted that a further 60,217 would have been employed by public and private sectors by March 1977.[67] Therefore, over 200,000 school graduates will be waiting for jobs, in any one year, in addition to an already unemployed rural labour force released from the land and an already unemployed urban labour force.

A final point which should be mentioned is that the only efficient agricultural institution which has ever been established on lands below the large reservoir dams in Iran is the state agro-industrial unit of the Haft-Tappeh Sugar Cane Project in the DIP area. It has been efficient in terms of both land productivity and employment creation. Indeed it is the only big business which seems in many respects to be a useful model for future agrarian development in Khuzestan and perhaps for many other areas below the large dam schemes in Iran. In this capital intensive unit the significant fact is that agrarian production could and can at the same time be a vehicle for the establishment of wider manufacturing or agrarian industries. As a result it has initiated an industrialization of the rural area, which is not to be seen in any other forms of farm business in Khuzestan or elsewhere in Iran. At Haft-Tappeh the intensity of land use in conjunction with industrialization has been responsible for the second positive social effect which is the large requirement of human labour, both skilled and unskilled. The only negative aspect of the Haft-Tappeh type of business is the position of the great number of seasonally employed hired labourers which remains hopelessly unsolved.

The several months of harvest on the plantations assure the seasonal workers of a comparatively acceptable income for part of the year. If it were possible for them, by husbanding their own land or livestock, not only to bridge the rest of the year, but also to achieve, at the same time, an income exceeding their own needs, then the most important development goal, i.e. the development of an economy which is not urban-dependent, would be achieved.

The promotion of improved traditional agriculture should have high priority in Iran, because apart from the Haft-Tappeh type of project, it seems to be the only alternative in the DIP and elsewhere in Iran, which can solve the problems of productivity growth and employment in rural areas. This must be done by the creation and accumulation of resources and capital in the rural areas, so that the purchasing power of the rural population is raised. In addition it is valid to extend and strengthen the rural infrastructure in such a way that money circulation or accumulation in the rural areas does not, as before, disappear into the towns, but stays instead in the countryside for the promotion of the rural proletariat class.

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28. For detailed data on free grants to every farm corporation see: Denman, D.R., 1973, "The King's Vista", The Keep, Berkhamsted, Herts, U.K., p.230.

29. ETTELAAT (information) Daily Press of Iran, Tehran, April 20, 1976, No.14988. p.32.

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32. GOODEL, G., 1975. "Agricultural Production in a Traditional Village of Northern Khuzestan", in Ehlers, E., p.275.

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34. AZKIA, M., 1975, op.cit. p.119.

35. INTERNATIONAL LABOUR ORGANISATION, (I.L.O.) 1973, Employment and Income Policies for Iran, Geneva, p.73.

36. STOBBS, Ch. A., January 1976, "Agrarian Change in Western Iran. A Case Study of Olya sub-district", unpublished Ph.D. Thesis, School of Oriental and African Studies, University of London, pp.349-350.

37. See Chapter 7.

38. KANEDA, H., February 1973, op.cit. p.34.

39. See Chapter 8.

40. See Tables 17-64A and 17-65-B on the cost-benefit analyses of the Irrigation Project of the Dez Scheme.

41. KAYHAN, Tehran, April 5, 1976, No.9838, p.13.

42. The agro and livestock breeding company of the Sefid River on the land below the Shahhanoo Farah Dam has been a losing proposition also. The company was established on 2.11.1346 (12 February 1967) on 10,000 hectares of the Sefid River Irrigation Project. The foreign farming institutions as the partners of the company have come from the Republic of Rumania. The capital stock of the company is 1,411,791,573 rials. Some 1,348,291,573 rials were to be financed by the Plan and Budget Organisation, and the remaining 63,500,000 rials by the Ministry of War in Iran. The objectives of the company were the production of 8,240 cows and 23,000 female calves, the fattening of 6,000 calves per year and the production of 1,000,000 chickens, 5,000 ewes, 3,000 lambs and 4,000 fattened sheep. By March 1970 some 2,249,000,000 rials had been invested. After two years of operation the loss of the company had grown to 37,689,219 rials. For more information see: Sabahi, S., 1973, "Agro and Livestock Production Comapny of the Sefid River, A University Research", Faculty of Social Sciences and Cooperation, University of Tehran, p.131. See also: Imperial Government of Iran, Plan Organisation, "The Fifth Development Plan, 1352-1356 (1973-1978), Day 1351 (January 1972", p.183.

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55. SAEDLOO, H., 1972, "A Criticism on the Policy of Agricultural Development at the Poles of Water and Land", Tahqiqat-e-Eqtesadi, Institute of Economic Research, University of Tehran, Nos. 25 and 26, pp.54-81.
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CHAPTER 18

WATER PRICING AND THE IRRIGATION EFFICIENCY OF THE D.I.P.

During the early years of the DIP operation, the procedure used for water pricing was based on an annual charge of 750 rials per hectare. This charge was supposed to recover the operational cost of the project. Since the chief objective of this method of pricing is to redistribute the income earned in the non-agricultural sectors in the agricultural sector, the term: "socio-political price" is used. The base charge of 750 rials/ha which was based solely on socio-political criteria was not connected with the real cost of the water. This method of charging would have practically recovered the operational costs of the DPIP in the period 1963 to 1968 and especially in Alternative I (Tables 18-1 and 18-2) if the Dez farmers had not refused to pay (see Chapter 8). Act 53 of the Nationalization of Water resources law has given the power to the Executive Authority to cut the water supply to the farmer and to take into custody his property and himself. The law has been executed in some parts of Iran, such as in the Sefid River Irrigation Project, by putting the farmers into jail.[1] In other parts the law has not yet been carried out. However, the farmers refuse to pay water charges. As a result, by 1969 the farmers of 28 villages of the northern DPIP area owed a total of 8,553,067 rials to KWPA. This problem of non-payment of water charges was not only confined to the Dez Irrigation Project. The water charges owed to the North Water Authority in Gilan totalled 96,350,186 rials by March 1971.[2]

The socio-political base pricing approach has the following disadvantages:

Table 18-1

Water Pricing of the DIP on the basis of Socio-political Price Fixing Techniques

(rials/ha) Alternative A

Year	Operational and maintenance costs (rials) (a)	Irrigated area (ha) (b)	Real water price (rials/ha)	Actual water charge (rials/ha)	Loss - Benefit +
1963	3,437,000	3,440	999	750	- 249
1964	3,437,000	11,568	297	750	+ 453
1965	3,437,000	19,920	173	750	+ 577
1966	18,512,000	19,920	929	750	- 179
1967	18,512,000	19,920	929	750	- 179
1968	26,352,000	19,920	1,323	750	- 573
1969	26,352,000	19,920	1,323	750	- 573
1970	26,352,000	19,920	1,323	750	- 573
1971	26,352,000	21,770	1,210	750	- 460
1972	26,352,000	36,570	720	750	+ 30

Sources: (a) Table 17-64-A

(b) Table 17-56.

Table 18-2

Water Pricing of the DIP on the Basis of Socio-political Price Fixing Techniques

(rials/ha) Alternative B

Year	Operational and maintenance costs (rials) (a)	Irrigated area (ha) (b)	Real water price (rials/ha)	Actual water charge (rials/ha)	Loss - Benefit +
1963	2,309,000	3,440	670	750	+ 120
1964	2,309,000	11,568	190	750	+ 560
1965	2,309,000	19,920	110	750	+ 640
1966	11,728,600	19,920	580	750	+ 170
1967	11,728,600	19,920	580	750	+ 170
1968	16,753,500	19,920	840	750	- 90
1969	16,753,500	19,920	840	750	- 90
1970	16,753.500	19.920	840	750	- 90
1971	16,753,500	21,770	760	750	- 10
1972	16,753,500	36.570	458	750	+ 292

Sources: (a) Table 17-65-B

(b) Table 17-56

a) It does not encourage farmers to make productivity improvements from irrigation.

b) Farmers are not aware of the real cost of water, and to some extent this prejudices their choice with regard to other products which can be partially substituted for water (fertilizers), or other more productive crop-growing techniques (use of new plant varieties, pest control, tilling, etc.)[3]

With regard to these disadvantages, it is not surprising that by 1968 field irrigation efficiency in the DIP area was as low as 30 - 40%.[4] Also crops grown under improved techniques covered only 23.3% of the cultivated area in 1966[5].

As a result the expected rise in farming income in the DIP area was not achieved[6] and the anticipated agricultural yield and output which could permit a water sub-charge of 750 rials/ha was impossible to introduce. By 1969 large scale mechanized farming institutions, such as Agro-business companies and Farm Corporations were established to use water more efficiently and to raise the productivity of the production resources. Subsequently irrigation water has been charged on a two-part tariff since July 1969.[7] The traditional sector of agriculture, and the Farm Corporations, were to be charged originally at the same base charge of 750 rials/ha, whereas agro-business companies were to be charged on a marginal cost pricing principle of 0.2 rials/m^3.

In this analysis, with regard to pure economic theory, the marginal cost pricing technique was employed for the computation of the real cost of the DIP irrigation water.

The construction cost of the dam, which entered into the calculation as the term D_c was calculated by using the equation:

$$D_c = \frac{\frac{\text{construction cost of the dam}}{\text{reservoir capacity}} \times \text{volume of water stored per year}}{\text{total annual water consumed}}$$

The building costs of the distribution works, i.e. d_c were calculated as follows:

$$d_c = \frac{\text{investment cost + annual maintenance and operational costs}}{\text{flow at the peak period of water demand}}$$

Thus the marginal cost per cubic metre of water (Pm^3) is obtained through the equation: $Pm^3 = D_c + d_c$

Because the development of the DIP was set up in three stages, the marginal cost pricing was made for these stages, i.e. 1968, 1973 and 1978. For these years hydrological data were calculated as required (Tables 18-3 and 18-4). The construction costs of the dam and the distribution works that entered the calculations are based on Alternatives A and B (Tables 18-5 and 18-6).

4.15% of the capital costs were accounted for as management and maintenance costs. A multiplication factor of 0.5 was employed as the value of marginal cost in proportion to the investment cost of the works (channels with lining, piping, etc.) and the materials employed (steel, concrete, etc).

Based on these criteria, six varied water prices were obtained (Table 18-7).

All of these prices are higher than the current charge of 0.2 rials/m^3.

Table 18-3

Mean Monthly Water Consumption of the DPIP

1966 - 69 m³/sec

Year	J	F	M	A	M	J	J	A	S	O	N	D
1965/66					18.22	31.16	36.98	54.14	55.32	47.30	12.35	19.36
1966/67	22.69	4.42	20.04	23.60	17.88	33.12	39.84	47.14	46.66	45.26	18.21	21.06
1967/68	18.48	8.76	25.93	22.44	13.51	27.20	37.01	48.31	49.00	48.44	13.32	6.52
1968/69	21.00	15.32	30.18	19.72	19.00	31.50	39.50	45.90	57.80	55.00	14.50	6.63
Mean	20.72	9.50	25.50	15.25	17.15	30.70	38.33	48.95	52.20	48.50	14.60	13.40

Source See Table 7-3

Annual Water Consumption of the DPIP

1965 - 69 m³

J	20.72	x	2,592,000	=	53,706,240
F	9.50	x	2,592,000	=	24,624,000
M	25.50	x	2,592,000	=	66,096,000
A	15.25	x	2,592,000	=	39,528,000
M	17.15	x	2,592,000	=	44,452,800
J	30.70	x	2,592,000	=	79,574,400
J	38.33	x	2,592,000	=	99,351,360
A	48.95	x	2,592,000	=	126,878,400
S	52.20	x	2,592,000	=	135,302,400
O	48.50	x	2,592,000	=	125,712,000
N	14.60	x	2,592,000	=	37,843,200
D	13.40	x	2,592,000	=	34,732,800
Total					647,801,690
Peak period water consumption (June - October)					566,818,560

Table 18-4

Total Annual Water Consumption of the DIP

(m^3) 1973

	(a)				
J	17.3	x	2,592,000	=	44,841,600
F	29.8	x	2,592,000	=	77,241,600
M	65.6	x	2,592,000	=	169,776,000
A	91.6	x	2,592,000	=	237,427,200
M	101.8	x	2,592,000	=	263,865,600
J	132.0	x	2,592,000	=	342,144,000
J	143.5	x	2,592,000	=	371,952,000
A	136.4	x	2,592,000	=	353,548,800
S	103.0	x	2,592,000	=	266,976,000
O	60.0	x	2,592,000	=	155,520,000
N	29.0	x	2,592,000	=	75,168.000
D	15.5	x	2,592,000	=	40,176,000

Total	2,398,636,800
Peak period water consumption (June - October)	1,490,140,800

Source for (a): See Appendix E.

