COPP/MIT/1963/9

REPORT

ON

MINOR IRRIGATION WORKS

(GUJARAT STATE)

COMMITTEE ON PLAN PROJECTS
(Minor Irrigation Team)
NEW DELHI
June, 1963

LETTER OF TRANSMITTAL

M. THIRUMALA RAO, M.P.,
Leader, Minor Irrigation Team.

Committee on Plan Projects,
NEW DELHI.
5th June, 1963.

My dear Shastri Ji,

The Minor Irrigation Team in the Committee on Plan Projects has finalised its report on the study of minor irrigation works in the State of Gujarat. I am forwarding a copy thereof for your perusal.

Gujarat is mostly a water deficient State. Irrigation, therefore, plays a very important part in its agrarian economy. Yet, utilisation of the potential created by way of minor irrigation works in the State is much below the desired level. A check up of the average utilisation against potential gives a percentage figure of 36·3 only. The State authorities are undoubtedly alive to this shortfall. The Team has made a number of suggestions in this respect, and it is hoped that efforts will be made towards fuller utilisation of the existing irrigation potential in the State.

Another significant minor irrigation programme in the State is the installation of deep tubewells for irrigation purposes. The Team has, however, expressed concern in this report on the limited subsoil water resources of the State, and have recommended that systematic subsoil water studies need to be carried out, more particularly in the areas where State tubewells are located. Besides, a number of procedural measures have also been suggested with a view to improve operational efficiency of the existing tubewells.

The views of the Team have been accepted by the State Government, and implementation of recommendations contained in this report will undoubtedly go a long way in improving the performance of irrigation works.

I also take this opportunity of expressing our thanks to the various officers of the State Government, who gave us fullest cooperation in our studies.

With kind regards,

Yours sincerely,

M. THIRUMALA RAO

Shri Lal Bahadur Shastri,
Home Minister,
Government of India,
NEW DELHI.

PREFACE

Study of Minor Irrigation Works in Gujarat State was taken up in accordance with the Terms of Reference laid down in Committee on Plan Projects No. COPP(4)/17/58, dated the 4th August, 1958 contained in *Appendix I* of this Report.

The Team comprised:—

(*i*) Shri M. Thirumala, Rao, M.P.	Leader	
(*ii*) Shri Baleshwar Nath, Chief Engineer (Addl.) .	Member	
(*iii*) Dr. Arjan Singh, Retired Director, Agri. Punjab	Member	
(*iv*) Shri Mahavir Prasad, Irrigation Adviser, Ministry of Food & Agriculture	*Ex-Officio*	Member

The study was initiated by the Leader on April 10, 1961 at Ahmedabad. A large number of projects in different parts of the State were subsequently visited by the Team and field studies were made on a few representative projects with a view to get general appraisal of performance and maintenance standards of Minor Irrigation Works of various types.

The Team has had discussions with the State authorities at appropriate levels on different aspects of irrigated agriculture dealt with in the Report. The observations of the Team and their recommendations thus reflect agreed views of the State authorities and the Team. Formal concurrence of State Government to the report is also implied in their communication No. MIR 1162/6600-H, dated 23rd May, 1963.

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CHAPTER I

General Aspects

1.1. Gujarat is the Western most State in the Indian Union. It extends from longitude 68.4 to 74.4 degrees east and latitude 20.1 to 24.7 degrees north. It is bounded on the west by Arabian Sea, in the north by the deserts of Pakistan and Rajasthan, in the east by the States of Rajasthan and Madhya Pradesh and in the south by Maharashtra. Physically the State can be divided into four distinct regions *viz.*,—

(*i*) Stretch of alluvial land extending from Abu hills to river Daman Ganga in the South.

(*ii*) Semi-arid tract of Kutch.

(*iii*) Peninsular region of Saurashtra.

(*iv*) Hilly tract in the North-east, comprising parts of Satpura, Vindhya and Gujarat-Malwa hill ranges.

PHYSICAL FEATURES

1.2. These regions have varying physical features. The north-eastern region consists of irregularly shaped hills including valleys, which form upper drainage area of the major rivers flowing towards the Gulf of Cambay, including rivers Tapi and Narbada, which flow through valleys formed by rifts along two flanks of Satpura hill range; the area lying between hilly ranges of Saurashtra peninsula is fairly alluvial. In the Central and Northern parts of Saurashtra and in the interior of Kutch there is a cover of Deccan trap. The marginal belts of the Saurashtra peninsula and Kutch are, however, marked by rocks of sedimentary origin. A special tract of Gujarat is Rann of Kutch, which is very peculiar in its natural features. It is an old arm of the sea, which has receded leaving behind a saline, sandy and barren plain, wholly unproductive. Geologically, therefore, Gujarat is a complex formation and has accordingly a varied pattern of agrarian practices, including its irrigational requirements. The soil classifications of the State are illustrated in Figure 1.1.

RAINFALL

1.3. The climate in Gujarat is dominated by monsoon rains which last from June to September and account for more than 90 per cent of total precipitation normally received in a year. They generally break early in June, reach their peak in July and begin to weaken from August onwards. The winter season from December to March is practically dry, with total rainfall for this period being even less than one third of an inch. There is rarely a rainy day during these months. April is the driest part of the year. In May, some early showers are received which help in starting agricultural operations.

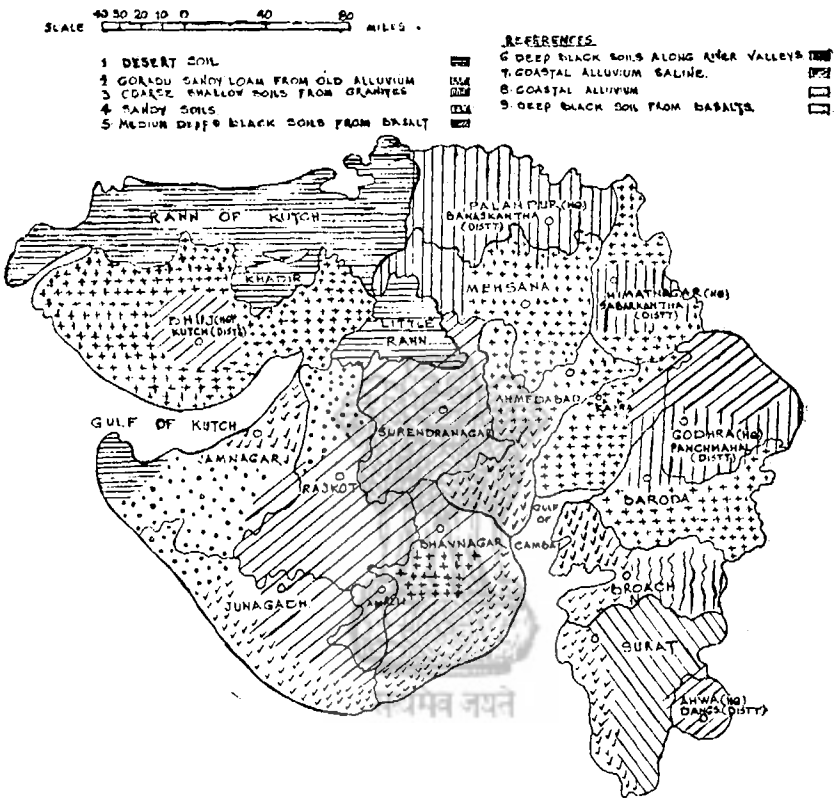

FIGURE 1.1 : *Soil map of Gujarat State.*

1.4. Rainfall also varies considerably from place to place. Monsoon weakens as one proceeds inland from the sea or from south to north. Thus, while the districts of south Gujarat get adequate rainfall during monsoon period, in parts of north Gujarat, Saurashtra and Kutch, the rainfall is not only inadequate but erratic. After long breaks, sometimes it is occasioned by torrential showers. Uneven and precarious rainfall is responsible for scarcity conditions in that belt and lead to either complete or partial failure of crops.

1.5. The study of rainfall data reveals existence of cyclic changes in the quantum of rainfall. These cycles are, however, neither simple nor regular to be the basis of forecasting. Isohyetal map of the State in Figure 1.2 gives the average.

AGRICULTURE

1.6. *Land Utilisation.*—According to 1958-59 figures Gujarat State had a total geographical area of 438.31 *lakh* acres, of which 118.88 *lakh* acres were reckoned as barren, uncultivated and land put to non-agricultural uses. This forms a percentage of 27.12 which is very high as compared to the Indian Union figure of 11.84 per cent. The total area under forest in the State is only 23.57 *lakh* acres but there are extensive culturable waste lands covering 18.27 *lakh* acres and permanent pastures and grazing lands with an area of 26.65 *lakh* acres. An area of 1.55 *lakh* acres is under miscellaneous tree crops and groves. The net sown area is 233.06 *lakh* acres. In addition, 7.76 *lakh* acres is under current fallows which gives total cultivated area of the State as 240.82 *lakh* acres. The population being 206.23 *lakhs*, per capita holding of cultivated area is 1.18 acre. The gross cropped area is 244.15 *lakh* acres, which gives 101.4 per cent as the intensity of cropping. In other words, by far, the most common practice in this State is to raise only one crop in a year from the soil and the area under double and multiple cropping is extremely low.

1.7. *Cropping Pattern.*—The cropping pattern of Gujarat State is characterised by the predominance of *kharif* cash crops and millets, and pulses in low area. Of the total area sown, about 45 per cent is under food grains and pulses, about 21 per cent under oilseeds and about 18 per cent under cotton. The principal crops of the State were groundnut, cotton, *bajri* and *jowar* with an area of 43.75 *lakh* acres, 32.85 *lakh* acres and 31.45 *lakh* acres respectively during the year 1960-61. Groundnut is generally grown in the lighter soils of Rajkot division. More than 1/5th of the area under cotton in the Indian Union is in this State. It is taken on heavy soils with a depth of 3-4 ft. and having 20-50 inches of rainfall. Most of the cotton is grown in Southern Gujarat where condition for raising long staple cotton are excellent. Cotton is mainly grown as a dry crop except in Ahmedabad and Kaira districts, where it is irrigated.

1.8. *Bajri* is entirely a rain-fed crop and is grown in light soils, in the districts of Banaskantha, Ahmedabad, Bhavnagar, Junagadh and Rajkot. In some parts, this crop is mixed with *tur*. *Jowar* is grown

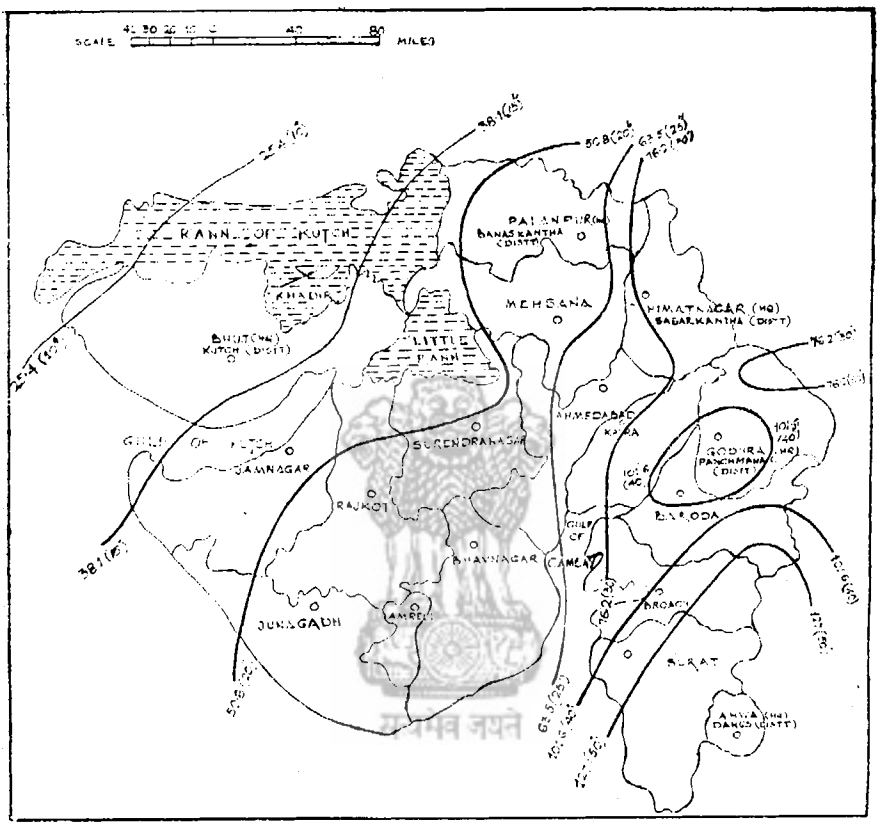

FIGURE 1.2 : *Isohyetal map of Gujarat State.*

in heavier soils of North Gujarat and Saurashtra. In Panchmahals maize takes the place of *jowar*. Even though, wheat and rice occupy far lesser area than *jowar* and *bajri*, yet because of high yields their production is sizeable. Wheat is specifically grown in North Gujarat and to some extent in Saurashtra districts, where winter climate is suitable for it. Rice is an irrigated crop and is grown in South Gujarat districts *viz.*, Panchmahals, Kaira, Baroda, Surat and Ahmedabad.

1.9. While in South Gujarat, the most common rotations are "*jowar*-cotton-cotton", "paddy-val", "paddy-paddy", in North Gujarat and Saurashtra, the usual cropping system is "*bajri-bajri*", "*bajri*-groundnut", "*bajri*-cotton-cotton", "*bajri*-groundnut-groundnut", "*bajri*-wheat-fallow-wheat". With irrigation, sugarcane, fruit crops and American cotton are also being grown. It is also common to raise summer *bajri* or *jowar* (without pulses) with irrigation, and grow wheat, tobacco or mustard with irrigation.

1.10. *Yield per acre.*—The average (per acre) yield of major food grains and cash crops of the State as compared with all-India figures for the period 1950-51 to 1960-61 are given in Table 1.1.

TABLE 1.1.

Crop	Average yield per acre in lbs., for 11 years 1950-51 to 1960-61 (Gujarat)	(All India)	Percentage of Col. 2 to Col. 3
1	2	3	4
Rice	543	756	72
Wheat	589	657	90
Gram	265	520	51
Jowar	189	405	47
Maize	709	685	104
Bajra	230	278	83
Cotton	100	87	115
Groundnut	468	599	78

It is evident that, except in cotton and maize, yields of all crops in Gujarat are not only less than the all-India averages but they are far below the optimum that can be reached if modern scientific methods are applied. It shows the magnitude of the task. Since *jowar* and *bajri* constitute staple food crops, their lower yield is primarily responsible for the food deficit in the State. With the present growth of

population, as it is, Gujarat, with such low yields, could not be expected to be self sufficient in food in the near future, but it can certainly produce greater proportion of her requirements than she is doing at present. The State is quite alive to this problem. The study of per acre yields reveal that during the quinquennium ending 1958-59, the average yields in comparison with those of the quinquennium ending 1953-54 rose by 33 per cent, 22 per cent, 31 per cent, 29 per cent, 30 per cent and 50 per cent for rice, *jowar*, *bajri*, gram, groundnut and cotton respectively. During the Third Five Year Plan, the following targets for the per-acre yields, have been fixed:

Rice	1,013 lbs. per acre
Wheat	800 lbs. per acre
Groundnut	635 lbs. per acre
Cotton	110 lbs. per acre

1.11. *Requirements.*—Although Gujarat is a lightly populated State yet increase in agricultural production is of as vital importance as in any densely populated part of the country. In food grains and pluses it is heavily in deficit, the total production in 1960-61 being 1.63 million tons of cereals and 0.14 million tons of gram and other pulses. After making an allowance of 12½ per cent for seed, wastage etc., the average quantity of food grains available per capita comes to nearly 6.81 ozs. of cereals and 0.58 ozs. of pulses (or 8 ozs. of cereals and 0.7 ozs. of pulses per adult equivalent). This falls far short of the standard requirements of 14 ozs. of cereals and 3 ozs. of pulses. In terms of total requirements of food grains, it is estimated that there is a deficit of 18 *lakh* tons in the State, a part of which is contemplated to be made good during the Third Five Year Plan. Since, however, food grains constitute only 45.4 per cent of the total cultivated area of Gujarat as compared with 75 per cent of the Indian Union and about 39 per cent of the area is under fibre and oilseed crops which also provide raw material to the industries, it is most essential to step up yield per acre of both food grains and cash crops.

IRRIGATION

1.12. The total area served with irrigation of one kind or the other was only 25.65 *lakh* acres. Prior to the Five year Plans irrigation received attention in some areas only. In the princely States, which comprise a large part of the present Gujarat State efforts were made only here and there. Integrated development of irrigation projects was not possible because of administrative divisions. Before the Plan period, therefore, in the State taken as a whole only 5.3 per cent of the cultivated area was being irrigated. During the First and Second Five Year Plans the additional irrigation potential created was hardly 0.74 per cent and 2.9 per cent respectively of the total cultivated area. The State Department of Irrigation expects that by the end of

Third Plan irrigation potential of 22.71 *lakh* acres *i.e.*, about 8.9 per cent of the total cultivated area will be created over that of 1950-51 figures. Working on that figure the total potential to be created by the end of 1965-66 will be 14.2 per cent, leaving about 86 per cent of the area dependent on the vagaries of nature.

1.13. A review of the progress of irrigation from minor works given in the Table 1.2 indicates that what has been said for the progress of irrigation in general holds equally good for the minor irrigation works.

TABLE 1.2

Item	Additional irrigation potential created (acres)	Actual area irrigated (acres)	Percentage
1	2	3	4
1 Before First Five Year Plan . . .	1,60,000	1,27,000	79·3
2 First Plan	1,32,000	73,000	55·3
3 Second Plan	1,28,000	73,500	58·0
4 Third Plan (Expected figure). . . .	2,45,000	2,21,000	90·0
Total up to the Third Plan .	6,65,000	4,94,500	

1.14. An actual expenditure of Rs. 4,25,81,000 incurred on minor irrigation works during the First Plan period resulted in creating an additional irrigation potential of 1,32,000 acres, while in the Second Plan period an estimated expenditure of Rs. 6,54,93,000 could add only 1,28,000 acres towards irrigation potential.

1.15. These figures indicate that costlier minor irrigation works were taken in the Second Five Year Plan period; actual outlay in the First Plan was Rs. 322 per acre of potential created and in the Second Plan was Rs. 542 (estimated) per acre of potential created. The percentage of potential to utilisation, which was 79.3 before the plan period has gone down to 55.3 towards the close of First Plan and to 58.0 towards the end of Second Five Year Plan. The State Department of Irrigation proposes to utilise 90 per cent of the potential created in the Third Five Year Plan. This appears to be an ambitious target. Unless an all-out effort is made by the State authorities to co-ordinate the project, it may be difficult to achieve this target, particularly in view of the experience during the First and Second Plan periods.

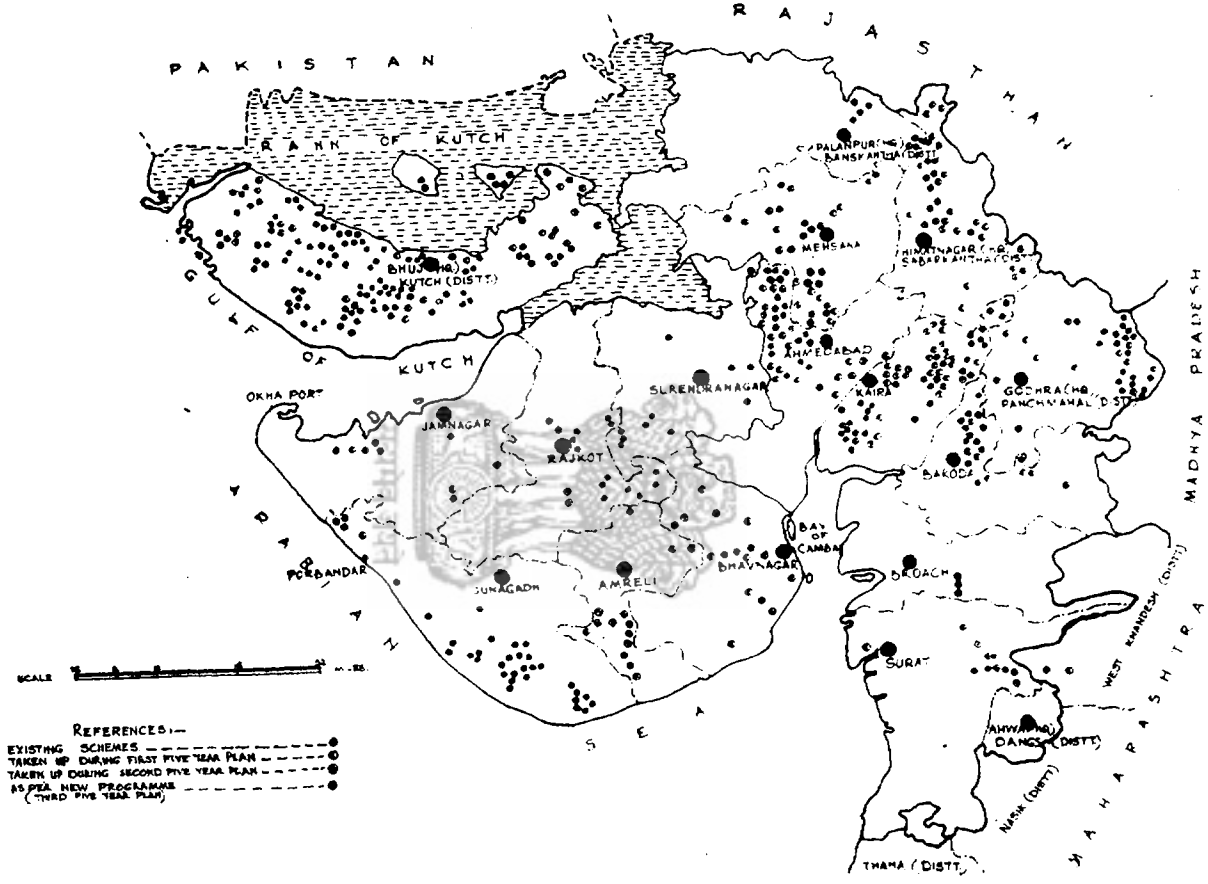

FIGURE 1.3 : *Map showing Minor Irrigation Works in Gujarat State.*

1.16. These figures also lead to the conclusion that:—

(*i*) either minor irrigation projects were taken up in those areas where the cropping pattern was such that appreciable benefits could not accrue by irrigation ; or

(*ii*) the cultivators are not well-versed with the benefits of irrigated agriculture ; or

(*iii*) the projects have not been completed in the stipulated manner, thus denying the cultivators the promised benefits, as could result only from completed schemes.

1.17. These various aspects need to be looked into by the State authorities. The field studies conducted by the Team as have been presented in the subsequent chapters, cover a wide field of minor irrigation works comprising diversion canals and tanks, tube-wells, surface wells and lift irrigation schemes and other ancillary subjects (Figure 1.3). These studies go to indicate that on a number of projects, completion of schemes by way of distributory and field channels and by way of planning for the use of created potential had not been done. Minor irrigation works are undoubtedly spread out in small units over vast areas. But, they are projects which can yield quick results. A greater attention is, therefore, warranted by them, so that they could be mobilised into productivity to a greater extent.

1.18. The aim of these studies is primarily to bring out techno-economic performance of these works indicating at the same time improvements possible in their construction, operation and maintenance, so that they could yield greater benefits than that has been possible so far, both to the State and to the people.

CHAPTER II

State Tube-wells

2.1. Tube-wells as a means of irrigation were built in Gujarat, particularly in the ex-Baroda State, more than 20 years ago. There has been a progressive development in this direction ever since. The progress of tube-wells in the State, since 1949-50 to 1960-61 is given in Table 2.1. Figure 2.1 gives the graphical representation of the same.

2.2. Sub-soil conditions in Gujarat vary from those obtaining in the Indo-Gangetic alluvial plains of northern States. Water aquifers are met with only in some localised tracts. Even so, in some areas water yielded is not free from salt. Besides, ground water levels are also low and comparatively deep borings have to be resorted to in order to tap good water bearing aquifers. The number of State tube-wells operating in the State as on 31st March 1961 are indicated group-wise in Table 2.2. and Figure 2.2.

2.3. Before undertaking the field inspection of some of the tube-wells in the State, the Team called upon the Chief Minister of Gujarat, Dr. Jivaraj Mehta. The Chief Minister, among other things, mentioned that he had had complaints about falling water tables in some of the areas served by State tube-wells. He felt that where tube-wells have been built, open well exploitation of sub-soil water through *Mote* or bullocks has become difficult. He expressed great concern about it, though the State Chief Engineer stated that the tube-wells mostly tapped deep confined aquifers. The Team feels that regular and systematic sub-soil water level studies should be carried out in the State, particularly in the areas served by State tube-wells. The State, authorities had subsequently been advised accordingly by the Team in their D. O. letter No. COPP/B/MIT/192, dated April 27, 1961 (*Appendix II*). It is gathered that the State authorities are taking necessary action thereabout.

2.4. The Team inspected a number of tubewells in the State. The first tubewell visited was No. 74 of Dehgam Block in village Lawerpur, district Ahmedabad. This tubewell was reported to have a discharge of 60,000 gallons per hour at a depression of 40 feet. Its irrigable command is fixed at 480 acres. It was put into commission in November, 1958 and during that year (1958-59) it irrigated an area of 51.42 acres only. In the subsequent years its performance was as given below :—

1959-60	169·86 acres
1960-61	220·11 acres

2.5. The shortfall in irrigation was attributed to the tendency of cultivators to depend on rains during the monsoon, and take to irrigation water only, when they fail. As it is, water is made available

TABLE 2.1

Statement showing No. of tube-wells in operation from 1949-50 *to* 1961-62 *along with their performance*

Year	No. of tube-wells in operation	Total area irrigated (acres)	Average area irrigated per tube-well (acres)	Total running hours	Average running hours per tube-well	Remarks
1	2	3	4	5	6	7
1. 1949-50	25	1,187·00	47·50	1,25,181·00	5,000	
2. 1950-51	25	2,202·00	88·00	46,986·00	1,875	
3. 1951-52	25	3,277·00	131·00	72,584·00	2,903	
4. 1952-53	27	2,794·00	103·50	72,934·00	2,701	
5. 1953-54	27	1,793·00	66·40	49,759·00	1,842	
6. 1954-55	53	1,661·20	31·30			
7. 1955-56	149	8,712·51	58·50	Not available.		
8. 1956-57	165	11,244·99	68·20			
9. 1957-58	320	29,937·04	93·55	4,79,650·25	1,499	Some incomplete tube-well units were in emergency operation in 1957-58 but did not operate in 1958-59 due to civil works in progress.
10. 1958-59	313	27,132·21	86·68	4,84,853·00	1,549	
11. 1959-60	365	30,467·47	83·47	6,23,419·25	1,708	
12. 1960-61	398	58,053·17	145·86	10,44,621·50	2,625	
13. 1961-62	460	35,673·85	77·55	7,74,034·25		

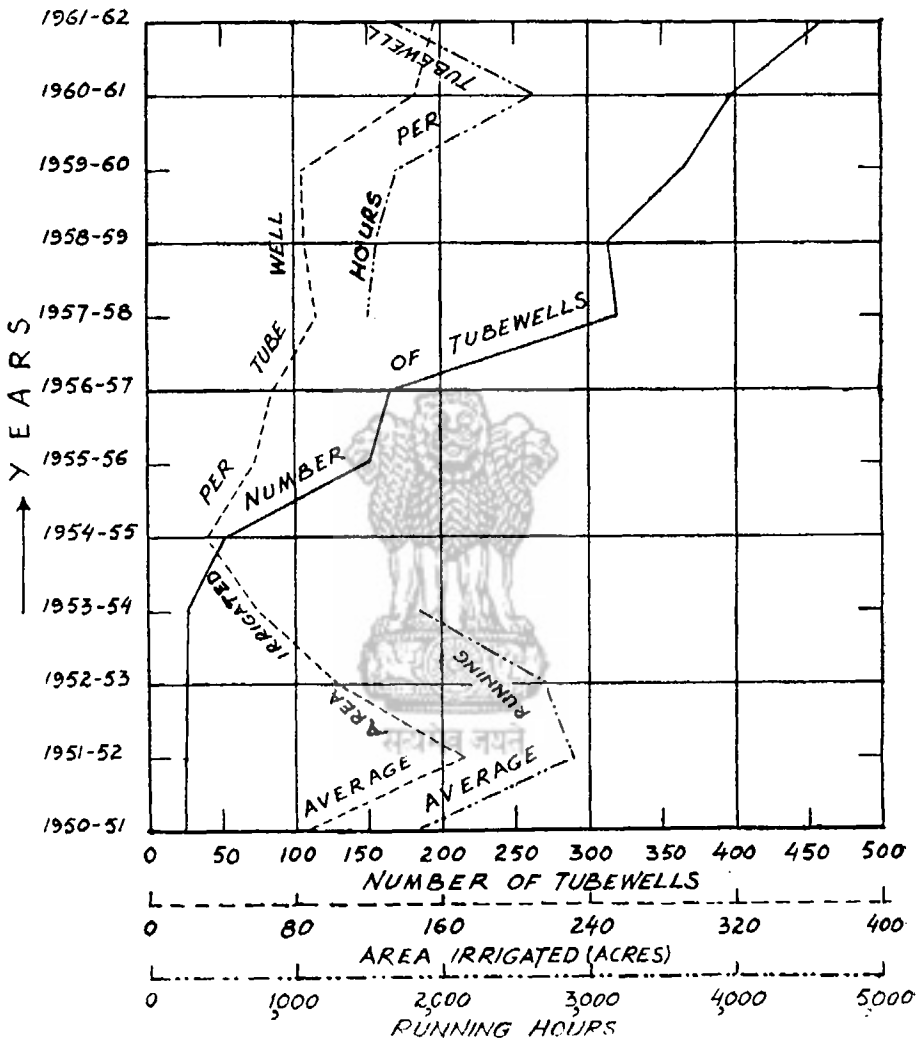

FIGURE 2 1 : *Graph showing progress of State tube-wells.*

TABLE 2.2

Statement showing performance of tube-well groups in Gujarat State (1960-61)

Name of Group	Total No. of tube-wells proposed	No. of tube-wells in operation on 31-3-61	Average irrigated area per tube-well (acres)	Average running hours per tube-well	Average assessment per tube-well (Rs.)	REMARKS
1	2	3	4	5	6	7
1. Dehgam Block	63	62	137·80	2500	4500	
2. Dehgam N.E.S.	9	9	224·00	3760	6768	
3. Dehgam Kanbha. . . .	18	10	112·20	1553	2795	
4. Vijapur Block	57	57	184·00	2910	5238	
5. Vijapur (Mehsana Sec.) . .	22	21	184·80	2890	5202	
6. *Ex*-Baroda State	27	27	156·50	3620	6516	
7. Vijapur (C.D.P.)	22	22	172·00	2990	6382	
8. Kadi Kalol.	49	49	139·20	2970	6348	
9. Patan Chanasma. . . .	60	60	144·50	2430	4374	
10. Banaskantha	74	73	112·00	2080	3744	
11. Mehsana (B' Block) . . .	84	8	34·30	284	511	

NOTE.—Information in Col. 2 *i.e.*, Total No. of tube-wells proposed is given for only successful tube-wells in Blocks when irrigation started.

