COPP/MIT/1962/7

REPORT

ON

STATE TUBE-WELLS

(PUNJAB)

COMMITTEE ON PLAN PROJECTS

(Minor Irrigation Team)

NEW DELHI

January 1962

LETTER OF TRANSMITTAL

M. THIRUMALA RAO, M.P.,
Leader,
Minor Irrigation Team,
Committee on Plan Projects.

PLANNING COMMISSION,
NEW DELHI.
December 28, 1961.

My dear Shastri ji,

The Minor Irrigation Team has conducted study of State Tubewells in the Punjab. I am accordingly sending herewith the Report of the Team.

Some very pertinent issues have been raised in this Report. They relate to the policy of further progressing State tubewells programme in the Punjab, construction and extension of water distribution system on the existing tubewells and rationalising the assessment of water charges on State tubewells. In consultation with the State authorities, almost agreed views have been expressed on these aspects, apart from various other recommendations incorporated in the Report with a view to maximise the benefits from tubewell water utilisation, both for the people and the Government. Factors emerging out of them, if taken into account, may also prove of considerable help, while formulating and sanctioning programmes of this nature, in other States too.

The Team received fullest co-operation from the Punjab Government authorities in these studies. Our thanks are, therefore, due to them, on that account.

With kind regards.

Yours sincerely,

M. THIRUMALA RAO

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

PREFACE

The Minor Irrigation Team appointed by the Committee on Plan Projects, undertook the study of State tubewells in the Punjab as part of the programme laid down in the Terms of Reference, communicated *vide* Committee on Plan Projects Memorandum No. COPP(4)/17/58 dated August 4, 1958, appearing on pages 47-48 of this Report. The Team comprised Dr. A. N. Khosla, Leader; Dr. K. Ramiah, Shri Baleshwar Nath, Members and Shri Mahavir Prasad, Irrigation Adviser to the Ministry of Food and Agriculture (Ex-Officio Member).

Dr. A.N. Khosla relinquished the Leadership of the Team on December 12, 1960 and Shri M. Thirumala Rao, M.P. took his place.

The Team made studies of a number of individual wells and also examined the performance data of State tubewells Division-wise. Discussions were held with the State authorities both at Chandigarh and New Delhi.

The Punjab tubewells have come up mostly during the two Plan periods and a large number of them are still in developmental stage. But, the pace of development of irrigation on tubewells has not been as fast, as was expected from the keen cultivators that the State of Punjab has. The Team, therefore, made special study of the development activities and drew attention of the State authorities to a number of salient features in the operational technique of tubewells, like extension and provision of distribution channels, both lined and unlined, and supply of water to the cultivators on actual volumetric basis. The financial picture of State tubewells, as reflected in this Report, is bound to improve, if effective co-ordination between Agriculture and Irrigation activities is brought about.

We take this opportunity to express our gratitude to Shri Ishwar Chandra, Secretary, Irrigation and Power Deptt., Punjab Govt., and the Chief Engineers of the State Shri G. S. Siddhu and Shri V. P. Goyal and the Director of Agriculture Shri G. S. Cheema and other officers of the State Government for their co-operation.

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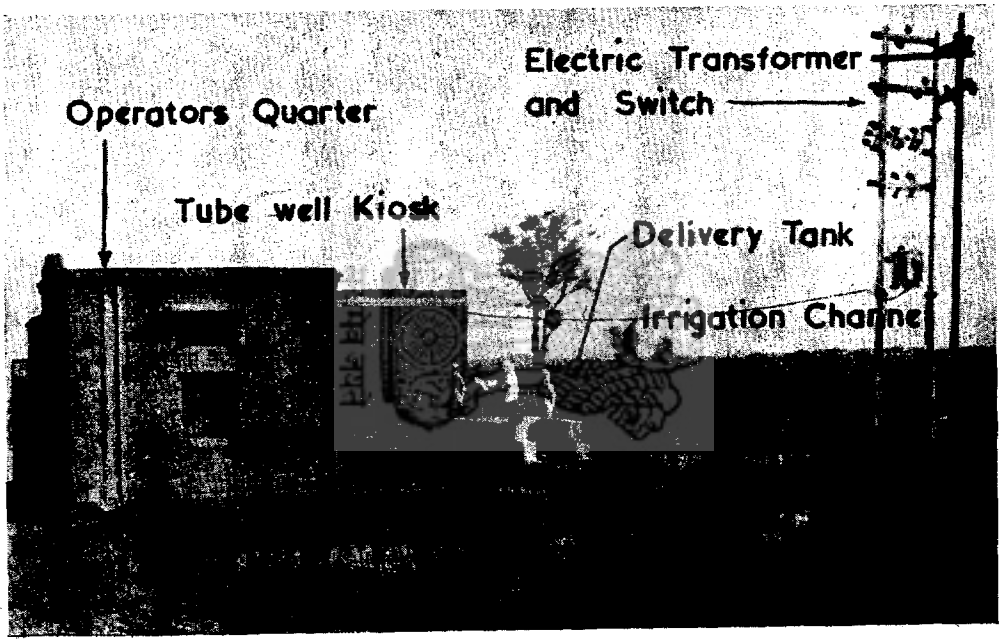