Volume stored per year (m^3)

Mean annual flow/sec x 31,104,000

220 x 31,104,000 = 6.842,880,000

Table 18-5

Water Price of the DIP on the Basis of the Marginal Cost*

(The Construction Cost of the Dam) (Rials/m^3)

Year	Alternative A (9% discount rate and 50 years life for the dam)	Alternative B (6.5% discount rate and 100 years life for the dam)
1967	$\frac{\frac{82,952,140^{(a)}}{3,550,000,000} \times 6,842,880,000}{847,801,680} = 0.19$	$\frac{\frac{55.727,000^{(a)}}{3,550.000,000} \times 6.842,880,000}{847,801,680} = 0.12$
1973	$\frac{\frac{82,952,140^{(a)}}{3,550,000,000} \times 6,842,880,000}{2,398,636,800} = 0.06$	$\frac{\frac{55.727,000^{(a)}}{3,550.000,000} \times 6,842,880,000}{2,398,636,800} = 0.04$

(a) 0.15% of the original uniform annual cost was added to the cost of the dam as the maintenance and the operational costs.(1)

- Calculations are made by using the following equation:

$$\text{The cost of the dam for one } m^3 \text{ of water} = \frac{\frac{\text{Construction cost of the dam}}{\text{Reservoir capacity}} \times \text{volume of water stored per year}}{\text{Total annual water consumed}}$$

(1) Farzaneh, R. 1970. "Economic survey of the irrigation projects. Water pricing techniques" in the International Commission on Irrigation and Drainage. Iranian National Committee. Irrigation and Drainage Seminar, November 1970. Tehran. pp 284-305.

Table 18-6

Water Price of the DIP on the Basis of the Marginal Cost

(Contraction costs of the distribution works)

Annual Costs of the DIP Distribution works (1,000 rials)

	Alternative A (9% discount rate and 50 years life for the dam)			Alternative B (6.5% discount rate and 100 years life for the dam)		
	1968	1973	1978	1968	1973	1978
Irrigation and drainage networks	218,004.7	542,061.5	406,809.5	149,886.7	374,402.5	279,595.50
General necessities	75,687.9			42,742.3		
Administrative costs	188,915.4			121,082 0		
Resource investigation	59,294.0			36,538.4		
Consultant Engineers	10,257.2			6,516.0		
Safiabad agricultural development			187,105.5			126,267.57
Land purchasing			148,434.0			95,020 30
Rural town building			77,279.0			48,057.30
Shush Shushtar road			19,525.0			13,748.2
Total	552,159.2	542,061.5	839,153 0	366,765.4	374,402.5	562,688.87

* 1968	552,159.2 x 0 04 = 22,087.36 maintenance cost	366,765.4 x 0.04 = 14,670.616
	552,159.2 + 22,086.36 = 574,245.56	14,670.616 + 366,765.4 = 381 436.01
	$\frac{574,245,560}{566,818,560} = 1$	$\frac{381,436,010}{566,818,560} = 0.67$
	1 x 0.5 = 0.5 Rials/m^3	0.67 x 0.5 = 0.33 Rials/m^3
1973	542,061 5 x 0.04 = 21,682.46	374,402.5 x 0.04 = 14,976.1
	542,061.5 + 21,682.46 = 563,743.96	14,976.1 + 374,402.5 = 389,378.6
	563,743.96 + 574,245.56 = 1,137,989.5	389,378.6 + 381,436.01 = 770,814.61
	$\frac{1,137,989,500}{1,490,141,000} = 0.76$	$\frac{770,814,610}{1,490,141,000} = 0.51$
	0 76 x 0.5 = 0.38	0 51 x 0.5 = 0.25
1978	839,135 x 0.04 = 33,566.12	562,688.87 x 0.04 = 22,507.5
	839,135 + 33,566.12 = 872,819.12	562,688.87 + 22,507.5 = 585,196.4
	872,819.12 + 1,137,989.5 = 2,010,708.62	585,196.4 + 770,814.61 = 1,356,011.1
	$\frac{2,010,708.620}{1,490,141,000} = 1.34$	$\frac{1,356,011,100}{1,490,141,000} = 0.9$
	1.34 x 0.5 = 0.67	0.9 x 0.5 = 0.45

* (a) 0.04% of the capital costs were calculated as the maintenance and operational costs. See Farzaneh, R. 1970. "Cost of water and the techniques on water pricing" in International Commission on irrigation and drainage, Iranian National Committee. Irrigation and Drainage Seminar, November 1970, Tehran. Ministry of Water & Power, Pub. No.1, pp.284-305.

(b) Calculations are made by using the following equation:

$$\text{Cost of irrigation network for 1 } m^3 \text{ of water} = \frac{\text{Investment cost + annual maintenance \& operational costs}}{\text{Flow at the peak period of water demand}}$$

Table 18-7

Water Price of the DIP on a Marginal Pricing Basis

(rials/m^3)

	Alternative A				Alternative B			
	d_c	+ D_c	=	Pm^3				
1968	0.50	+ 0.19	=	0.69	0.33	+ 0.12	=	0.45
1973	0.38	+ 0.06	=	0.44	0.25	+ 0.04	=	0.29
1978	0.67	+ 0.06	=	0.73	0.45	+ 0.04	=	0.49

It is only for Alternative B and in the year 1973 that the marginal cost price of 0.28 rials/m^3 is almost the same as the current charge of 0.2 rials/m^3. The new water pricing policy, however, has not increased the irrigation efficiency throughout the DIP area. By 1973 the irrigation efficiancy was only 35%[8] against a target of 40% . The Agro-business Company of Iran-Shelcott has used water more efficiently than the Farm Corporations so far. By 1974 the Company had raised the irrigation efficiency to 43% (Table 18-8) whereas excess water use by the Farm Corporations of the Northern DPIP has caused the foreign advisers of the DIP to inform people about the possibility of rising water tables and soil salinity problems in the mid and lower sections of the DPIP agro-business lands[9] .

Farm Corporations should have paid for water at a rate of 0.2 rials/m^3 from 4.10.1353 (October 1974). By Farvardin 1354 (April 1975) when the Corporations were visited by the author, they were still paying the base price charge of 750 rials/ha. The farm corporations have opposed the new water tariff because they believe that it is too expensive[10] . This would not have been logical if they had used water more efficiently. In other words if they had used water according to water requirements and had paid 750 rials/ha, the price of water for each cubic metre of water would have been much higher than 0.2 rials/m^3 (Table 18-9). Since the amount of water used by the Farm Corporations is much higher than the water requirement per hectare for each crop, the actual cost of the water is much less than 0.2 rials/m^3 (Table 18-10). With this method, the greater amount of water that is used the cheaper the price/m^3 of

Table 18-8

Irrigation Efficiency of
Iran-Shellcott Agro-business Company in 1974

Crop	a Area under cultivation (ha)	b Water requirement per hectare (m^3)	c Calculated water need in 1974 (m^3) c = a x b
		(1)	
Alfalfa	486	15,000	7,290,000
Wheat	434	4,000	1,736,000
Barley	123	4,000	492,000
Surghum	475	10,750	5,106,250
Maize	22	10,750	236,500
Safflower	46	3,250	149,500
Cotton (winter)	1,715	10,750	18,436,250
Cotton (summer)	464	11,750	5,452,000
Sugar beet	85	9,000	765,000
Total			39,663,500

Total water consumed in 1974 91,598,174

Irrigation efficiency 43%*

* Water efficiency = $\frac{\text{Calculated water need}}{\text{Total water consumed}}$

Source: (1) D.R.C. 1968. Dez Irrigation Project, Stage I Feasibility Report. pp.106-133.

Table 18-9

Water Pricing of the DIP for One Cubic Metre of Water using 750 rials/ha Water Charge and an Estimated Water Requirement per Hectare

	a Water requirement per hectare (m^3) (1)	b Water charge (rials/ha)	c Water charge (rials/m^3) c = b ÷ a
Alfalfa	15,000	750	0.05
Wheat	4,000	750	0.18
Cotton (Winter)	10,750	750	0.69
Cotton (Summer)	11,750	750	0.63

Source for (1): See Table 18-8.

Table 18-10

Water Pricing of the DIP for One Cubic Metre of Water Using 750 rials/ha Water Charge and the Amount of Water Consumed by the Iran-Shellcott Company in 1974 with a 43% Water Efficiency(1)

Selected Crops	a Water consumed by Iran-Shellcott Company in 1974 (m^3/ha) (2)	b Water charge (rials/ha)	c Water charge (rials/m^3) c = b ÷ a
Alfalfa	34,500	750	0.02
Wheat	9,200	750	0.08
Cotton (Winter)	24,735	750	0.03
Cotton (Summer)	27,025	750	0.027

Source for (1) and (2): See Table 18-8.

that water becomes. This discourages the improvement of water use efficiency. The DIP traditional farmers are still complaining about the high charge of 750 rials/ha also[11].

The irrigation efficiency of the Haft-Tappeh Sugar Cane Project was 41.7% in 1974 (Table 18-11). This is lower than that of the Iran Shellcott agrobusiness company. The major reason for this lower efficiency compared with that of the Iran-Shellcott Company seems to be a lower water tariff of 0.05 rials/m^3 for the Haft-Tappeh Sugar Cane Project[12]. This is also because the Iran-Shellcott Company began to practice sprinkler irrigation on 500 hectares in 1973. It did so for the following reasons:

a) To raise the irrigation efficiency.

b) To avoid land levelling, because the company has to move masses of soil (usually an average of 17,000 tonnes/ha) which is costly. This also changes the soil texture which has resulted in crop failures.

The overall project irrigation efficiency however has to come up to 50% by 1978 and to 60% by 1988. The headgate unit efficiency is not expected to increase more than 40% if irrigation by gravity flow is practiced. Agro-business enterprises hope to achieve an irrigation efficiency of 65% through the development of a sprinkler irrigation technique, despite an additional capital investment requirement of 50,000 Rials/ha.[13] The most important social disadvantage of the sprinkler irrigation technique in the DIP area is that it will reduce the number of irrigators from the present 4/50 ha for furrow irrigation to 1/50 ha for sprinkler systems[14].

Table 18-11

Irrigation Efficiency of
the Haft-Tappeh Sugar Cane Project in 1974

a Area under cultivation (ha)	b Water requirement per hectare (m^3) (1)	c Calculated water need in 1974 (m^3) c = a x b	d Industrial water requirement m^3/tonne (2)	e** Total Industrial requirement
9,149	25,000	228,725,000	1.7	165,403.2

Total consumed water in 1974 547,587,250.0

Total consumed water in 1974 for farming 547,421,847.8

Irrigation efficiency 41.7%*

* Water efficiency = $\frac{\text{Calculated water need}}{\text{Total water consumed}}$

** c is obtained by multiplying d by 97,296 tonnes of sugar produced in 1974.

Source for (1) and (2): Department of Information, Ministry of Information, Khuzestan, 1972. "The Sugar Cane". p.25.

KWPA and the agro-business enterprises negotiated and agreed that the water tariff should be revised once in every five years. The first change of tariff coincided with the development of the DIP and at the expiry of the adaptation period.

A new price for irrigation water is currently under investigation[15]. Despite these calculations it is very difficult to price water accurately. This is because the theory of charging at marginal cost presents considerable difficulties, amongst which the most significant ones are:-

a) Insufficient reliable information.

b) Uncertainty as to the trend of water demand and its sensitivity to price.

c) Lack of knowledge of the productive function of water for each crop in economic terms.

The overall irrigation water pricing policy in Iran has supported the principle of an operational cost deficit in one region, provided that water revenues from another region compensate for it[16].