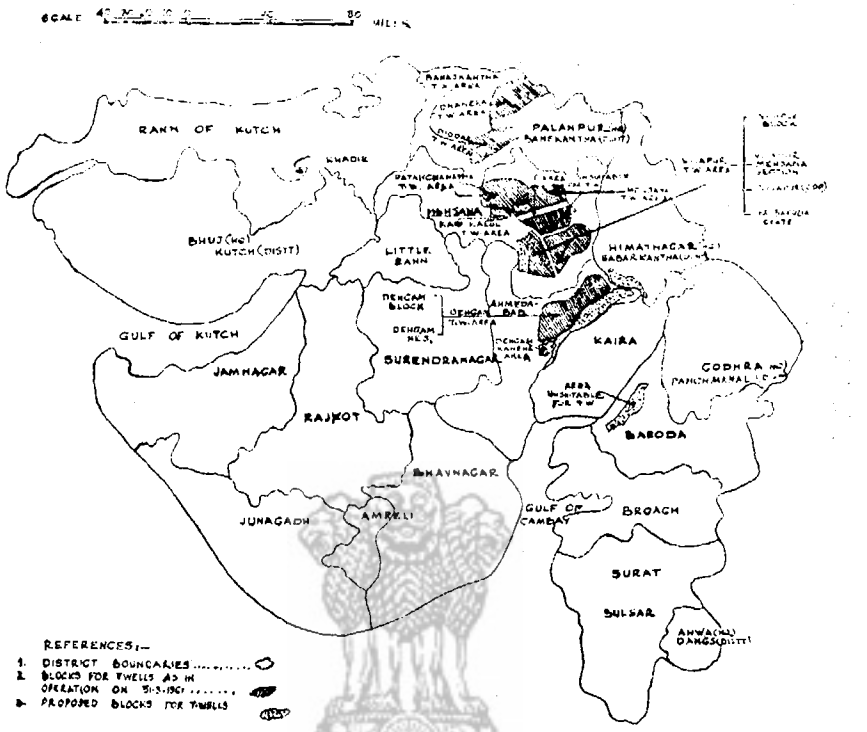

FIGURE 2.2 : *Map showing location of tube-well areas developed and proposed.*

to the cultivator only on application. It was gathered that if an applicant is a defaulter in the payment of water rates, no further supply of water is given to him. This condition is rather hard and is not conducive to optimum utilisation of tube-well water. Realisation or non-realisation of water rates should not normally stand in the way of irrigation development in the field. The Irrigation Department should supply water and prepare assessment papers, as in the northern States of Uttar Pradesh and the Punjab, and the responsibility for realisation of water rates should rest on Revenue authorities. Recoveries of arrears of water rates should be made under Section 57 of the Bombay Irrigation Act, 1879.

2.6. It was observed that when there is demand, water is supplied to the cultivators in the order in which applications are received. This is not a healthy system. There is loss of both water and time in filling the different water courses one after the other. According to the procedure of *Osrabandi* in U.P. and *Warabandi* in the Punjab the area on one water course or its branch is fully served before water is diverted to the other branch. The added advantage of this system is that the turns are fixed on rotational basis. The irrigators thus become irrigation minded in utilising the supplies.

2.7. It was also observed on some tube-wells that the discharge tank being high above ground level, water was being unnecessarily lifted by about 2 feet. This lift, it is felt could be avoided by providing outlets at different levels to suit different water channels, because there is difference in the levels of the commanded areas.

2.8. The next tube-well visited by the Team was No. 72 in village Chiloda in Dehgam Block. This tubewell was put into commission in November, 1958. Its discharge is reported to be 35,400 gallons per hour. Its irrigable command has been fixed as 283 acres consisting of 85 acres of Hot Weather, 56.50 of *Kharif* and 141.50 of *Rabi* crops. During the two subsequent years *i.e.*, 1959-60 and 1960-61 its performance has been as indicated in Table 2.3.

TABLE 2.3

Year	Hot weather (acres)	*Kharif* (acres)	*Rabi* (acres)	Total	Actual pumping hours
Irrigable Target . .	85·00	56·50	141·50	283·00	..
1959-60	52·47	2·30	88·45	143·22	2,185·00
1960-61	76·02	55·00	73·28	204·30	2,898·50

Although there is a progressive increase in the irrigation, the achievement is below the target. There is scope for further development.

2.9. On this tubewell, the Team got the depression observed. It was found to be about 40 feet. It was also gathered that no regular system was developed for observation of discharge and depression on tube-wells, even though it is very important to keep a watch on the behaviour of tubewells with regard to their supplies. Table 2.4 showing comparative criteria for acceptance as laid down in Uttar Pradesh, Punjab and Gujarat is given below :—

TABLE 2.4

Comparative statement showing criteria for acceptance of the Tube-wells in various States

Particular	STATES		
	Uttar Pradesh	Punjab	Gujarat
1. Minimum discharge . . .	33,000 G/PH	33,000 G/PH	15,000 G/PH
2. Pumping water level . .	50 feet	50 feet	90 feet
3. Draw Down	20 feet	20 feet	30 feet

It will be advantageous if the State authorities introduce regular pro-forma as are in operation in Uttar Pradesh for periodic inspection and check up of tube-wells by the supervisory staff.

2.10. Another tube-well visited by the Team was No. 65 in village Chiloda, Dehgam Block in Ahmedabad district. This tube-well came into operation in 1957. Its discharge is reported to be 31,100 gallons per hour. Performance of the tube-well is given in Table 2.5.

TABLE 2.5

Year	Hot weather (acres)	*Kharif* (acres)	*Rabi* (acres)	Total	Actual pumping hours
Irrigable target . .	75·00	49·50	124·50	249·00	
1957-58	..	..	229·72	229·72	1,812·25
1958-59	19·02	..	37·79	56·81	1,173·75
1959-60	15·80	3·25	83·27	102·32	1,813·00
1960-61	89·17	48·10	94·30	231·57	3,076·75

2.11. The shortfall in irrigation was again attributed to the cultivators' dependence on monsoon. Another reason advanced was that people could not take water because of heavy arrears of irrigation

charges due from them. This recovery of arrears has stood in the way of utilisation of the potential created. The Team feels that until a regular Tubewell Act comes into operation in the State, the recoveries of tubewell charges could be effected under Section 57 of the Bombay Irrigation Act, 1879 as arrears of land revenue.

2.12. Another tubewell visited by the Team was No. 2 in Vijapur Block, village Pilwai. This tubewell was commissioned in 1955 with an oil engine. Its discharge was reported to be 18,000 gallons per hour with an annual irrigation target of 144 acres. In 1960-61 it was switched over to electricity and its commanded area has been raised to 195 acres and discharging capacity to 24,400 gallons. In 1955-56, 1956-57 and 1957-58 it irrigated 84, 81 and 106 acres respectively. Its performance in the subsequent years, *viz.*, 1958-59, 1959-60 and 1960-61, is given in Table 2.6.

TABLE 2.6

Year	Hot weather (acres)	*Kharif* (acres)	*Rabi* (acres)	Total	Actual pumping hours
Irrigable target	43·00	29·00	72·00	144·00	
1958-59	8·15	10·05	81·48	99·68	1,669·00
1959-60	22·70	..	92·20	114·90	3,722·75
1960-61	..	..	..	172·45	3,346·00

2.13. It will, therefore, be apparent that there is much scope for development on this tubewell. The Team looked into its financial picture which is a typical one. Expenditure and earnings during the year 1957-58 on it are given as under:—

	Expenditure (Rs.)	Income (Rs.)
		water rates
Cost of fuel	3,032	3,802
Spares	144	
Sundry	80	
Mechanical works	60	
Civil works	100	
Work-charge establishment	684	
Oilman's salary	585	
Depreciation @ 4%	2,000	
Interest @ 4½% on Rs. 50,000	2,250	
TOTAL	8,935	3,802

There was thus a net loss of Rs. 5,133 in 1957-58. Since the area irrigated in that year was 106 acres, this loss works out to about Rs. 48 per acre. During the subsequent years, *i.e.*, 1958-59 and 1959-60 corresponding figures for losses are reported to be Rs. 5,148.06 and Rs. 7,330.49 respectively. The Team feels that the State finances cannot go on sustaining such losses for long.

Depreciation @ 4% seems to be on the conservative side. In States like Uttar Pradesh, where tubewell irrigation has a history of about 30 years, the average life of a tubewell is put at 17 years only and depreciation is accordingly allowed.

2.14. With switching over of the tubewell to electricity in 1960-61 the expenditure incurred is as under:—

	Rs.
Working expenditure	8,163
Depreciation @ 4%	2,000
Interest @ 4½% on Rs. 50,000	2,250
TOTAL	12,413

The tubewell is stated to have run for 3,346 hours and irrigated an area of 172.45 acres. Expenditure per acre thus comes to Rs. 72, which is roughly Rs. 23 per acre less than what it was when the tubewell was running on diesel oil. In the interest of economy and efficiency, the pace of energising the tubewells working on diesel oil may be accelerated.

2.15. Tubewell No. 12 in Kalol Block in village Nandasan was next visited by the Team. This tubewell came into operation in September, 1957. Its discharge is reported to be 25,300 gallons per hour. Its irrigable commanded area is 203 acres. Performance of the tubewell is given in Table 2.7.

TABLE 2.7

Year	Hot weather (acres)	*Kharif* (acres)	*Rabi* (acres)	Total	Actual pumping hours
Irrigable target	61·00	40·50	101·50	203·00	
1957-58		20·00	60·00	80·00	1,340·00
1958-59	3·75	0·90	79·87	84·52	2,288·25
1959-60	15·31	..	82·35	97·66	1,935·00
1960-61	28·80	68·41	50·12	147·33	3,123·30

The shortfall in irrigation has been attributed to the primitive agricultural practices prevalent. It was also stated that land is allowed to remain fallow during hot weather once in three years for restoration of fertility. Difficulty in procurement of land for water courses was also responsible for poor development of irrigation. It is felt that process of acquisition of land for water courses under the existing rules being lengthy and complicated, some sort of amendment to the existing Act is warranted, as has been done in the State of Punjab. Irrigation on this tubewell reached 150.07 acres as against a target of 203 acres. The Team feels that the incentive of concessional water rates for hot weather and green manure crops, might help development because the shortfall of hot weather crops is very conspicuous.

2.16. The Team also visited tubewell No. 11 in Kalol Block. This tubewell discharged only 21,900 gallons per hour and has irrigable command of 175 acres. It came into operation in 1957 and its performance is given in Table 2.8.

TABLE 2.8

Year	Hot weather (acres)	*Kharif* (acres)	*Rabi* (acres)	Total	Actual pumping hours
Irrigable target . .	53·00	34·50	87·50	175·00	
1957-58	..	31·00	70·00	101·00	1,550·00
1958-59	23·32	1·00	92·52	116·84	2,424·00
1959-60	20·32	..	83·25	103·57	2,089·50
1960-61	40·37	58·25	55·07	153·69	4,092·80

This tubewell has almost achieved its target with regard to its irrigation.

2.17. A few tubewells visited by the Team during their inspection go to show that State needs a Tubewell Act, proper regulation of supplies, on *Osrabandi-Warabandi* system, tubewell channels and a co-ordinated drive all the year round for agricultural activities on the tubewells, which have perennial supplies. With regard to cultivators depending on monsoon it may seem advisable to introduce a 'Two-part Tariff' consisting of a fixed yearly standing charge and a recurring charge on actual area irrigated. Steps are required to be taken immediately to see that non-recovery of arrears does not stand in the way of development of irrigation on tubewells.

2.18. As stated earlier, deeper strata have to be tapped in Gujarat, as compared to Uttar Pradesh and the Punjab, to get adequate discharge from the tubewells. As a result, the cost of tubewells is higher in Gujarat than in northern States. It is estimated to be about Rs. 81,500 per tubewell.

TABLE 2·9

Table giving the working expenditure for tubewells run on electricity

Running hours	Fixed overhead charges including fixed electricity charges (Rs.)	Cost of energy @ 0·12 nP. per unit at 14 unit per Hr. 1.68 (Rs.)	Total cost (col. 2+3) (Rs.)	Income @10,500 gallons per rupee (Rs.)	Income through slab rate on specific crops (Rs.)	Total Income [col. 5(a) + col. 5(b)] (Rs.)	Cost per hour in pumping (Rs.)	Gain (+) or loss (—) per tube well per year [col. 5(c)—4] (Rs.)	% Return gain (+) or loss (—) on average of tube-well (Rs.)	Remarks
1	2	3	4	5(a)	5(b)	5(c)	6	7	8	9
Nil .	6,560	..	6,560	..	..	..	..	— 6,560	— 8·08	Details of col. 2 are as under:
500 .	6,560	840	7,400	1,200	240	1,440	14·80	— 5,960	— 7·31	Depreciation charges Rs. 3,260
1,000 .	6,560	1,680	8,240	2,400	480	2,880	8·24	— 5,360	— 6·57	Establishment charges Rs. 1,000
1,500 .	6,560	2,520	9,080	3,600	900	4,500	6·05	— 4,580	— 5·61	Fixed Eectricity charges Rs. 1,800
2,000 .	6,560	3,360	9,920	4,800	1,200	6,000	4·90	— 3,920	— 4·80	Maintenance & Repairs charges Rs. 500
2,500 .	6,560	4,200	10,760	6,000	1,500	7,500	4·30	— 3,260	— 3·19	Total Rs. 6,560
3,000 .	6,560	5.040	11,600	7,200	1,800	9,000	3·50	— 2,600	— 3·19	
3,500 .	6,560	5,880	12,440	8,400	2,100	10,500	3·40	— 1,940	— 2·40	
4,000 .	6,560	6,720	13,280	9,600	2,700	12,300	3·30	— 980	— 1·2	
4,500 .	6,560	7,560	14,120	10,800	3,000	13,800	3·10	— 320	— 0·39	
5,000 .	6,560	8,400	14,960	12,000	3,300	15,300	2·90	+ 340	+ 0·42	

NOTE.—The average cost of tubewell is taken as Rs. 81,500.

2.19. The Team has made a study of the financial picture of the tubewell project as a whole in the State. This is given in Table 2.9. It will show that unless a tubewell is run for 5,000 hours, it will not be able to balance its working expenditure. If interest charges are also included, the running hour limit will go still higher. In the case of diesel oil run engine, this limit for cost-balance operation will come to 5,500 hours per tubewell.

2.20. Water rates on Government tubewells in Gujarat are higher as compared to those in the northern States of Uttar Pradesh and Punjab. Water is supplied at the rate of 10,500 gallons per rupee on a volumetric basis. Besides, there are additional slab rates on specific crops as outlined below:—

(*i*) On the Variali, & Virginia tobacco an additional slab rate of	Rs. 25/- per acre.
(*ii*) On the three cash crops *viz.*, Jiru, Sarsav and country tobacco an additional slab rate of . . .	Rs. 15/- per acre.
(*iii*) For individual vegetable crop an additional slab rate of	Rs. 8/- per season.
(*iv*) For cotton an additional slab rate of . . .	Rs. 20/- per acre.

2.21. With the rate already pitched at that level, there is hardly any scope for increase in the rates. Initial cost of the tubewells being high ; power supply rate being 12 nP. per unit, cost per hour of pumping works out to Rs. 2·90 (for 5,000 hours yearly running) as against Rs. 1·02 for similar running of State tube-wells in Uttar Pradesh.* The rate of electricity is quite high. Electric supply for agricultural consumption like that on tubewells has to be cheap.

2.22. Figure 2.1 indicates that average running of 398 tubewells during 1960-61 was 2,625 hours. It is doubtful if the tubewells can easily catch up 5,000 hours per year level so as to balance the cost of operation. Tables 2.10 and 2.11 will indicate the State has sustained a loss of about Rs. 3,00,000 and a minus return on capital outlay of the order of 4.5 per cent.

There may, however, be indirect benefits of irrigation. If these could be translated into monetary terms, the State authorities might be in a position to evolve a different financial criteria to arrive at a more favourable financial return from tubewells. The picture, as it is, shows investment on State tubewells as highly unremunerative.

2.23. A large number of borings had been attempted in the peninsular part of the State by the Exploratory Tubewells Organisation of the Ministry of Food and Agriculture, Government of India. The results of these borings are shown in Figure 2.3. A great majority of these have been failures. It is strange that so many borings were tried

*Report on State Tubewells—Uttar Pradesh, issued by the Committee on Plan Projects, paragraph 3.4, page 16.

TABLE 2.10

Statement showing the overall financial picture of the State tubewells

	Year	Total No. of tube-wells at the end of the year	Gross receipt	Total working expenses	Net revenue	Simple interest @ 4½%	Profit (+) or loss (—)	Remarks
1		2	3	4	5	6	7	8
			Rs.	Rs.	Rs.	Rs.	Rs.	
1	1949-50 . .	25	53,278	66,547	— 13,269	62,028	— 75,297	
2	1950-51 . .	25	68,173	79,352	— 11,179	62,028	— 73,207	
3	1951-52 . .	25	1,29,428	1,01,322	+ 28,106	63,697	— 35,591	
4	1952-53 . .	27	1,32,054	2,06,825	— 74,771	64,737	— 1,39,508	
5	1953-54 . .	27	1,04,632	1,99,562	— 94,930	66,420	— 1,61,350	
6	1954-55 . .	53	76,940	1,36,393	— 59,453	1,94,377	— 2,53,830	
7	1955-56 . .	149	3,43,931	5,65,258	— 2,21,327	5,46,457	— 7,67,784	
8	1956-57 . .	165	4,00,941	11,24,983	— 7,24,042	6,05,137	— 13,29,179	
9	1957-58 . .	320	11,18,320	15,51,710	— 4,33,390	11,73,600	— 16,06,990	Loss is apparently high due to concession given in water rates as per G. M. P.W.D. No. WTR/4858, dated 20-1-58.
10	1958-59 . .	313	9,72,490	20,94,909	— 11,22,419	11,47,928	— 22,70,347	
11	1959-60 . .	365	11,17,902	23,80,477	— 12,62,575	13,38,638	— 26,01,213	
12	1960-61 . .	398	18,75,120	33,38,175	— 14,63,055	14,59,665	— 29,22,720	
13	1961-62 . .	460	15,13,932	33,75,335	— 18,61,403	16,87,050	— 35,48,453	

TABLE 2.11

Table giving the cumulative financial picture of all the tubewells during the year 1961-62

Item	Total of 27 tubewells of *Ex*-Baroda State	Total of 122 tubewells during the 1st Plan	Total of 249 tube-wells during the 2nd Plan	Total of 398 tube-wells (cols. 2+3+4)	Remarks
1	2	3	4	5	6
1 (*a*) Capital outlay	17,13,833	99,43,000	2,02,93,500	3,19,50,333	
(*b*) Per tubewell	63,475	81,500	81,500	80,277	
2 (*a*) Gross revenue	1,75,549	5,76,250	11,23,321	18,75,120	
(*b*) Per tubewell	6,609	4,719	4,509	4,699	
3 (*a*) Working expenditure	3,04,023	10,24,444	20,09,708	33,38,175	
(*b*) Per tubewell	11,260	8,373	8,048	8,364	
4 (*a*) Net revenue	— 1,28,474	— 4,48,194	— 8,86,387	— 14,63,055	
(*b*) Per tubewell	— 4,755	— 3,673	— 3,558	— 3,667	
Return on capital	— 7·45%	— 4·50%	— 4·36%	— 4·57%	

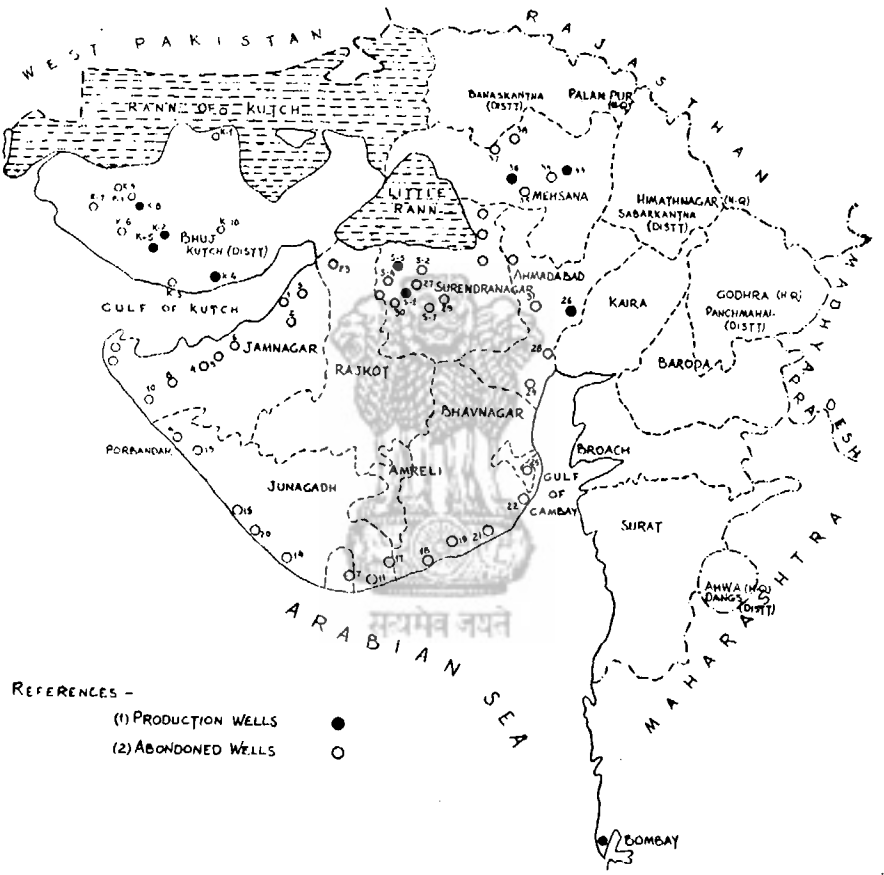

FIGURE 2.3 : *Showing sites of Exploratory tubewells.*

in the same region to face failures, one after the other. This will be clear from the study of the data indicated on the plan. Some tubewells have, however, been taken up as production wells. But their running operation is not satisfactory. The State authorities may have to take into consideration the matter on more precise lines, so that the potential which has been created at such a high cost is put to maximum use.

2.24. The financial success of the tubewells could be attained only when there is so much increase in agricultural production that both the State and the cultivator make profit out of tubewell irrigation. This may require change in the crop pattern. This was in fact envisaged when tubewells project was undertaken in the State, as will be clear from an extract from the Project Memorandum given in *Appendix III*, showing crop groups season-wise. The Team feels that this should be demonstrated and implemented upon by using improved seeds, improved implements, green manuring and plant protection measures etc. The question of construction, maintenance and operation of State tubewells and their financial remunerativeness is a subject of great complexity. On the one hand it involves close study of geology, subsoil water resources, natural precipitation and its variations, hydrology, engineering, source of energy and mechanical equipment, and on the other it involves the utilisation of water supply available, agronomic practices and traditional backgrounds, agricultural statistics, revenue returns and financial analysis of the available indirect benefits. Their development has, therefore, to be co-ordinated with the development of the community through Community Development Blocks and agriculture has to be intensified wherever conditions at site permit the same. Rules and regulations have to be framed and enforced so that tubewells do not remain idle and are made use of in the most economic manner and in the best interest of agricultural production therefrom.

2.25. Some tubewells visited by the Team were sited at the high sandy location in the command. The area round about being high and sandy is unable to grow much and absorb a lot of water. It would seem better if tubewells are sited somewhere in the area which could be better irrigated resulting in better yields therefrom. On some tubewells irrigation commands are too extensive. A restriction on their command will lead to efficient and effective service being rendered by the tubewell to the area. This will also lead to economy in the water distribution system which is fairly extensive at present.

2.26. On some of the tubewells, it was observed that the lined water courses have been taken on high embankments in order to provide irrigation to isolated patches at higher elevation which could have been left out because of unduly heavy cost of carrying water upto them. This has also involved acquisition of extensive land areas for water courses and high cost of construction and maintenance. A typical cross-section of the water courses as practised in the State is shown in Figure 2.4 (Nos. 1 & 2). Cross section No. 3 in the same Figure is a

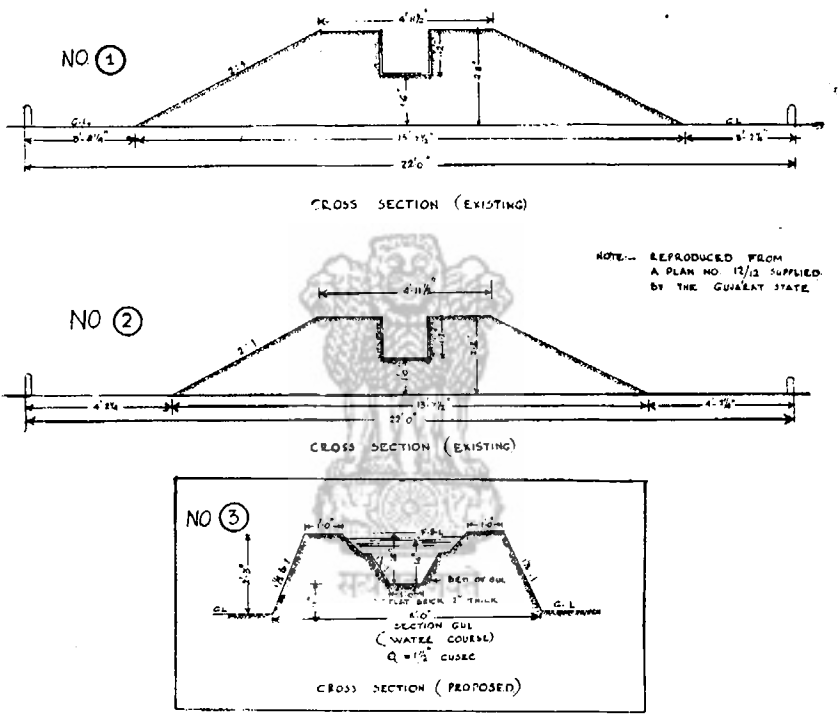

FIGURE 2.4 : *Showing existing and proposed cross-section of lined water courses on tubewells.*

typical section adopted on tubewell channels in Uttar Pradesh. Adoption of a more economical section will not only result in saving in capital cost but reduce the extent of land otherwise occupied by water channels which put them perpetually out of agricultural use. Variations from these typical sections are unavoidable under varying site conditions. The Team, however, feels that there is room for economy in this aspect on State tubewells in Gujarat.

CHAPTER III

Wells and lift Irrigation

3.1. In the State of Gujarat, as the figures for 1958-59 show, out of the total irrigated area, 83.92 per cent was irrigated from open wells, while tanks accounted for 2.93 per cent, Government and private canals for 9.65 per cent and other sources for 3.43 per cent as given in *Appendix IV*. It will thus be seen that most of the area irrigated is dependent on wells. While dependence on wells is so great, the underground water supply in the State, particularly in the Saurashtra and north-eastern region is of uncertain nature. In this region saltish water unsuitable for irrigation is met and in some tracts suitable sites for construction of wells are found with difficulty. Very little hydrological data is available to afford necessary guidance for siting of wells. Nowhere the need could be more justified than in the western regions of the country for a systematic survey of underground and surface water supplies. Where the supplies are inadequate, steps may have to be taken for building percolation tanks and doing *nalla* plugging, contour bunding with a view to help retention of moisture in the bunded fields and in the subsoil, as much as possible.

3.2. The survey conducted by the Technical Committee set up by the undivided Bombay State to assess the extent of work done under the wells scheme, as given in their Report, May 1959, Part I, reveals that in the year 1956-57, there were 4,00,245 wells in Gujarat State out of which 3,76,582 were in use and 23,663 out of use. The percentage of wells not in use comes to 5.9 against 19.46 per cent of such wells in Maharashtra, which shows a greater dependence of agriculture on wells in Gujarat than in Maharashtra.

3.3. Though wells are such a vital need to sustain agricultural economy of the region, yet the Team, during its visits of different areas, found a large number of wells in derelict condition. The sample survey of wells conducted by the undivided Bombay State in 1958 also revealed that about 17 and 34 per cent wells had gone derelict in Rajkot and Ahmedabad Divisions respectively. The causes for wells going derelict could be classified under the following subheads :—

(*i*) Inability of the cultivators for deepening or widening the wells to obtain better supplies and thus giving up existing sources.

(*ii*) Inadequate water supply in the well itself.

(*iii*) Water being found unsuitable for irrigation purposes.

(*iv*) Creation of alternative irrigation sources.

(*v*) Other (human) factors like internal disputes etc.

3.4. It will thus be seen that if a proper survey of the sites is made in advance and technological information is made available to the cultivators well in time, most of the disappointments faced by them could be avoided and also the number of wells going derelict could be reduced. It is also felt that where good supplies are not available at a reasonable depth and cultivators get into distress, it would be expedient as well as helpful to them, if State agencies are organised to deepen such wells so as to make available adequate supplies to sustain the dependent agriculture thereon. The cost of such operation could be realised from the beneficiaries themselves, if not fully, at least to some extent. It was gathered that steps in that direction are already being taken.

3.5. On a large number of open wells operated with the help of *Mote,* it was observed, that with the downward movement of the bucket, bullocks are made to retrace their steps upslope. The leads may be short and the animals may even get used to it, but the practice is unnatural and enervating. This aspect of animal efficiency and preservation thereof deserves attention not only of bullock owners, but of the State authorities as well. An improvement in the operation of the *Mote vis-a-vis* the operational efficiency of the bullocks could be effected if mechanical advantage as can be gained with modern appliances is made use of. A good number of wells in the State are fitted with *Rahats.* This system could be extended with advantage.