According to the available data and interviews with water authorities in different parts of the country, the problem is that many other irrigation projects associated with large dam schemes in Iran have been costly and have faced the same problems as the DIP, from the point of view of economic efficiency[17]. It is inevitable that KWPA and the other water authorities will have to establish a one, two or three-part water tariff to recover the operational and capital costs of projects ultimately. This is indeed a difficult problem since there are many socio-political, as well as economic issues which must be taken into account in any water pricing policy. The introduction of such a policy

seems impossible, at least at the present time, in Iran because of the lack of necessary information (outlined in difficulties associated with the theory of charging at marginal cost in this Chapter). Such information is a prerequisite for the application of such water pricing techniques. Up to the present time there has been little research work carried out in Iran dealing with water resource management problems.

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CONCLUSION

Iran, with a population of 34.1 million in 1976, has an annual population growth rate of approximately 3.0%. Although the country has benefited from a steady stream of oil revenues since 1908, it is only since the Second World War, and mostly within the past 15 years or so, that it has been transformed from an under-developed country to a country with a large, dynamic and increasingly modern economy. During the past decade, Iran has experienced a high growth rate and considerable advance towards economic development. The rapid increase in oil revenues, especially since 1971, is the most important factor in the current development of Iran. In the early 1960's, Iran's growth performance was not outstanding. The Gross National Product, excluding the oil sector, grew at only 5.1% during the period 1959 to 1965. Agricultural production grew at only half the population rate. The mid-1960's marked a turning point in Iran's economic growth. The GNP growth averaged 10% annually and, more importantly, the per capita income increased by 40% during the five years ending in 1969/70. Manufacturing output grew more than 14% annually at this time. In real terms, the GNP increased at an annual compound rate of 10% during 1968/71, 14.3% in 1971/72 and 14.7% in 1972/73. This sharp increase reflects the rapid rise in value of the oil sector.

The Agricultural sector, which makes up about 16.6% of the country's gross national product with 40% of the labour force in 1971, continues to decline as a component of the GNP. It represented 15% of the GNP in 1971/72, compared with 25% in the mid-1960's and 90% at the turn of the century (see Chapter 2). On the other hand, the oil sector's contribution

to the GNP increased from about 12.6% in 1963/64 to 19.5% in 1972/73. Despite the efforts of the government to diversify its industry and to emphasize growth in all sectors of the economy, the oil industry remains the primary source of income. Oil revenue supplied 50% of the combined receipts of the treasury and funding for the Plan Organization during the period 1965 to 1969. Furthermore, oil provided just under 90% of Iran's export earnings in 1971/72.

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 strategy was reached with the implementation of the land reform programme. Land reform constitutes the backbone of all policy measures in the agricultural sector in Iran. It primarily aimed at improving the social order between two distinct social classes: the landlords and the cultivators. This was achieved by weakening the traditional fabric of society and replacing it by a broader based social order with greater economic participation being given to the inhabitants of the countryside.

The first phase of the nation-wide land reform did achieve a considerable transfer of power from the landlords to the farmers. The land reform which was initiated from the highest level, namely the Shah, eventually attracted the support of the great majority of the potential beneficiaries. The immediate and most tangible effect of the first phase of land reform was an income increase accruing to those people who received land. This increase took the form of differentials between instalment payments and the former rental or share of the crop grown. Unfortunately the first phase of the land reform law applied only to 22%

of rural families (see Chapter 2). Therefore by 1963 the legal status of 78% of rural families had been left unchanged.

For those 22% who benefited, the reform was real since subsequent evidence has shown that the standard of living of the peasant has increased. Independence, self-reliance and confidence were the valuable social results of the first phase of land reform which were gained by the peasants in some parts of Iran, especially in the northern and central provinces.

So far as the second stage of the reform is concerned, the measures which were introduced were extremely complex, with three main alternatives. Where the first alternative was chosen, the peasant obtained the lease of the land for 30 years, subject to a five year review of the rent. The landlord lost nothing and gained a government enforced lease. Real hardship arose when landowners refused to maintain the qanats, so that incomes fell and peasants could not meet the rent payments.

The second course of action, which was the sale of the land to the peasants, seems to be the most favourable measure of the second stage as far as the peasants were concerned. The percentage of self-sufficient farmers who bought the land was even smaller than those affected by the first phase, since the former group of new owners might have to meet a price set by the landlords.

As to the third course, which was the division of the land between the land owner and peasant in proportion to the prevailing crop-sharing agreement, the results do not seem to have been too good for the peasants. Wherever the crop-sharing agreements gave the peasant a small share (one fourth or one fifth) of the produce, the plot of land would be too small to provide subsistence and would rarely provide a cash surplus for

improvements. As a result, those peasants who have not been able to live on the small areas, have continued to work under a tenancy agreement on the landowners' land, without security of tenure. The great mistake, however, in allowing this course of action at all is that it overlooked the possibility of the landowner who might contrive to retain the best part of land or to keep control of the water supplies. Even if he retains only a minor proportion of the land, he can, legally, sink a deep well which dries up the water in the qanat or qanats supplying the rest of the land. In such a case, the land reform, originally intended to better the lot of the peasants, may, in fact, considerably worsen it.

To sum up, the second stage of the reform programme has not sustained the aims of the first stage. It has suffered from too much complexity, but it has brought some improvement in security of tenure for the peasants where the method of selling the land to the peasants was chosen.

The success of the land reform would obviously depend on a good performance of the rural cooperatives which were created as a supplementary measure to the land reform law. Although on paper the cooperatives have wide functions, including marketing, the upkeep of qanats, pest control, etc., at present they are concerned almost entirely with the provision of credit, so far on a fairly small scale. Under-capitalization of the cooperatives means that the credit needs of the peasant are supplied by money-lenders or merchants. As a result of the creation of this new bourgeoisie class in the countryside the major objective of the cooperatives, which was to make the peasants more independent, has been obscured.

Central to the above discussion is the socio-political outcomes of land reform. The government cannot set the clock right back, but it can let the old interests build up their power again, and prevent the peasants from developing any power of decision by using the cooperatives as agencies of the government, or by denying them credit. Alternatively the government, in seeking to control and check the growth of independence, may find that the reform has started a movement too big to be controlled. If this movement can again find pro-peasant leadership, then the next step may be the complete expropriation of the property of the landowners. If so, then the 1962 reform will prove to have been the cornerstone in a new organization of society. If the land reform of Iran had followed the objectives introduced at the first stage, the results would have been numerous. These results though not quantifiable, would have been great in value. It would have brought optimism to the peasants and the hopes for a just order. It would also have given the peasant a new sense of communality, and provided many new challenges to work together and to build mutual trust. In the long run these are values which are essential to national prosperity. Those concerned with land use and the achievements of the agricultural economy must never take these values for granted.

In addition to the landlord peasant relationship, water supply for agriculture has always been considered as one of the most significant factors affecting the agricultural economy of Iran. Iran is an arid country with water surpluses existing in only small portions of the northern and western parts (see Chapter 2). Until recently, traditional irrigation systems using both surface and ground water supplies have been widely utilized for agricultural production. The qanat is found

throughout Iran, especially on the alluvial fans bordering the great central desert of Iran. This source of water, though relatively cheap to supply, could not be considered as a reliable source because the supply of water is heavily dependent on the level of the ground water. In addition, the seasonal variation in the qanat's discharge discourages its development as a reliable source of water. Water supplied through the qanat flows to waste during the winter months when the agricultural demand for water is small and also during the night. In Iran, surface waters are the most important source of water. Until recently a considerable amount of these waters have not been utilized and have run to waste every year. These waters could not be utilized because when there was sufficient water in the rivers the agricultural demand for water was small. In contrast, during the summer months in which the river discharges are at a minumum there is a great need for water for irrigation. To control and utilize these water resources, during the second Seven Year Development Plan, a number of large multi-purpose water resource projects were initiated. One of the most spectacular developments in Iran within the field of water resource management has been the construction of a number of large reservoir dams. The initial studies for a number of dams were made during the first seven year plan. It was, however, during the second seven year plan that the first large dams were built. At the present time, 12 dams have already been built and a further 11 are under construction or at the planning stage, (see Chapter 3). During the early plans, emphasis was placed on the provision of water for agricultural use. An exception to this was the Karaj Dam which was given top priority as it supplied domestic and industrial water to Tehran. In the Third and the Fourth Development Plans

the policy of water resource development followed the same objectives as in the Second Plan. By 1973 almost all fertile lands had been supplied with regulated water. In addition the development of urbanization the expansion of the towns and cities and the development of industries in and around the cities had increased the domestic and industrial water needs. Therefore, during the Fifth Plan, more attention was paid to the provision of water supplies to meet the rapidly increasing demands of water for industrial and domestic uses. Many problems occurred during the early years of the Second Development Plan. Large scale multi-purpose dam schemes had been designed for Iran in countries many thousands of miles away. They were completely beyond the capability of Iran in terms of financial, technical, administrative and management know-how. Financially they were so costly that Iran had to borrow a substantial foreign loan so that the projects could be completed. The estimated cost of the large irrigation projects increased greatly between the planning and construction stages. The cost of the Karaj Dam, for instance, increased from an estimated figure of 1.5 billion rials to 6 billion rials. The Moghan Canal, which was planned initially to be a one kilometre canal, was later increased to 100 kilometres in length. These costs and constructional increases created two major problems in the planning of projects. First, they forced the basic agricultural programmes to be cut down substantially to help make room for the large multi-purpose projects and secondly, they increased the total cost of the plan. Until 1964 Plan Organization was the only authority dealing with the planning and budgeting of the projects. The separation of the

investment function from execution, operation and maintenance (organizationally) contributed to the continuing lack of programme planning. This made it difficult within Plan Organization to come to a sound judgement on budget requests for identical pieces of equipment for projects with no attempt to reduce expenditure through coordination of use of equipment. The lack of planning within Plan Organization seems to be the main factor which had caused delays in the development of the projects. In almost all large water resource development projects, the construction, running and execution was done by high cost foreign management. Of course, these delays caused further increasesin the cost of foreign contracts. In addition, none of the irrigation projects had made adequate provision for the management and sale of water, for the establishment of a water authority, for the determination of water rights, for the provision of maintenance costs, for the canal networks, and for land use and tenure problems. These problems existed for both the Sefid River and the Dez projects. There were people who believed that progress could not wait for the completion of all aspects of planning policy, and that problems should be solved when they arose. The past experiences with the irrigation dams in Golpayegan, Kuhrang, Kahak and Zahak were examples which indicated that this approach had not been satisfactory.

For the solution of these numerous problems associated with the large scale dam schemes and to achieve a more integrated and organized planning and execution of water resource development projects, the Ministry of Water and Power was established in 1964. The Ministry has the tasks to supervise, coordinate and implement policies dealing with

water and power resource development. To carry out these tasks it was felt that there was a need for the modification of the water legislation of Iran. The immediate problem which faced the Ministry of Water and Power was the lack of adequate water law which would permit the setting and collecting of higher water charges. The irrigation projects of the first development plan experienced difficulties because of the lack of finance to meet operating and maintenance costs. The water from the Golpayegan reservoir dam, a 160 million rial project, was sold at 0.1 rials per cubic metre. The revenue at this rate was not enough for the operation and maintenance costs of the dam. The Kuhrang diversion tunnel in Isfahan was also faced with the problem of collecting adequate water charges and of meeting the increasing operation and maintenance costs of the project. The water of the Kahak and Zahak dams in Sistan was utilized without any charge being made for it. In the irrigation projects of the Dez and the Sefid Rivers, which were constructed during the Second Development Plan, the peasant farmers and the land owners had refused to pay any water charges. In addition the major grievance of the peasants of the second phase of the land reform law was the shortage of water because the landlords seized the water supplies. The new government and private irrigation and well-sinking projects were drying up the old qanats by lowering the water table. The major objective of the land reform programme of 1962 was the abolition of landlords' power from the land. This power was reduced through the implementation of the first phase of the law. The way in which the second phase was implemented did, in fact, give more legal power to the landlords in the control of water resources in the country. Therefore it seems that a new law for water resources was urgently needed by

which the following objectives could be achieved:-

(a) To reduce the power of landlords over water resources and to transfer this power to the government.

(b) To provide government legislation to simplify the implementation of water resource management measures.

With the enactment of the Nationalization of water resources law in 1968 all water resources within the country were considered as belonging to the State. The act gave the Ministry of Water and Power the authority to supervise and control all future water resource development and to issue permits for water use.

High evaporation and percolation losses have characterised the irrigation and drainage networks of Iran at regional level. Complex customs and traditions have also governed the pattern of water use for irrigation. These combined with lack of consideration of the water needs of growing plants has resulted in a low irrigation efficiency in the fields. Since the creation of the Ministry of Water and Power it has been hoped that modern approaches in water resource management will be introduced and new remedies for these problems will be sought. Amongst the numerous measures of water resource management which should have been applied to increase the efficiency of the use of the scanty water resources, the most effective ones seem to have been as follows:

a) Improvement and modernization of the irrigation and drainage canals.

b) Dissemination of the knowledge of modern irrigation techniques amongst the farmers.

c) Modification of water prices in such a way that the new price of water encourages a more efficient use of water.

The large scale water resource developments which have been chosen for Iran have required both enormous investments and the application of advanced techniques. This meant that government finance was essential for such schemes.

During the early large multi-purpose water resource development projects, Plan Organization was vested with the authority to carry out regional development schemes involving multi-purpose undertakings. Four large regional development projects, namely: the Khuzestan Development Plan for South-west Iran, the Sefid River Project in the Caspian littoral, the Karaj Dam Project north-west of Tehran, and the Sistan-Baluchestan Development Project of South-eastern Iran had reached the stage of construction. 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. Amongst these regions Gilan in the north has the most fertile land and the most densely populated area in Iran. Sistan and Baluchestan does not possess fertile land such as Gilan and has little population whereas Khuzestan has salty soils, but abundant water, oil and natural gas resources and a relatively small population. All three regions are politically important because of their strategic situation. Among these regional development plans, the Khuzestan plan has always been given the highest priority since 1955. The Pahlavi Dam on the Dez River, which is a part of the master plan for the regional development of Khuzestan, was opened in the Spring of 1963. When the operation of the Dam began, many problems still remained to be solved. Amongst these the most important one was the lack of capital for the construction of the irrigation and drainage networks.

As a result the government had to depend on the financial assistance of the landlords for canalization and land development of the irrigation project associated with the large dam. This was owing to the lack of an efficient management for both the planning and execution of the large dam scheme at the time of its construction. As a result, the bulk of capital from both domestic sources or from international loans had already been spent for the construction of the reservoir dam and its associated hydro-electric power plant. In addition another important problem was the traditional land ownership system through which the landlords had maintained power for generations. If they had participated in the canalization and land development programmes, their powers would have been extended inevitably through the control of the water resources of the area. If the landlords maintained control of essential resources this would undermine the whole strategy of the modern irrigation project which was to make more efficient use of scarce water resources. For, as a result, the peasants had no incentive to improve irrigation efficiency and to improve agricultural productivity. Indeed under such circumstances a reform of the traditional agrarian structure of Iran was urgently needed. Already billions of cubic metres of water were being stored behind the large reservoir dams of the First and Second Development Plans and were not being used efficiently. From the beginning of the implementation of the land reform law it was not realised by the government that the small new landowners were not capable of investing sufficient capital to provide the infrastructures of a large irrigation project. In addition the first and second phases of the land reform law had been implemented in such a way that by 1966 in many areas the land was still cultivated under the old system of land tenancy

and crop sharing throughout Iran. This situation was true for 70% of the land of the DIP. These landlords had also refused to invest in the land which they had feared would not belong to them for very much longer. These are some of the main problems which had not received the necessary attention by the planners at the time of the planning of large multi-purpose dam schemes or during the designing of the land reform law. Also it soon became clear that there was insufficient capital available for the countless commitments of the government within the irrigation project associated with the Pahlavi Dam.

In spite of these problems KWPA, which was backed by foreign monetary funds, had been able to supply regulated water for 20,000 hectares of the Pilot Area by 1965, after a two year delay. However, this area only represented 16% of the entire DIP area. It had first been thought that the small farmers would be able to raise the productivity of a unit of water by giving them the water they needed. In the short term, the achievement of this objective was, of course, impossible because of the following reasons:

1) The farmers had used water in a traditional way for generations, therefore they were not acquainted with modern irrigation techniques which could help them to use water more efficiently.

2) The dissemination of modern irrigation techniques amongst the peasant farmers required both capital investment for the training of the required personnel and for the education of the peasants. These were important issues for which the government should have prepared long before the time that regulated water reached the

fields. All the irrigation projects of Iran have suffered from a lack of agricultural extension workers during the planning and/or execution stages of the projects.

3) Water is an enabling factor which can improve the productivity of agriculture, but it is only one amongst many others. These are the application of fertilizers, improved seeds, agricultural machinery, pest control, insecticides, etc. These are factors which require both capital input and a trained personnel. Neither KWPA of the DIP, nor the other water authorities were able to meet these requirements.

4) To operate and administer a modern irrigation and agricultural system it was essential to provide an efficient management organization. This was lacking in the DIP and in all the irrigation projects associated with the large dam schemes. This meant that the water authorities were not capable of carrying out their tasks and commitments properly.

5) The water pricing policy, which was established on a water charge per hectare basis, did not encourage the more efficient use of water or the diversification of crops. Indeed in some areas the use of excess water caused ground water levels to rise leading to soil salinity. This was especially true for the DIP.

6) An alteration of the pricing mechanism of water was impossible because of the following reasons:-

   a) If the government wanted to charge water on the basis of a charge/m^3, this would have required a further capital investment. Such investment would have been necessary for

the installation of meters to measure the water consumed. The government did not possess the funds to achieve this.

b) To perform such a policy it was necessary to extend the irrigation networks (laterals and sublaterals) to smaller areas for which the small landowners were not prepared to allow. This is one of the major problems which still faces many water and power authorities, and is especially true on the rice fields of the Sefid River irrigation project (240,000 ha), below the Shahbanoo-Farah Dam in Gilan.

c) To operate a water-metering irrigation system, trained personnel are needed. Most of the water authorities did not have the necessary personnel.

d) This system of irrigation required that the farmers knew what their crop water demands would be. Unfortunately the small farmers were not prepared to commit themselves to modern development. The dissemination of such knowledge amongst the peasants was impossible. This was because traditional methods of irrigation and farming were closely interwoven with the culture of the rural communities of Iran. Alteration of traditional cultures was not so easy.

7) Above all, recent and frequent investigations of the siltation of the Pahlavi Dam reservoir, as well as those of other dams, showed that the useful life of these reservoirs was much less than had been estimated by either the planners in the U.S.A. or by other foreign advisors. This meant that another larger problem, the limitation of the life of the reservoir, had to be considered

seriously in every plan associated with these reservoirs. In other words, there was not enough time for the provision of all the economic and social requisites associated with the large irrigation projects. The problem had become more serious especially because the operation of the hydro-power project of the Pahlavi dam and other dams proved that they were uneconomic. This created the incentive for the government to concentrate its attention on the irrigation projects, to achieve a capital return from agriculture, instead of from hydro-electricity production.

8) When the regional development plan of Khuzestan was drawn up, the development of the social status of the rural people was considered to be a prerequisite for the future economic development of the region. The social development plan included the following aims:-

a) Improvement of health and sanitation conditions.

b) Development of Education.

c) Improvement of human nutrition.

d) Development of rural roads and communication facilities.

e) Water and electricity supply to all rural areas.

f) Improvement of the housing situation.

g) The problem of rural unemployment and under-employment had remained unsolved for a long time. The introduction of agricultural machinery would release human labour and would therefore worsen the unemployment situation.

To solve these chronic social problems, there was a great need for the creation of jobs through the establishment of rural industries. Technical training of all rural people was a prerequisite for the

establishment of such industries. The achievement of all these social objectives required both considerable capital investment, and the training of rural people and government personnel. With regard to the problems of the irrigation projects of Iran and particularly of the DIP, the Iranian planners, assisted by their own foreign advisers, came to the conclusion that "the major obstacle which prevents the development of the irrigation projects is the small scale ownership of land below the large dam schemes." They put forward a strategy for the consolidation of land. They thought that this would assist the establishment of farms of economic size. These farms would be large scale capital intensive units, which would be operated on a commercial basis. These were considered as an ideal institutional alternative for the solution of the problem of land development, and the growth of agricultural productivity on the large irrigation projects. Therefore the paramount theme now, in the development strategy of Iran's agriculture has become the maximizing of returns from the use of irrigation water. It is somewhat surprising that the U.S.A. advisers to the Iranian planners recommended such a policy as a solution for the Iranian agricultural problem, knowing that it is not the size of farms which guarantees improvement of land productivity. Many other inter-related factors are involved. In addition, some of the large scale farming institutions had already shown signs of failure in the U.S.A. It has become clear that in Iran emphasis has shifted from social to economic objectives. The immediate social outcome of this policy is that the rural communities of the DIP will be left to tackle their own problems, both the old ones and also those

created recently. The problems that have been mentioned by the government as the major reasons for the introduction of new farm management within the DIP are as follows:-

1) It was difficult to disseminate knowledge of modern irrigation and agricultural techniques amongst the traditional farmers and therefore the irrigation efficiency did not improve.

2) The gross value of products of the DIP was not enough to recover the capital investment required for the infrastructures. (See chapter 8).

Both of these reasons seem illogical because:

1) The training of the traditional farmers in modern irrigation techniques was a prerequisite for the large dam construction projects in Iran. This should have been given priority long before the construction of these dams commenced. In addition, the training of traditional farmers in modern techniques will one day be inevitable and there seems to be no alternative available to the government.

2) The main reason for the creation of the new large farming managements seems to be to get a quick and short-term economic return for the government instead of the long-term social and economic improvements originally planned for.

The legislative support for this strategy came from the act of 16th June 1968 for the establishment of Farm Corporations and the law of 20th May 1968 which governed the establishment of companies for the development of land below the large reservoir dams. So far, many farm corporations have been established in different parts of the

country with a spatial concentration in the northern, north-western and western parts of Iran. The Iranian Farm Corporation combines the traditional village structure with modern farming management by consolidating individual farm plots into large units. The policy of the creation of agro-businesses is associated with the long-term (30 years) leasing of irrigated lands below the large dams or close to a system of deep wells. The companies may be founded by the government, by domestic and/or foreign capitalists or a combination of government and foreign investors. Until now a number of agro-business corporations have also been established in the north (below the Shahbanoo Farah dam), in the north-west (below the Aras dam in Dasht-i-Moqan), and specifically in the lowlands of Khuzestan, within the DIP area.

The economic and social consequences of the Dez farm corporation, the agro-industry of the Haft-Tappeh Sugar Cane Project and five agro-business corporations of the DIP, have been examined in detail in this thesis (see Chapters 9, 10 and 11).

Investigations suggest that until now the performance of the agro-business enterprises has been somewhat below what had been expected. In the long run, as soon as the labour force is cut down through the application of full mechanization and better management and administration techniques, the achievement of a 20% return on capital will be realized. There is the possibility that all the agro-businesses will diversify to cash crops such as cotton which will then be exported. If this happens, Iran will be left on her own to overcome the serious question of the rapidly growing demand for food stuffs (see Chapters 2 and 17). Even if the agro-businesses plan to produce food to supply Iran's needs and

also to raise the agricultural productivity, then one may argue that the profits gained will leave the country. In addition a 20% return on capital for agro-businesses reflects none of the external and social costs imposed on the government. These costs are also imposed on the displaced farmers and on their families in particular, and on the farmers who are left out of favour and have to fend for themselves under difficult conditions. Cost-benefit analysis of the Dez irrigation project of the Pahlavi dam has confirmed the high explicit external costs imposed on the government such as the costs of the irrigation and drainage networks, etc. (see Chapter 17). This work by the author seems to be the first attempt which has ever been made to provide a fully objective appraisal of a large multi-purpose dam scheme in Iran. For this analysis every attempt has been made to quantify all the measures of costs and benefits resulting from the project. Nevertheless such quantification was impossible in a number of cases. These are for instance:-

a) The social costs of unemployment caused by the mechanization of agriculture and also by resettlement.

b) The nutritional situation of the resettled people in the new village centres (shahraks).

c) The impact of rural-urban migration and the pressure imposed on the urban welfare systems.

d) The effect of bilharzia on the health of the people.

e) The environmental impacts on wild life. For instance the destruction of fish life as the result of molluse control of the schistosomiasis snail, and

f) The psychological impact on the local traditional farmers associated with changes of farming management.