3.6. As the supplies of water in the wells both in Gujarat and Saurashtra region vary considerably from one unit to another, it is difficult to standardise a unit and to allocate a specified area to each well. In the Deccan trap area the supplies are dependent mostly in spasmodic location of water bearing strata or fissures which sometimes dry out very quickly. In some cases wells cannot sustain the full agricultural operation of a crop. The criteria fixed by the State for each new and old well to irrigate six and four acres area respectively is not sustained by the actual observations of the Technical Committee revealing that approximately 3 acres and 1.75 acres are actually irrigated by new and old wells respectively. The target of 29,000 tons of additional food production by wells envisaged by the State by the end of 3rd Five Year Plan may not be fulfilled. To achieve that, a much bolder programme of well sinking and repairing may be necessary.

3.7. The Sample Survey of wells conducted in 1958 by the State authorities reveals that the pre-irrigated crop-pattern had considerably changed with the introduction of well irrigation. Relevent extract from the Report is given in Table 3.1.

3.8. There is thus appreciable reduction in the areas under millets, pulses and oilseeds, which have been replaced by major food crops like wheat and paddy, fruits, and vegetables etc. Cultivation of sugarcane and chillies also was introduced. This amply depicts the trend of the cultivators' receptive mind to adopt irrigated crop pattern in

TABLE 3.1

Crop	Area cropped prior to construction of wells (acres)	Subsequent to construction of wells (acres)	Difference between cols. 3 & 2 (acres)	Percentage increase or decrease
1	2	3	4	5
Vegetables & fruits . .	10·33	76·83	+ 66·50	+ 643·76
Wheat	84·94	216·11	+ 131·17	+ 154·43
Paddy	55·65	93·51	+ 37·86	+ 68·03
Cotton	242·67	254·40	+ 11·73	+ 4·83
Groundnut . . .	307·41	317·04	+ 9·63	+ 3·13
Gram	38·15	40·66	+ 2·51	+ 6·58
Jowar	527·04	484·68	— 42·36	— 8·04
Bajri	475·62	387·92	— 87·70	— 18·44
Maize	20·43	16·10	— 4·33	— 21·19
Tur & other pulses . .	68·27	58·29	— 9·98	— 13·19
Oilseeds	36·69	27·80	— 8·89	— 24·23

the interest of his overall economy and calls for a well planned programme for extension of well irrigation wherever feasible and possible. In water deficient regions, wells can at best provide a sort of protection, whenever there is a break in the monsoon or whenever water is critically required for a crop. In other words, a large number of wells are working only as protective measure rather than productive. To convert them into dependable productive source of irrigation, it is necessary to take a number of measures to augment subsoil supplies. These should be taken on at least in specific localities where the need is utmost.

3.9. It was gathered that in some areas where good underground supplies are available pumping sets have been fitted upon wells. These wells do good irrigation. The Team had occasion to visit one such well, on their way from Baroda to Ahmedabad. This well is located in village Gamdi, *taluka* Anand, district Kaira. Previously this well was worked on diesel engine and the owner, Shri Jawaharbhai Lakhan Das used to charge for supply of water to other cultivators @ Rs. 4 per hour. For the last four years the well has been energised electrically. It consumes about 10 units per hour. With 0-2-0 annas per unit as cost of electricity to run the tubewell, the running charges for electricity work out to be Rs. 1-4-0 per hour. The owner, however, charges the cultivators Rs. 3 per hour of running.

3.10. The well serves an area of about 20 acres and the investment made by the owner on the well was reported to be of the order of Rs. 15,000. 3,000 feet length of underground hand-spun concrete

pipeline has been laid which is reported to be functioning very well. This pipe system seems to be an ideal system with a view to save evaporation and percolation losses as well as land. Hydrants are provided at suitable places from where water can be led into fields. Pipes being hand-spun, the whole thing has been done on indigenous basis and is indeed a commendable effort.

3.11. Irrigation charges, however, work out to be high as compared to those in Northern India. It was learnt that *bajri* is the main *rabi* crop followed by tobacco. *Bajri* takes about three months to mature with an average of about 8 waterings. Each watering of an acre takes about seven hours for the well to run. The cost of each watering comes to Rs. 21. Total irrigation charges per acre for waterings works out to Rs. 168. The average yield of *bajri* is about 16 mds., and @ Rs. 14 per maund his income therefrom is about Rs. 224. Adding to it Rs. 60, the price of 600 *pulies* of fodder (per acre) @ Rs. 10 per hundred *pulies,* the income to the cultivator from an acre of *bajri* after meeting irrigation charges works out to about Rs. 224 + Rs. 60—Rs. 168 = Rs. 116.

3.12. Another open well irrigation farm visited by the Team was in village Limbriya. This is a private farm called Panchavati Farm. It has an area of 60 acres. A centrifugal pumping set of 15 H. P. has been installed at a cost of Rs. 5,000. Rs. 15,000 were stated to be the cost of building. Though irrigation was being done through *kacha* open channels, the owner was getting the hand-spun pipes of 9″ dia. manufactured at his farm for laying underground pipeline water distribution system at a cost of Re. 1 per foot. Water table in the area was about 36 feet. The well had 15 feet column of water. Consumption of diesel engine was 6 gallons of oil in 8 hours giving about 3 acres of irrigation. The cost of diesel oil being Rs. 1-11-0 per gallon, fuel cost for 3 acres of irrigation, therefore, works out to Rs. 3-6-0 per acre of watering. The cost of pumped water, therefore, varies considerably from place to place. Even so, considerable enthusiasm is evinced by the cultivators in pumped water supplies wherever they are available.

3.13. *Co-operative Lift Irrigation Scheme.*—A number of co-operative lift irrigation schemes are under operation in the State. The Team visited two such schemes at Gadat and Umra on river Ambica in Surat district. Some details of these schemes are given in the following paragraphs.

(i) *Gadat Co-operative Lift Irrigation Society*

3.14. Gadat lift irrigation scheme started functioning in the year 1939 as a State (ex-Baroda) venture. Gross command under the scheme is 300 acres out of which 250 acres is culturable commanded area.

Later, a co-operative society was formed with 249 members in 1955 with an authorised share capital of Rs. 50,000 and subscribed share capital of Rs. 24,455. The scheme was taken over by the Society.

3.15. Water is lifted with the help of two motors of 55 H. P. each and having a discharge of 5.6 cusecs (1,20,000 gallons) per hour, individually. It has a rising main of 16 inches diameter and total head is 50 feet. Total cost of the project is Rs. 1,16,000, Rs. 83,000 being the cost of civil and Rs. 33,000 of mechanical works. Well aligned lined water-courses are laid in the command. As gathered from the annual report of the society, the areas as given in Table 3.2 were irrigated in the year 1960-61.

TABLE 3.2

Crops	Area	Gross Irrigation	Average No. of waterings
	A G	A G	
Sugarcane	114—31	946—05	8
Trents	10 —25	35—01	3
Banana	9—22	130—28	14
Suran	17—19	113—21	7
Haldar	2—36	15—27	7
Vegetables	18—03	191—28	11
Grass	8 —08	96—30	12
Waste	27—13	89—13	3
Wheat	2—19	15—03	7
Mung	0—13	1—24	5
Pepper	0—24	1—05	2
Jute	6 —18	11—01	2
Adukhadan	0—22	2—14	4
Ginger	0—19	2—38	6
Rice	28—17	86—27	3
	248—08	1,739—25	

3.16. Against 250 acres of culturable commanded area, 248 acres were irrigated on the project. This is a satisfactory performance which is almost 100 per cent utilisation of the potential created and depicts amply the eagerness of the cultivators to take to well dispersed irrigated crop pattern. Out of a total income of Rs. 21,993.81 in the year 1960-61, the Society earned a net profit of Rs. 2,765.89 deducting the expenditure of Rs. 19,227.92 which includes electricity bill of Rs. 10,018.57, establishment charges of Rs. 3,458.12, canal repairs Rs. 884.51, machinery depreciation charges of Rs. 1,930.00 etc. Out of the net profit, Rs. 1,467.00 were given to the shareholders as share dividend @ 6%, which is a great incentive to them.

3.17. Electric energy is supplied to the Co-operative society on monthly basis on a sliding scale @ 19 nP. for first 1,000 units, 13 nP. for subsequent 1,700 units and 7 nP. for further consumption thereafter. Water rates are levied @ 12 nP. per unit of electricity consumed plus 16 nP. per *guntha** irrigated. The staff engaged by the Society comprise a Manager @ Rs. 130, *Patkari* @ Rs. 71, *Patkari-helper* Rs. 50 and Oilman @ 50 per mensum. Pumping was done for 2,462 hours during 1960-61, consuming 86,046 units of electricity. Total water rate assessment being Rs. 21,581.05 for irrigating 1739-25 acres, watering rate per acre works out to Rs. 12.40 np. Inspite of such dividends being paid to the shareholders, it was stated that a sum of Rs. 22,256.93 was recoverable from the shareholders as arrears of irrigation charges. This has resulted in the Society being down-graded to a lower category.

3.18. To keep the morale of the responsible elements, among the shareholders, boosted up and ensure solvency of the Societies, strict enforcement of the bye-laws of the Irrigation Co-operative societies under Article X 'Recovery of rates due to Society' given in leaflet "K K" is called for. Water of river Ambica used for irrigation by the Co-operative Society does not bring any revenue to the State Government. The Team feels that the State Government may examine the possibility to impose suitable Royalty on the use of water of the natural streams by private individuals or societies. That will bring in some revenue to the State exchequer. It will also ensure that water is used by the Society in a more economical manner and enlarge the area of activity as far as possible.

(ii) *Umra Lift Irrigation Co-operative Society Surat.*

3.19. This lift irrigation scheme was also started in 1937. Area under its command is 428 acres. In the year 1957-58, the scheme irrigated an area of 417 acres out of which Sugarcane was 164 acres, cotton 90, paddy 93, *jowar* 37, vegetable 12 and the rest was under miscellaneous crops. Availability of water is assured here as a cross bund is constructed in river Ambica below this scheme. Previously there was only one oil engine of 50 H. P. giving a discharge of 1,20,000 gallons per hour. Later on, this was replaced by an electric motor of the same capacity and another 25 H. P. electric motor was fitted as a stand-by arrangement.

3.20. Irrigational results indicate amply that the scheme is functioning satisfactorily. Recoverable water charges arrears upto June, 1961 amounted to Rs. 4,139 on this scheme also as on Gadat Lift Irrigation Scheme. Open well irrigation allied with lift irrigation from open wells has, therefore, considerable scope for expansion in the State. This exploitation, however, needs a concerted programme of conservation of subsoil and surface supplies as much as possible along with a judicious crop planning so that production from the land and water resources of the State are maximised.

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*One acre=40 *Gunthas.*

CHAPTER IV

Tanks and Diversion Canals

4.1. Tanks and diversion canals irrigate only a small percentage of area in the State of Gujarat. Most of the area is served by open wells. In Saurashtra peninsular tract tanks are of great significance, because the surface of the country is generally undulating. The area is traversed by a large number of streams, whose supplies during the dry season are insignificant. Rainfall in this area is about 20 inches and is confined to the south-west monsoon, *i.e.*, from July to October. The only means of increasing irrigated agriculture is, therefore, through a system of storage works. In the southern part of Gujarat, however, the country is comparatively flat. Tanks, if built, have to be fairly large, submerging vast tracts of the area. They are, therefore, comparatively less in number. The Team had occasion to visit some of the tanks and diversion works shown in Figure 4.1 in different parts of the State. The results of their field studies are given in the following paragraphs.

I. TANKS

(i) Wandh Irrigation Dam

4.2. The dam is located near village Sukhapur, *taluka* Bhuj, district Kutch. This is a rolled-filled zoned earthern embankment, to store water from a catchment of about 3.5 square miles. It was completed in 1938 at a cost of Rs. 49,759.00. The length of the dam is 1,301 feet. Its maximum height is 43:6 feet and top width is 8 feet, 1,301 feet. Its maximum height is 43·6 feet and top width is 8 feet. The waste weir is clear overfall type, designed for a depth of $3\frac{1}{2}$ feet over it. The canal taking off from the tank is 1.8 miles long and designed to carry 20 cusecs of discharge.

4.3. In the normal rainfall years, the tank with average storage can irrigate an area of about 204 acres. Under full supply conditions it can provide irrigation to 414 acres.

4.4. Average annual rainfall in the catchment is 13.56 inches. The water stored in the tank, its utilisation and depth of water actually used per watering is given in the Table 4.1 and graphically in Figure 4.2. On the whole it appears that available supplies in the tank have almost been used up every year but, water applied to the various crops has been more than required. In the year 1954-55, maximum area of 425 acres was served by the tank.

4.5. During discussion with the cultivators at site, they expressed that the present supply in the tank is not adequate and that it should be augmented. It was observed that the channels taking water to fields were not built scientifically and the water was let to the field according to the choice of the irrigators, who generally took more

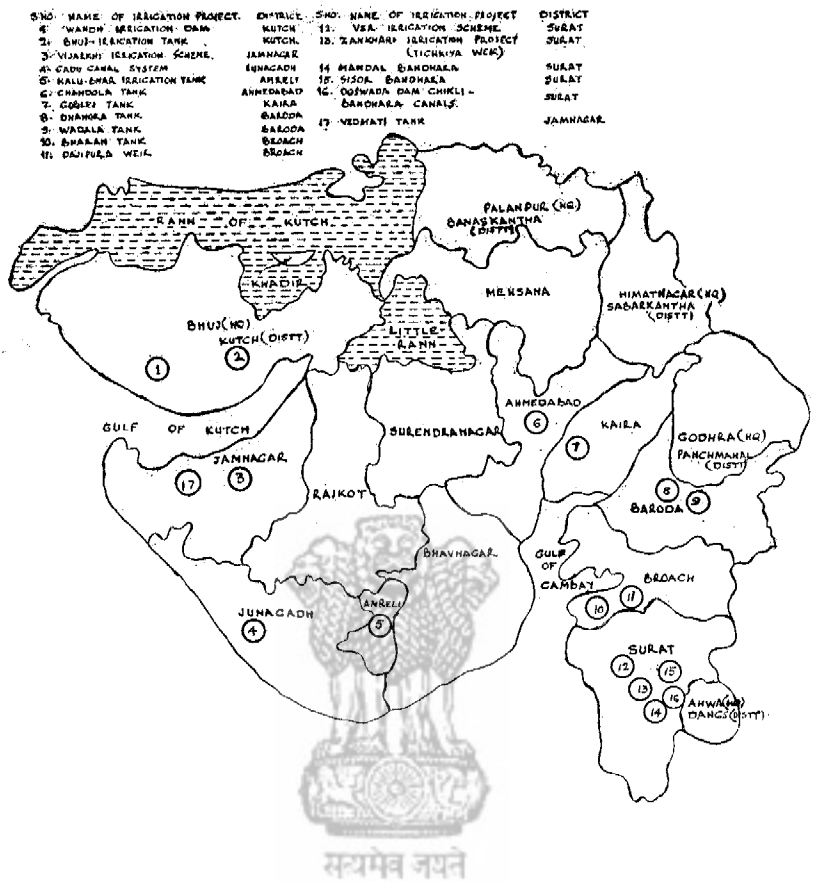


FIGURE 4.1 : *Map of Gujarat State showing locations of tanks and diversion works visited by the Team.*

water than actually required for the crops. Another feature of the system is that no irrigation is done during night. The cultivators who were present explained that they do not do any irrigation during night as their women-folk who also have to work in the fields cannot stay out during night. It is felt that to increase the efficiency of irrigation and to effect the optimum utilisation of supplies steps have to be taken to introduce night irrigation. It will help in saving losses by way of seepage and evaporation that take place otherwise. Besides, proper outlets have also to be provided on the channels to let, only required quantity of water, go into the fields. In fact, the system requires remodelling and refixing of outlets on a rational basis. Some quantity of water will thus be saved, which can be utilised for extending irrigation from the tank.

TABLE 4.1

Showing Water Storage, Utilisation and Required Delta

	Particulars	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61
	1	2	3	4	5	6	7
1	Annual rainfall (inches)	7.50	20.80	8.50	10.83	19.33	3.16
2	Water stored above sill level (Mcft) .	15.81	27.60	18.82	23.05	27.06	7 27
3	Water utilisation (Mcft)	15.81	21.69	18.82	15.75	27.06	7.27
4	Area irrigated (acres)	184.00	355.00	204.00	411.00	193.00	58.00
5	Delta (Depth of irrigation) watering at head of canal (in inches) . .	23.64	17.04	25.32	10.44	38.52	34.44
6	Delta (Depth of irrigation) per watering (in inches) . .	7.88	5.68	8.44	3.48	12.84	11.48
7	Required Delta (Depth of irrigation) per watering at head of canal (in inches) .	4.50	4.50	4.50	4.50	4.50	4 50
8	Depth used in excess per watering (in inches) . . .	3.38	1.18	3.94	—1.02	8.34	6.98

4.6. Another feature of this area is that the fields are not properly levelled. This means that the water cannot be applied uniformly. More water is required to bring the higher patches of the field under irrigation than on a level field. This leads to a great loss of water. To effect economy in the use of water in scarcity areas like those in Kutch, levelling of fields should be got done, even if State help in the shape of loan or subsidy is required by the cultivators.

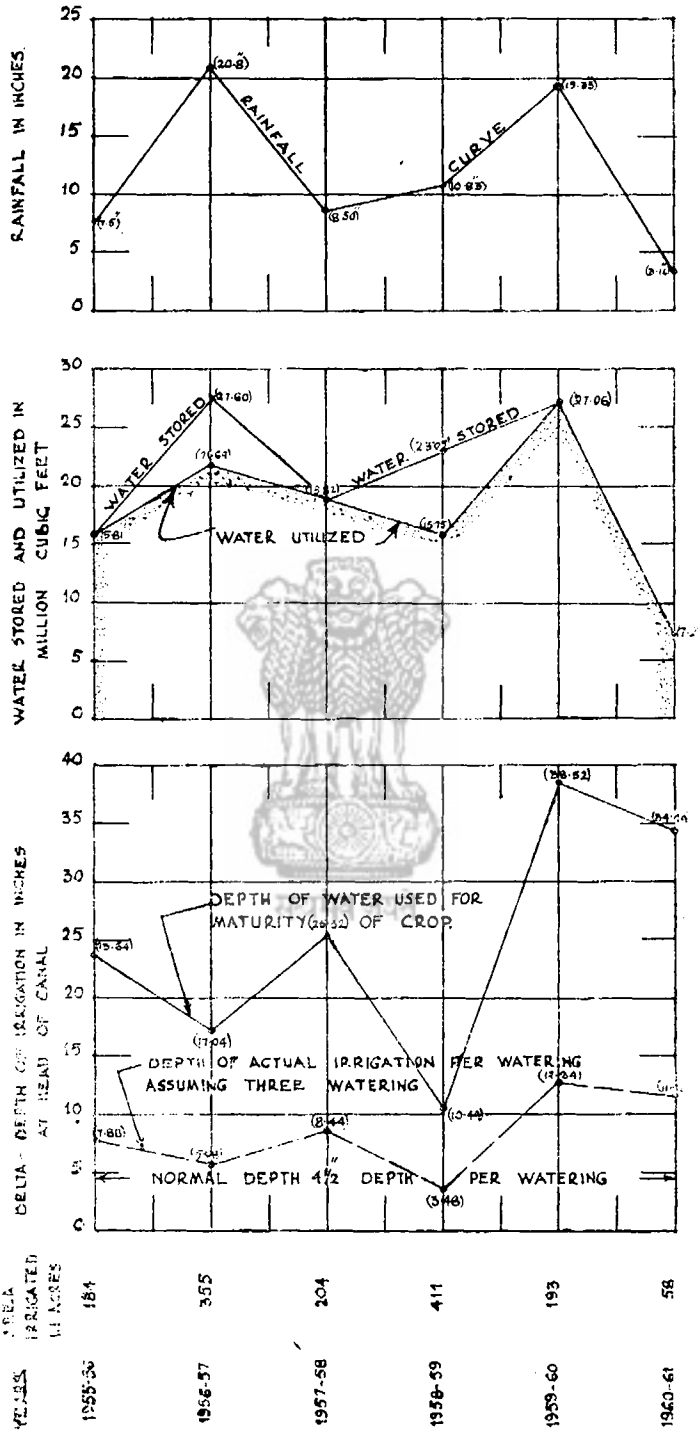


FIGURE 4.2 : *Graph showing water storage utilized for irrigation and delta per watering at head of canal.*

4.7. There is considerable scope for improvement in cropping pattern on this tank. The number of waterings applied to these crops is fairly high. In case of wheat the cultivators stated that they need 8-10 waterings. There is no leguminous crop grown at present. It was suggested to the cultivators that they may grow some leguminous crops to improve the fertility of the soil and adopt a rational cropping pattern.

4.8. The spillway on this dam was lying damaged. The work was almost in a precarious condition. The proposal for repairing the work by loose rock-fill apron was examined. It was suggested that ordinary rockfill may be replaced wih sausages of G. I. wire of S. W. 6 or 8 so that stones are not carried away by gushing water.

(ii) Bhuj Tank

4.9. Bhuj irrigation tank located in close proximity to Bhuj town is provided with an earthen dam and masonry weir on flanks. It was completed in 1951 at a cost of Rs. 5.75 *lakhs*. It has a catchment area of 33 sq. miles and can hold water to the extent of 161.8 M. cft. above the sill level. To arrest the incoming silt, there is a silt pocket below the sill level capable of holding a storage of about 22 M. cft. The areas commanded and proposed to be irrigated are as indicated below :—

1. Gross commanded area . . . . . 2,637 acres
2. Culturable commanded area . . . . . 2,427 acres
3. Area targeted to be irrigated . . . . 900 acres

4.10. The tank started functioning in 1951-52. Its yearly performance is given in Table 4.2.

TABLE 4.2.

Year	Area irrigated (acres)			Assessment (Rs.)
	Kharif	*Rabi*	Total	
1950-51			53	
1951-52			42	
1952-53			106	
1953-54			154	
1954-55			205	4,480.50
1955-56			60	293.50
1956-57			228	1,324.50
1957-58			73	698.25
1958-59			10	96.00
1959-60			57	915.00
TOTAL			988	7,807.75
AVERAGE			98.8	
		say	99 acres	

4.11. The ten years' performance gives an average of 99 acres which is only 11 per cent of the target. This performance is an example of poor utilisation of the potentials created. The maximum areas brought under irrigation in the year 1954-55 and 1956-57 were 205 and 228 acres respectively. No record has been maintained crop-wise. Looking at the average of 99 acres, the effective cost per acre works out to Rs. 5,900 as against a projected cost of Rs. 640.

4.12. Another observation made on this tank was loss of water through seepage from the tank itself. At the time of Team's visit, the seepage was estimated to be of the order of $7\frac{1}{2}$ cusecs. A scrutiny of the dam design indicated that the seepage took place through the body of the dam between RD 1,700 and 3,900, which coincides with the location of the deeper portions of the gorge. The strata on which foundations of the cut-off core-wall are founded appears to be of soft and porus nature, yet a cut-off trench has been built only to a depth of about 2 to 5 feet, whereas the depth of water in the gorge portion of the dam is between 30 to 40 feet. Apparently, heavy leakage is primarily due to inadequate depth of the cut-off trench.

4.13. If the leakage cannot be treated or minimised effectively, it could with advantage be picked up down stream for irrigation purposes.

4.14. Though Bhuj is a scarcity area, yet the application of water to the crops as could be judged by the Team was not on economic basis. The off-taking channels do not appear to follow any standard design. Outlets provided appear to be over-sized. For equitable use of water, it would seem essential that the channels are re-modelled to the section actually needed for carrying water to the irrigated areas so that there is no unnecessary percolation and evaporation losses, and the outletting is done on systematic field survey basis, allowing only required quantity of water in each tract. A proforma as could be prescribed for such outletting system and for remodelling of the channel is suggested in *Appendix V* for guidance.

4.15. As on Wandh tank, cultivators are not acquainted with the irrigation practices and its benefits on this tank too. Apparently, therefore, water used per unit of land and per unit of crop produced is much more than what it would otherwise be, if water is scientifically supplied to the crops through well made channels, properly laid out outlets, in proper dosages, at proper times and in continuous farming process. State authorities are undoubtedly alive to this fact. But, this area having been located away from regularly irrigated zones of the country and with no irrigational traditions behind, needs pointed attention in this respect, so that irrigators realise the value of water and use it to their greater advantage than what has been done so far.

4.16. With the irrigation facilities available, dry cropping system prevalent in the region should be changed to a pattern of irrigated agriculture as far as possible. It is suggested that leguminous crops should be encouraged and green manuring should be introduced as lavishly as possible even though it may require a concessional supply of water from the reservoir.

(iii) Vijarkhi Irrigation Scheme

4.17. This is a minor irrigation scheme comprising central masonry dam with earthen flanks and canal systems near village Vijarkhi in Jamnagar *taluka* of Jamnagar district. It was constructed at a cost of Rs. 3 *lakhs* during the regime of the erstwhile Nawanagar State in 1902.

The tank has a catchment area of about 12 square miles with an average rainfall of 18 inches. It can hold water to the extent of 210 M. cft. and has an irrigation potential of 400 acres out of a gross command of 800 acres. The work had been maintained by Roads & Building Department until February 1960. The details of actual irrigation done from 1950-51 onward are given in Table 4.3.

TABLE 4.3.

Year	Area irrigated in acres			Assessment		
	H.W.	*Kharif*	*Rabi*	Total	(Rs.)	Realisation (Rs.)
1	2	3	4	5	6	7
1950-51 .	..	..	..	300		
1951-52 .	..	..	..	806		
1952-53 .	..	..	..	706		
1953-54 .	..	..	..	520		
1954-55 .	..	..	..	796		
1955-56 .	..	..	..	400		
1956-57 .	..	..	..	340		
1957-58 .	..	..	..	404		
1958-59 .	..	..	..	299		
1959-60 .	11.20	341.60	..	352.80	10,808	2,474
1960-61 .	99.60	133.20	345.60	578.40	13,793	10,415

4.18. It was gathered that the channels as laid out on the system are not according to any standard type design. These have just *ad-hoc* sections, which do not correlate with the slopes and sections for the required discharge. There are no gauges fixed on the channels, which are very essential and should be provided to assess the discharge. Irrigation is done from field to field, which is a wasteful process. Remodelling the canal system to the standard section locating outlets at suitable sites and aligning water courses will lead to considerable saving in water and help the development of irrigation.

(iv) Kalubhar Irrigation Tank

4.19. The Kalubhar irrigation scheme is located near Kariana village in Babra *taluka*, Amreli district. It is an earthen dam 2,230 feet long and 55 feet high with 12 feet width at top. It is constructed across Kalubhar stream. It has a catchment area of 26.17 miles. Annual rainfall is about 18.43 inches. The work was completed in 1958 at an actual cost of Rs. 11.72 *lakhs* (work portion) against the estimate for Rs. 15.68 *lakhs* for the project. The dam has been constructed in arch shape which is very unusual. This increased length has necessitated increased cost. Some saving could have been possible, if attempts had been made to rehabilitate the dislocation caused in the locality falling in the straight alignment of the dam. But local authorities are best judge.

4.20. The tank can hold water to an extent of 260 M. cft. above sill level (R. L. 495.00) with F. S. L. at R. L. 516.00. There is 13.00 M. cft. of dead storage below sill level. The off take canal is 7.72 miles in length. It has a bed slope of 1 in 2,000. The designed discharge at head is 39.13 cusecs. The gross commanded area of the system is 4,000 acres of which 3,000 acres is annual irrigable area.

4.21. Irrigational performance of the tank since 1958-59 is given in Table 4.4.

TABLE 4.4.

Year	Gross commanded area (acres)	Annual irrigable area (acres)	Irrigation (acres)				Assessment (Rs.)	Realisation (Rs.)
			Kharif	*Rabi*	Hot weather	Total		
1	2	3	4	5	6	7	8	9
1958-59 .	4,000	3,000	..	600	..	600	1,009	1,004
1959-60 .	..	..	26	398	112	536	6,283	4,013
1960-61 .	..	..	204	654	289	1,147	12,530	7,869

4.22. The tentative proposal of target areas for irrigation on this scheme was stated to be as follows :—

Kharif crops	600 acres	2,110 acres
Rabi crops	1,200 acres	
Other crops	310 acres	

As it is, after a slight decrease in the second year, the irrigated area increased to 1,147 acres in 1960-61. This is only 54 per cent of the tentative target. Prospects of extension of irrigation on this project, however, seem bright.

4.23. Main *kharif* crops grown are cotton, maize, paddy, *jowar*, *bajri* and wheat and gram in *rabi*. Lately, sugarcane is also coming up in some parts. The cultivators seem aware of the benefits of irrigation and are planning to grow two crops in a year. It is felt that on projects where cultivators are interested in irrigation more efforts should be mobilised to develop an intensive system of irrigated agriculture. This irrigation scheme can very well serve as a model, as it is located close to an important highway and has a set of keen cultivators.

(v) Chandola Tank

4.24. Chandola tank is situated in the village limits of Dani Limda near Ahmedabad. Its development work was taken in hand in the famine year of 1901-1902 and completed in 1905 at a cost of Rs. 3,31,477. It is a closed tank having a bund of approximately two miles length, covering three tanks, namely, Old Chandola, New Chandola and Shah Alam. 200 acres is the tank bed area and the capacity at F. S. L., R. L. 142.00, is 100 M. cft. It is provided with 6 outlets commanding approximately 1,700 acres area of village Hanpura, Isanpura, Dani Limda, Narol, Shaijpura and Shahwadi. Water distribution system on this project is well established to give adequate irrigation in the area under command.

4.25. The tank is fed through a channel known as 'Chandola Feeder' which is nearly 1 mile in length with 20.0 feet bed width, 5.0 feet full supply depth and carrying capacity of 250 cusecs. It draws water from Khari cut main canal. At the offtake point arrangement is made to draw the required quantity of water and thus the inflow in the tank is regulated. No open waste weir is provided and excess water, if any, passes to river Sabarmati through Shahwadi branch.