However, as far as the consequences of the agro-businesses are concerned, their negative external effects and their social costs have been great. They are businesses which are concerned only with highly mechanised farming operations. These are not associated with any industry nor is any industry expected to develop in the future. Therefore their negative impact of releasing human labour has been devastating. With the coming of the agrobusinesses into the DIP a resettlement programme was introduced. The negative effect of under-employment and unemployment increased even more with the removal of population into Shahraks (see Chapter 13). The psychological impact of this socio-economic uprooting of the rural population of the DIP, which had been formerly active agricultural in the same area, is impressive.

It seems that one of the reasons for wishing to attract and to promote foreign investment in the agricultural economy of Iran by the establishment of agro-businesses, was to meet the country's need for modern technology and managerial know-how. The need is more sharply felt as a consequence of the ambitious economic development plans which are under way and which aim to change the face of the country in the shortest possible period.

The revised Fifth five year Development Plan (1973-78) has called for a 51.5% growth rate in oil and gas, 18% for industry, 16.4% for services and 7% for agriculture. GNP should rise from $17,300 million in 1973 to $54,600 million at the end of the plan period. In the same period per capita income is expected to rise from $556 to $1,521. The growth rate for the oil sector was projected under the original plan at only 11.8%. Average annual growth rates for the other sectors of the economy in the First Plan were:- industries and mines, 15%; services, 11.5%

and agriculture, 5.5%. The plan envisages total fixed investments of 4,634,000 million rials compared with 2,619,000 million rials for the original plan. The spread of technology through the Khuzestan region has been severely limited by factors such as the difference of technology level employed by the agro-businesses and that used by the traditional farmers.

Farm Corporations have proved to be efficient in terms of productivity. This productivity will be raised even more as an inevitable consequence of the consolidation of land to economic farm sizes and the mechanization of agriculture. Here again this efficiency has only been achieved with massive investment costs, especially where the Corporations have been established on lands within the large irrigation projects associated with the large reservoir dams. In addition the provision of free technical and financial assistance, as grants and low rate loans, have been enormous so far. This assistance has been supplied at the expense of the rural cooperatives of Iran, which account for the major proportion of the farming community of Iran. Against the claim of efficiency for the farm corporations, there stand two negative impacts. These are:

1) The release of a large number of the people who until now were engaged in agriculture, as the inevitable result of mechanization, and
2) The separation of the Farm Corporation's population from agricultural processes is in no way compensated by the possession of shares (see Chapters 9 and 17).

The self-help principles which were gained through the implementation of the land reform law have been discouraged by the desire for quick financial results underlying the management of the farm corporations.

In contrast to these two forms of big business organisations within the large irrigation projects, is the state agro-industry of the Haft-Tappeh Sugar Cane Project in the DIP. The project was established on 10,000 hectares of land located at the south of the DIP in 1960. The project was irrigated through a system of pumps which lifted water from the Dez River. Regulated water has been supplied to the project since 1971 through the modern irrigation system. It has functioned as a stimulus for the establishment of large scale mechanized farms. This project seems to be the only efficient agrarian institution in all the large irrigation projects in Iran in terms of both productivity and the creation of employment. Here agricultural production has been considered as a means for the establishment of rural industries. The positive social effects of the Haft-Tappeh type of organisation have been a large demand for labour, both skilled and unskilled (see Chapter 10). The only criticism which can be made of the project is the seasonal employment of the hired labourers. Indeed the Haft-Tappeh project could be a useful model for the planning of big businesses below the large reservoir dams, if it was possible to overcome the seasonal unemployment which it causes. This problem could be easily solved by giving the agricultural labourers a piece of land to cultivate for themselves. This could bridge the rest of the year and meanwhile achieve an income exceeding their own needs.

Economically speaking, although the Haft-Tappeh Project is costly it promises to bring benefits in the near future. The high financial costs of the project can be accepted because of the great social advantage resulting from the creation of thousands of jobs for the local

people. The promotion of improved traditional agriculture is also a valuable approach which seems to be a useful alternative to agro-business and farm corporations in the DIP and elsewhere in Iran. The traditional farmers of the DPIP made progress in 1963-68. This was the result of the supply of infrastructures to them such as an assured and regulated water supply and the provision of the communication facilities by the construction of the rural roads and the service roads alongside the irrigation canals. Had the resources been accumulated and circulated in the DIP and the purchasing power of the local farmers improved, the money would not have disappeared into the towns but would have stayed in the countryside. As a result, a market oriented economy would have supplied an independent rural economy from the urban areas. In such circumstances, the high social costs of the DIP would have been reduced. Therefore one may conclude that there were other alternatives which were not considered seriously, when big businesses were introduced onto the land which had been cultivated by farmers for generations. Alternative policies could modernize the farms without causing disruptive impacts on the traditional village life. The shift from peasant proprietorship to vast commercial farming in the policy formulation of the government was so swift that the possibility of fostering medium sized farms within the large irrigation projects or on newly accessible land was missed. As the government had committed itself to undertake infrastructural expenditure to serve units of land of 100 hectares, there appears no reason to set the minimum limit of land to be leased at 1,000 ha (see Chapter 11). Financial requirements for developing land within the boundaries of 100 hectares would not be of a magnitude beyond the means of a medium sized

potential entrepreneur. On more generous terms it would still be possible to stretch government expenditure to smaller areas than 100 hectares and consequently accommodate more farmers who would thus acquire the privilege of contributing towards the general development of the country. New administrative machinery could be introduced to ensure the satisfactory utilization of such water and land resources with a view to promoting the rural economy and at the same time, modernizing the agricultural economy along the lines planned by the government. It seems that short-run economic effects of a few large agro-businesses have caused the planners to under-estimate the social costs and long term negative effects of establishing big businesses. It is not clear on what criteria the farm limit or the optimum farm size has been set at 1,000 hectares by the government. Of course, introducing an element of planning means, as a first principle, that the government should relate its reform policy to some scale of farm operation which is neither uneconomically small nor uneconomically large. It should use some standard to optimise farm size or set a minimum size limit. It is impossible to generalize as to what this standard area should be. The optimum size, i.e. the size which maximizes output per man, is a variable dependent on several factors. These include the density of farm population expressed in the man : land ratio, the type of land use, determined on the one hand by the type of soil and on the other by the market; the methods of production, determined by the supply of capital and the level of technology. These conditions vary as between countries, and some of them change in the process of development. This point may be illustrated by reference to farm size in different conditions. The one-man

farm on 258 hectares in the American and Canadian prairies was and may still be optimal for mechanized grain growing. The typical Danish 20 hectares farm worked by two men working hard all the year round, was optimal for livestock production and intensive mechanized arable farming up to the mid-fifties. Now, with a rapidly shrinking farm population and further mecharization of livestock feeding, optimum size increases. In Japan, the one hectare farm was optimal for intensive rice cultivation over a long period but the increase in farm population after the Second World War caused further sub-division of holdings and would have led to a fall in farm income, if yields of rice and other crops had not been raised by increased inputs of fertilizers. Now that phenomenally rapid industrialization has reduced farm populations, Japanese farmers earn higher incomes by using slightly more land as well as more capital. India exhibits the more familiar evidence of excessively small scale farm sizes in the continued sub-division of small holdings on which under-fed oxen compete with under-fed humans for the meagre yields. In the U.S.S.R., the state farms, with an average of 10,000 hectares of arable land, employ an average of 850 workers per farm. The average area cultivated amounts to 12 hectares per worker, as compared with the collectives, which average 1,200 arable hectares and 500 workers per farm, so that the area worked amounts to only 2.5 hectares per worker. What the Soviet experience shows is that though tractors and combines can increase the area cultivated (almost double in the thirty-five year period between 1928 and 1963) the advantages of large-scale farming will not offset lack of incentive. No farming system is efficient if people will not work under it; this is a principle worth remembering. The farmers in Iran have tended to

have the same attitude towards work in the imported model of the state farms (farm corporations) as well as in the agro-businesses.

The examples show that it is not the size of the farm measured in hectares that should be regarded as the criterion for farm efficiency, nor the degree of mechanization, but the amount of capital, including land, invested per man. The more capital invested, the greater the demands on the farmer's managerial ability and technical knowledge, and the greater the need for national overhead investment in research, extension and education. Also the examples show that the scale of efficient farm operation may be comparatively small, but the scale of efficient marketing is large. In other words, there are different economies of scale for different functions. Efficiency depends on their co-ordination, not on the scale of farm operation as such. The recent agrarian revolution in Iran, has emphasised largely the farm size as a criterion for farm efficiency. Other criteria have been hopelessly under-estimated. There is need for decision on the priorities of investment in agriculture. The agricultural revolution of our own time is a total revolution, not the engineers' revolution of forty years ago. Iran, as a developing country with densely settled and increasing farm population sizes must aim at increasing output per hectare, which means higher inputs of water, fertilizer, selected seeds, pesticides, etc. These forms of investment require different scales of operation. Irrigation schemes, a high priority in Iran, India and Iraq, may serve a whole catchment basin. Water, like the complementary inputs of seeds, fertilizers and pesticides, is divisible, and can be used on small farms as well as large, provided that the farmer is educated to its use. Therefore, the question of

efficient scale is rather more complex today than it seemed a generation or so ago. During the early years of the operation of the Pahlavi dam, in order to redistribute the income earned in the non-agricultural sectors in the agricultural sector, a socio-political pricing policy of water was used in the DIP. Later, since 1969 reliance on the water price mechanism has been the straightforward approach to change prevailing in the decision-making process in the DIP, (see Chapter 18). Of course, the initial price of water neither encouraged farmers to use water resources more efficiently nor let them be aware of the real cost of water. Inefficient use of water by the traditional farmers was one of the major reasons for the introduction of the strategy for the creation of big farming businesses in 1968. To achieve both objectives of more efficient use of water and diversification of crops, a marginal cost pricing policy has been performed within the DIP since 1969.

In fact this is a modification of the political framework in water resour management of the DIP. Examinations of the agro-businesses show that the first objective is being achieved gradually through the improvement of the irrigation techniques. The second objective of diversification of crops is also obtained by the cultivation of export crops (especially cotton). Of course, this has been achieved at the expense of import crops (wheat, rice. oil seeds, etc., see cost-benefit analysis of the DIP - Chapter 17).

Farm Corporations of the DIP have not been able to pay the new water charges. because they have not passed the transformation period, and have not yet reached the goal of diversification of crops. In general the water pricing policy in Iran has followed the socio-political principle

rather than real cost pricing basis. However, application of the marginal cost pricing technique for the irrigation projects of the large dam schemes is inevitable. Employment of such a technique seems somewhat impossible at least for the present time. This is especially because of the existence of some socio-political constraints. In addition the lack of sufficient information is another limiting factor. The former will be solved as time passes and the rural economy improves. The latter needs a vast research programme in the field of water resource management within the large irrigation projects.

One of the great positive impacts of the Pahlavi dam scheme is that with the construction of the dam, floods have been partially controlled. As a result savings from the flood control project have been considerable (see Chapter 17). Although flood damage downstream of the Dez dam has been considerably reduced, further damage has been created in the towns and settlements located upstream of the reservoir (see Chapter 15). This damage has never been investigated. Research should be done in the field of flood damage and flood control projects in the water-shed of large reservoir dams in Iran.

With the creation of the Dez irrigation project, bilharzia has become more widespread. Schistosomiasis was not unknown in the area previously, but the infected areas have been extended as a consequence of more canalization. The disease, of course, is not common in all the irrigation projects of Iran, but it is confined to the Khuzestan region. This is because of the existence of favourable environmental conditions for Schistosomiasis in Khuzestan. With the extension of the irrigation canals, the already existing snail habitats have been

widely stretched over the entire DIP area and elsewhere in Khuzestan (see Chapter 14). So far, threetechniques have been used for the control of the desease. Each technique has its associated advantages and disadvantages. However, none of these techniques can be useful in absolute terms, unless they are accompanied by a continuous health and sanitation education programme for the local people. DIP brought a comprehensive health and sanitation education programme to the DPIP between 1962 and 1968 (see Chapter 7).