4.26. Supply of water to the tank is stated to be assured in normal years of rainfall and irrigation of the lands under command is thus a matter of certainty in most of the years. Though the main crop of the tract is *kharif* paddy, hot-weather crops and *rabi* crops are also grown. Irrigational performance and financial returns of the project are given in Table 4.5 and graphically reproduced in Figure 4.3.

TABLE 4.5

Year	Commanded area (acres)	Actual Irrigation (acres)				Amount assessed (Rs.)
		Kharif	H.W.	*Rabi*	Total	
1	2	3	4	5	6	7
1947-48 . .	2,050	1,142	..	..	1,142	12,834
1948-49 . .	..	..	..	..	..	..
1949-50 . .	..	..	..	..	..	..
1950-51 . .	..	1,064	..	160	1,224	13,802

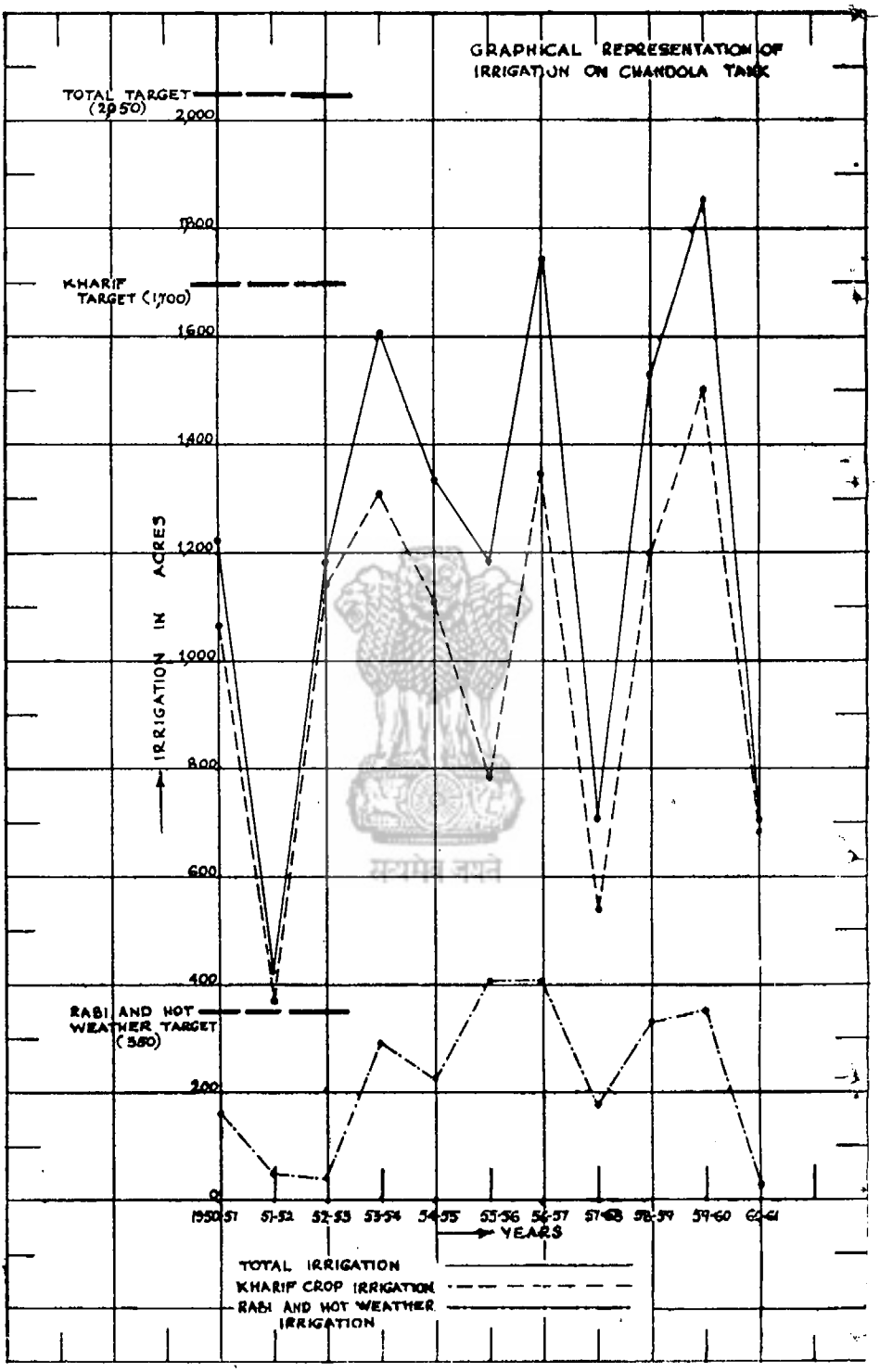
1	2	3	4	5	6	7
1951-52 . .	..	371	51	..	422	4,989
1952-53 . .	..	1,140	..	40	1,180	13,539
1953-54 . .	..	1,313	11	281	1,605	16,399
1954-55 . .	..	1,111	73	151	1,335	18,075
1955-56 . .	..	780	111	295	1,186	14,691
1956-57 . .	..	1,344	185	217	1,746	19,155
1957-58 . .	..	540	169	..	709	7,710
1958-59 . .	..	1,200	2	328	1,530	16,943
1959-60 . .	..	1,500	..	351	1,851	21,602
1960-61 . .	..	680	..	23	703	8,275
TOTAL .	..	12,185	602	1,846	14,633	1,68,023
AVERAGE	..	870	43	132	1,045	12,002

4.27. It will thus be seen that the average irrigation for the period under review is 1,045 acres against annual irrigable target of 2,050 acres. This 51 per cent performance of the scheme in spite of the favourable conditions in respect of supply, well established water distribution system and suitability of land for cultivation is low. The intensity of the cropping is hardly 20 per cent which needs to be appreciably stepped up under such favourable conditions. In some of the years irrigation fell to very negligible levels during hot weather and *rabi* seasons. There are also abnormal fluctuations in irrigated areas. Whereas irrigation had touched the peak figure of 1,851 acres in 1959-60, it was also as low as 422 acres in 1951-52, and in 1948-49 and 1949-50, no irrigation at all is reported to have been done.

4.28. Against *rabi* irrigable area of 350 acres, actual irrigation in 1958-59 and 1959-60 was 328 and 351 acres respectively. It came down to 23 acres in 1960-61 and was nil in 5 out of 14 years under review. Reasons for the acute shortfalls, therefore, need to be thoroughly investigated and remedied so that performances of 1958-59 and 1959-60 could be maintained. The tank is situated in close proximity to Ahmedabad, which is a developing city and a good market for the agricultural produce. Growing vegetables could be very remunerative.

4.29. Though there is an efficient system of distributaries, minors and water courses in the command of this tank, yet in certain portions field to field irrigation is practised. It is desirable that this wasteful practice is replaced by well aligned water courses.

4.30. About 1,500 feet length of the bund requires repairs and strengthening. It was gathered that the work would be taken up soon at an estimated expenditure of Rs. 70,000. It is also understood that the Municipal Corporation of Ahmedabad is contemplating to develop the tank as a picnic spot. This will undoubtedly help to keep the tank in good condition.



FIGUI

FIGURE 4.3 : *Graphical representation of Irrigation on Chandola tank.*

4.31. Apart from water rates on Chandola tank, some income is accruing through auction of lotus, grass and *shingadi* and also through tank bed cultivation. These sources could be further developed to earn more revenues. This scheme which is presently doing 51 per cent irrigation, yields an average annual return of Rs. 12,000 from water rates. With the development of irrigation it could prove more productive both to the State and the cultivators.

(vi) Goblej Tank

4.32. Goblej tank was visited by the Team, when irrigation was in progress. The tank is situated in village Goblej, *taluka* Matar in Kaira district. It is a closed tank having around it 7 miles long bank with 11 feet maximum height and 12 to 14 feet top width. Area of the tank basin is 550 acres and area under command is 1,800 acres. Construction of the tank was taken up in the famine year of 1901-1902 at an estimated cost of Rs. 34,000 to store 8.53 M. cft. of water for irrigational purposes. Subsequently the scope of irrigation was extended and the tank was enlarged to hold 99.2 M. cft. at a cost of Rs. 1,49,877. To further increase the capacity of the tank an expenditure of Rs. 1,25,000 was incurred to bring more area under command.

4.33. Present capacity of the tank at F.S.L., R.L. 83·50 is 132 M. cft., and H.F. R.L. 85.50, 180 M. cft. The tank which was formerly fed from the spill of river Khari was later connected with Meshwa canal system and gets replenishments when water is not required for direct irrigation on the areas under canal system. To regulate the discharge flowing into the tank from these two sources, one inlet regulator having 4 openings of 8 feet × 6 feet each was provided at an estimated cost of Rs. 36,938.

4.34. This tank is expected to irrigate 1,800 acres *kharif* and 600 acres *rabi* annually. Its actual performance and financial returns are given in Table 4.6.

TABLE 4.6

Year	Area Irrigated (acres)	Amount assessed (Rs.)	Rev. from tank bed cultivation (Rs.)	Rev. from auction of grass (Rs.)	Revenue realised (Rs.)	Annual M & R expenditure (Rs.)
1	2	3	4	5	6	7
1955-56 . .	1,574	17,615	342	30	17,987	3,080
1956-57 . .	1,831	19,203	853	31	20,087	2,417
1957-58 . .	2,630	28,881	964	..	29,845	5,171
1958-59 . .	2,363	27,008	1,797	37	28,842	2,772
1959-60 . .	1,929	22,522	1,626	37	24,185	2,785
	10,327	1,15,229	5,582	135	1,20,946	16,22
YEARLY AVERAGE	2,065	23,046	1,116	27	24,18	3,245

4.35. The average yearly irrigation of 2,065 acres is 86 per cent of the targeted figure of 2,400 acres. Financially too the project is a good revenue earner bringing to the State exchequer an average of Rs. 24,189 annually, against the M. & R. expenditure of Rs. 3,225.

4.36. The area out of submergence was stated to be leased out for cultivation by the Revenue Department @ Rs. 8 per acre. Maximum return from this source was Rs. 1,797 in 1958-59 when 182 acres area was given on lease.

4.37. Meshwa Storage Reservoir Dam, about 15 miles up-stream of the present weir of Meshwa canal is under completion and would shortly be providing perennial supplies in Meshwa canals. With the availability of assured supplies in the system, this tank would automatically become superfluous, as it would be un-economical to store water and encounter heavy seepage and evaporation losses besides other expenditure.

4.38. The area served by Goblej tank lies between Meshwa Canal and its Kajipura Branch. It could very well be irrigated from this canal directly, but the canal system is not prennial. It, therefore, seems worthwhile to retain the tank as storage for providing water for irrigation, when the canal is dry.

4.39. The usual price of agricultural land in village Goblej and its vicinity was quoted @ Rs. 1,000 to Rs. 1,200 per acre. This tank of 550 acres water spread would fetch about Rs. 5 *lakhs* and be a good contribution towards the cost of the Storage Dam Project.

4.40. In proximity to Goblej tank, the Team had the occasion to visit three more closed tanks namely Wadadla, Foiwala and Samadra fed from Kajipura Branch of Meshwa canal (shown in Figure 4.4). These tanks have 293, 200 and 175 acres tank bed area under them and have in their command 1,200, 320 and 600 acres area respectively. Thus, these four tanks alone have a total tank bed area of 1,218 acres which is 31 per cent of 3,920 acres commanded area under them.

4.41. Besides, there are many big and small minor irrigation tanks in the State which are coming under the command of medium and major irrigation schemes likely to receive perennial supplies in the near future. Sale of the tank bed areas of such tanks would bring considerable amounts to the State. This is a vital issue and needs to be considered and planned well in time.

(vii) Dhanora Tank

4.42. Construction of Dhanora storage tank, situated in village Dhanora, *taluka* Savli, district Baroda, was first proposed in 1907 by the erstwhile Baroda Government. A scheme for creation of about 178 M.cft. storage was accordingly prepared and sanctioned for Rs. 73,000 in the year 1908. Initially sanctioned as purely an irrigation tank, was later modified to supply unfiltered water to the

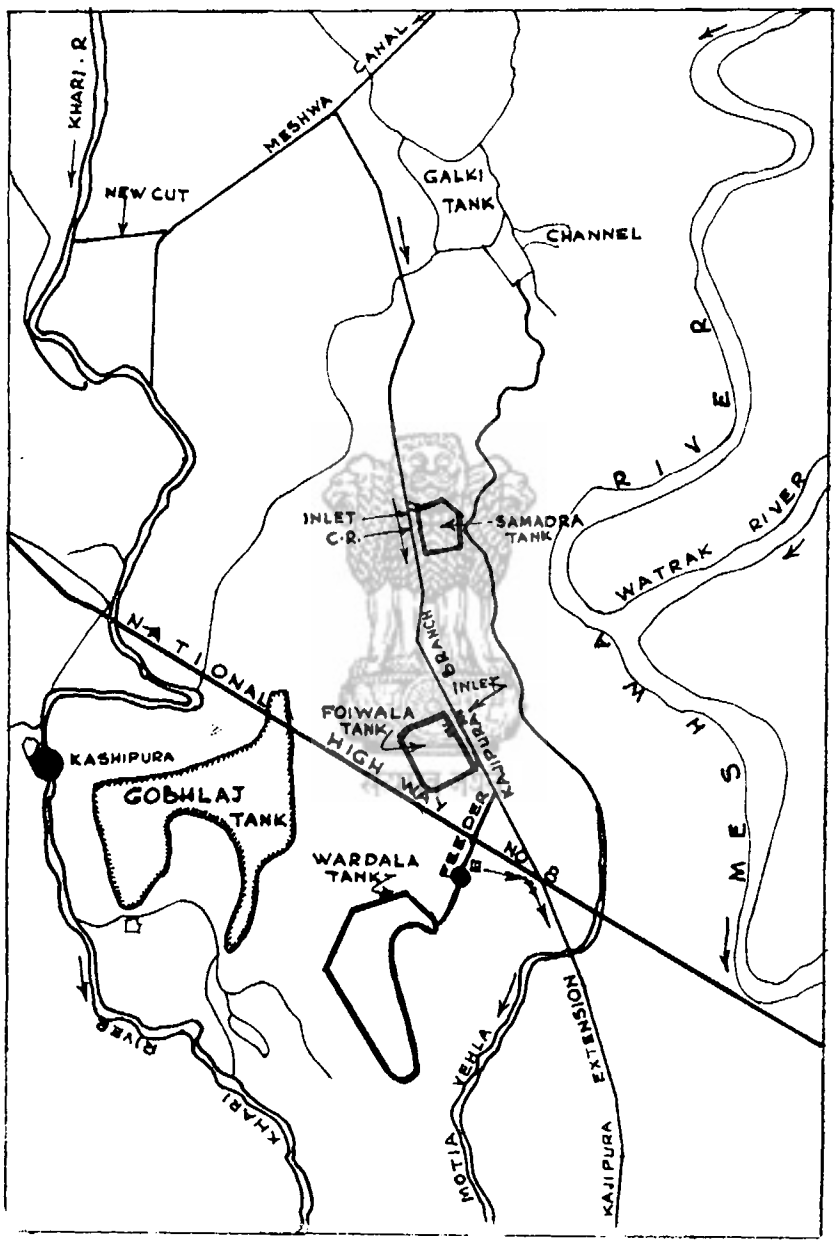


FIGURE 4.4 : *Index map showing the locations of Goblej, Samadra, Foiwala and Wadadla Tanks fed from Meshwa canal.*

gardens in Baroda. Constructed on a tributary of Vishwamitri river, it could be expected to help in moderating to some extent floods of Vishwamitri near Baroda city.

4.43. The work was actually started in 1914 with a revised estimate of Rs. 1,43,200 and completed in the beginning of 1917 at an actual cost of Rs. 1,09,704. In the monsoon of 1917 the year of completion, the tank is stated to have breached at nine places. The causes of the breaches remained a moot point till it was considered to bring down the F.S.L. from R.L. 206.00 to R.L. 200.00, reducing thereby the capacity of the reservoir from 178 to 66 M. cft. It involved construction of a 30 feet waste weir to pass off maximum discharge of 8,000 cusecs, according to Dicken's formula.

4.44. No headway was, however, made towards restoration of the tank. The issue came up for review in 1950, more from the point of view of disposal of about 900 acres of acquired land under the tank bed as the tank was not being used for storing any water since long. Thereupon restoration of the tank was decided at an estimated expenditure of Rs. 3,91,520. Restoration work commenced in December 1951. The estimate was later revised to Rs. 4,80,000 and the work was completed in the year 1955. Actual expenditure incurred was Rs. 4,81,566. Earthen dam of 6,600 feet length with 33 feet maximum height was rebuilt. F.S.L. was fixed at R.L. 204.00 creating gross capacity of 178.00 M.cft. Utilisable capacity above sill level is 128.00 M.cft. 450 feet long brick masonry waste weir of the stepped apron type, capable to pass 5 feet maximum flood depth was provided. Two canals, 3.20 and 1.65 miles in length with 39 and 25 cusecs discharge respectively, take off from the reservoir.

4.45. Retrogression of the waste weir tail channel approaching the waste weir itself is reported to have been observed in September, 1959. During the monsoon of 1959, the canal syphon pipe line was washed away and was relaid on earth filling as a temporary measure. To solve this problem, a fall type waste weir at chainage 1,050 feet of the tail channel costing Rs. 2,71,500 was being provided at the time of Team's visit in April 1961.

4.46. The Team, however, felt that boulder sausages could be used with advantage to check the retrogression. The retrogression, which assumed such an ugly shape in 1959, must have developed in course of years. With timely attention the situation would not have been so serious. To ensure that the 16 feet fall now being created does not possibly give further trouble, model study of the design was suggested by the Team.

4.47. The performance of the tank from 1954-55 the year of reconstruction, to 1960-61 is given in Table 4.7.

TABLE 4.7

Year	Irrigation (acres)			Assessment (Rs.)			Remarks
	Kharif	*Rabi*	Total	*Kharif*	*Rabi*	Total	
1	2	3	4	5	6	7	8
Targeted irrigable area	..	..	1,250	..	..	..	
1954-55	..	305	305	..	1,891	1,891	
1955-56	35	300	335	157	1,751	1,908	
1956-57	25	242	267	134	1,627	1,761	
1957-58	333	144	477	1,274	1,038	2,312	
1958-59	249	364	613	1,045	1,646	2,691	
1959-60	169	441	610	1,016	1,682	2,698	
1960-61	116	103	219	1,178	798	1,976	

4.48. The average annual irrigation comes to 405 acres. It is 32 per cent of the targeted irrigation of 1,250 acres. This shortfall in irrigation has been attributed to the cultivators' preference to stick to rainfed crops, like cotton in *kharif*. With the co-ordinated efforts of the Irrigation and Agriculture Departments and trial-*cum*-demonstration farms, it should be possible to bring home to the cultivators the benefits of irrigated agriculture.

4.49. Total capital expenditure incurred on the tank comes to (Rs. 1,09,704 + Rs. 2,71,500 + Rs. 4,81,566) Rs. 8,62,770. Cost per acre of the irrigable command of 1,250 acres is thus Rs. 690. Effective cost per acre on the average irrigated area (405 acres) comes to Rs. 2,130. The average annual assessment of Rs. 2,176 may not even be sufficient to cover the maintenance and other over head charges. Looking at the project from the productivity point of view also, the rainfed crops in 900 acres tank bed area may have yielded more than the total production from 405 acres of irrigated crops. To derive the best advantage of the huge expenditure incurred, concerted steps need be taken to bring more area under irrigation and introduce double cropping.

(viii) Wadadla Tank

4.50. Wadadla irrigation tank situated in village Wadadla, *taluka* Savli in district Baroda is an old tank constructed about forty years back at a cost of Rs. 69,429. It has a catchment of 10.10 sq. miles. Average rainfall of the tract is 39.19 inches. It is an earthen bund 6,400 feet long. The bund has a maximum height of 18 feet with a top width of 12 feet. The capacity above sill level is 75.46 M.cft. It has been provided with a fall type waste weir of 130 feet length. Two

main canals No. 1 and No. 2 take off from the reservoir which are 0.7 and 1.9 miles in length with 10 and 24 cusecs designed discharge respectively. Annual irrigable command is 1,000 acres. Its cropwise break-up is; *kharif* 600 and *rabi* 400 acres. The land under command is quite fertile and eminently suitable for paddy cultivation.

4.51. The clayey soil of the tract develops cracks due to shrinkage during summer, which normally close during the first monsoon showers. When, however, the first showers are heavy the tank fills up at a rapid rate, allowing hardly any time for even the surface cracks to close. The water finds its way through the cracks leading ultimately to piping. In the year 1950, the tank is stated to have been saved from a disastrous breach by timely action in preventing further development of piping. Measures were thereafter initiated to take up the work of trial pitching in a length of about 200 feet which was worst affected. Various methods were tried namely, (i) 4½-inch-brick on edge, (ii) Soil-cement (10 : 1) 6-inch-thick and (iii) cement-sand (1 : 10) 6-inch-thick. The work was completed in the summer of 1951. It was observed that the soil-cement (10 : 1) pitching, the cheapest of all, does not stand weathering and wave action. Brick pitching stood well. Cement-stand (1 : 10) which is also moderate in cost, stood the test best. To bring down the cost of cement-sand pitching, it has since been proposed to try 1 : 12 ratio and observe its behavior. The vigilance and enthusiasm with which the piping trouble is being attended to needs to be continued. Experience gained on this work could be suitably employed on other works where such trouble is experienced.

4.52. The operational aspect of the scheme, both irrigational and financial, is given in Table 4.8.

TABLE 4.8

Year	Irrigation (acres)			Amount assessed (Rs.)			Remarks
	Kharif	*Rabi*	Total	*Kharif*	*Rabi*	Total	
1	2	3	4	5	6	7	8
Targeted irrigable area . .	600	400	1,000	..	..	..	
1954-55 . .	176	293	469	710	1,777	2,487	
1955-56 . .	28	288	316	115	1,823	1,938	
1956-57 . .	469	353	822	2,045	2,865	4,910	
1957-58 . .	710	98	808	2,649	797	3,446	
1958-59 . .	245	348	593	1,116	2,415	3,531	
1959-60 . .	229	430	659	1,357	1,937	3,294	
1960-61 . .	313	Nil	313	4;459	Nil	4,459	
TOTAL .	2,170	1,810	3,980	12,451	11,614	24,065	
AVERAGE .	310	259	569	1,779	1,659	3,438	

4.53. Thus during the seven years under review, this project has done an average of 57 per cent irrigation with respect to the potential created on it. Actual irrigation was as high as 82 per cent and 80 per cent in the years 1956-57 and 1957-58 respectively and as low as 31 per cent in the years 1955-56 and 1960-61.

4.54. The *kharif* and *rabi* irrigation figures vary widely. Irrigation in *kharif* 1955-56 was only 28 acres and went up to 710 acres in 1957-58. Similarly in *rabi* 1959-60 it was 430 acres, highest in the seven years under study, whereas it was 98 acres only in 1957-58 and came down to nil in 1960-61. These widely fluctuating performances of the scheme need a thorough probe and sifting of the causes, rather than generalisation and attribution to the trend of cultivator's mind and whim, as was stated.

4.55. The potentialities of the project have been established beyond doubt as irrigation in *kharif* 1957-58 and *rabi* 1959-60 on it was 118 per cent and 109 per cent with respect to *kharif* and *rabi* targeted figures of 600 acres and 400 acres respectively. Concerted efforts of the Irrigation and Agriculture Departments are needed for optimum utilisation of water.

(ix) Bharan Tank

4.56. Bharan tank is situated in village Bharan, 4 miles from Panoli Railway Station (Western Railway) in district Broach. It is an earthen bund. The tank has a catchment area of 1,120 acres situated in a rainfall zone with an average annual precipitation of 47 inches. It has a gross capacity of 26.99 M.cft. of which the suable capacity above sill level is 26.70 M.cft.

4.57. Before improvements were made, the tank basin (bed area) was 24.4 acres only. The tank had neither a waste weir nor any outlet and it was learnt that cultivators were irrigating their fields by making cuts in the bund. The tank was then irrigating about 60 acres.

4.58. In 1954-55 the following works were taken up at a total estimated cost of Rs. 1,57,100 to effect improvements.

(i) The area of the tank bed was increased from 24.4 acres to 175-35 acres;

(ii) the banks were raised to R.L. 63.00 with a view to have 3 feet free board;

(iii) a clear overall type masonry bar waste weir 400 feet in length was constructed; and

(iv) two outlets at R.L. 50.00 were provided to give gravitational irrigation in the command with a view to take full advantage of the storage.

4.59. Scouring is stated to have occurred in about 400 ft. length of the earthen bund. Re-sectioning of the bund with provision of

4½ inch brick pitching up to H. F. L. was approved and carried out under special repair estimate of Rs. 4,980. Owing to abnormal monsoon in 1958 further repairs were necessary as the headwalls of an outlet were damaged and went out of plumb and also as the waste weir got exposed. Repairs to the headwalls and waste weir were carried out at an estimated cost of Rs. 5,200 and Rs. 9,825 respectively. Sanction was also accorded for the provision of rubble pitching and toe wall. Thus, the reconditioning of the tank cost a total of (Rs. 1,57,100 + Rs. 4,980 + Rs. 5,200 + Rs. 9,825) Rs. 1,77,105 (estimate).

4.60. The scheme, which was formerly in the charge of the Revenue Department has been, since 1961-62, transferred to the P. W. Department. The reconditioned tank has a gross command of 600 acres of which the irrigable commanded area or targeted area is 450 acres. The actual irrigation done since 1955-56 is given in the Table 4.9 :—

TABLE 4.9

Year	Area actually irrigated (acres)
Targeted irrigable area . 450 acres	
1955-56	188
1956-57	266
1957-58	188
1958-59	200
1959-60	200
1960-61	147
1961-62	Nil
TOTAL .	1,189
AVERAGE .	170

4.61. During the seven years under review, the tank has thus yielded an annual average irrigation of 170 acres which is 38 per cent of the targeted irrigation of 450 acres. Rs. 350 the projected cost per acre works out to Rs. 921 as effective cost (per acre) which is rather high. Irrigation in 1961-62 is reported to be nil. Sufficient rains for *kharif* paddy and late rains during October 1961, helpful for *rabi* cultivation are stated to be the reasons for no demand on the part of

cultivators. A probe in the circumstances leading to it seems necessary. Helpful rains may account for some shortfall but no irrigation at all during *kharif* 1961 and *rabi* 1961-62 is not likely.

4.62. Irrigation is done field to field. Suitably aligned water courses need to be laid out in the command to achieve optimum utilisation of the available supplies.

No water rates are so far levied on irrigation from Bharan tank. Fixed annual cess called "Himayat Cess" amounting to Rs. 1,393.22 is levied and recovered by the Revenue Department.

Irrespective of it whether the assessment is "fixed" or "fluctuating", it is imperative that correct record of actual irrigation is maintained to gauge the capacities and capabilities of the projects.

4.63. Wheat, *jowar* and gram were stated to be the main crops of the area prior to the reconditioning of the tank. Paddy, wheat, gram *etc.* are the principal irrigated crops in the post irrigation period. No specific crop pattern is stated to have been approved for this project which is the pre-requisite before any project is taken up for execution.

(x) Vedmati Tank

4.64. The Team visited Vedmati tank in village Deraja, *taluka* Jam-Khambalia, district Jamnagar, in the jurisdiction of Jamnagar Irrigation Division. The scheme comprises an earthern dam storage reservoir on river Vedmati. The dam was completed in 1951-52 and the canal in 1954. The project was maintained by the Roads and Buildings Division, Jamnagar, and the charge was transferred to Jamnagar Irrigation Division in February 1960. Estimated cost of the scheme was Rs. 6,15,200 and expenditure incurred up to March 31, 1961 is stated to be Rs. 5,03,745.

4.65. The scheme has a catchment area of 9 sq. miles located in 18 inches annual rainfall zone. Length of the earthen dam is 2,150 feet, maximum height 46 feet and top width 12 feet. It has a gross storage of 94 M.cft. and storage above sill level is 89 M.cft. No observations about the silt deposits have so far been made. To have a proper assessment, it is advisable to have these observations made on reservoirs likely to get silted.

4.66. The waste weir is of channel type 400 feet long and designed to pass 5 feet maximum flood depth. The right bank and left bank canals are 2.80 and 3.40 miles in length respectively, each having 5.56 cusecs designed discharge. The scheme has under it a gross command of 1,250 acres. Culturable commanded area is 875 acres and annual irrigable area 625 acres.

4.67. Actual performance of the project is given in the Table 4.10.

TABLE 4.10

Year	Annual irrigation target (acres)	Actual irrigation (acres)	Amount assessed (Rs.)	M. & R. expenditure (Rs.)
1	2	3	4	5
1953-54	625	170	N.A.	N.A.
1954-55	..	131	N.A.	N.A.
1955-56	..	81	N.A.	N.A.
1956-57	..	8	N.A.	N.A.
1957-58	..	238	N.A.	1,360
1958-59	..	75	N.A.	4,170
1959-60	..	115	1,847	80
1960-61	..	310	2,587	3,160
TOTAL	..	1,128	4,434	8,770
AVERAGE	..	141	2,217	2,192

It is thus seen that against an annual target of 625 acres, 310 acres or nearly 50 per cent only could be irrigated in the 8th year after the inception of the scheme, and the average irrigation works out to 141 acres or 23 per cent which is too meagre. From the available figures of revenue assessment for the last 2 years and annual maintenance and repair expenditure for 4 years the averages come to Rs. 2,217 and Rs. 2,192 respectively. Although this can not be taken as a representative picture, yet it can be safely said that the two just equate. Taking into account the interest on capital cost and other overhead expenditure, the project is unremunerative.

4.68. The Team observed that the record of irrigation on this tank was being kept on loose sheets pinned together. This is an important initial record on which assessment of revenue is based. It should be maintained on properly bound printed registers prescribed for the purpose and the recording should be subjected to physical check (partial) by supervisory staff.

II. BANDHARAS AND WEIRS

(i) Mandal Bandhara

4.69. In the vicinity of Vyara, the Team had the occasion to visit Mandal *bandhara* in village Mandal, district Surat. Construction of the *bandhara* commenced in February 1959 and was completed in the middle of 1960. Actual expenditure incurred was Rs. 82,166. It

is located on a stream joining Mindhola river and has a catchment of 3.5 sq. miles with an average rainfall of 60 inches. A fairly long rubble masonry bar of 563 ft. was necessitated as there is no exposed rock and the left bank of the stream is shallow. Maximum height is 6.41 feet and top width is 4 feet. The canal, one mile and three furlongs in length, is designed for 6 cusecs discharge.