Indeed, the great efforts which KWPA made for the improvement of the health and sanitation conditions in the DPIP have been widely admired. Unfortunately with the coming of agro-businesses, the valuable efforts of KWPA in this field were diminished. In such circumstances, there will not be any improvement in the health situation of the people. Therefore, DIP, which brought health and education to people during its development period, may possibly introduce disease as a result of more canalization and the new policies of the government.

So far, every large dam scheme which has been constructed in Iran has had its associated hydro-electric power project. Since the Second World War there has been a great attempt for the industrialization of Iran. A great effort has been made for the development of the electric power industries. Prior to the 1930's electricity was almost unknown in Iran. By 1962 (the end of the Second Development Plan) the installed electricity capacity was 66 times that of 1935. Half of this capacity came from hydro-electric power plants (see Chapter 3). Electricity services in Iran were inefficient in terms of both quantity and quality. With the

creation of the Ministry of Water and Power in 1964 all the tasks of planning, implementation, supervision and management of electric power generation and transmission were undertaken by this Ministry. Since 1964 it has been hoped that the situation of electricity supply, transmission and distribution will be improved at the national, as well as the regional level in both quantity and quality.

During the Third and the Fourth Development Plans, more hydro-electric power projects were constructed. By 1973 (end of the Fourth Plan) over one third of the electricity generated in the country came from hydro-electric power plants.

By 1978 the contribution of the hydro-electric plants to the total installed capacity of Iran is expected to decline to almost one fifth (see Chapter 3). In the future more electricity will be produced through the installation of a number of nuclear power stations. The economic feasibility of such enterprise for Iran seems questionable, at least for the present time. This is mainly because for the generation of nuclear power, Iran has to depend entirely on expensive foreign technology and knowledge. In addition the disadvantages of the generation of nuclear power in terms of its associated environmental impacts is now well known in the advanced countries, if not in Iran.

Until now, the largest hydro power plant in operation in Iran in terms of its installed capacity is the Mohamad Reza Shah Pahlavi hydro power plant on the Dez river. The plant has been in operation since the Spring of 1963. The regional economic impacts of the project with regard to the development of industry and commerce have been somewhat behind those which had been planned. This is mainly because of

the high electricity tariffs in Khuzestan (see Chapter 16). The social impacts of hydro-electricity supply from the dam have been very significant. The number of electricity subscribers and the per capita electricity consumption for both the urban electricity consumers and the urban population show a noticeable development, though it is still small compared with that of the advanced countries.

In pure economic theory, cost-benefit analysis of the Pahlavi hydro-power project has indicated that the project has not been beneficial (see Chapter 17). Because of the lack of an electricity market in Khuzestan, half of the electricity has been transferred to Tehran at a very low price since 1971. Had there already existed an electricity market in Khuzestan, all the electricity produced from the dam would have been consumed in Khuzestan and the project would have been beneficial. The Shahbanoo Farah dam in Gilan illustrates the same problems. The market for its electricity was thought by the planners to be the Gilan area. However, this can only use 20,000 Kw out of a total 87,500 Kw which represents the installed capacity of the dam. Because of the lack of an electricity market, the electricity produced from the dam is transferred to Tehran over a 240 Km line which cost an estimated 500 million rials.

In Khuzestan, if the growth rate of electricity demand follows the same trends as in the past 14 years, the "break-even" point of the project will be reached in the early 1980's, which is after almost 20 years of the operation of the dam.

Multi-purpose dam schemes in Iran reveal time conflicts between the water flow required for power and the flow needed for irrigation. The

peak demand for irrigation is during the nine months from March to November. The water stored during the winter could be used for irrigation in the summer, but the peak demand for electric power is in winter. The same problems exist between the maximum need of water for irrigation during the day and the maximum water need for electricity generation in the evening. This has caused great quarrels on the one hand between the farmers and the officers of the departments of irrigation within every water and power authority and on the other hand between the senior officers of the departments of irrigation and the departments of the dam operations. The latter was specifically the case which was observed by the author in Gilan in July 1975 (when the dam was visited by the author in July 1975 only two generators out of 5 were in operation). Within the Dez Irrigation Project also the farming organisations were complaining about the shortage of water during the day and at the weekend for irrigation and the problem of shortage of irrigators during the night when water is available but irrigators are not.

One of the most important environmental reasons for the disappointing results of the large dam schemes in Iran is the way in which soil erosion within the catchments behind the dams has been grossly under-estimated. This has meant that the calculations regarding the life expectancy of the man-made reservoirs have been extremely optimistic (see Fig. 17-1). As a result the economic worth of the projects has been substantially reduced. (See cost-benefit analysis of the hydro-power project of the Pahlavi dam scheme in Chapter 17). In addition dams have often been planned and constructed on the basis of a short period of hydrological observations. (In the case of the Dez Dam less than five years instead of at least 30 years).

The available records on the Dez river seem to have been for periods of greater precipitation than average. This has meant that the project has been designed for a mean discharge value which is actually greater than the long term average. The consequence is that the project will produce fewer benefits than were planned or hoped for. The best example of this is that the Pahlavi reservoir can produce an average of approximately 2,050 million Kwh of electricity per annum instead of its installed capacity of 4,555 million Kwh/year (see Chapter 16). Another example can be seen from the Karaj dam which was designed and constructed for the installation of three generators with a total capacity of 90,000 Kwh whereas only two generators have been installed and, of these two, usually only one is in operation at any time. (Author's observation of the Karaj dam power house in June 1975.) The same situation exists for the Shahbanoo Farah dam. Only two generators out of five were in operation, when the dam was visited by the author in July 1975.

The experience gained through this analysis suggests a great question. This is whether it was necessary to install generators wherever a reservoir dam was constructed. Perhaps at first, from the point of view of the planners who designed the large multi-purpose dams for Iran, this was because of a general feeling that each Kwh generated by falling water irrespective of season or hour of the day means conservation of exhaustible fuels and a corresponding saving in thermal plant operation. One may not be convinced because surprisingly no electric power system alternative analysis has ever been made by the consultant companies which confirmed the economic preference of the hydro-electric power systems in Iran compared with any thermal power systems. Experience has shown that electricity

produced by the dams could be cheaper than that of a thermal plant provided that the costs of the transmission and distribution systems are disregarded (see Chapter 17). Twenty-five years ago, when the large hydro-power projects were being conceived for Iran, the logic of the construction of these projects in terms of saving fuel was meaningless. This is especially true for the Khuzestan region which has abundant available natural gas resources.

Experience gained through this analytical work as well as work carried out by other reserchers in Iran and abroad, express doubt as to the wisdom of continuing to build large high cost water resource projects. Had smaller projects been designed and constructed, the schemes would have been completed and would have earned a return long before the high priority schemes could be put to beneficial use. The question therefore arises, whether long-range development programmes necessitating large capital outlay should have been given top priority when smaller undertakings often yield earlier returns and provide greater benefits to classes needing the greatest help. In spite of the large size of some water resource projects, the proportion of the total population which benefits directly from them is still surprisingly small. Also the regions receiving new irrigation water supplies are only a small portion of the total cultivated area of the country. The government should have decided whether money spent on building a dam is better used than on some totally different development of its environment, e.g. transport; whether one large or several small dams are to be preferred, and whether expenditure is to be strictly economic, or partially or wholly regarded as expenditure on social welfare. In addition, and much more important, the government

should have decided what methods of farming were to be undertaken on an irrigation scheme, and whether they should be mechanised agriculture operated by the peasants, traditional agriculture, mechanised agriculture with paid labour or a combination of these. If the peasants are to become the operators of such projects they may need subsidies and training. The size of their holdings should have been decided - a very difficult yet crucial matter. Crop combinations, rotations, methods of harvesting, processing and marketing all call for decisions between alternatives. These were measures that, because of the absence of sufficient research and records, or because of some political issues, were not considered seriously by the planners and also by the Iranian authorities involved. In addition, perhaps, all attention has been devoted almost entirely to the solution of engineering problems and also the problems of financing the projects with little or no consideration of the needs of the local communities who will be affected by the projects. The lack of such coordinated surveys and studies is considered a crucial point for many large water development projects in Iran. A few works which have been carried out by foreigners are either not comprehensible to the Iranians or else they are scattered and inaccessible in the different departments of ministries in Tehran and/or in the regions. Such works have often cost millions of dollars to prepare. Because of these problems, despite the very great advantages which the large dam schemes should have brought, in practice, they are very few. It has been claimed that the dissemination of knowledge of modern irrigation techniques could not be easily achieved amongst the peasant farmers. As a result although the distribution of water through newly constructed canal networks has been achieved, the

utilization of the water by the farmer for irrigation has often been wasteful and in some cases has given rise to salinity problems (see Chapter 18). Water pricing policies also have not stimulated more efficient use of water, but rather have discouraged it. It is now clearly recognized that the newly constructed irrigation and drainage networks have not been functioning as efficiently as was initially hoped. As a result in the Fifth Development Plan considerable emphasis has been placed on the successful and profitable operation of irrigation networks below the large reservoir dams. Greater supervision of water resources are to be introduced to ensure that wastage is reduced to a minimum. Also attempts are to be made to improve traditional irrigation and drainage networks by direct government and/or by financial assistance. through self-help programmes. The implementation of this part of the plan should not be under-estimated since the traditional systems are so important to the rural livelihood. It seems unlikely that the programme will be successful through the self-help assistance principle. This is because after the implementation of the law concerning the establishment of the agro-business enterprises and the farm corporations, the confidence of the peasants has been greatly undermined. They often do not invest for the improvement of irrigation and drainage networks, because many of them still do not know whether their land will be purchased compulsorily, or what their new pwoers and rights will be in the rural community.

The application of recent modern technological advances in water resource management to the Iranian situation, such as sea water desalination, cloud seeding and recycling of waste waters, are new phenomena. Amongst

these, sea water desalination was begun earliest (during the Fourth Plan). Although this is a costly technique for Iran at the present time, it is likely to supply more water for urban and industrial purposes in the future.

In general over the next decade or so it seems inevitable that the demand for water will continue to increase rapidly in Iran.

With regard to the demand for water by different users (agricultural, domestic and industrial), Iran is now in a situation that some of the advanced countries such as the U.S.A. were faced with in the early nineteenth century (see Chapter 1).

The agricultural demand for water seems likely to rise at a much slower rate than that for industrial and domestic consumption. This is partly because most of the easily irrigable land is already utilized. If the continued rapid rise in the population causes further demands for food and fibres on the country's agricultural capacity, then there will be a need for a further large increase in the area of the agricultural land. In such circumstances, therefore, it is likely that more attention will be concentrated on the efficient utilization of available water resources.

Expansion of industrial activities in and around the large cities will result in a larger share of the increased demand for water. Tehran has already been faced with the problem of water supply. It is difficult to predict the urban demands for water in Iran but from the experience of Tehran it is likely to be very large (see Chapter 3).

With increasing urbanization, there will also be the associated increase in the general standards of living. This in turn means

greater per capita demands for water. The advanced countries experienced this long ago (see Chapter 1), whereas Iran is being currently faced with this phenomenon. The common rises in the standards of living produces a tremendous burden on water supply systems. As was discussed in Chapter 2, only the northern and western parts of the country have abundant water surpluses. As a result it seems inevitable that in the future, large scale water movement by pipelines or aqueducts will become essential for economic growth in Iran. The Lar project will be the first major project of this kind. This project diverts waters draining into the Caspian Sea towards the basin of the central desert.

In future, for successful water resource development, the following managerial measures must be taken into consideration:-

1) Great efforts must be made to ensure the efficient use of water already available within the irrigation projects.

2) Urgent action must be taken by the government or through the self-help principle of the farmers for the improvement of traditional irrigation and drainage networks. The latter could not be hoped for unless incentive measures were created by the government.

3) The construction of the irrigation and drainage networks associated with the large reservoir dams under construction or at the planning stage must be carried out simultaneously with the construction of the dam.

4) It seems there is need for an increase in the number of synoptic, rain gauging and climatological stations.

5) Hydrological and meteorological data must be recorded regularly and the data stored in computers.

6) Water resource development projects must be drawn up based on long-term hydrological data (at least 30 years).

7) Research has to be done on the assessment of long-term water demands by different users (agricultural, industrial and domestic) in every region, as well as at the national level.

8. Water resource development projects for industrial and urban purposes should not lead to a reduction in water supply for agriculture and so eliminate irrigated areas.

9) Water resource development projects require integrated planning using both surface and ground water resources. Therefore research has to be done on the following measures:

   a) Assessment of the available ground water resources which can be economically developed.

   b) Feasibility studies of the application of artificial ground water recharge techniques.

10) Introduction of the recycling and re-use of water for industrial purposes, especially in areas of water shortage such as in Tehran.

11) Allocation of funds to water resource development projects must be carried out in a coordinated way. In other words, all agricultural inputs must be financially assured for a relatively long period.

12) Priority must be given to regions with high agricultural potential at the planning stage. This means that scarce resources of capital must be accumulated in the areas of higher potential.

13) Plans must be drawn up in such a way that a higher proportion of the population benefit from the project. Therefore capital investment in areas of scattered population should be avoided.

14) Agricultural development of Iran must function as a supplementary element within the economy of the country, not as an alternative.

15) Social surveys must be considered as a prerequisite for water resource development planning. Research has to be done in this field in the irrigation projects already constructed, as well as within those under construction or at the planning stage.

16) Research needs to be done on the problem of soil erosion in the upper parts of the catchments of the reservoir dams already in operation and those under construction or being planned. Soil conservation measures must be set up long before the construction of these dams.

17) Flood damage has been enormous in Iran so far. Research ought to be done on the impact of floods on both controlled and uncontrolled rivers. New techniques of flood control must be used to reduce this damage.

18) Multi-purpose water resource projects will create many new inter-related problems. These problems have to be investigated in detail prior to the construction of the project.

19) The economic feasibility of projects ought to be investigated accurately before the time of the execution of the projects. In doing so, the wastage of scarce capital resources and the disappointing results will be considerably reduced.

20) The installation of the hydro-electric power plants must be avoided unless the economic feasibility of such enterprises is confirmed through the application of alternative system analysis techniques.

21) Plans should be drawn up based on national capabilities and national needs. Imported technical, administrative and economic models regardless of the countries of their origin (capitalist or communist) have not been successful so far. These models have brought a few advantages. Against these advantages stand many problems, the solution of which is very difficult.

22) The education of the farming population with regard to the use of modern techniques of irrigation and farming, the application of improved seeds, fertilizers, pest control, insecticides, etc. must be considered seriously at the planning stage as well as during the execution of the projects.

Having said so much concerning the large dams one should not lose sight of the fact that small dams, often of rock or earth, may not receive much attention in the literature, but yet may be of great local importance, especially when large dams cannot be built, or at least not for many years. Small dams should be encouraged to improve water supplies for man and animals, especially in the dry and poor areas, such as some parts of the central, southern and south-eastern provinces of Iran.

Today after almost thirty years of trial and error in water resource development, it is clearly recognised that it is more feasible and convenient to look at nature as it is and to use water and land resources in a more natural way. In doing so many problems will be avoided and environmental values will be conserved. In general, water for Iran and for other nations must be regarded as one of man's most

fundamental assets, an essential of civilization, yet one in short supply in many parts of the world (see Chapter 1).

APPENDIX A

DIP - Absolute Maximum Air Temperatures (Degrees Centigrade)

	Year	May	June	July	Aug	Sept	Summer
Andimeshk	1961	45.0	50.0	50.0	49.5	44.0	50.0
	1962	44.5	48.5	49.5	47.0	45.0	49.5
	1963	41.5	46.5	49.5	48.5	42.5	49.5
	1964	46.0	46.0	49.5	49.0	45.0	49.5
	1965	-	-	-	-	-	-
	1966	-	-	-	-	-	-
	1967	42.5	48.5	52.0	49.0	-	52.0
	Maximum	46.0	50.0	52.0	49.5	45.0	52.0
Dezful	1951	41.0	45.0	50.0	48.6	50.0	50.0
	1952	44.0	44.8	49.4	49.2	44.6	49.4
	1953	46.5	47.5	49.8	47.8	46.5	49.5
	1954	44.0	45.5	48.5	47.5	46.0	48.5
	1955	-	-	-	-	50.0	50.0
	1956	47.0	49.5	50.0	50.0	47.0	50.0
	1957	43.5	47.5	49.5	50.0	46.5	50.0
	1958	45.0	48.0	49.5	49.0	47.0	49.5
	1959	45.0	48.5	48.5	49.5	47.0	49.5
	1960	46.0	50.5	50.0	49.5	47.0	50.5
	1961	45.0	48.0	50.5	49.5	45.0	50.5
	1962	45.5	48.0	51.0	50.0	46.0	51.0
	1963	42.0	49.0	51.5	49.5	46.0	51.5
	1964	46.0	48.5	52.5	49.0	46.5	52.5
	1965	47.0	48.5	51.0	50.0	49.5	51.0
	1966	45.0	49.0	48.0	49.0	47.5	49.0
	1967	43.5	47.5	54.0	48.0	-	54.0
	Maximum	47.0	50.5	54.0	50.0	50.0	54.0

Source: DRC. 1970. Agro-business opportunities, Prospectus Series No.5 Grape production, processing and marketing. Imperial Government of Iran. KWPA. Table 23.

APPENDIX B

Natural Discharge of the Dez River - 1954-1962 (m^3/sec)

Dezful (at gauge stations 300 m and 375 m upstream from bridge)

Water year ending 30 September	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
1954	-	-	-	-	453	807	977	626	338	214	141	98	
1955	86	125	447	267	169	464	508	478	225	137	100	83	257
1956	89	120	163	170	314	459	556	395	238	165	100	82	238
1957	72	71	94	160	290	531	811	841	408	211	128	93	309
1958	107	170	207	261	227	455	362	214	138	91	72	59	197
1959	52	55	294	154	178	401	573	324	182	123	88	65	207
1960	58	64	70	175	108	171	371	294	154	98	68	53	140
1961	48	79	90	497	298	305	483	469	214	136	93	66	232
1962	58	67	109	198	323	195	417	361	181	120	84	62	181
Mean annual													220

Source: Ministry of Water & Power, KWPA. July 1971. Long term operation and capabilities of M.R.S. Pahlavi Dam and Reservoir on the Dez River in Khuzestan, by resource investigations project, Ahwaz. Table II-4.

APPENDIX C

Mean monthly precipitation at the Dezful Station (mm)
Mean monthly water flow into the reservoir (m^3/sec)
Mean monthly water released from the reservoir (m^3/sec)
Mean monthly agricultural water use of the DIP (m^3/sec)

1964 - 1969

YEAR		J	F	M	A	M	J	J	A	S	O	N	D
1964	Precipitation	2.0	20.3	10.9	0	0	0	0	0	0	0	13.0	74.0
	Water flow into reservoir	100.0	182.0	387.0	310.0	232.0	152.0	106.0	83.0	57.0	48.0	59.0	105.0
	Water released from reservoir	89.0	67.0	200.0	278.0	180.0	155.0	147.0	160.0	192.0	172.0	172.0	184.0
	Agricultural water use												
1965	Precipitation	171.3	11.0	39.3	9.5	0	0	0	0	0	23.0	87.0	5.4
	Water flow into reservoir	381.0	305.0	448.0	392.0	314.0	187.0	131.0	97.0	83.0	80.0	233.0	116.0
	Water released from reservoir	128.0	191.0	343.0	255.0	183.0	178.0	188.0	206.0	199.0	204.0	149.0	180.0
	Agricultural water use					37.7	49.9	55.9	80.3	82.7	79.8	44.2	50.0
1966	Precipitation	28.0	85.0	46.5	5.5	3.0	0	0	0	0	26.5	0	30.0
	Water flow into reservoir	154.0	500.0	443.0	336.0	311.0	197.0	145.0	110.0	87.0	99.0	73.0	78.0
	Water released from reservoir	148.0	325.0	428.0	237.0	180.0	185.0	200.0	210.0	202.0	170.0	167.0	149.0
	Agricultural water use	37.8	15.0	36.7	38.0	31.2	50.7	59.8	75.6	75.8	73.0	43.0	47.0
1967	Precipitation	15.5	59.5	10.0	17.6	22.5	0	0	0	0	1.0	68.0	7.5
	Water flow into reservoir	91.0	117.0	238.0	269.0	258.0	115.0	111.0	83.0	64.0	54.0	134.0	111.0
	Water released from reservoir	149.0	129.0	126.0	84.0	98.0	134.0	150.0	166.0	160.0	152.0	118.0	110.0
	Agricultural water use	41.0	54.0	50.0	43.0	41.0	62.0	55.8	79.4	79.9	80.5	32.0	19.0
1968	Precipitation	30.5	54.0	6.5	53.0	26.5	0	0	0	0	9.0	66.0	66.5
	Water flow into reservoir	158.0	213.0	305.0	548.0	472.0	276.0	177.0	122.0	96.0	74.0	143.0	198.0
	Water released from reservoir	99.0	100.0	242.0	325.0	484.0	277.0	198.0	200.0	200.0	194.0	145.0	146.0
	Agricultural water use	38.0	25.0	59.0	48.0	48.0	61.0	73.0	87.0	94.0	86.0	30.0	17.0
1969	Precipitation	172.5	41.0	56.0	67.5	31.0	0	0	2.0	0	2.0	29.0	46.0
	Water flow into reservoir	667.0	463.0	1,264.0	1,151.0	675.0	370.0	258.0	172.0	119.0	101.0	110.0	121.0
	Water released from reservoir	512.0	522.0	1,216.0	1,151.0	642.0	402.0	313.0	216.0	180.0	194.0	191.0	186.0
	Agricultural water use	13.0	13.0	34.0	27.0	29.0	50.0	67.0	88.0	82.0	79.0	29.0	45.0

Sources: (a) KWPA. Resource Investigation Project Department. (Date were obtained from Engineers - Dr. Dehqanian, Mostofi and Hosainzadeh, April 1975). Also from Ghazinoori, M., Ministry of Water & Power, Department of surface water resources, personal communications in February and May 1975.

(b) Ministry of Water & Power, KWPA, July 1971. Long term operation and capabilities of M.R.S. Pahlavi Dam and Reservoir on the Dez River in Khuzestan by Resource Investigations Project, Ahwaz, Table II-4.

APPENDIX D

Mean Monthly Discharge of the Karkheh River at Hamidieh Station. 1964 - 1969

(Drainage Area - 51,900 Km^2) (Discharge - m^3/sec)

Year	Mean Monthly Discharge												Mean Annual
	J	F	M	A	M	J	J	A	S	O	N	D	M-A
1964	75.3	116.0	206	169	69.7	22.7	14.3	8.56	6.18	30.20	59.0	89.0	72.4
1965	246.0	118.0	212	232	155.0	42.0	18.8	17.60	13.50	9.26	22.3	76.9	105.0
1966	47.5	259.0	265	212	123.0	30.9	19.3	14.40	13.00	27.80	115.0	56.4	98.6
1967	45.8	83.1	104	110	106.0	33.0	14.0	8.09	8.49	39.60	42.2	30.6	52.1
1968	82.8	103.0	193	262	391.0	211.0	48.9	30.90	23.90	12.60	35.5	122.0	127.0
1969	197.0	638.0	681	1,150	862.0	290.0	145.0	91.80	65.30	28.20	82.5	128.0	358.0

Source: Data were obtained from Ghazinoori, Officer of the Department of Surface Water Resources, Ministry of Water & Power, February and May 1975, Tehran.