4.70. Gross command under the scheme is 190 acres out of which 102 acres is the irrigable commanded area. The project is envisaged to give 40 acres irrigation in *kharif* and 62 acres in *rabi*.

4.71. The *bandhara* started functioning in 1961-62. Actual irrigation is reported to be 10 acres in *kharif* and 26 acres in *rabi*. Paddy is grown only in 6 acres out of 102 acres irrigable commanded area. By the co-ordinated efforts of the Agriculture and Irrigation Departments, sound irrigated crop pattern could be introduced. About two cusecs discharge flows in the stream up to end of March. At the time of Team's visit in early June 1962, about one cusec water was seen flowing. The potentialities of the project for *kharif* and *rabi* crops should be exploited with advantage.

4.72. Rs. 82,166 being the actual cost of the project, cost per acre on 102 acres irrigable commanded area comes to Rs. 806 which is on the high side. In view of the area being promising, it may seem expedient to explore the possibilities of conserving supplies through some small storage work in upper reach of the stream and extend the scope of its serviceability.

(ii) Sisor Bandhara

4.73. Construction of Sisor *bandhara* in village Sisor, *taluka* Sengadh, district Surat, was taken up in February, 1959 and completed in the end of 1960. Administrative approval for estimated expenditure of Rs. 1,06,600 for the *bandhara*, providing main canal and cross-drainage works was accorded. Actual expenditure incurred was Rs. 91,437. The *bandhara* is constructed across river Ajani which has its source in local hillocks and ultimately joins Tapi river about 5 miles upstream of Kakrapar weir. Catchment area of the scheme is about 10 sq. miles with an average rainfall of 60 inches.

4.74. The length of the *bandhara* is 442 ft. with 4 ft. top width and 6 ft. height above the river bed. Carrying capacity of the main canal is 16 cusecs.

4.75. The project was financed from the funds of C. D. and N. E. S. Block Sengadh. Some rock was encountered at R. D. 7,500 of the canal which could not be cut as the N. E. S. authorities were stated to have refused to allow any funds for excavations. As a result, during the first year of the functioning of the scheme, water in the canal could not flow beyond R. D. 7,500. The P. W. D.. has since been asked to go ahead with rock cutting. This exigency of rock cutting could have been met with, had proper surveying of the land strata under the canal alignment been made and the required item

of rock cutting included in the project estimates in the first instance. Due to this lacuna the channel could not be completed and only 20 acres irrigation in *kharif* and 29 acres in *rabi* 1961-62 was done against 297 acres *kharif* and 298 acres *rabi* irrigable area targeted in the scheme.

4.76. It was stated that there was hardly one cusec discharge running in the stream by the end of January. Thus, there is no assured supply available for maturing *rabi* crops. In normal years with an average of 60 inches of rainfall there may not be appreciable demand for *kharif* crops as well. Utility of the *bandhara,* is therefore, questionable.

4.77. The present rainfed *kharif* crop pattern of the area is paddy, *jowar, bajri,* groundnut and cotton. The hesitancy of the cultivators to take to irrigated agriculture is a handicap.

To derive the best advantage of the project, a suitable irrigated *kharif* crop pattern needs to be evolved and propagated.

4.78. There is no watch and ward arrangement at the *bandhara* site. The gate of the scouring sluice was found damaged by some miscreants.

(iii) Doswada Dam—Chikli Bandhara Canals

4.79. Doswada rubble masonry dam, situated in Sengadh *taluka* of Surat district was constructed in the year 1912-13 by the former Baroda State at a cost of Rs. 2,40,387. It has an irrigable command of 1,200 acres. The scope of conservation of supplies was later extended and administrative approval for raising the dam by 10 feet in two stages, along with remodelling and extension of canal system, was accorded.

4.80. The dam was raised by 5 feet from R. L. 395 to 400 and remodelling of canal system completed during 1955-56. The second stage raising by another 5 ft. to R. L. 405 was carried out in 1956-57. Total expenditure incurred on raising and remodelling was Rs. 6,35,050. The targeted irrigable command was increased from 1,200 acres to 2,273 acres out of a gross commanded area of 3,300 acres.

4.81. The dam has a catchment area of 24 sq. miles located in 70 to 80 inches rainfall zone. Its gross capacity works out to 176 M.cft. It is stated that 9 ft. silt has since accumulated in the reservoir. It is provided with 450 ft. long trapezoidal section rubble masonry waste weir.

Water released from the dam is utilised through the main canal of 60 cusecs capacity taking off from Chikli *bandhara* constructed down stream of the dam site. The project is designed to give 2,048 acres irrigation in *kharif* and 230 acres in *rabi.* Actual performance is given in Table 4.11.

TABLE 4.11

Year	Irrigation (acres)			Amount assessed (Rs.)		
	Kharif	*Rabi*	Total	*Kharif*	*Rabi*	Total
1	2	3	4	5	6	7
Targeted irrigable area			1,200			
1948-49 . .	887	6	893	9,382	64	9,446
1949-50 . .	854	123	977	9,565	3,480	13,045
1950-51 . .	937	120	1,057	12,872	2,591	15,462
1951-52 . .	970	60	1,030	15,791	1,428	17,219
1952-53 . .	926	177	1,103	12,310	2,717	15,027
1953-54 . .	911	277	1,188	9,858	5,009	14,867
1954-55 . .	893	251	1,144	10,980	4,113	15,093
1955-56 . .	904	339	1,243	16,983	6,871	23,854
1956-57 . .	888	245	1,133	11,548	6,275	17,823
1957-58 . .	1,053	281	1,334	17,161	7,144	24,305
1958-59 . .	1,147	322	1,469	19,924	8,642	28,566
1959-60 . .	967	266	1,233	20,789	5,967	26,756
1960-61 . .	969	212	1,181	N.A.	N.A.	N.A.
1961-62 . .	934	312	1,246	N.A.	N.A.	N.A.
Total from 1957-58 to 1961-62	5,070	1,393	6,463	57,874	21,753	79,627
AVERAGE .	1,014	279	1,293	19,291	7,251	26,542

4.82. From the persual of the above irrigational and financial performance of the project from 1948-49 to 1961-62, it is seen that, with the initial height of the dam upto R. L. 395 the irrigation figures reached a level of 1,188 acres in 1953-54. With raising of F. S. L. in the reservoir by 10 ft. and extension of irrigable commanded area to 2,278 acres, a maximum irrigation of 1,469 acres was recorded in the year 1958-59, which yet leaves a considerable scope for further development. A maximum amount of Rs. 28,566 was assessed in that year.

4.83. Annual average irrigation from 1957-58 to 1961-62 is 1,293 acres which is 57 per cent of the targeted area of 2,278 acres. But upto 1954-55 before the raising of the F. S. L. the actual average irrigation was of a higher order of 88 per cent of the irrigable commanded area of 1,200 acres. Thus, the extra expenditure of over Rs. 6 *lakhs* incurred in extending the capacity of the reservoir, has not so far been justified by the resultant increase in irrigation as the relative average increase is only 237 acres against an anticipated

increase of 1,078 acres. All out efforts are, therefore, needed to step up the irrigation. *Kharif* and *rabi* break-up reveals that much ground is needed to be covered in *kharif* particularly as the average irrigation is only 1,014 acres against 2,048 acres (*kharif permissible*). Average *rabi* irrigation of 279 acres has, however, surpassed the target of 230 acres.

4.84. Crop pattern of the area in pre-irrigated period was stated to be paddy, pulses, ground-nut and cotton, and in the post-irrigated period it is paddy, sugarcane, vegetables and wheat. As revealed by *kharif* irrigation figures quoted above, response of the cultivators to take to more irrigated *kharif* crops may not be adequate in view of ample rainfall. Sowing of early paddy and cotton with the available supplies in the reservoir may lead to more production and double cropping. The Team feels that possibilities of having more area under irrigation in *rabi* may be explored.

(iv) Gadu Canal System

4.85. This is an old irrigation Scheme constructed by the erstwhile Junagarh State. It was visited by the Team in December 1961. It is masonry broad crested weir built across the river Meghol near village Gadu, *taluka* Malis in district Junagarh. It was originally irrigating an area of about 200 acres. To raise the commanded area to 960 acres it was remodelled in 1954 at a cost of Rs. 83,843. The remodelling consisted of providing uniform section for the canal for a discharge of 12 cusecs at the head of the canal and some additional cross-drainage works.

4.86. There was some leakage below the weir in the central portion of the river due to formation of cavities in the rock on which the weir is founded. Almost 100 cusecs were being escaped to the sea at the time of Team's visit. The apron was also lying damaged. Wing wall had been undermined. This needs to be investigated and the work repaired.

4.87. The canal was lying silted up. It did not have any gauge at head. It was observed that the water of stream is not being put to use as much as possible. Irrigation potential of the system has been raised to 960 acres for *kharif* and *rabi*. Actual irrigation done in this scheme since the year 1952-53 to 1960-61 is given in Table 4.12.

TABLE 4.12

(acres)

Year	*Kharif*	*Rabi*	Total
1952-53	N.A.	N.A.	180-09
1953-54	N.A.	N.A.	163-37
1954-55	N.A.	N.A.	137-38
1955-56	N.A.	N.A.	138-00
1956-57	46—18	68—16	114-34
1957-58	50—00	64—34	114-34
1958-59	..	41—15	41-15
1959-60	91—39	..	91-39
1960-61	N.A.	N.A.	123-00

From Table 4.12 it appears that after remodelling the weir and the canal to increase the irrigated area, water utilization has been on the decline.

4.88. The Team feels that the alignment of the canal needs to be checked up. Outlets need to be located rationally. Area allotted to each outlet should also be such, which could be commanded by gravity flow.

4.89. There is no set crop pattern for this scheme. Wheat is the major crop in *rabi*, and groundnut and rice in *kharif*. The Revenue Department is in charge of the irrigation management and P. W. D. is in charge of maintenance of the canal system. The water rates are included in land revenue and are collected by the Revenue Department. Poor performance of the scheme may be due to this organisational duplication. To improve irrigation performance, the Team feels, that on such schemes there should be unitary control, preferably by an agency competent to look after the technical aspects of the problem which are of importance in this case, while collection of assessment dues can be left to the Revenue Department.

(v) Dajipura Weir

4.90. Dajipura weir is located on Amravati river near village Dajipura, *taluka* Valia Mahal, district Broach. It is a stone masonry structure 150 feet long, with a maximum height of 23.4 feet from the deepest point of foundation and 6 feet width at top. The catchment area of the stream above the weir site is 42 square miles. The average annual rainfall in the area is 50 inches. The weir has been designed for the maximum flood discharge of 43,000 cusecs. The canal head regulator is constructed at a distance of about 200 yards on the upstream side of the weir with F. S. L. at R. L. 225.00; sill level of the canal outlet at R. L. 220.50 and top of the weir at R. L. 226.00.

4.91. The scheme was taken up for construction in 1955-56. The total expenditure incurred on the scheme up to May 1962 is Rs. 441,200 as shown in Table 4.13. The abstract of the original estimate and of the revised one is given in Table 4.14.

TABLE 4.13

Year	Expenditure	Total
1955-56	8,875.00	..
1956-57	31,309.81	40,184.81
1957-58	1,11,411.05	1,51,595.86
1958-59	6,949.74	1,58,545.60
1959-60	28,824.53	1,87,370.13
1960-61	58,632.28	2,46,002.41
1961-62	1,66,838.82	4,12,841.23
1962-63	28,346.70	4,41,187.93
Upto May 1962	say	4,41,200.00

TABLE 4.14

Showing abstract of cost as per sanctioned and revised estimates

	Item	Amount as per sanctioned estimate (Rs.)	Amount as per modified revised estimate (Rs.)
	1	2	3
1	Preliminary Survey	6,000	6,000
2	Land Acquisitions	1,12,431	1,18,274
3	Weir	1,58,065	1,20,322
4	Head Regulator	19,960	22,926
5	Earth Work	6,39,732	9,93,644
6	C. D. Works	2,14,448	2,63,922
7	Miscellaneous	20,081	22,785
8	Distributaries	..	1,06,540
9	Approach Road and Causeways (Earth work & Causeway)	..	33,574 62,967
10	Special repairs to damage etc. . . .	..	5,605
		11,70,717	17,56,559

4.92. The project was originally approved for Rs. 9,70,700 and revised to Rs. 12,66,500 in December 1958. But as per comparative statement given in Table 4.14 the total amount, sanctioned item-wise was Rs. 11,70,717 which was later raised to Rs. 17,56,559 in the modified revised estimate. The reasons stated for this increase in the estimate are as under :—

Item 5 (Table 4.14)

(a) In original estimate, the earthwork was calculated on the basis of cross-sections at every 400 ft. whereas by calculating on actual measurements at cross-section of 100 feet apart it has given effect to heavy increase in the quantity of earth work and cost.

(b) Estimated rate of Rs. 3.00 was too low. The rate now adopted is higher as per rates on the Main canal.

(c) There is slight increase in length on Main and Branch canals.

(d) There were no provisions of certain items in the original estimate.

Item 6 (Table 4.14)

The same as under Item 5(d).

Item 8 (Table 4.14)

There was lumpsum provision for distributaries of Rs. 78,750.00 in the original estimate under item 5, but the modified and revised estimate of Rs. 1,06,540.00 has been taken separately.

Items 9 & 10 (Table 4.14)

No provision for these items is in the original estimate, hence excess.

4.93. The work on weir and Head Regulator has since been completed, but the work on distributaries and other items is in progress. At the time of the visit of the Team it was stated by the Local Officers that the work is likely to be completed by the middle of 1963. A time lag of about 5 years on such minor schemes between completion of the weir and Head Regulator and the channels is a matter of concern. The reasons for the delay in the completion of the schemes have been attributed mainly to the poor response from the contractors to accept the low rates as provided in the estimate. But, with all this, the money spent on the construction of *bandhara* is not yet yielding any results and the people are being denied the promised benefit of irrigation.

4.94. The canal is designed to carry 75 cusecs discharge at head to serve 7,500 acres (*kharif* 4,500 and *rabi* 3,000 acres) irrigable commanded area out of a gross command of 32,000 acres.

4.95. There is no defined crop pattern for the project. The main crops grown in the area are cotton, *jowar* and fodder. Besides these rice, wheat, groundnut and tobacco are also grown to some extent, as detailed in Table 4.15.

4.96. It will thus be seen that 96.5 per cent of the cultivable commanded area under the scheme is cultivated. There are about 80 wells located in this area and the average water table varies between 25 feet to 35 feet. It will be very helpful if suitable demonstrations are laid out by the Agricultural Department for the creation of required pre-preparedness amongst the cultivators to derive the benefits of irrigation.

(vi) Ver Irrigation Scheme

4.97. Ver Irrigation Scheme was visited by the Team in July 1962. It is a drowned masonry weir constructed across the Ver river near village Goddha, *taluka* Mandvi, District Surat. The Ver river is a perennial stream. It meets river Tapi five miles below village Mandvi. The average rainfall in the catchment area of the river is 55 to 60 inches. Supplies in the river, however, run down to a mere trickle during years of scarcity and scanty rainfall.

4.98. The right bank main canal of the Kakrapar scheme is passing through the outskirts of Mandvi village. But it has no command in its head reach. Therefore, Ver Irrigation Scheme was taken up in 1954 to provide irrigation to the area lying between the river Ver and Kakrapar main canal. The scheme was completed in March 1959 at an actual cost of Rs. 9,04,547 against its estimate of Rs. 9,08,900.

TABLE 4.15

Table showing the agriculture data for the commanded area from Dajipura Irrigation Project in Broach district

(Acres)

Talukas	Total area	Area cultivated	Cultivated area 1953-54							Uncultivated area		No. of wells	Average water depth below ground level (feet)	Percentage of cultivated area to total area
			Rice	Cotton	Wheat	Groundnut	Tobacco	Jowar	Fodder	Govt.	Private			
Jhagadia, Valia & Ankleshwar.	22,396	21,607	938·08	12,531	174·27	336·03	80·30	2,702·27	4,845.76	517·11	271·32	79	25 to 35	96·5%
			4·3%	58·00%	0·8%	1·6%	0·4%	12·5%	22·4%					

4.99. *Return as envisaged in the Project.*—Total culturable commanded area of the Project is 6,750 acres. Taking 60 per cent of culturable commanded area the irrigable area comes to 4,000 acres. The existing water rates on Doswada Tank canals for *kharif* are Rs. 10 per acre and if the same rates are charged on this scheme, it will yield a revenue of Rs. 40,000 a year.

4.100. The expenditure on establishment and maintenance is given below :—

Establishment	Scale	Pay per month	Total expenditure	Allowance
	Rs.	Rs.	Rs.	Rs.
1. Section Officer 1 No.	80-270	175.00	2,100	$55 \times 12 \times 1 = 660$
2. Maintenance Karkum 4 Nos.	46-85	70.50	3,384	$45 \times 12 \times 4 = 2,160$
3. Pathkari 4 Nos	30-40	35.00	1,680	$35 \times 12 \times 4 = 1,680$
4. Canal Chowkidars 4 Nos.	30-35	32.50	1,560	1,680
			8,724	6,180

Maintenance @ 1.5%	$\frac{9,08,900 \times 1.5}{100}$	= 13,633
Total expenditure		28,553
Total income		40,000
Net income		11,447

Besides, value of food crops protected would be as under:—

Irrigable area (acres)	Production in tons per acre	Total production (tons)	Cost per ton	Total value
			Rs.	Rs.
4,000	0.88	3,520	500	17,60,000

Thus the total value of crops protected is of the order of Rs. 17.60 *lakhs*. If only 50 per cent of this value should be the actual yield, the protection bestowed by irrigation is very considerable. Under unfavourable monsoon conditions if half of even this 50 per cent should be written off, irrigation alone can protect food crops of a value of at least Rs. 4.00 *lakhs* which is a considerable addition to the National wealth.

4.101. The irrigation performance is given below :—

Year	Target (acres)			Actual Irrigation (acres)			Amount assessed (Rs.)	Loss or gain over working expenses @28,553 per year
	Kharif	*Rabi*	Total	*Kharif*	*Rabi*	Total		
1958-59			4,000	933	94	1,027	3,833	
1959-60				234	94	328	1,604	
1960-61				694	91	785	13,091	Loss
1961-62				61	61	122	1,668	
			TOTAL .	1,922	340	2,262	20,196	
			AVERAGE .	481	85	566	5,049	

The scheme which could irrigate an area of 1,027 acres in the first year hardly did 329 acres in 1959-60 and 123 acres in 1961-62. For the four years the annual average of irrigated areas was a low figure of 566 acres which is just a little over 14 per cent of the targeted area of 4,000 acres. The annual average of assessment was Rs. 5,049 which is a little less than 1/5 of 1 per cent of the annual expenditure on establishment and maintenance. Thus the objectives of increased production to the cultivator and increased revenue to the State, that were expected of an enlarged command, were not fulfilled.

4.102. Reasons for poor performance as gathered by the Team at site are :—

1. Lack of knowledge regarding suitable crop pattern and crop planning.
2. Non-construction of field channels by irrigators.
3. Non-supply of fertilisers and seeds.
4. Lastly, that the irrigation is in its initial stage and the area is backward.

4.103. The scheme, therefore, needs to be looked into by the State authorities also in all these respects. What is more important than anything else is the construction of field channels so that the initial inertia of the cultivators towards utilisation of irrigation supplies is overcome. May be, the work could be tackled through co-operative action motivated through local *Panchayats*, or that the work may be got done through State agency and cost realised from the beneficiaries in convenient yearly or half yearly instalments added to water charges or even land revenue. The land in the command area of the project is of medium deep and black soils. The cropping pattern before the commencement of the project was paddy in *Kiari* land and cotton and *tur* in *Jarait* land.

4.104. It was envisaged in the project that more area will be brought under *Kiari* land (Paddy crop) from the cotton and *tur* area but the same is not coming true. Cultivators in the area seem to feel that cotton crop being equally paying should be continued. On the other hand, there being a need for increasing cotton area in the country, it may not seem advisable to direct the cultivators to take up rice instead of cotton. In view of there being only a limited supply of water available during *rabi* season, it would seem desirable if :—

(a) area under crops like wheat, which require water till the maturity state is limited.

(b) instead semi-*rabi* crops like pulses should be encouraged as they mature without artificial irrigation as it is likely that supplies will fall short every year.

(vii) Zankhari Irrigation Project (Tichkiya Weir)

4.105. Water is diverted from a drowned masonry weir, (*Bhandhara*) across Zankhari stream, of Purna river basin near village Tichkiya, *taluka* Vyara, district Surat. The catchment area of the stream above the weir is 230 square miles with an average annual rainfall of 70 inches. The weir is designed to pass the maximum flood discharge of 1,05,000 cusecs.

4.106. It is an old scheme constructed in 1917 at a cost of Rs. 90,000. During heavy floods of the succeeding monsoon, the central portion of the *bandhara* was washed away. The scheme was reinvestigated in 1936. An alternative proposal was formulated.

4.107. The weir was ultimately taken up for construction in 1953-54 with its crest at R. L. 282 and length 600 feet. It was completed in 1955-56. The construction of the Right Bank Canal system was taken up in 1954-55 and completed in 1957-58. The estimated sanctioned cost of the scheme was Rs. 2,96,500 and Rs. 6,99,300 respectively but the actual expenditure on both works amounts to Rs. 10,65,171 upto March, 1961.

4.108. The channel system consist of main canal 6.5 miles, Bhojpur branch 3.7 miles and Kapura branch 3.2 miles in length with capacity of 150, 70 and 28 cusecs respectively. The gross commanded area covered by the system is 10,988 acres, out of which 6,700 acres is culturable commanded area and only 4,288 acres of land is irrigable. Irrigation started in 1955-56. The performance since that year is given in Table 4.16.

4.109. While the average performance is far below the targeted figure, the maximum area irrigated was 1,373 acres in the first year of irrigation. It has been falling ever since and came down to 638 acres in the period of six years. The yearly average irrigation being only 880 acres is about 20 per cent of the target. There is considerable scope for development of irrigation on this scheme. As at present against its capital cost of Rs. 248 per acre the effective capital cost comes to Rs. 1,188 per acre.

TABLE 4.16

Year	Canal	C. C. A. (acres)	Irrigable area (acres)	Actual Irrigation (acres-gunthas)				Assessment (Rs.)
				Kharif	*Rabi*	Total		
1	2	3	4	5	6	7		8
1 1955-56	Main Canal	2,000	1,584—14	101—37	655—15	757—12	1,373·17	10,961·44
	Bhojpur branch	2,800	1,800—00	193—00	270—25	463—25		
	Kapura branch	1,900	904—14	30—35	121—25	152—20		
		6,700	4,288—28					
2 1956-57	Do.	Do.	Do.	62—28	458—37	521—25		
				140—05	181—00	321—05	928·38	8,463·00
				25—00	61—08	86—08		
3 1957-58	Do.	Do.	Do.	141—19	283—05	424—24		
				192—39	256—32	449—31	1,076·30	6,402·95
				68—15	134—00	202—15		
4 1958-59	Do	Do.	Do.	186—29	94—24	281—13		
				279—01	104—16	383—17	783·19	11,051·93
				72—25	46—04	118—29		
5 1959-60	Do.	Do.	Do.	114—07	136—12	250—19		
				226—38	52—32	279—30	607·17	8,371·73
				38—00	39—08	77—08		
6 1960-61	Do.	Do.	Do.	566—07	186—08	752—15	752·15	11,759·97
7 1961-62	Do.	Do.	Do.	365—00	273—03	638—03	638·03	..
				GRAND TOTAL			6,160·19	57,011·02
				YEARLY AVERAGE			880·03	9,502·00

4.110. The reason for this shortfall in the development of irrigation, as stated, is that the people in this area are not amenable to change the existing *Jarait* lands to *Kiari* lands to grow fine quality of rice which is the only crop that may require irrigation facilities in this area having an average rainfall of 70 inches. The above operation needs various measures such as financial assistance, supply of better quality of seeds and manure etc. The principal crops grown in the area are cotton, *jowar* and rice.

4.111. It is doubtful if diversion works of this type should at all be built in such areas where there is heavy rainfall during *kharif* period. If there is good rainfall during *kharif* season they serve no useful purpose. During *rabi* season there is generally no water in the streams. They, therefore, are functionless during *rabi*. Unless such works are supplemented with some storage backing, their utility remains very limited and expenditure incurred thereon results in very poor return to the State.

CHAPTER V

Performance and Financial Picture

5.1. Statements of performance of 106 Minor Irrigation Schemes, excluding tubewells, have been received from ten Irrigation Divisions, namely (1) Baroda, (2) Bhavnagar, (3) Broach, (4) Jamnagar, (5) Eastern Kutch (Bhuj), (6) Western Kutch (Bhuj), (7) Panchmahals, (8) Rajkot, (9) Sabarkantha and (10) Kaira. They contain information in respect of capital outlay, interest on capital outlay, direct working expenditure, irrigation potential created and actual areas irrigated on each scheme. (*Appendix VI*).

5.2. The picture of Minor Irrigation Works in the State, as is presented in the statements, goes to show that the schemes do not yield targeted results. Consequently there is considerable loss not only of revenue but of national production. Often they are unable to meet even the direct working expenses.

5.3. The overall area irrigated, in respect of the schemes included in the statement, to the potential created is about $\frac{1}{3}$. This is low. Out of the 106 projects, for which figures are available, 8.5 per cent or nine projects only exceeded their stipulated irrigation targets. Details of their performances and returns are seen in the Table 5.1. Figures are annual averages of data uniformly available for consecutive years as indicated in col. 3 of Table 5.1.

Six out of the nine projects namely Ramdhari, Valavad, Jamara, Wandh (Mandvi), Kalyanpur and Veri yielded surpluses over direct working expenditure. Together they irrigated 4,294 acres or 79.2 per cent of 5,420 acres which is the total actual acreage for all the 9 projects. The three projects, namely, Fakirwadi, Edmund Lake and Naranpur which together irrigated 20.79 per cent of the actual irrigated area for 9 projects, showed minus returns against working expenditure. It is not understood how these three projects which did irrigation acreage more than their targets were unable to meet their working expenses. Apparently, there is room for economy in the operation and efficiency of utilisation of these projects so that they do not remain a source of loss to the State exchequer. If interest charges are taken into consideration the losses are heavier still.

5.4. *Division-wise Perfomance.*—Out of 10 divisions, Baroda and Broach give information for 1960-61 for one project each only. Jamnagar gives capital outlay only for one project under report. In respect of Sabarkantha division except the irrigation potential of 1,200 acres and actual irrigated area of 786 acres (65.5%) other details are not reported. Kaira division reports capital outlay for 3 out of a total of 4 works and gives irrigational achievement (42.25%). The revenue and expenditure picture is not available except for Salvi Tank. Therefore, the other five divisions namely, Bhavnagar, Eastern Kutch

TABLE 5·1

Name of project	Name of Irrigation Division	Average for Years	Irrigation acreage		Profit (+) or Loss (—)		Remarks
			Potential or targeted	Actual	Over direct working expenditure	After meeting interest	
1	2	3	4	5	6	7	8
					Rs.	Rs.	
1 Ramdhari	Bhavnagar . .	1958-59 1959-60	600	727	+7,132·00	N.A.	
2 Valavad	Do. . .	Do.	1,200	1,242	+15,555·50	N.A.	
3 Fakirwadi	Eastern Kutch (Bhuj)	1958-59 1959-60 1960-61	125	295	—2,299·00	—4,623·00	
4 Edmund Lake	Do. . .	Do.	275	374	—303·00	—4,179·00	
5 Jamara	Do. . .	Do.	194	204	+2,262·25	+1,395·25	
6 Naranpur	Do. . .	Do.	229	457	—3,398·00	—11,699·00	
7 Wandh (Mandvi) . . .	Do. . .	Do.	161	298	+417·49	— 233·51	
8 Kalyanpur	Do. . .	Do.	137	159	+417·25	—5,217·75	
9 Veri	Rajkot . .	1958-59 1959-60	1,200	1,664	+22,401·00	—27,774·00	

TABLE 5.2

Abstract of data received from Executive Engineers of five Irrigation Divisions in respect of minor irrigation project (excluding T. wells) in Gujarat

(Rs. in Lakhs)

Irrigation Division	No. of Projects	Capital Outlay	Direct working expenditure	Profit (+) or loss(—) over direct expenditure	Rate % Capital Outlay	Interest	Net profit (+) or loss (—)	Net Rate % on Capital Outlay	Irrigation		Figures are annual averages for years	Remarks
									Potential (acres)	Actual (acres) % of Col. 10		
1	2	3	4	5	6	7	8	9	10	11	12	13
1. Bhavnagar	7	32·5	0·16	+0·36	+0·11	N.A.	+0·36	+1·11	4,200	3,944 94·00%	(1956-57 to 1959-60)	Capital Outlay for six works only (excluding Hamapar scheme).
2. Eastern Kutch (Bhuj)	35	96·74	0·97	—0·43	—0·44	3·84	—4·27	—4·42	29,499	15,167 —51·42%	(1958-59 to 1960-61)	

3. Western Kutch (Bhuj).	25	38·81	0·59	—0·48	—1·24	2·92	—3·40	—0·09	21,846	3,328 15·23%	(1956-57 to 1960-61)	Dafa for first 17 projects only as per statement received from Executive Engineer.
4. Panchmahals	14	10·35	1·30	—0·44	—4·25	2·33	—2·77	—0·27	8,126	3,999 49·21%	(1957-58 to 1960-61)	
5. Rajkot .	14	44·38	2·38	+3·14	+7·00	2·02	—3·08	—6·86	18,585	7,137 38·40%	(1957-58 to 1960-61)	Actual acreage in col. 11 is annual average for 1957-58 to 1959-60

NOTE. —Figures in columns 4 to 9 are flat annual averages (rounded to the nearest 1,000) for all projects for which reports were received from the concerned Executive Engineers.

(Bhuj), Western Kutch (Bhuj), Panchmahals and Rajkot are taken up for consideration. The statements received in respect of these projects are placed in *Appendix VI.*

5.5. Figures in col. 4 to col. 9 in the Table 5.2 are annual averages. The averages ignore the fact that some of the individual projects did not irrigate at all. The reason is that the idle projects are a burden on the operating ones. In the case of Western Kutch, (Bhuj) data for 17 schemes only are considered because the data in respect of the other 8 do not lend themselves for a study. In the Panchmahals division the Vijayagadh project is a feeder to Futelao. So, separate irrigation figure is not available for the Vijayagadh project while capital interest and working charges are separately debited to its account.

5.6. *Irrigation and Revenue.*—A total 95 projects in the above named five divisions is under review here. 7 of these, in Bhavnagar, reported the highest percentage of 94 for irrigational achievement. In this division there was an annual average of Rs. 0.36 *lakh* of profit over direct expenditure, for four years of 1956-57 to 1959-60. This does not take into account the interest charges (information about which is not available). Similarly, in Rajkot division, 14 projects with an irrigational achievement of 38.40 per cent only, secured an average of Rs. 3.14 *lakhs* of profit over direct working expenses, for four years of 1957-58 to 1960-61. In the other three divisions covering 84 schemes the revenue assessment is not enough even to meet their working expenses fully. Their irrigational achievements as per cent of the targeted figures are as follows :

Eastern Kutch (Bhuj)	51.42%
Western Kutch (Bhuj)	15.23%
Panchmahals	49.21%

The cases of Eastern Kutch (Bhuj) and Panchmahals especially warrant attention for, their irrigational achievements favourably compare with that of Rajkot division (38.40%). But they are not earning enough to meet even their working expenses. When the interest charges are also taken into account all the five divisions report net losses varying from 4.4 per cent in Eastern Kutch (Bhuj) to 26.8 per cent in Panchmahals, on the capital outlays. Their corresponding irrigational achievements and net losses, as percentage, are shown below:

(Percentages)

Name of Division	Irrigational achievement	Net loss on Capital outlay
1	2	3
1 Bhavnagar	94.00	N.A.
2 Eastern Kutch (Bhuj)	51.42	4.4
3 Western Kutch (Bhuj)	15.23	8.7
4 Panchmahals	49.21	26.8
5 Rajkot	38.40	6.9

5.7. *Capital Outlay.*—A total sum of Rs. 289.97 *lakhs* has been spent in the construction of 98 projects. It is seen that Bhavnagar which has spent Rs. 32.05 *lakhs* on 7 works for a total irrigation potential of 4,200 acres has the largest capital outlay per acre, the amount being Rs. 762.87. The effective outlay per acre, which is determined by the actual area irrigated, is Rs. 863.34. Kaira has laid out the smallest amount per acre projected and the effective outlays being Rs. 101.55 and Rs. 246.18 respectively. The following figures (Table 5.3) for the six divisions are given in the descending order of capital outlay for the potential area and the effective capital outlay for the actual area is paired alongside.

TABLE 5.3

Name of Division	Capital outlay per acre (in Rs.)		Rate % of projected cost to effective cost per acre	Percentage of irrigational performance to potential
	Projected area	Actual irrigated area		
1	2	3	4	5
1 Bhavnagar	762.87	363.34	113.17	94.00
2 Eastern Kutch (Bhuj) . .	327.90	637.90	194.54	51.42
3 Rajkot	236.11	620.00	629.07	38.40
4 Western Kutch (Bhuj) . .	182.28	1,166.67	640.04	15.23
5 Panchmahals . . .	127.40	270 00	211.93	49.21
6 Kaira (for 3 works) . .	101.55	246.18	242.42	41.21

There is, therefore an approximate parity between figures in cols. 4 and 5.

PRE-PLAN AND PLAN PERFORMANCE

5.8. *Rajkot Division.*—In the statement on Rajkot Division in *Appendix VI*(8) it can be seen that out of the 14 projects 10 were commissioned before the plan years and 4 were constructed or commissioned during the Plan years, *i.e.*, since 1951-52. All these projects do not present a different picture except Pancli that was commissioned in 1908. In the other projects the net returns have been on the minus side. However, losses have been on the lowside in projects commissioned before the Plan years. If the interest charges are excluded, all the ten pre-Plan projects record plus returns. One possible explanation may be the fall in Rupee value so that if the variation in Rupee value is allowed for, even the pre-Plan projects may show totally minus returns. The following Table 5.4 (A & B) gives scheme-wise details for the 14 schemes in the division.

TABLE 5.4

Performance of pre-Plan and Plan period minor irrigation schemes in the Rajkot Irrigation Division during 1960-61

Irrigation project	Year of Construction	Capital outlay (Lakhs)	Direct working expenditure	Profit (+) or loss (—) over working expenditure	Rate of profit (+) or loss (—) over direct working expenditure	Interest	Net Profit (+)or loss(—)	Rate of net profit (+) or loss (—) on capital outlay	Irrigation		Remarks
									Potential (acres)	Actual in 1960-61 (acres) & % of Col. 10.	
			Rs.	Rs.	Rs.		Rs.	Rs.			
1	2	3	4	5	6	7	8	9	10	11	12
A. *Projects Commissoned During Pre-Plan Year*											
1 Ravenia .	1882	0·41	2,794	+ 865	+2·10%	1,845	— 980	—2·40%	400	353 88·25%	
2 Panelia .	1882	0·50	2,301	+ 1,216	+2·40%	2,250	— 1,034	—2·06%	400	434 108·50%	
3 Lalpari .	1888	4·10	20,650	+ 7,074	+1·70%	18,450	—11,376	—2·75%	4,200	2,260 53·81%	
4 Adhia . .	1901	0·60	3,099	+ 4,295	+2·20%	2,700	— 1,405	—2·34%	600	419 69·83%	
5 Alansagar .	1902	2·25	9,730	+ 9,945	+1·00%	10,125	— 180	—0·08%	4,000	2,200 55·00%	
6 Rajavadla .	1902	3·00	6,511	+ 3,015	+4.40%	13,500	—10,485	—3·48%	600	721 120·16%	
7 Veri . .	1906	11·15	8,281	+21,209	+1·90%	50,175	—28,966	—2·60%	1,200	1,745 145·41%	
8 Anandpar .	1907	N.A.	1,794	+ 3,706	N.A.	N.A.	N .A.	N.A.	600	415 69·16%	

1	2	3	4	5	6	7	8	9	10	11	12
9 Kuvadra .	1908	N.A.	2,624	+ 1,353	N.A.	N.A.	N.A.	N.A.	350	231 80·28%	
10 Paneli .	1908	4·00	10,814	+21,261	+5·30%	18,000	+3,261	+0·82%	3,500	1,866 53·31%	
B. *Projects Commissioned During Plan Period*											
1 Ghunada .	1952	2·74	2,840	—2,001	—0·73%	12,330	—14,331	—5·24%	265	110 41·5%	
2 Kotharia .	1956	3·36	148	— 148	—0·04%	15,120	—15,268	—5·30%	360	N.A. N.A.	
3 Kalubhar .	1958	11·68	8,517	—4,504	—0·39%	52,460	—56,964	—4·80%	2,110	536 25·4%	
4 Hadala .	1961	1·09	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	

5.9. *Western Kutch (Bhuj) Division.*—Information is available in respect of Western Kutch (Bhuj) also for 15 schemes completed during the pre-Plan Period and 7 schemes during the First Plan Period. 6 projects of the Second Plan period are reported as being in progress and particulars of these are not available. In respect of the 22 projects of the pre-Plan and First Plan years, excepting the particulars of working expenses and revenue returns, other particulars are given regarding estimated cost, start and completion of works, total command, total area to be irrigated, potential and actual areas. The relevant data are reviewed. The 15 pre-Plan projects were completed at an estimated cost of Rs. 207.00 *lakhs*. Their irrigation potentials and actuals are given in Table 5.5 for three years.

TABLE 5.5

Year	Estimated cost (in lakhs)	Targeted area	Cost per acre	Actual area	Cost per acre	% of actual (col. 5) to target (col. 3)
	Rs.	Acres	Rs.	Acres	Rs.	
1	2	3	4	5	6	7
1958-59 .	207.00	18,620	1,112	5,836	3,547	31.34
1959-60 . .	207.00	17,120	1,215	7,075	2,926	41.33
1960-61 . .	207.00	25,295	818	3,116	6,643	12.32

As elsewhere here also it can be seen that as the ratio of actual irrigated area to the potential area falls, the effective capital cost on the irrigated land increases. There is another feature that comes to notice. The potential area increased from 18,620 acres in 1958-59 to 25,295 acres in 1960-61, by nearly 35 per cent. It requires more detailed knowledge to reconcile this enlarging of the potential area with a falling performance from 5,836 acres in 1958-59 to 3,116 acres in 1960-61; the decrease is by nearly 47 per cent.

5.10. Tables 5.6 and 5.7 separately present particulars of 15 pre-Plan and 7 First Plan Projects. They reveal similar trends.

TABLE 5.6

Pre-Plan-Schemes (15)

Year	Estimated cost (in lakhs)	Targeted area	Cost per acre	Actual area	Cost per acre	% of actual area to potential area
	(Rs.)	(acres)	(Rs.)	(acres)	(Rs.)	
1	2	3	4	5	6	7
1958-59	181.63	15,870	1,145	4,265	4,259	27%
1959-60	181.63	15,095	1,203	6,091	3,000	40%
1960-61	181.63	22,270	816	1,991	9,123	9%

TABLE 5.7

First Plan Schemes (7)

Year	Estimated cost (in lakhs)	Targeted area	Cost per acre	Actual area	Cost per acre	% of actual area to targeted area
	(Rs.)	(acres)	(Rs.)	(acres)	(Rs.)	
1	2	3	4	5	6	7
1958-59	25.17	2,750	916	1,570	1,603	57%
1959-60	25.17	2,025	1,243	984	2,558	49%
1960-61	25.17	3,025	832	1,125	2,237	33%

This analytical study goes to show that there is considerable room for improvement both in respect of operational efficiency of these schemes and their utilisation for maximising the agricultural production therefrom. As this improvement takes place, their financial returns are also bound to improve.

CHAPTER VI

Irrigation in coastal areas

6.1. The State of Gujarat has a long stretch of coastal area along Arabian Sea where natural precipitation varies considerably from north to south. While northern coastal area in Bhuj and Saurashtra verge on aridity, those in southern part of the State, *i.e.* Surat and Broach sustain good banana plantation.

6.2. The Team had occasion to drive along almost the entire western coast line and observed cultivation extending right upto the water edge in large stretches along the sea coast. Fresh water is available in limited quantity from surface wells and is used for irrigation purposes. These wells, however, dry up in the hot weather.

6.3. Land in this region of the State has a special feature. It is covered with hard crust on top with soft soil below. Most of the fields have been made out by digging the hard crust. These hard crust blocks are used for field fencing.

6.4. Areas along the coast, however, present a prospect of conservation of fresh water through contour bunding, *Nala* plugging and small storages in suitable catchments in this tract. In the old Porbandar area, it was gathered that the area little inland presents considerable drainage difficulties. Large stretches of land get inundated with rain water. Drainage Division has accordingly been set up by the State Government for improvement of the area. Since rainfall in the locality is limited, it is felt that along with drainage improvement, water conservation aspect may also be kept in view. Thereby, we can serve dual purpose of improving the land and at the same time providing water for irrigation, whenever needed. In other words, unidirectional attempt towards improvement of drainage may be broad-based, so that it serves the above dual purpose.

6.5. It was surprising to find that over a vast sea front as the Saurashtra and Kutch coast line present, there is not any appreciable effort mobilised towards coconut plantation even though there seems to be considerable climatic and environmental suitability in this area for its promotion. It is necessary that the technique of planting date palm and coconut should be brought home to the cultivators either by imparting necessary training in the cultivation of these crops or by bringing about some progressive cultivators from other areas, who are well versed in their cultivation.

6.6. There are about 3 million acres of land in Kutch bordering the gulf of Cambay, which is highly saline. The chief source of salinity in these soils is the sea water which during monsoon inundates vast

stretches of land in Kutch and deposits through tidal waves, salt laden silt in the estuaries of Narbada, Tapi, Mahi, Sabarmati and numerous small rivers. Soil survey indicates that soil under influence shows high contents of exchangeable monovalent bases and of soluble salts and predominance of chlorides in the total soluble salts amounting to more than 50 per cent. Such soils can be used for agricultural purposes, if they are freed from salinity and suitable cropping patterns are followed.

6.7. Soil subjected to flooding can only be reclaimed by putting up embankments with sluices to prevent the ingress of sea water and allow the impounded rain or river water to go out. The State has undertaken a pilot project scheme with the assistance of Dutch Experts to reclaim *Khar* land at Vallabhipur. The pilot project covers 6,000 acres. The technique used is that of keeping water standing constantly on the land and allowing percolation through saline layer of the soil into the ditches from where it is carried into channels and finally to the sea. The cost of reclamation is estimated to be Rs. 350 per acre. If it proves a success, it is envisaged to reclaim 55,800 acres at a total cost of Rs. 195.3 *lakhs*. The State is also reclaiming *Khar* land under *Khar* Development Scheme at an average cost of Rs. 120 per acre. In the Third Five Year Plan, a pilot project to reclaim areas under Little Rann of Kutch at a cost of Rs. 250 per acre has also been included. No doubt, that the resources of sweet water in areas with uncertain and low rainfall are somewhat meagre, but the possibility of exploring sweet water in the subsoil at certain depths should be examined.

6.8. The problem of coastal land reclamation and utilisation is an intricate one and is only distantly related to minor irrigation problems. The Team, therefore, did not go into details thereof. Another aspect of obtaining some quantity of fresh water in coastal areas in arid and semi-arid zones is from solar radiation evaporation process which is being tried in some of the western countries. It is felt that in really precarious areas, where crops stand damaged for want of one or two critical waterings in the hot season, when humidity is also very low, experimental units may be started in some coastal areas for producing sweet water through solar evaporation process. The know-how in this respect is available in the current literature already published on the subject. It has a wide range of application. If successful, such experiments are likely to pay heavy dividends, not only for irrigational purposes but also for the much needed domestic water supplies.

6.9. Water logging is not a serious problem in the State except in some parts of Junagadh, where about one *lakh* acres are affected by this and salt efflorescence. It is contemplated to reclaim this land in the Third Five Year Plan at a cost of Rs. 60 *lakhs*. The reclamation of such lands is quite expensive as it involves removal of salt by scrapping, flushing out that salt which involves a good drainage system and adoption of sound farming techniques like levelling of land,

uniform application of water in sufficient quantity, use of adequate organic matter, green manuring and a good system of crop rotations and application of gypsum. Where reclamation cost is rather prohibitive, to bring the waste lands to suitable conditions for farming or its development into pastures, it will be desirable to grow salinity resistant species of plants which will not only be helpful in reducing the chances of salts to rise upland in the soil but will also have a healthy effect on soil structure. Salt bushes, accacia and date palm are good salt tolerant trees and should be encouraged.

CHAPTER VII

Planning and prospecting of minor irrigation works

7.1. Looking to the overall land and water utilisation aspect of Gujarat State for agricultural production, the broad irrigation planning policy should appear to be as follows:—

(a) In northern areas bordering arid tracts of Rajasthan, where subsoil water extraction through tubewells and open wells is practised, specific large scale sub-soil water conservation measures need to be taken for re-charging sub-soil to maintain the balance between additions and withdrawals of water so that a long range agricultural economy could be developed without over-straining the existing reserves.

(b) In the western parts of the State, where natural precipitation is meagre and run-off tends to be fast because of undulating nature of the country, emergent steps seem necessary to be taken to conserve as much natural rainfall as possible in subsoil and on surface through storage works for agricultural and other uses.

(c) In the southern parts of the State, where rainfall is fairly good, and which have large tracts of black cotton soil, artificial irrigation needs to be provided at present for helping rice cultivation and a few specialised crops only. Besides, streams with fair dry weather supplies could provide irrigation water to needy tracts through lift irrigation schemes, preferably on co-operative basis, apart from the open wells pumping already in vogue.

7.2. These broad planning aspects are naturally being dealt with as dictated by the site conditions, but with somewhat mixed up objectives, particularly in so far as minor irrigation works are concerned. The Team feels that major irrigation schemes like Kakrapar, which they had occasion to look into and where utilisation of irrigation potential of the order of 5½ *lakh* acres, created almost 8 years ago, is still at an alarmingly low figure of about 50,000 acres (9.9%) is indicative of the natural trend of the area. This is only one example. Utilisation of potential is poor on many other schemes of different categories. Minor Irrigation works planning policy is, therefore, to be orientated so as to follow natural trend of development of irrigated agriculture in the different parts of the State. Artificial irrigation may be a universal need, but it cannot be eschewed of its financial implication. It has, therefore, to be provided on a financially planned basis taking into account soil and climatological features along with traditional and socio-economic background of the tract.

7.3. *Capital cost.*—A rough analysis of capital cost of irrigation per acre on different types of State Works in Gujarat State, as gathered by the Team is given in the Table 7.1.

TABLE 7.1

Name of Work	Type of Work	Year of completion or commission	Potential area or irrigation target (acres)	Capital Outlay	
				Total (Rs.)	Per acre (Rs.)
1	2	3	4	5	6
1 Kalubhar Tank .	Earthen dam .	1958	3,000	11,72,000	390
2 Mandal Bandhara (Started functioning since 1961-62.)	Bandhara . .	1960	102	82,166	806
3 Ver Irrigation Scheme	Diversion weir .	1959	4,000	9,04,547	226
4 Gadat Co-operative Lift Irrigation Society.	River Lift Scheme	1939	250	1,16,000	464
5 Tubewell No.11 in Kalol Block.	Deep Tube-well .	1957	175	81,500*	466
6 Open well** . .	Open well . .	N.A.	3·2	1,890	591

(Amounts in col. 6 are corrected to the nearest rupee)

7.4. Keeping these figures in view, it becomes clear that unless indirect benefits resulting from artificial irrigation outweigh the minus direct return on investment, it may not lead to a stabilised pattern of agro-economic development. The Team, therefore, suggests that close financial scrutiny of the project should be made on a rational basis. It does not, however, mean to dampen the enthusiasm of the State authorities with regard to development of irrigated agriculture in the State if need therefor is warranted on an overall basis, of financially sound agricultural development. It may need improvement in the existing agricultural norms and practices to attain financial solvency. Irrigation works have, undoubtedly an insurance value, but a limit is always to be set even on insurance premium. A State cannot afford to lose on its irrigation development when its entire economy

*The Capital outlay of Rs. 81,500 on tubewell is an average figure as shown elsewhere in this Report (Ch. II Table 2·9)

**Data relating to open well irrigation are averages extracted from Report of the Technical Committee of the Maharashtra Government, to assess the extent of work done under the Wells Scheme, April 1960 Part II. The area of 3·2 acres is average of actual irrigated area in the sample.

is based on agriculture. Planning and prospecting of irrigation works of all categories has, therefore, to be on a sound basis so that benefits therefrom both to the State and the Irrigators are maximised *i.e.* at least overall national return should be commensurate with national investment.

7.5. *Irrigation Code.*—The State of Gujarat consists of parts of erstwhile British India and a number of big and small princely States. The various units, before integration, were governed by their local rules and regulations in the realm of irrigation, as in other spheres, which now present a varying cross section. The Team during their tours in the State, therefore, came across many paradoxical situations. It seems necessary that a unified Irrigation Code is enacted and enforced, throughout the State alongwith a rationalised water rate structure so that development of irrigated agriculture takes place without any adverse implications, which are otherwise natural to follow, where investments on works are made from a common resource like the State exchequer.

7.6. *Pre-preparedness.*—The Team observed in many cases that the potential created lied unutilised because the irrigators were not ready to make use of the irrigation water for one reason or the other. In a number of cases, field channels had not been built. On some projects while storage was ready, the distributary canals had not been laid out and completed, and stored water had to be escaped to the sea. Even with all these items complete, unpreparedness on the part of irrigators to utilise the available supplies was felt on a number of projects. Wherever irrigation projects are undertaken, big or small, it is imperative that advance action is taken to create a state of pre-preparedness among the intending irrigators. This needs a co-ordinated action on the part of the various Departments of the State. The Team, therefore, feels that greater attention need to be given to this important aspect of pre-preparedness.

7.7. *Trial-cum-Demonstration Farms.*—Gujarat is one of the few States which have set up research centres for irrigated agriculture. In each of the four important irrigated areas of the State, one Trial-*cum*-Demonstration farm has recently been established under the joint auspices of Irrigation and Agriculture Departments, to find out the requirements of water for major crops like wheat, *bajri* and cotton, to introduce new crops and to evolve suitable cropping rotation and agricultural practices. For tubewell irrigated areas also, three research centres have been set up where varietal, manurial and hydraulic experiments are being conducted. The Team had an opportunity of visiting some of these farms like Bardoli, Vyara and Kim. It was observed that the experiments conducted on these farms are more or less similar to those conducted at any other departmental Research Station. For the conversion of dry into wet land, a good deal of research is required on the water requirements of crops (under different soil and climatic conditions), depth and frequency of watering, economics of the new crops desired to be introduced, crop rotation, application of

water to the fields, size and shape of irrigated fields, location of out-lets, irrigation methods, size of irrigation streams in relation to soil topography and drainage conditions etc. Thus, the objective in setting up Trial-*cum*-Demonstration Farms, requires to be clearly stated and appreciated if re-orientation in the operational policy of these farms is to be brought about. Work has also to be initiated for conditions where only limited supply of water is available like those on Minor Irrigation Schemes. To tackle these problems, it will be necessary to set up a well equipped Research Station for the State in an important irrigated area and to strengthen the existing Research-*cum*-Demonstration Centres by providing adequate staff and laboratory facilities. This is necessary so as to ensure proper utilisation of costly irrigation water. The technicians and the extension workers have to be fully armed with necessary data to advise the cultivators in land management, water utilisation and crop production under irrigated conditions. This is the field which requires much greater attention than has been given hitherto.

7.8. *Land Capability Surveys.*—Recommendations have to be formulated for each of the major soil types in different regions. To be able to do this, it is necessary to carry out land capability survey of the area brought under irrigation. Since conditions vary widely from place to place, examination of all land that comes under irrigation projects requires to be done by men technically qualified, trained and experienced in this work. The Team learnt that soil studies (mechanical and chemical) are being conducted by the Irrigation Research Laboratory. But in crop production, three properties of the soil are of special importance which should be included in surveys and studied in detail. They are: soil texture, soil structure and soil depth and layers. The capacity of soil to absorb and hold water for plant use depends upon these factors. Each soil can hold definite quantity of water under different drainage conditions. Water supplied in excess of retention capacity percolates through the soil and moves out of the root zone. Good soaking or heavy irrigation is harmful rather than beneficial. We have to apply water just enough to fill the soil through the root zone upto the required capacity. Soil structure is the key to the property of the soil which effects water utilisation and crop production. Unlike soil texture, it can be changed. Excellent soil structure could develop with organic matter. In some areas, the Team noticed that wheat was being given even upto ten waterings, which in comparison with four waterings in U.P. and Punjab, are far too many. Considerable savings in water and frequency of irrigation can be brought about by improving the structure of the soil through green manuring. Besides, levelling or grading and smoothening of soil is very necessary in preparing land for irrigation.

7.9. *Productivity Figures.*—For proper and judicious planning of projects, definite information about productivity under irrigated and un-irrigated conditions is a pre-requisite of planning. The State Department of Agriculture reported that they have no information regarding per acre yield under irrigated and unirrigated conditions for

crops. This shortcoming needs to be made up earlier the better. Strangely enough, annual reports published by the Government of undivided Bombay for Gujarat area reveal that irrigation has either negligible effect or no effect at all on per acre yield of crops in most of the districts of the State, particularly in the southern districts. The relevant portions have been extracted in *Appendix VII*. Experiments conducted at Dhulia farm also reveal the same fact. If this is so, expenditure on irrigation projects will not only be un-remunerative but infructuous. This matter, therefore, needs to be looked into by the State authorities, otherwise their planning and prospecting of irrigation projects will naturally stand vitiated.

7.10. *Multiple cropping.*—One of the methods for stepping up agricultural production is to increase the area under double or multiple cropping. With the availability of irrigation water, especially perennial supply, it should be possible to grow two or even more crops on the same land in a year. Some of the progressive farmers are fully aware of these practices and in some parts of Gujarat, it is a common practice with the farmers to grow wheat, rape or pulse after paddy. But a determined drive is necessary to increase the area under multiple cropping in order to achieve the success to the desired extent. Such obstacles in the way of intensive cultivation as damage by cattle, let loose after harvest of paddy, could be overcome by education and collective action. Double cropping, generally, involves some adjustments in the sowing time or evolution of early maturing varieties of major crops. Crops which can be introduced can best be selected by the State Department of Agriculture after experimentation. But once the decision has been made, extension work has to be taken up vigourously and the whole irrigated area must be covered.

7.11. *Substitution of low yielding crops by high yielding crops.*—As already stated, food deficit in Gujarat is mainly because of the predominance of low yielding millets and coarse grains. With irrigation it will be desirable to increase the area under high yielding crops like paddy, maize, potato and even wheat. During the quinquennium ending 1960-61, while the average yields of *jowar* and *bajri* were 222 lbs., and 269 lbs. respectively, those for rice, maize and wheat were 619 lbs., 842 lbs., and 578 lbs., respectively. The potato yield in Gujarat is fairly high, being 15,505 lbs. which is over 63 times that of millets and nearly 27 times that of wheat. As regards food value, about 2½ times of potato by weight is equivalent to one unit of food grains. It will, therefore, be desirable to replace wherever possible the low yielding crops by the high yielding ones. The research stations have to devote greater attention to this problem than uptil now. There is ample scope in Gujarat for producing high yielding crops. It is seen that the area and production under maize, rice and wheat are going up and those under *jowar* and *bajri* are coming down. The area under potato is almost stationery. Side by side, campaign has to be launched for bringing about change in the food habits of the people.

7.12. *Co-ordinated Courses.*—During their tour the Team felt that there is need to organise co-ordinated courses covering the necessary elements of irrigational and agricultural norms and practices which should be gone through by both the irrigation and the agricultural field staff. It would seem advantageous if these courses are open even to progressive farmers in the area so that they also get conversant with most appropriate methods of agriculture leading to optimum production from our land and water resources.

SUMMARY OF RECOMMENDATIONS

Gujarat is mostly a water deficient State. A techno-economic appraisal of its minor irrigation schemes, as presented in this study, may thus invoke interest towards betterment of their performance. The study conducted by the Team is, in its very nature, an applied technical research with an economic bias. The recommendations emerging out therefrom have, therefore, generalised implications though they have been inferred from direct field observations made on sample works. Again, the recommendations are orientated to impinge primarily on policy matters leaving out details pertaining to individual works to be attended to by the State authorities. They are enumerated below:—

I. Regular and systematic sub-soil water studies, both quantitative and qualitative, should be carried out in the State, more particularly in the areas, where State tubewells are located. (*Para 2.3*).

II. Responsibility of management and preparation of assessment papers (demand statement) of irrigation works may rest with the Irrigation Department and realisation of water rates be the responsibility of the Revenue Department. (*Paras 2.5 and 4.89*).

III. Stoppage of water supply from tubewells to the defaulter cultivators is not conducive to optimum utilisation of water. Effective recourses to Section 57 of the Bombay Irrigation Act 1879 be had, to recover arrears of water rates till a regular Tubewells Act governing the operation and management of State Tubewells is enacted and enforced. (*Paras 2.5, 2.11 and 2.17*).

IV. Supply of water to the cultivators in the order in which applications are received involves loss of both water and time. *Osrabandi —Warabandi* System (as in U.P. and Punjab) may be adopted, as necessary. (*Paras 2.6 and 2.17*).

V. Where commanded areas are on different contours it would be advisable to provide separate outlets in the delivery tank at corresponding levels, thus obtaining any unnecessary lift. (*Para 2.7*).

VI. To keep a watch on the behaviour of tubewells, a regular proforma should be introduced for periodic inspection and check up of discharges and depressions by the supervisory staff. (*Para 2.9*).

VII. In the interest of economy and efficiency the pace of energising the State tubewells working on diesel oil should be accelerated. (*Para 2.14*).

VIII. Land acquisition procedure for water courses should be suitably amended to accelerate the process of acquisition. (*Para 2.15*).

IX. Supply of water on concessional rates for hot weather and green manure crops should be offered in order to encourage cultivation and to secure a balanced irrigation performance throughout the year. (*Paras 2.15 and 4.16*).

X. Two-part Tariff consisting of a fixed yearly standing charge on the area in the command and a recurring charge on the area actually irrigated may be introduced to help utilisation of the potential created. (*Para 2.17*).

XI. Extensive commands of tubewells be restricted to render service more effective and efficient as well as leading to economy in the water distribution system. (*Para 2.25*).

XII. Isolated patches of land at higher elevation be left out of command because of unduly heavy cost of reaching water up to them on high embanked water channels. (*Para 2.26*).

XIII. State agencies be organised to help needy agriculturists to deepen open wells which may otherwise become derelict and costs of deepening be recovered in convenient instalments. (*Para 3.4*).

XIV. Lifting of water through '*Motes*' could be replaced wherever feasible with modern lifting appliances, *Rahats*, etc. (*Para 3.5*).

XV. A bold programme of well sinking and repairing should be undertaken to achieve targets of food production and also to serve as insurance against failure of monsoon. (*Paras 3.6 and 3.8*).

XVI. Closure of irrigation channels during night hours needs to be avoided. Instead irrigation at night should be encouraged. (*Para 4.5*).

XVII. To effect economy in the use of water, land levelling and grading in the irrigation commands should be done even if State help in the shape of loan or subsidy is required by the cultivators. This process should be expedited. (*Para 4.6*).

XVIII. Channel sections and outlets need to be checked up and remodelled to standard designs in the interest of efficient, economic and equitable distribution of irrigation supplies. (*Paras 4.14 and 4.18*).

XIX. Practice of field to field irrigation should be discouraged. Instead properly aligned water courses should be laid out. (*Paras 4.18, 4.29, 4.62 and 4.103*).

XX. Irrigation tanks which would come in the command of perennial major or medium irrigation schemes would not be required to be retained. Necessary planning about reclamation and utilisation of tank bed areas should be done well in time. (*Paras 4.37 and 4.41*).

XXI. Correct record of actual irrigation should be maintained to gauge the capacities and capabilities of projects and schemes, whether under fixed or recurring water rate system. (*Para 4.62*).

XXII. To have a proper assessment of the capacities, it is desirable to conduct regular silt observations on reservoirs likely to get silted. (*Para 4.65*).