APPENDIX E

Total Water Requirements from the Dez River below the Pahlavi Dam Reservoir (m^3/sec)

Use	J	F	M	A	M	J	J	A	S	O	N	D
DIP including Haft-Tappeh	17.3	29.8	65.6	91.6	101.8	132.0	143.5	136.4	103.4	60.0	29.0	15.5
Military lands	0.1	1.7	3.4	5.1	5.8	7.0	7.2	6.6	5.7	3.4	1.8	1.2
Zavieh	2.9	2.3	2.0	3.4	3.4	2.8	3.8	4.7	4.6	3.9	3.3	3.2
Dez East Flood Plain	0.2	0.4	0.9	1.5	2.8	3.6	3.6	3.3	2.4	1.4	0.9	0.2
Dez town. Pumps plus 10%	12.1	12.1	14.3	12.1	12.1	9.9	14.3	15.4	19.8	13.2	9.9	8.8
Housing area	0.5	0.5	0.6	0.8	1.1	1.2	1.5	1.6	1.4	1.0	0.8	0.6
	33.1	46.8	86.8	114.5	127.0	156.5	173.9	168.0	136.9	82.9	45.7	29.5
Reserve and contingency levels (estimated at 25 %)	8.3	11.7	21.7	28.6	31.8	39.2	43.5	42.0	34.2	20.7	11.4	7.4
	42	59	109	144	159	196	218	210	172	104	58	37

Source: Ministry of Water and Power, KWPA. July 1971. "Long term operation and capabilities of M.R.S. Pahlavi Dam and Reservoir on the Dez River in Khuzestan," by Resource Investigations Project, Ahwaz, Table V-F.

APPENDIX F

New Habitats of the Schistosomiasis Snail and Infected Areas created by the Expansion of the Greater Dez Irrigation System

Name of Village	Area	Type of Habitat	Date of Investigation	Caused by	Extent of Infection
Hossayniye, Balangoon	Pilot irrigation	1 Canal	1st quarter 1972	Expansion	Highly infected.
Khosrow agro-worker village	" "	1 Drain & 1 Swamp	2nd quarter 1973	"	Possibility of infection
---	Haft-Tappeh	2 Canals, 3 Drains & 4 night storage reservoirs	2nd quarter 1972	"	Highly infected
Bayza	West irrigation	1 Canal	4th quarter 1972	"	No infection yet
Boneh Issa	" "	1 Canal, 2 Ponds	3rd quarter 1972	"	Highly infected
Boneh Mahmid	" "	1 Drain	1st quarter 1972	Excess water	" "
Boneh Morad	" "	1 Drain	1st quarter 1973	" "	No infection yet
Chichali Ahmad	" "	1 Canal, 1 Drain & 2 Swamps	4th quarter 1972	Expansion	Possibility of infection
Chichali Bali	" "	1 Drain	4th quarter 1972	"	
Chichali Karam	" "	1 Canal & 1 Drain	4th quarter 1972	"	Possibility of infection
Chichali Rahim Khani	" "	No infected habitat but it is located between two other chichali	---		Possibility of infection
Chaleh, Shahrokni	" "	1 Drain & 3 Swamps			Highly infected
Khalaf, Haydar	" "	1 Drain, 2 Swamps and 1 Side-pool	1st quarter 1973	Excess water	Highly infected
Khan Abad, Ghotb	" "	1 Drain & 2 Swamps	4th quarter 1972	" "	Highly infected
Khayr Abad	" "	1 Swamp & Drain tailed to Karkheh River	2nd quarter 1973	" "	
Mian Choghan	" "	1 Canal, 1 Drain and 1 Swamp	3rd quarter 1973	Expansion	No infection yet
Morad Hadi	" "	2 Canals, 5 Swamps and 2 Ponds	4th quarter 1972	"	Highly infected
Radadeh	" "	1 Canal & 1 Swamp	1st & 4th quarters 1972	"	" "
Sayedeh	" "	1 Drain	1st quarter 1974	"	" "
Sayed Moosa	" "	1 Drain & 2 Swamps	4th quarter 1972	Excess water	" "
Sayed Razi	" "	2 Drains & 3 Swamps	2nd quarter 1972	" "	" "
Shavayeh	" "	2 Drains	1st & 3rd quarters 1972	" "	Possibility of infection

Source: Hazrati, The Health Department of the Ministry of Health in the Khuzestan Privince, Ahwaz. Personal communication, April 1975.

APPENDIX G

Cost of Sugar Production at Haft-Tappeh Sugar Cane Project - 1962-74

Year	Sugar production (tonnes)	Total cost (Alternative A) (rials)	Total cost (Alternative B) (rials)	Cost per tonne (A)		Cost per tonne (B)	
				rials/tonne	US.$/tonne	rials/tonne	US.$/tonne
1962	17,003	796,874,980	721,712,000	46,866.7	618.7	42,446.2	560.0
1963	15,298	730,284,980	650,894,800	47,737.3	630.2	42,547.7	561.6
1964	25,847	762,195,380	680,299,400	29,488.7	389.0	26,320.0	347.0
1965	37,023	777,909,420	694,245,900	21,011.2	277.0	18,751.7	247.5
1966	38,615	809,528,390	724,712,900	20,964.1	276.7	18,767.7	247.7
1967	42,394	833,332,750	747,670,800	19,656.9	259.5	17,636.0	235.9
1968	47,833	880,956,750	794,232,200	18,417.0	243.0	16,604.3	219.2
1969	54,100	915,963,870	825,998,600	16,927.8	223.0	15,265.2	201.5
1970	54,716	925,318,020	832,112,100	16,911.3	223.0	15,207.8	200.7
1971	49,348	992,855,560	892,328,400	20,119.5	265.6	18,082.5	238.7
1972	62,438	1,174,915,800	1,104,221,600	18,818.0	248.0	17,685.1	233.5
1973	88,166	1,935,172,200	1,767,792,000	21,949.2	322.8	20,050.7	294.9
1974	97,296	2,398,437,400	2,231,057,000	24,650.9	362.5	22,930.6	337.0

Note: A research group of the Institute of Social Research and Studies of the University of Tehran points out that in 1965 the sugar cost per tonne at Haft-Tappeh was high compared with the Dominican Republic standard of $100 per tonne[1]. (The cost of Sugar at Haft-Tappeh ranged between $170 - $200). As it is shown in the above chart, in both alternatives the costs per tonne have always been over $200. It was only in 1969 & 1970 that the cost of sugar was the same as that quoted by the research group.

(1) Research Group, 1965. Rural economic problems of Khuzestan in Tahqiqat-i-Eqtasadi, Nos.9 & 10, pp.153-223. p.180.

APPENDIX H

Grants and Loans supplied to the Farm Corporations - 1968 - 1971

Year	Number of shareholders	Free grants (1,000,000 rials)	Total free grants per shareholder (rials)	Low rate loans (1,000,000 rials)	Total low rate loans per shareholder (rials)
1968	4,698	214	45,551.0	69	14,687.0
1969	6,169	230	37,283.0	70	11,347.0
1970	6,169	173	28,043.4	73	11,833.3
1971	8,689	343	39,473.2	106	12,199.3
1972	15,250				
1973	22,778				

Source: Plan and Budget Organisation, Statistical Centre of Iran, Statistical Yearbook of 1352. p.304.

Loans Supplied to the Rural Co-operatives - 1964 - 1973

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
(1) Number of Cooperatives	3,846.0	5,518	7,033.0	8,236	8,388.0	8,102.0	8,298.0	8,450.0	8,361.0	2,717.0
(1) Number of Members (1,000)	665.0	746.	936.0	1,087	1,260.0	1,400.0	1,606.0	1,854.0	2,065.0	2,263.0
(2) Loans (1,000,000 rials)	1,434.0	1,883	5,024.0	4,077	5,041.0	5,752.0	6,314.0	6,812.0	10,072.0	12,370.0
(2) Loans per Member (rials)	2,156.3	2,524	5,367.5	3,750	4,000.7	4,108.5	3,921.5	3,674.2	4,877.5	5,466.2

Sources: (1) Plan and Budget Organization, Statistical Centre of Iran, Statistical Yearbook of 1352, p.302.

(2) Ibid. p.263.

APPENDIX J

Indicated Supply and Demand Balance
Selected Annual Crops of Iran
(million tonnes)

	Supply[1]		Demand		Balance	
	1975	1980	1975	1980	1975	1980
Wheat	4.9	6.0	5.8	6.9	-0.9	-0.9
Barley	1.1	1.3	0.9[2]	1.1[2]	0.2	0.2
Rice	1.5	2.0	1.5	1.8	*(+)	0.2
Sugarbeet	3.6	5.1	5.5[3]	6.6[3]	-1.9	-1.5
Sugar Cane	0.8	1.1				
Alfalfa	1.8	2.8				
Other fodder crops	0.5	1.3				
Pulses	0.2	0.3	0.2	0.2	*(+)	(+)
Oil seeds	0.2	0.3	0.3	0.4	-0.1	-0.1
Vegetables	2.4	2.8	2.3	2.9	*(+)	*(+)
Potatoes	0.6	0.9	0.6	0.7	*(+)	0.2
Melons	1.3	2.1	1.3	1.7	*(+)	0.3

Source: A. Lebaron, Tables S.7, S.8 and S.9 cited in Kaveda, H. 1973. I.L.O. p.12.

1. Estimated production from all crop lands, existing and planned.

2. Human consumption only. 1965 animal feed consumption estimated at 2.

3. Sugarbeet equivalent demands.

*(+) Indicates slight surplus.

APPENDIX K

Indicated Supply and Demand Balance

Selected Iranian Agricultural Products

(thousand tonnes)

Product		1975	1980
Milk equivalent (total)		- 1,368	- 1,527
Meat: Sheep and goats		- 64	- 76
Cattle and buffalo		- 38	- 54
Other red meat		- 14	- 20
Poultry		- 36	- 50
Vegetable oil*		- 62	- 54
Sugar		- 291	- 208
Eggs		6	5
Cotton (lint)		155	215
Animal products:	Skins	16	18
	Wool & hair	- 20	- 26
	Hides	- 7	- 9

* Net of amount available from domestic cotton seed production.

Source: A. Lebaron, Table S.10. Cited in Kaneda, H., 1973. I.L.O. p.13.

APPENDIX L

The Analysis of the Capital Recovery Factor

To solve the problems of discounting, the capital recovery factor was developed to reduce the work required. In other words, to produce equal value of costs for each of the 50 or 100 years of projections for the projects of the Pahlavi dam scheme, 50 or 100 separate single-payment present worth factors would have to be applied to find the present worth of the uniform annual cash flow. The task was made much shorter by developing the uniform-annual-series factor. The uniform-annual-series factor indicates equivalence between the value of the capital investment at an earlier date and its equal amount at the end of each of the N years or between the N equal values at the end of each year and an accumulated amount. To derive the equation of the capital recovery factor, the sinking-fund factor must be calculated first. The sinking-fund factor indicates the number of rials which must be invested in uniform amounts (A) at i% interest at the end of each of N years to accumulate 1 rial (F). The functional notation is (A/F i% N). By the application of the single-payment-compound-amount factor individually to each of the N values of A and by summing the result to obtain F, the result would be:-

$$F = A\left[1 + (1 + i) + (1 + i)^2 + (1 + i)^3 + \ldots + (1 + i)^{n-1}\right] \qquad \text{I.}$$

where the first value of A accumulates no interest because it is withdrawn immediately upon deposit and the last value of A accumulates interest for N - 1 years. Multiplying both sides of equation I by (1 + i) gives:

$$(1 + i)F = A\left[(1 + i) + (1 + i)^2 + (1 + 1)^3 + (1 + i)^4 + \ldots + (1 + i)^n\right] \qquad \text{II.}$$

The relationship may be converted from a series to an explicit expression through term by term subtraction of equation I from equation II to give:-

$$iF = A\left[(1 + i)^n - 1\right]$$

Then the sinking fund factor becomes:-

$$\frac{A}{F} = \frac{i}{(1 + i)^n - 1} \qquad \text{III.}$$

The capital recovery factor indicates the number of rials (A) which can be withdrawnin equal amounts at the end of each of N years, if 1 rial (P) is initially deposited at i% interest. The functional notation is (A/P i% N), because:-

$$\frac{A}{P} = \frac{A}{F} \times \frac{F}{P}$$

In which $\frac{A}{F}$ is the sinking fund factor and $\frac{F}{P}$ is the single payment compound amount factor "$(1 + i)^n$". If the equation III and the equation: "$\frac{F}{P} = (1 + i)^n$ " are substituted the capital recovery factor: " $\frac{A}{P}$ " will be obtained through the following equation:-

$$\frac{A}{P} = \frac{i}{(1 + i)^n - 1} \times (1 + i)^n$$

$$\frac{A}{P} = \frac{i(1 + i)^n}{(1 + i)^n - 1}$$

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