XXIII. Basic record of irrigation on which devolves assessment of water rates, should be maintained on prescribed, printed and machine numbered registers and brought under required physical check by the supervisory staff. (*Para 4.68*).

XXIV. Potentialities of schemes located on perennial streams may be exploited with advantage both for *kharif* and *rabi* with adoption of suitable cropping patterns, evolved with the co-ordination of the Irrigation and the Agriculture Departments. (*Para 4.71*).

XXV. Where serviceability of the diversion weirs located on perennial streams could be extended, possibilities of creating storages in upper reaches may be examined. (*Para 4.72*).

XXVI. Abnormal variations from the original estimate need to be guarded against, with a view to avoid heavy unforeseen financial commitments, through a thorough initial check up of scheme. (*Paras 4.75, 4.92 and 4.93*).

XXVII. *Kharif bandharas* do not seem to fulfil irrigational requirements effectively. Their further construction may not seem justified. (*Paras 4.76, 4.111*).

XXVIII. Gauges need to be fixed at head, tail and other control points of the canals where they do not exist. (*Para 4.87*).

XXIX. The concerning situation in respect of minus financial returns as obtained on some irrigation works should be particularly looked into with a view to secure optimum utilisation of water and to make such works remunerative to the State. (*Paras 5.2 and 5.5*).

XXX. In coastal areas water conservation measures need to be taken along with drainage schemes. (*Para 6.4*).

XXXI. Where the climatic and environmental conditions are favourable, suitable measures should be taken to encourage cultivation of coconut and date-palm, particularly in coastal areas. (*Para 6.5*).

XXXII. Suitable sluice arrangements should be made at river mouths which will prevent the ingress of brackish sea water and at the same time allow the river into the sea so that the river water in the lower reaches does not become saline. (*Para 6.7*).

XXXIII. Experiments to produce sweet water from saline sources may be undertaken in areas with precarious water resources through solar radiation process. (*Para 6.8*).

XXXIV. Where the cost of mechanical and other allied methods of land reclamation from salinity is prohibitive, salinity resistant species of plants and trees may be grown with advantage. (*Para 6.9*).

XXXV. Early steps need to be taken to enact and enforce a unified Irrigation Code with a rationalised water rate structure, applicable to the whole State. (*Para 7.5*).

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XXXVI. To achieve wholesome utilisation of irrigation supplies a sense of awareness and pre-preparedness is required to be created amongst the cultivators before any scheme is undertaken and during its execution. (*Para 7.6*).

XXXVII. The research programme on the Trial-*cum*-Demonstration Farms should be re-orientated to suit regional needs. (*Para 7.7*).

XXXVIII. Stress on soil studies relating to its texture, structure, depth and layers is required to be given so that effective and economic use can be made of available irrigation water. (*Para 7.8*).

XXXIX. Determined drive is necessary to increase the area under multiple cropping and substitution of low yielding crops by high yielding varieties. (*Para 7.10*).

Appendices

I. Terms of Reference of the Minor Irrigation Team.

II. Copy of letter No. COPP/B/MIT/192 of April 27, 1961 from Shri Baleshwar Nath, Member Minor Irrigation Team, C.O.P.P., to Shri N. D. Daftary, Chief Engineer, Irrigation Department, Ahmedabad. **(Para 2.3.)**

III. Model cropping Scheme for an area under an average command of a tubewell with a discharge of 25,000 gallons per hour with distribution of water spread over one year.

(Para 2.24.)

IV. Statement showing areas under different sources of irrigation.

(Para 3.1.)

V. Proforma for the system of outletting of irrigation water into fields and for remodelling field channels. **(Para 4.14.)**

VI. Statements showing financial results of Minor Irrigation Works in ten Divisions of the P. W. Department **(Para 5.1.)**

(1) Baroda	Irrigation	Division	
(2) Bhavnagar	,,	,,	
(3) Broach	,,	,,	
(4) Jamnagar	,,	,,	
(5) Eastern Kutch (Bhuj)	,,	,,	
(6) Western Kutch (Bhuj)	,,	,,	
(7) (*i*) Panchmahals	,,	,,	1957-58
(*ii*) Panchmahals	,,	,,	1958-59
(*iii*) Panchmahals	,,	,,	1959-60
(*iv*) Panchmahals	,,	,,	1960-61
(8) Rajkot	,,	,,	
(9) Sabarkantha	,,	,,	
(10) Kaira	,,	,,	

VII. Statement showing standard yields per acre in lbs. in irrigated and unirrigated areas in each district of the Gujarat State—1956-57. **(Para 7.9)**

APPENDIX I

Terms of Reference of the Minor Irrigation Team

(*Vide* C.O.P.P. Memorandum No. C.O.P.P. (4)/17/58, dated August 4, 1958.)

The minor irrigation projects may be divided for study into two parts :—

(*a*) Works already in existence.

(*b*) Works which are now being constructed.

2. Case studies should be made of a number of projects of each type under the above headings with a view to judging their efficiency having regard to the objectives with which such works were carried out.

3. The following points should be especially borne in mind :—

Existing Projects

(*i*) The present state of repair and maintenance.

(*ii*) The system of keeping works in proper maintenance with particular reference to the customary obligations of villagers for keeping such works in a sound condition from year to year, the Team should also examine the extent to which these obligations are enforced, the reasons for the failure to do so and the steps that should be taken to carry out such obligations efficiently.

(*iii*) Reasons, if any for non-utilisation of water by cultivators.

(*iv*) Improvements necessary to make the projects more efficient either in the matter of better agricultural planning and practices or in respect of engineering works.

(*v*) Cost of restoration if the project is in a state of disrepair and whether it has been included in the Plan.

New Projects

(*i*) Method of selection-procedure and principles on which priorities are based.

(*ii*) Flow Chart of the construction Project should be prepared to examine whether any avoidable delay has occurred in its completion.

(*iii*) Whether fullest use is made of catchment capacity in preparing designs.

(*iv*) Economics of design.

(*v*) State of agricultural planning with a view to optimum utilisation of benefits.

(*vi*) Institutional arrangements provided for the proper maintenance of new works with special reference to the customary obligation of villagers in this regard.

(*vii*) Cost of actual construction compared to estimated costs—the reasons for increase if any and the care with which the initial estimates were framed.

4. Any other matter which the Team considers necessary to report upon having a bearing on economy and efficiency of such projects.

5. The following information should be gathered by the Team for each State, taken as a whole in regard to existing minor irrigation works :—

(*i*) The Total area irrigated from them according to Settlement registers.

(*ii*) The area actually irrigated from year to year beginning from 1947.

(*iii*) The reason for the reduction, if any, in the area irrigated.

6. In addition, the Team will carry out a study of the tubewell schemes of the Punjab and the U.P. with reference to the fact whether optimum use has been made of the facilities available by ensuring scientific crop planning and by improving agricultural practices. The study should be based on an examination of individual tubewells, which may be divided into most successful, successful and least successful varieties for the purpose of study. The Team should also select a few tubewells for which alternative crop planning and practices may be recommended that are being carried out at present in order to make them more successful. The consideration mentioned regarding minor irrigation works in paragraph 3 *mutatis mutandis* be taken into consideration for the study of tubewells also.

APPENDIX II

Copy of D.O. letter No. COPP/B/MIT/192 of April, 27, 1962 from Shri Baleshwar Nath, Member, Minor Irrigation Team, Committee on Plan Projects to Shri N. D. Daftary, Chief Engineer, Irrigation Department, Ahmedabad

Our report on the study of minor irrigation works in Gujarat State will take sometime before it is finalised and formulated. It occurs to me that in the meantime we might, with advantage, cause implementation of some suggestions as emerge out of our field studies and discussions with you and your officers. It is with that intention that I am addressing this letter to you.

You may recollect that during our meeting with the Chief Minister at Ahmedabad, some concern was expressed by Dr. Jivraj Mehta about the decline in the sub-soil water level in some tubewell areas. In this connection it would be expedient to start spring level observations in the concerned areas, commencing from next month *i.e.* May, 1961. Observation points have to be set out along appropriate lines running across the tract. Reference marks can be established on existing *pucca* wells. Their reduced levels can be deduced from nearest G. T. Bench marks.

First observations can be recorded during May, 1961. Thereafter, observations could be taken with respect to fixed reference marks once after monsoon and once before monsoon, *i.e.* October and May every year. Such observations taken for a couple of years will reveal the trend of sub-soil water level behaviour. They will also show how far the water table recuperates during rainy season and maximum variations in spring levels. If the recuperation is steady every year and if there is no decline in the water table, we can feel re-assured about our sub-soil supplies.

A long range study in this connection will yield very useful data for the years to come. Probably your Soil Studies Organisation could take up this work. Such observations are a regular feature in irrigated areas in U.P. and the Punjab.

Another point needing attention is the need for a Tubewell Act for the State. Without a specific legislation on the subject, it is difficult to exercise effective control on the utilisation of supplies from irrigation resources like State tubewells. For example, we observed on certain tubewells that the water is given to the cultivators on "First come, first served" basis. This basis is unwholesome, so far as irrigation is concerned. Irrigation should proceed *Chak-wise*. This is regulated on U.P. tubewells through a system of *Osrabandi*, which could be enforced under the U.P. Tubewells Act. Similar action seems necessary in respect of tubewells in Gujarat State.

Our report will undoubtedly bring out many other points of worthwhile significance, and we will also be writing to you separately thereabout in due course, if necessary. The two points referred to above, however, need express attention.

Model Cropping Scheme for an area under average command of a tube-well with

Crop group	Monsoon crops (Paddy, ground-nut & vegetables)	Rabi crops (Wheat, tobacco, variali, potato curuin)	Hot weather (Chemo, *Kharif*, *Jowar*, vegetables)
Area	40 acres	100 acres	50 acres
No. of waterings	3—5	6—9	6—7
Total gallons	16·20 million	75·0 million	25·8 million
Water charges	Rs. 1,710/-	Rs. 7,125/-	Rs. 2,450/-

Month	Irriga-tion turns	Gallons required (million)	Total hrs. of pumping	Irriga-tion turns	Gallons required (million)	Total hrs. of pumping	Irriga-tion turns	Gallons required (million)
1	2	3	4	5	6	7	8	9
June	2	6·48	259·2	..	..	..	1	4·3
July	1	3·24	129·6	..	..	..	..	..
August	..	..	..	..	..	..	..	..
September	1	3·24	129·6	..	..	..	..	..
October	..	..	..	1	7·5	300	..	..
November	..	..	..	2	15·0	600	..	..
December	..	..	..	2	15·0	600	..	..
January	..	..	..	2	15·0	600	..	..
February	..	..	..	2	15·0	600	..	..
March	..	..	..	1	7·5	300	1	4·3
April	..	..	..	..	..	..	2	8·6
May	1	3·24	129·6	..	..	..	2	8·6

III

a discharge of 25,000 *gallons per hour with distribution of water spread over one year.*

Perennial crops (Sugarcane, & fruit trees)

3 acres
26—30
8·0 million
Rs. 760/-

Total hours of pumping	Irrigation turns	Gallons required (million)	Total hours of pumping	Total gallons reqd. 125 million	Total hours of pumping 5,000	Equivalent hrs. of pumping per day 13 hrs. 49 minutes
10	11	12	13	14	15	16
172	2	0·53	21·2	11·31	452·4	15·1
..	1	0·26	10·4	3·50	140·0	4·51
..	1	0·26	10·4	0·26	10·4	0·33
..	2	0·53	21·2	3·77	150·8	5·23
..	3	0·80	32·0	8·30	332·0	10·70
..	3	0·80	32·0	15·80	632·0	21·07
..	3	0·70	28·0	15·70	628·0	20·26
..	3	0·72	28·8	15·72	628·8	20·28
..	3	0·80	32·0	15·80	632·0	22·57
172	3	0·90	36·0	12·70	508·0	16·39
344	3	0·90	36·0	9·50	380·0	12·70
344	3	0·90	36·0	12·74	509·6	16·40

Total in a year : 5,004.0

APPENDIX

Statement showing cultivated area irrigated by various sources in

Division	District	Geographical area according to village papers	Net area sown	Net area irrigated	% age of irrigation col. 4 and 5	Govt. Canals	
						Area	Per cent
1	2	3	4	5	6	7	8
Rajkot	Kutch	1,03,362	14,523	1,160	7·989	175	15·086
Do.	Jamnagar	23,189	13,882	577	4·163	24	4·160
Do.	Rajkot	30,865	21,382	1,195	5·588	109	9·121
Do.	Surendernagar.	25,124	15,723	335	2· 13	88	26·268
Do.	Bhavnagar	27,004	18,686	1,072	5·742	150	13·993
Do.	Junagarh	22,843	15,040	1,526	10·146	39	2·555
Do.	Amreli	9,626	5,867	377	6·425	17	4·509
Baroda	Banaskantha.	29,368	17,178	1,287	7·492	..	..
Do.	Sabarkantha	17,517	10,771	1,011	9·387	27	2·671
Do.	Mehsana	22,729	17,160	2,888	16·829	3	0·103
Do.	Ahmedabad	22,243	16,101	925	5·732	441	47·675
Do.	Kaira	16,644	13,060	979	7·496	174	17·773
Do.	Panch-Mahal.	21,958	11,852	340	2·868	48	14·118
Do.	Baroda	18,688	13,214	230	1·740	16	6·957
Do.	Broach	18,914	11,052	123	1·113	5	4·065
Do.	Surat	26,327	16,752	397	2·368	76	19·144
Do.	Dangs	1,910	816	..	..	..	..
	Gujarat State	4,38,311	2,33,059	14,422	6·188	1,392	9· 65

Source.—Handbook of Basic Statistics, Gujarat State 1961.

IV

Gujarat State in the year 1958-59

(*in* '00' *Acres.*)

Private Canals		Tanks		Wells		Other sources	
Area	Per cent	Area	Per cent	Area	Per cent	Area	Per cent
9	10	11	12	13	14	15	16
5	0·431	35	3·017	909	78·362	36	3·104
..	..	1	0·173	552	95·667	..	..
..	..	18	1·504	1,067	89·288	1	0·084
..	..	11	3·283	231	68·956	5	1·493
..	..	..	..	922	86·007	..	..
..	..	1	0·065	1,467	96·135	19	1·245
2	0·53	4	1·061	354	93·9	..	..
..	..	6	0·466	1,163	90·366	118	9·168
..	..	11	1·088	920	95·945	3	0·296
..	..	6	0·206	2,592	89·75	287	9·941
2	0·216	51	5·513	428	46·271	3	0·325
..	..	60	6·13	739	75·484	6	0·613
..	..	12	3·529	280	82·353	..	..
..	..	106	46·087	99	43·043	9	3·913
..	..	13	10·569	98	79·675	7	5·691
..	..	89	22·418	232	58·438	..	..
..	..	..	..	..	..	..	..
9	0·07	424	2·93	12,103	83·92	494	3·43

APPENDIX V

A proforma for outletting system

Sl. No.	Outlet		Area (acres)				Area proposed to be irrigated annually.%age of col. 7	Discharge at-cusecs/ acres.	Other allowances for garden etc.	Total authorised discharge (in cusecs)	Remarks
	Chainage or R. D.	Side Right or left	Gross	Uncultu-rable	Un-commanded	Culturable (col. 4—col. 5+ col. 6)					
1	2	3	4	5	6	7	8	9	10	11	12

NOTE.—Based on the practice followed in the Punjab Irrigation Department.

APPENDIX VI

Abstract of Division-wise Performance of Minor Irrigation Works as detailed in Appendix VI (1) to VI (10) (excluding Tubewells)—Gujarat State

Name of Irrigation Divisions	No. of works	Potential created (acres)	Actual area irrigated (acres)	Annual average taken for the period
1	2	3	4	5
Baroda	1	13,000	6,012	1960-61
Bhavnagar	7	4,200	3,540	1959-60
Broach	1	201	201	1955-56 to 1961-62
Jamnagar	1	2,270	296	1960-61
Eastern Kutch	35	31,499	15,117	1958-59 to 1960-61
Western Kutch	17	23,578	1,959	1960-61
Panchmahal	15	8,126	2,113	1960-61
Rajkot	13	18,585	6,798	1957-58
Sabarkantha	4	1,200	788	1960-61
Kaira	4	8,150	3,443	1960-61
TOTAL	98	1,10,809	40,267	
Percentage of actual area irrigated to potential created		$\frac{40,267 \times 100}{1,10,809}$ =		36·34

Source :—Based on Figures supplied by the State authorities as in Appendix VI(1) to VI(10)

APPENDIX VI (1)

Baroda Irrigation Division. Financial results of Minor Irrigation Works (1960-61)

Project	Direct Capital Outlay		Revenue Receipt		Net revenue excluding interest									
	During the year	To the end of year	Direct revenue of P. W. receipts	Portion of land revenue due to irrigation and irrigation cess	Total revenue receipt	Direct working expenses during the year	Surplus (+) or deficit (—) of revenue over expdt.	Rate % on capital outlay to the end of year	Interest on capital	Net profit or loss after meeting the interest	Surplus(+) or deficit (—) of rev. over expdt. including interest	Rate % on capital outlay to the end of year	Total irrigation potential created	Total actual irrigation
	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)		(Rs.)	(Rs.)	(Rs.)		(Acres)	(Acres)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Jojwa & Wadhwana Irrigation system .	—6,222	9,46,739	2,61,815	..	2,61,815	2,66,025	— 4,210	..	25,148	— 4,210	..	..	13,000	6,012
Fig. as reconciled	..	..	7,49,924	471	7,49,924	9,37,744	—1,87,820	..	..	—1,87,820	..	..	(Total area irrigated from 1951-52 to 60-61 is 44,584 acres)	

NOTE :— 1. Expenditure as booked and reconciled with A. G.'s office and that shown in the Adm. accounts under works does not tally and needs to be reconciled again.

2. Figure of capital outlay to the end of year shown is for extension and improvement of the tank constructed by ex-Baroda State of which capital cost is not known and hence the figure of percentage over capital outlay to that of revenue will not give correct idea of financial result and not given.

3. Figures shown in columns No. 4 to 13 are from Adm. accounts and those shown in col. 2 and 3 are from the books of this office as reconciled with A.G.'s office.

APPENDIX

Bhavnagar

Financial Results of

Project		Direct capital outlay		Revenue Receipt			Direct working expenses during the year
		During the year	To the end of the year	Direct Revenue of P. W. Receipt	Portion of land revenue due to irrigation and irrigation cess	Total revenue receipt	
			(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)
1		2	3	4	5	6	7
1 Chervadla	1956-57	7,32,310	1,432	..	1,432	1,540
	1957-58	,,	8,133	..	8,133	2,871
	1958-59	,,	6,520	..	6,520	1,713
	1959-60	,,	7,337	..	7,337	2,351
2 Solmatia	1956-57	5,70,797	91	..	91	2,416
	1957-58	,,	2,573	..	2,573	3,639
	1958-59	,,	2,332	..	2,332	1,970
	1959-60	,,	1,873	..	1,873	1,437
3 Zelapuri	1956-57	10,74,335	3,662	..	3,662	4,067
	1957-58	,,	5,698	..	5,698	5,886
	1958-59	,,	7,051		7,051	3,074
	1959-60	,,	2,764		2,764	819
4 Ramdha	1956-57	2,25,600	..	..	..	..
	1957-58	,,	..	..	..	..
	1958-59	,,	9,062	..	9,062	3,093
	1959-60	,,	10,637	..	10,637	2,342
5 Valavad	1956-57	4,96,000	..	..	..	..
	1957-58	,,	..	..	..	..
	1958-59	,,	21,177	..	21,177	3,642
	1959-60	,,	16,173	..	16,173	2,597
6 Ambla	1956-57	1,05,600	..	..	..	..
	1957-58	,,	..	..	..	..
	1958-59	,,	5,834	..	5,834	1,043
	1959-60	,,	7,976	..	7,976	1,920
7 Namapar	1956-57	..	..	..	..	..
	1957-58	..	..	..	..	..
	1958-59	..	147	..	147	726
	1959-60	..	326	..	326	623

VI (2)

Division

Minor Irrigation Works

Net revenue excluding interest			Net profit or loss after meeting the interest	Surplus (+) or deficit (—) of revenue over expdt. including interest	Rate % on capital outlay to the end of the year	Total irri. potential created	Total actual irrigation
Surplus (+) or deficit (—) of revenue over expenditure	Rate % on capital outlay to the end of the year	Interest on capital					
(Rs.)		(Rs.)	(Rs.)	(Rs.)		(Acres)	(Acres)
8	9	10	11	12	13	14	15
— 108	..	Not known	— 108	— 108	..	600	410
+ 5,262	..	,,	+ 5,262	+ 5,262	..	600	874
+ 4,807	..	,,	+ 4,807	+ 4,807	..	600	478
+ 4,986		,,	+ 4,986	+ 4,986	..	600	331
— 2,325	..	,,	— 2,325	— 2,325	..	250	249
— 1,066	..	,,	— 1,066	— 1,066	..	250	191
+ 362	..	,,	+ 362	+ 362	..	250	185
+ 436	..	,,	+ 436	+ 436	..	250	363
— 405	.	,,	— 405	— 405	..	900	193
— 188	..	,,	— 188	— 188	..	900	454
+ 3,977	..	,,	+ 3,977	+ 3,977	..	900	640
+ 1,945	..	,,	+ 1,945	+ 1,945	..	900	780
..	..	,,	..	..	..	600	527
..	..	,,	..	..	..	600	1,442
+ 5,969	..	,,	+ 5,969	+ 5,969	..	600	853
+ 8,295	..	,,	+ 8,295	+ 8,295	..	600	601
..	..	,,	..	..	..	1,200	942
..	..	,,	..	..	..	1,200	1,765
+ 17,535	..	,,	+ 17,535	+ 17,535	..	1,200	1,407
+ 13,576	..	,,	+ 13,576	+ 13,576	..	1,200	1,074
..	..	,,	..	..	..	500	382
..	..	,,	..	..	..	500	774
+ 4,791	..	,,	+ 4,791	+ 4,791	..	500	527
+ 6,056	..	,,	+ 6,056	+ 6,056	..	500	368
..	..	,,	..	..	..	150	10
..	..	,,	..	..	..	150	54
— 579	..	,,	— 579	— 579	..	150	65
— 297	..	,,	— 297	— 297	..	150	23

APPENDIX VI (3)

Broach Irrigation Division. Financial results of Minor Irrigation Works. (1960-61)

Pro ect	Direct Capital Outlay		Revenue Receipt		Total revenue receipt	Direct working expenses during the year	Net Revenue excluding interest		Interest on capital	Net profit or loss after meeting the interest	Surplus (+) or deficit (—) of rev. over expdt. including interest	Rate % on Capital outlay to the end of the year	Total irrigation potential created	Total actual irrigation
	During the year	To the end of the year	Direct revenue of P. W. Receipt	Portion of land revenue due to irri. cess			Surplus (+) or deficit (—) of rev. over expenditure	Rate % on Capital outlay to the end of the year						
	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)		(Rs.)	(Rs.)	(Rs.)		(Acres)	(Acres)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Bharan Irrigation Tank		1,87,800	..	1,393·22	1,393·22	8,774	— 7,380.78		N.A.	N.A.	N.A.	..	201·31	201·31

APPENDIX VI (4)

Jamnagar Irrigation Division. Financial results of Minor Irrigation Works

Project	Year	Direct Capital outlay		Revenue Receipt		Total revenue receipt	Direct working expenses during the year	Net revenue excluding interest		Interest on capital	Net profit or loss after meeting the interest	Surplus(+) or deficit (—) of revenue over expt. including interest	Rate % on capital outlay to the end of the year	Total Irr. potential created	Total actual irrigation
		During the year	To the end of the year	Direct revenue of P.W. receipt	Portion of land revenue due to Irr. & Irr. cess			Surplus(+) or deficit (—) of rev. over expenditure	Rate % on capital outlay to the end of the year						
		(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)		(Rs.)	(Rs.)	(Rs.)		(Acres)	(Acres)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Vinue Irri. Scheme .	1955-56	7,38,986	7,38,9	..	..	..	..	This scheme is such for which neither capital nor revenue accounts are kept, hence no details are furnished.					..	..	..
	1956-57	2,99,196	10,38,18	..	..	..	..						..	..	..
	1957-58	7,255	10,45,43	..	..	..	..						..	..	..
	1958-59	34,743	10,80,18	..	..	..	..						..	..	..
	1959-60	1,57,977	12,38,15	225	..	225	..						..	..	..
	1960-61	1,36,213	13,74 3	333	..	333	..							2,27[illegible]	296

APPENDIX

Eastern Kutch Irrigation Division, Bhuj.

Project	Direct capital outlay		Revenue receipt			Direct working Expd. during the year.
	During the year	To the end of the year	Direct revenue P.W. receipt	Portion of land revenue due to irri. and irri. cess	Total revenue receipt.	
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1	2	3	4	5	6	7
1 Fakirwadi	Nil	51,647	151·00	Nil	151·00	2,450
2 Khengarsagar	Nil	3,04,061	2,547·00	Nil	2,547·00	2,544
3 Wandh (Bhuj)	Nil	49,759	151·00	Nil	151·00	3,066
4 Lee	Nil	97,847	380·00	Nil	380·00	6,751
5 Khared	Nil	2,87,664	14,783·00	Nil	14,783·00	3,133
6 Lilpur No. 1	Nil	2,00,656	3,320·00	Nil	3,320·00	3,698
7 Samatra	Nil	13,759	Nil	Nil	Nil	4
8 Mamuara	Nil	20,890	56·25	Nil	56·25	442
9 Warsamedi	Nil	62,402	Nil	Nil	Nil	318
10 Edmund Lake	Nil	86,130	1,308·00	Nil	1,308.00	1,611
11 Madhapar U/I.	Nil	97,748	126·00	Nil	126·00	4,905
12 Rajda	Nil	4,95,772	11,027·08	Nil	11,027·08	1,984
13 Jhuran	Nil	80,264	261·50	Nil	261·50	Nil
14 Jamara	Nil	19,268	2,378·25	Nil	2,378·25	116
15 Vijay Sagar	Nil	6,52,353	23,304·20	Nil	23,304·20	9,209
16 Naranpur	Nil	1,84,664	582·00	Nil	582·00	3,971
17 Satapar	Nil	3,46,171	Nil	Nil	Nil	21,803
18 Serai	78,349·58	3,53,850	5,020·00	Nil	5,020·00	3,290
19 Vanothi	Nil	2,50,159	4,261·00	Nil	4,261·00	2,506
20 Wandh (Mandvi)	Nil	1,11,898	477·25	Nil	477·25	60
21 Gajod	Nil	11,74,665	15,831·00	Nil	15,831·00	8,373
22 Vengadi	2,710	6,20,555	2,269·00	Nil	2,269·00	5,707
23 Lilpur No. 2	Nil	3,03,818	1,861·75	Nil	1,861·75	647
24 Chhasara	Nil	5,60,419	4,298·00	Nil	4,298·00	1,832
25 Badargadh	Nil	5,84,854	1,637·25	Nil	1,637·25	647
26 Mewasa	3,308	7,34,770	5,251·50	Nil	5,251.50	1,308
27 Jatawada	Nil	1,34,152	56·00	Nil	56·00	899
28 Mauana	Nil	1,32,142	52·50	Nil	52·50	79
29 Phot	Nil	3,49,697	335·25	Nil	335·25	6
30 Chang	Nil	5,86,946	4,465·00	Nil	4,465·00	2,039
31 Lotia	Nil	2,91,587	217·00	Nil	217·00	Nil
32 Guniasar	Nil	1,02,140	101·25	Nil	101 25	538
33 Kalyanpur	13,970	14,251	417·49	Nil	417·49	Nil
34 Bela	175·25	2,22,227	293·50	Nil	293·50	Nil
35 Pundi	Nil	95,201	11·00	Nil	11·00	Nil

VI (5)

Financial results of Minor Irrigation Works (1958-59, 59-60 & 60-61)

Net revenue excluding interest		Interest on capital	Net profit or loss after meeting interest	Surplus (+) or deficit (—) of rev. over expdt. incldg. interest	Rate % on capital outlay to the end of the year	Total potential created (on one filling)	Total actual irrigation. Av. of 58-59, 59-60&60-61	REMARKS
Surplus(+) or deficit (—) of revenue over expdt.	Rate % on capital outlay to the end of the year							
Rs.		Rs.	Rs.	Rs.		(Acres)	(Acres)	
8	9	10	11	12	13	14	15	16
— 2,299·00	..	2,324	— 4,623·00	— 4,623·00	..	125	295	
+ 3·00	..	13,683	— 13,680·00	— 13,680·00	..	2,520	744	
— 2,915·00	..	2,239	— 5,154·00	— 5,154·00	..	204	433	
— 6,371·00	..	4,403	— 10,774·00	— 10,774·00	..	328	101	
— 11,650·00	..	12,540	— 890·00	— 890·00	..	2,134	1,266	
— 378·00	..	4,516	— 4,894·00	— 4,894·00	..	520	121	
— 4·00	..	619	— 623·00	— 623·00	..	61	20	
— 385·75	..	940	— 1,325·75	— 1,325·75	..	124	16	
— 318·00	..	2,808	— 3,126·00	— 3,126·00	..	248	225	
— 3,033·03	..	3,876	— 4,179·00	— 4,179·00	..	275	374	
— 4,779·00	..	4,399	— 9,178·00	— 9,178·00	..	197	48	
— 9,043·08	..	22,310	— 13,266·92	— 13,266·92	..	2,718	1,399	
+ 261·50	..	3,612	— 3,350·50	— 3,350·50	..	262	105	
+ 2,262·25	..	867	+ 1,395·25	+ 1,395·25	..	194	204	
— 14,095·20	..	29,401	— 15,305·80	— 15,305·80	..	4,592	3,080	
— 3,389·00	..	8,310	— 11,699·00	— 11,699·00	..	229	457	
— 21,803·00	..	15,578	— 37,381·00	— 37,381·00	..	763	193	
— 1,730·00	..	15,923	— 14,193·00	— 14,193·00	..	974	511	
+ 1,755·00	..	11,527	— 9,772·00	— 9,772·00	..	991	655	
+ 417·25	..	5,035	— 4,617·75	— 4,617·75	..	161	298	
+ 7,458·00	..	52,680	— 45,222·00	— 45,222·00	..	2,628	1,529	
— 3,438·00	..	27,905	— 31,343·00	— 31,343·00	..	2,088	1,365	
— 1,214·75	..	13,672	— 12,457·25	— 12,457·25	..	490	478	
— 2,466·00	..	13,121	— 10,655·00	— 10,655·00	..	1,395	205	
+ 990·25	..	25,219	— 24,288·75	— 24,288·75	..	1,223	173	
+ 3,943·50	..	33,065	— 29,121·50	— 29,121·50	..	1,170	148	
— 843·00	..	6,037	— 6,880·00	— 6,880·00	..	127	18	
— 26·50	..	5,946	— 5,972·50	— 5,972·50	..	79	44	
+ 329·25	..	4,596	— 4,266·75	— 4,266·75	..	390	65	
+ 2,426·00	..	26,317	— 23,890·75	— 23,890·75	..	1,208	150	
+ 217·00	..	26,413	— 26,196·00	— 26,196·00	..	222	88	
— 436·75	..	15,510	— 15,946·75	— 15,946·75	..	157	96	
+ 417·49	..	641	— 223·51	— 223·51	..	137	159	
+ 293.50	..	10,000	— 9,706·50	— 9,706·50	..	435	36	
+ 11·00	..	4,284	— 4,273·00	— 4,273·00	..	2,130	18	

8—1 Project (N. D.)/63

APPENDIX

Western Kutch Irrigation Division, Bhuj.

	Project	Direct capital outlay		Revenue receipts		Total revenue receipts	Direct working expenses during the year
		During the year	To the end of the year	Direct revenue of P.W. receipts	Portion of land revenue due to irri. and irri. cess		
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
	1	2	3	4	5	6	7
1	Sarguala	..	4,19,381	262	..	262	5,045·00
2	Balapur Budadro	13,940	7,08,179	51	..	51	8,364·00
3	Balachor	..	3 40,978	110	..	110	3,309·00
4	Nalia	2,009	3,76,756	6	..	6	1,150·00
5	Ustia	..	41,605	9	..	9	2,385·00
6	Kuapadhar	..	2,24,269	804	..	804	5,086·00
7	Waior	..	1,20,841	34	..	34	582·02
8	Kadoli	..	3,37,735	3,801	..	3,801	6,768·01
9	Kalyanpur	..	31,599	1,200	..	1,200	1,579·30
10	Bhuj Irri.	..	5,80,866	717	..	717	6,253·22
11	Ratia	..	5,86,866	724	..	724	641·00
12	Adhochhani	..	1,51,748	723	..	723	6,179·00
13	Vigodi	208	1,63,559	..	..	..	4,687·00
14	Gopalwadi Wand	..	86,705	392	..	392	2,673·00
15	Tara	..	49,220	317	..	317	229·00
16	Kanoj	..	57,524	..	..	..	1,629·00
17	Fulra	..	2,89,146	77	..	77	2,857·00
18	Chawdhka	..	24	..	..	..	1,282·00
19	Kharwa	..	..	..	..	..	1,197·00
20	Kapdisar	..	..	31	..	31	297·00
21	Habae	..	..	57	..	57	235·00
22	Dhrung	..	..	..	..	..	215·00
23	Kotal	..	..	..	..	..	246·00
24	Rasalia	..	..	..	..	..	971·00
25	Jhikdi No. 1 & 2	..	..	..	..	..	235·00

Note.—Annual average figures of actual area irrigated given in col. 16 are worked out from irrigation and assess-

VI (6)

Financial results of Minor Irrigation Works (1960-61)

Net revenue excluding interest		Interest on capital	Net profit or loss after meeting the interest	Surplus of rev. over expd. inclg. interest	Rate % on capital out-lay to the end of the year	Total Irri. potential created	Total actual irrigation	Average annual irri. for five years (1956-57 to 1960-61)
Surplus of rev. over exp. (—) or (+)	Rate % on capital outlay to the end of the year							
Rs.	Rs.	Rs.	Rs.	Rs		(Acres)	(Acres)	(Acres)
8	9	10	11	12	13	14	15	16
— 4,783·00	In almost	18,872	23,655·00	— 4,783·00	Since	929	163	283
— 8,313·00	all the	31,310	39,623·00	— 8,313·00	the re-	4,490	100	62
— 3,199·00	cases	15,181	18,380·00	— 3,199·00	venue is	1,794	328	247
— 1,144·00	that is	13,198	14,342·00	— 1,144·00	less	1,177	..	..
— 2,376·00		1,872	4,248·00	— 2,376·00	than ex-	418	48	52
— 4,282·00	very neg-	10,092	14,374·00	— 4,282·00	penditure,	1,394	392	231
— 548·02	ligible.	5,295	5,843·02	— 548·02	the ques-	341	..	..
— 2,967.01		15,198	18,165·01	— 2,967·01	tion does	1,740	171	472
— 379·30		3,671	4,050·30	— 379·30	not arise.	783	29	323
— 5,536·22		25,858	31,394·22	— 5,536·22		2,427	128	99
+ 83·00		6,829	6,746·00	+ 83·00		473	141	215
— 5,456·00		11,860	17,316·00	— 5,456·00		1,579	13	283
— 4,687·00		1,24,361	17,123·00	— 4,687·00		1,008	204	133
— 2,281·00		3,902	6,183·00	— 2,281·00		350	45	68
+ 88·00		2,215	2,127·00	+ 88·00		840	103	118
— 1,629·00		2,589	4,218·00	— 1,629·00		617	4	27
— 2,780·00		13,012	15,792·00	— 2,780.00		1,432	90	55
— 1,282·00		..	1,282·00	— 1,282·00		975	..	..
— 1,197·00		..	1,197·00	— 1,197·00		184	..	..
— 266·00		..	266·00	— 266·00		90	..	..
— 178·00		..	178·00	— 178·00		136	..	..
— 215·00		..	215·00	— 215·00		129	..	..
— 246·00		..	246·00	— 246·00		70	..	..
— 971·00		..	971·00	— 971·00		..	..	..
— 235·00		..	235·00	— 235·00		202	..	..

ment returns supplied by the Irrigation Division.

APPENDIX

Panchmahal Division. Financial

Project	Direct capital outlay		Revenue receipt			
	During the year	To end of the year	Direct revenue (P.W.D.)	Portion of land revenue due to irrigation and irrigation cess	Total revenue receipt	Direct working expenses during the year
	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)
1	2	3	4	5	6	7
1. Muvalia . .	3,25,952	3,25,952	15,314·88	..	15,314·88	7,573·54
2. Fatelao . .	1,45,972	1,45,972	2,308·10	..	2,308·10	2,123·98
3. Zari Gangarda	1,51,887	1,51,887	1,205·39	..	1,205·39	794·06
4. Nandelao .	1,39,440	1,39,440	278·76	..	278·76	4,249·89
5. Moti Handi .	1,16,928	1,16,928	658·56	..	658·56	576·96
6. Mora Heda .	66,801	66,801	105·22		105·22	194·68
7. Ghatia Waghet	1,12,555	1,12,555	97·75	..	97·75	59·12
8. Chaka Chhayan	33,056	33,056	..	..	..	..
9. Jaferpura .	66,581	66,581	251·29	..	251·29	2,350·96
10. Chakalia .	54,953	54,953	..	..	..	..
11. Swarupsagar .	1,75,000	1,75,000	5,990·00	..	5,990·00	9,543·00
12. Khangelao .	26,031	26,031	..	..	..	..
13. Hanamant Khunta . .	41,870	41,870	..	..	..	..
14. Kopra Kharwani	54,558	54,558	..	..	..	..
15. Vijayagadh .				Feeder tank to Fatelao tank		

VI [7 (i)]

results of Minor Irrigation Works (1957-58)

Net revenue excluding interest		Interest on capital	Net profit (+) or loss (—) after meeting the interest		Total irrigation potential created	Total actual irrigation
Surplus (+) or deficit (—) of revenue over expenditure	Rate per cent on capital outlay to end of the year		Profit (+) or loss (—)	Rate per cent on capital outlay to end the year		
(Rs.)		(Rs.)	(Rs.)		(Acres)	(A.G.)
8	9	10	11	12	13	14
+ 7,741·34	..	10,834	—3,092·66	..	2,500	2,804-20
+ 184·12	..	4,854	—4,669·88	..	800	482-18
+ 411·33	..	7,443	—7,031·67	..	504	328-22
— 3,971·13	..	6,275	—10,246·13	..	650	69-38
+ 81·60	..	5,729	—5,647·40	..	375	116-28
— 89·46	..	3,273	—3,362·46	..	80	35-23
+ 38·63	..	5,515	—5,476·37	..	300	18-80
..	..	1,487	—1,487·00	..	240	..
— 2,099·67	..	3,262	—5,361·67	..	200	70-60
..	..	2,693	—2,693·00	..	35	..
— 3,553·00	..	5,819	—9,372·00	..	2,000	1,723-23
..	..	1,171	—1,171·00	..	92	..
..	..	1,884	—1,884·00	..	..	..
..	..	2,573	—2,573·00	..	80	..

APPENDIX

Panchmahals Division. Financial

Project	Direct capital outlay		Revenue receipt			Direct working expenses during the year
	During the year	To the end of the year	Direct rev. of P. W. Deptt.	Portion of land rev. due to irrigation cess	Total revenue receipt	
	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)
1	2	3	4	5	6	7
1. Muvalia .	3,25,952	3,25,952	8,080·00	Nil	8,080·00	13,510·00
2. Fatelao . .	1,45,972	1,45,972	747·33	Nil	747·33	736·28
3. Zari Gangarda	1,51,887	1,51,887	438·96	Nil	438·96	947·91
4. Nandelao .	1,39,440	1,39,440	64·62	Nil	64·62	471·12
5. Moti Handi .	1,16,928	1,16,928	1,033·46	Nil	1,033·46	233·73
6. Mora Heda .	66,801	66,801	48·86	Nil	48·86	202·72
7. Ghodia Waghela	1,12,555	1,12,555	Nil	Nil	Nil	Nil
8. Chaka Chhayan	33,056	33,056	Nil	Nil	Nil	Nil
9. Jaferpura .	66,581	66,581	Nil	Nil	Nil	Nil
10. Chakalia	54,953	54,953	Nil	Nil	Nil	4·72
11. Swarupsagar .	1,75,000	1,75,000	7,414·85	Nil	7,414.85	14,382·30
12. Khangelao .	26,031	26,031	Nil	Nil	Nil	Nil
13. Hanamant Khunta .	41,870	41,870	Nil	Nil	Nil	47·00
14. Kopra Kharwani	54,558	54,558	Nil	Nil	Nil	Nil
15. Vijayagadh .	Feeder tank to Fatelao					

VI [7(ii)]

results of Minor Irrigation Works (1958-59)

Net revenue excluding interest			Net profit or loss after meeting the interest			
Surplus (+) or deficit(—) of rev. over expenditure	Rate % on capital outlay to end of the year	Interest on capital	Profit (+) or loss (—)	Rate % on capital outlay to end of the year	Total Irr. potential created	Total actual irrigation
(Rs.)		(Rs.)	(Rs.)		(Acres)	(A.G.)
8	9	10	11	12	13	14
—5,430·00	..	10,834	—16,264·00	..	2,500	1,428-31
+ 11·05	..	4,854	—4,842·95	..	800	145-23
— 508·95	..	7,443	—7,951·95	..	504	65-29
— 406·50	..	6,275	—6,681·50	..	650	12-38
+ 799·73	..	5,729	—4,929·27	..	375	190-20
— 153·86	..	3,273	—3,426·86	..	80	9-30
Nil	..	5,515	—5,515·00	..	300	Nil
Nil	..	1,487	—1,487·00	..	240	Nil
Nil	..	3,263	—3,262·00	..	200	Nil
— 4·72	..	2,693	—2,697·72	..	35	Nil
—6,967·45	..	5,819	—12,786·45	..	2,000	1,723-23
Nil	..	1,171	—1,171·00	..	92	Nil
— 47·00	..	1,884	—1,931·00	..	270	Nil
Nil	..	2,673	—2,673·00	..	80	Nil

APPENDIX

Panchmahals Division. Financial

	Project	Direct capital outlay		Revenue receipt			Direct working expenses during the year
		During the year	To the end of the year	Direct rev. of P.W.D. receipt	Portion of land revenue due to irr. cess	Total rev. receipt	
		(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)
	1	2	3	4	5	6	7
1	Muvalia	3,25,952	3,25,952	12,874·00	Nil	12,874·00	30,666
2	Fatelao	1,45,972	1,45,972	909·00	Nil	909·00	1,970
3	Zari Gangarda	1,51,887	1,51,887	64 00	Nil	64·00	1,331
4	Nandelao	1,39,440	1,39,440	197·00	Nil	197·00	1,260
5	Moti Handi	1,16,928	1,16,928	2,592·00	Nil	2,592·00	2,002
6	Mora Heda	66,801	66,801	64·00	Nil	64·00	296
7	Ghodia Waghela	1,12,555	1,12,555	Nil	Nil	Nil	64
8	Chaka Chhayan	33,056	33,056	Nil	Nil	Nil	213
9	Jaferpura	66,581	66,581	Nil	Nil	Nil	481
10	Chakalia	54,953	54,953	Nil	Nil	Nil	128
11	Swarup sagar	1,75,000	1,75,000	9,442·08	Nil	9,442·08	7,052
12	Khangelao	26,631	26,031	Nil	Nil	Nil	Nil
13	Hanamant Khunta	41,870	41,870	Nil	Nil	Nil	36
14	Kopra Kharwani	54,558	54,558	Nil	Nil	Nil	6
15	Vijayagadh	Feeder tank to Fatelao					

VI [7(iii)]

results of Minor Irrigation Works (1959-60)

Net revenue excluding interest			Net profit or loss after meeting interest		Total irrigation potential created	Total actual irrigation
Surplus (+) or deficit (—) of revenue over expenditure	Rate % on capital outlay to the end of the year	Interest on capital	Profit (+) or loss (—)	Rate % of capital outlay to the end of the year		
(Rs.)		(Rs.)	(Rs.)		(Acres)	(A. G.)
8	9	10	11	12	13	14
— 17,792·00	..	10,834	—28,626·00	..	2,500	1,754-26
— 1,061·00	..	4,854	—5,915·00	..	800	136-17
— 1,267·00	..	—9,443	—6,176·00	..	504	9-7
— 1,063·00	..	6,275	—7,338·00	..	650	29-23
+ 590·00	..	5,729	—5,139·00	..	375	334-14
— 232·00	..	3,273	—3,505·00	..	80	9-7
— 64·00	..	5,515	—5,579·00	..	300	Nil
— 213·00	..	1,487	—1,700·00	..	240	Nil
— 481·00	..	3,262	—3,743·00	..	200	Nil
— 128·00	..	2,693	—2,821·00	..	35	Nil
+ 2,390·08	..	5,819	—3,428·92	..	2,000	1,489-00
Nil	..	1,171	—1,171·00	..	92	Nil
— 36·00	..	1,844	1,920·00	..	272	Nil
— 6·00	..	2,673	—2,679·00	..	80	Nil

APPENDIX

Panchmahal Division. Financial

Project	Direct capital outlay		Revenue receipt			Direct working expenses during the year
	During the year	To the end of the year	Direct rev. of P. W. receipt	Portion of land rev. due to irr. cess	Total rev. receipt	
	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)
1	2	3	4	5	6	7
1. Muvalia	3,25,952	3,25,952	11,750	..	11,750	12,749
2. Fatelao	1,45,972	1,45,972	2,148	..	2,148	1,448
3. Zari Gangarda	1,51,887	1,51,887	1,048	..	1,048	2,556
4. Nandelao	1,39,440	1,39,440	498	..	498	9,089
5. Khangelao	..	..	..	..	..	..
6. Vijayagadh	..	..	Feeder tank to Fatelao tank			..
7. Chakalia	..	..	..	..		
8. Chaka-Chayan	..	..	..	..	..	..
9. Godia Waghela	1,12,555	1,12,555	316	..	316	12
10. Kopara Kharwani.	..	..		..	..	..
11. Moti Handi	1,16,928	1,16,928	215	..	215	723
12. Jaferpura	..	..	..	..	..	..
13. Hanamant Khunta	41,870	41,870	..	..	..	..
14. Muraheda	..	..	..	..	..	..
15. Swarupsagar	1,75,000	1,75,000	..	..	..	..
Kanelao	..	..	Nil	..	Nil	1,037
Ratneshwar	..	..	1,670·07	..	1,670·07	1,067
Dungaria	..	..	Nil	..	Nil	545
Alwa Usar	..	..	289·40	..	289·40	852
Orwada	..	..	Nil	..	Nil	997
Wada talao	..	..	26·60	..	26·60	800

VI [7(iv)]

results of Minor Irrigation Works (1960-61)

Net revenue excluding interest			Net profit or loss after meeting the interest		Total irrigation potential created	Total actual irrigation
Surplus(+) or deficit (—) of revenue over expenditure (Rs.)	Rate% on capital outlay to the end of the year	Interest on capital (Rs.)	Profit (+) or loss (—) (Rs.)	Rate % on capital outlay to the end of the year	(Acres)	(A.G.)
8	9	10	11	12	13	14
— 999	..	10,834	— 11,833	..	2,500	1,718-16
+ 700	..	4,854	— 4,154	..	800	254-24
— 1,508	..	7,443	— 8,951	..	504	94-25
— 8,594	..	6,275	— 1,486	..	90	No canal
..	..	..	..	..	..	..
..	..	..	..	..	..	..
..	..	..	..	..	..	..
..	..	..	..	..	..	..
+ 304	..	5,575	— 5,271	..	300	12-17
..	..	..	..	..	..	..
— 508	..	5,729	— 6,237	..	375	33-01
..	..	..	..	..	..	..
..	..	1,884	..	..	270	No canal
..	..	..	..	..	..	..
..	..	..	..	..	..	2235-20
..	..	..	..	..	..	105-00
..	..	..	..	..	..	Nil
..	..	..	..	..	..	Nil
..	..	..	..	..	..	57-09
..	..	..	..	..	..	Nil
..	..	..	..	..	..	46-04

APPENDIX

Rajkot Irrigation Division. Financial

	Project	Year	Direct capital outlay up to end of that year	Revenue receipt: Direct revenue of P.W. receipt	Revenue receipt: Portion of land revenue due to irr. & irr. cess	Revenue receipt: Total revenue receipt	Direct working expenses during the year
			(Rs. in lakhs)	(Rs.)	(Rs.)	(Rs.)	(Rs.)
	1	2	3	4	5	6	7
1	Kalubhar	57-58	..	..	Nil	Same as	..
		58-59	Cost of const.	1,004	..	in col.	1,702
		59-60	Rs. 11·68	4,013	..	4	8,517
		60-61	(1958)	7,869	..	..	6,553
2	Hadala	58-59	Cost of const.	..	..	..	..
		59-60	Rs. 1.09	Nil	Nil	,,	Nil
		60-61	(1961)				
3	Veri	57-58	Cost of const.	24,335	,,	,,	N.A.
		58-59	Rs. 11·15	32,585			8,952
		59-60	(1906)	29,490			8,281
		60-61		22,551			11,171
4	Paneli	57-58	Cost of const.	N.A.	,,	,,	N.A.
		58-59	Rs. 4·00	22,786			8,935
		59-60	(1908)	32,075			10,814
		60-61		22,551			22,202
5	Lalpari	57-58	Cost of const.	21,518	,,	,,	16,556
		58-59	Rs. 4·10	42,058			14,331
		59-60	(1998)	2,7724			20,650
		60-61		22,764			15,879
6	Anandpar	57-58	N.A.	5,254	,,	,,	851
		58-59	(1907)	2,478			2,811
		59-60		5,500			1,794
		60-61		5,215			2,965
7	Kuvadva	57-58	N.A.	2,889	,,	,,	1,597
		58-59	(1908)	2,697			1,476
		59-60		3,977			2,624
		60-61		4,186			3,535
8	Ghunada	57-58	Cost of const.	N.A.	,,	,,	1,487
		58-59	2·74	757			1,353
		59-60	(1952)	839			2,840
		60-61		828			2,622

VI (8)

results of Minor Irrigation Works

Net revenue excluding interest			Net profit or loss after meeting the interest	Surplus (+) or deficit(—) of rev. over expenditure	Rate% on capital outlay to the end of the year	Total Irrigation potential created	Total actual area irrigated
Surplus (+) or deficit (—) of rev. over expenditure	Rate on capital outlay to the end of the year	Interest on capital @4 1/2%					
(Rs.)		(Rs.)	(Rs.)	(Rs.)		(Acres)	(Acres)
8	9	10	11	12	13	14	15
..	..	..	..	As per	..	..	..
— 698	..	52,460	— 53,158	col. 11	..	2,110	600
— 4,504	..	,,	— 56,964		..	,,	536
+ 1,316	..	,,	— 51,144		..	,,	N.A.
..	..	4,905	..	..	..	..	..
nil	..	,,	..	..	..	Nil	
		,,					
..	..	..	..	..	..	..	..
+23,633	..	50,175	— 26,542	,,	..	1,200	1,291
+21,209	..	,,	— 28,966	,,	..	,,	1,572
+11,380	..	,,	— 38,795			,,	1,745
N.A.	..	..	..	,,	..	3,500	507
+13,851	..	18,000	— 4,149		..	,,	1,725
+21,261	..	,,	+ 3,261		..	,,	1,865
+ 349	..	,,	— 17,651		..	,,	N.A.
+ 4,962	..	18,450	— 13,488	,,	..	4,200	2,028
+27,727	..	,,	+ 9,277		..	,,	2,569
+ 7,074	..	,,	— 11,376		..	,,	2,260
+ 6,885	..	,,	— 11,565		..	,,	N.A.
+ 4,403	..	..	..		..	600	246
— 333	..	..	..		..	,,	421
+ 3,706	..	..	..		..	,,	415
+ 2,250	..	..	..		..	,,	N.A.
+ 1,292	..	..	..		..	350	250
+ 1,221	..	..	..		..	,,	245
+ 1,353	..	..	..		..	,,	281
+ 651	..	..	..		..	,,	N.A.
N.A.	..	..	..	,,	..	265	40
— 596	..	12,330	— 12,926	,,	..	,,	64
— 2,001	..	,,	— 14,331		..	,,	110
— 1,794	..	,,	— 14,124		..	,,	N.A.

APPENDIX

1	2	3	4	5	6	7
9 Alansagar .	57-58	Cost of const.	26,214	Nil	Same as	4,825
	58-59	Rs. 2·25	25,926		in col. 4	4,411
	59-60	(1902)	19,675			9,730
	60-61		46,791			8,569
10 Rajavadla .	57-58	Cost of const.	6,516	,,	,,	2,111
	58-59	Rs. 3·00	10,625			1,493
	59-60	(1902)	9,526			6,511
	60-61		9,969			4,149
11 Adhia . .	57-58	Cost of const.	7,338	,,	,,	871
	58-59	Rs. 0·60	6,186			1,553
	59-60	(1901)	4,394			3,099
	60-61		14,098			3,781
12 Revania . .	57-58	Cost of const.	5,478	,,	,,	861
	58-59	Rs. 0·41	7,931			763
	59-60	(1882)	3,659			2,794
	60-61		5,620			2,385
13 Panelia . .	57-58	Cost of const.	4,242	,,	,,	973
	58-59	Rs. 0·50	4,532			1,442
	59-60	(1882)	3,517			2,301
	60-61		6,637			2,291
14 Kotharia .	57-58	Cost of const.	Nil	,,	,,	57
		Rs. 3·36				275
		(1956)				148
						Nil

VI (8)—*Contd.*

8	9	10	11	12	13	14	15
+21,389	..	10,125	+11,264	As per	..	4,000	1,863
+21,515	..	,,	+11,390	col. 11	..	,,	1,558
+ 9,945	..	,,	— 180		..	,,	2,200
+38,222	..	,,	+28,097		..	,,	N.A.
+ 4,405	..	13,500	— 9,095	,,	..	600	577
+ 9,132	..	,,	— 4,368		..	,,	455
+ 3,015	..	,,	—10,485		..	,,	721
+ 5,820	..	,,	— 7,680		..	,,	N.A.
+ 6,467	..	2,700	+ 3,768	,,	..	600	449
+ 4,633	..	,,	+ 1,933		..	,,	420
+ 1,295	..	,,	— 1,405		..	,,	419
+10,317	..	,,	+ 7,617		..	,,	N.A.
+ 4,617	..	1,845	+ 2,772	,,	..	400	469
+ 7,168	..	,,	+ 5,323		..	,,	292
+ 865	..	,,	— 980		..	,,	353
+ 3,235	..	,,	+ 1,390		..	,,	N.A.
+ 3,269	..	2,250	+ 1,019	,,	..	400	369
+ 3,090	..	,,	+ 840		..	,,	208
+ 1,216	..	,,	— 1,034		..	,,	434
+ 4,346	..	,,	+ 2,096		..	,,	N.A.
— 57	..	15,120	— 15,177	,,	..	360	Irrigation
— 2,751	..	,,	— 17,871		..	,,	not started
— 148	..	,,	— 15,268		..	,,	
Nil	..	,,	..	..	..	,,	

APPENDIX VI (9)

Sabarkantha Irrigation Division. Financial results of Minor Irrigation Works

Project	Direct capital outlay		Revenue receipt			Net revenue excluding interest				Net profit or loss after meeting the interest	Surplus (+) or deficit (—) of rev. over exp. including interest	Rate% on capital outlay to the end of the year	Total irrigation potential created	Total actual irrigation	Remarks
	During the year	To the end of the year	Direct revenue of P. W. receipt	Portion of land revenue due to Irr. and Irr. cess	Total revenue receipt	Direct working expenses during the year	Surplus (+) deficit (—) of rev. over expr	Rate % on capital	Interest on capital						
	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)		(Rs.)	(Rs.)	(Rs.)		(Acres)	(Acres)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 M. I. Tank at Agia	..	..	..	4,803·62	Lastly recovered by Revenue Department.	4,803·62	Nil	..	..	..	..	..	450	360	All these four tanks were in charge of R.D. They have been transferred to P.W. since Dec. 1960. The capital revenue A/C. are still not maintained by this office as the water rates of recovery of irrigation assessment from the cultivators are still not fixed. The water rates were fixed by the collectors of S. K. Distt. as Rs.2/- for Khedbrahma Taluka as per collector's office order No. R.D.V. 204 of 5-3-53.
				For all the four tanks.									250	243	
2 M.I. Tank at Maloda	..	..	..			..	..	..	..	..	..	..	250	111	
3 M. I. Tank at Umedpur	..	..	..			..	..	..	..	..	..	..	250	74	
4 M.I. Tank at Gadhada	..	..	..		..	..	..	..	..	..	..	..	..	..	

APPENDIX VI (10)

Kaira Division. Financial results of Minor Irrigation Works (1960-61)

Project	Direct capital outlay		Revenue receipts		Total revenue receipt	Direct working expenses during the year	Net revenue including interest		Interest on capital	Net profit or loss after meeting the interest	Surplus (+) or deficit (—) of rev. over exp. including interest	Rate % on capital outlay to the end of the year	Total Irrigation potential created	Total actual average annual irrigation (1957-58 to 60-61)
	During the year	To end of the year	Direct revenue of P. W. receipt	Portion of land revenue & irri. & irr. cess.			Surplus (+) or deficit (—) of rev. over exp.	Rate % on capital outlay to the end of the year						
	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)		(Rs.)	(Rs.)	(Rs.)		(Acres)	(Acres)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1st Class Tank :														
1 Kangreli Tank Taluka Thasra .	..	2,87,293	..	..	..	4,608	..	..	..	..	..	..	2,000	9 60
2 Savli Tank Taluka Repodganj .	..	2,32,260	..	14,444·20	14,444·20	4,641	..	..	..	..	..	..	2,500	1,505
3 Suhedia Tank Taluka, Salasiner	..	Not known	..	..		3,327	560·69	..	..	..	..	..	1,700	658
2nd Class Tank :														
1 Saiwat Tank Taluka Thasra .	..	1 34,895	..	..	..	6,556	..	..	..	..	..	..	1,950	320

NOTE.—Actual average annual irrigation in Col. 15 is worked out from the Irrigation and Assessment return.

APPENDIX VII

***Standard yield per acre** in Irrigated & Unirrigated areas in each District of Gujarat State for* 1956-57

Principal Crops (*in lbs.*)

District	Rice		Wheat		Kharif Jowar		Rabi Jowar	
	Irrigated	Un-irrigated	Irrigated	Un-irrigated	Irrigated	Un-irrigated	Irrigated	Un-irrigated
1	2	3	4	5	6	7	8	9
1. Kutch	..	..	..	..	..	..	..	..
2. Amreli	1,440	..	1,300	500	..	..	600	..
3. Banaskantha	1,440	..	1,300	500	600	71	600	..
4. Mehsana	1,440	1,440	1,300	500	600	83	600	600
5. Sabarkantha	1,440	1,440	1,300	500	600	65	600	600
6. Ahmedabad	1,440	1,440	1,300	500	..	..	..	600
7. Kaira	1,320	1,320	1,320	1,320	..	..	600	600
8. Panchmahals	1,200	1,200	1,300	700	..	..	..	820
9. Baroda	1,320	1,320	1,300	600	..	..	600	600
10. Broach	900	900	600	600	..	..	820	820
11. Surat	1,560	1,560	560	560	..	..	..	600
12. Dangs	..	1,080	..	600	..	..	..	..

SOURCE :—**Season and Crop Report of the Bombay State**—year 1956-57.

Principal Crop—contd.

District	Bajra		Maize		Ragi		Gram	
	Irrigated	Un-irrigated	Irrigated	Un-irrigated	Irrigated	Un-irrigated	Irrigated	Un-irrigated
1	2	3	4	5	6	7	8	9
1. Kutch	..	..	..	..	..	..	..	..
2. Amreli	750	750	1,080	1,080	..	..	..	500
3. Banaskantha	750	750	1,080	1,080	..	..	500	500
4. Mehsana	750	750	..	1,080	..	..	..	500
5. Sabarkantha	750	750	1,080	1,080	..	53	500	500
6. Ahmedabad	750	750	1,080	1,080	..	50	..	500
7. Kaira	970	970	1,050	1,050	..	64	500	500
8. Panchmahals	..	820	1,000	1,000	76	51	600	500
9. Baroda	970	970	1,050	1,050	..	50	500	600
10. Broach	..	700	..	1,000	..	..	..	500
11. Surat	..	600	..	1,160	..	69	..	500

GIPN—S4—1 Project (N.D.)/63—6-2-64—750


सत्यमेव जयते