A Tubewell in operation

CHAPTER I

STATE TUBEWELLS IN THE PUNJAB—GENERAL

1.1. Climatic Features—State tubewells in East Punjab are located in the areas comprising of the doab between Beas and Sutlej rivers, the table land of Sirhind, the area south of the Sutlej and the wedge country between the Yamuna and the Ghaggar. The terrain, as such, is a part of the great Indo-Gangetic alluvial plain. It is nearly flat, only gently sloping south-east. The region is favoured with generally productive soil, but the rainfall is not sufficient for agricultural needs and also suffers from irregular distribution throughout the season. Though the tract is traversed by perennial streams, and is served by elaborate canal systems, yet there exist vast areas in between, which depend for their irrigation on shallow surface wells or rainfall alone, or are not adequately served by the existing irrigation canals.

1.2. Rainfall—Yearly rainfall varies from 381.00 mm. to 635.00 mm. (15 inches to 25 inches) except in the sub-mountain region of North, where it is of the order of 1,270.00 mm. (50 inches). An isohyetal map of the Punjab is shown in Figure 1.1 There are sometimes serious deficiencies and even total failure of monsoon. Such inadequate and ill-spaced rainfall often brings about scarcity or near desert conditions. The general rainfall (1) pattern of the area is reflected by the Table 1.1 :

TABLE 1.1

Station	Mean Rainfall (Inches)	Maximum (Inches)	Minimum (Inches)	Period
(1)	(2)	(3)	(4)	(5)
New Delhi	26·64″ or 676·66 mm	60·36″ or 1533·44 mm	10·35″ or 262·89 mm	1881—1940
		1933	1929	
Hissar	16·76″ or 435·70 mm	41·26″ or 1048·00 mm	6·82″ or 160·53 mm	Do.
		1917	1938	
Ambala	32·97″ or 837·44 mm	80·62″ or 2047·75 mm	13·69″ or 347·73 mm	Do.
		1933	1918	
Ludhiana	27·21″ or 701·03 mm	54·93″ or 1394·72 mm	9·31″ or 236·48 mm	Do.
		1917	1889	

Artificial irrigation of one kind or other is, therefore, inescapable for the agriculturists of the Punjab. This is what has made Punjab such an irrigationally developed State.

1.3. Geological Features—These areas are fortunately underlain with stream sediments comprising of unconsolidated alluvium, inter-stratified

(1) *Source* : Climatological Tables of Observations in India, 1953.

with clays, silty clays and medium and coarse sands, which are generally good water bearers (aquifers). Water yielding pebble gravels are also sparingly present in the northern areas, where the plains get closer to the Himalayan mountain front. In northern region artesian aquifers are met with at a depth ranging from 200 feet below surface. They consist of sand gravels capped with clays, but are not good producers of water. Ground water conditions, as a whole, however, appear favourable for installation of irrigation tubewells in areas not already provided for by other means of artificial irrigation. A programme of State-owned tubewells was accordingly initiated in the Punjab about the year 1951-52. A general distribution plan of State tubewells is shown in Figure 1.2.

1.4. The reservoir of water contained in the sub-soil is intimately related to its geology. Though the entire stretch extending into Pakistan in the west and right up to Bengal in the east is of the same geological type, yet there is marked difference in detail. Geological stratification of the Punjab aquifers is somewhat different than those to the east of Yamuna. In the Punjab, owing to the presence of craverse crustal warps the characteristics change sharply. The clay appears in beds and layers of varying thickness and of varying extent. In some instances the subsoil water is held under pressure between two clay beds. There also exist some perched water tables. Also, the subsoil flow in the Punjab is not parallel to the crustal warp as is the case in the areas east of the Yamuna, where it flows almost uniformly in easterly direction. Precise knowledge of the extended composition of the subsoil is not easily available. Information on subsoil water table is sought from statistical analysis of actual observations of the effects of pumping, rainfall and subsoil flow.

1.5. Quality of Water—By and large, however, the subsoil water in the Punjab is considered suitable for agriculture, except in some areas like those around Rajpur and Safidan, where it is said to be of poor agricultural quality. At some places, presence of calcium carbonate in the subsoil water leads to encrustation of the strainer slots in tubewells. At other places sodium salts are present to such an extent as to make the water harmful to agriculture. Therefore, while installing tubewells in the Punjab for agricultural purposes, special care needs to be taken in regard to the quality of water present in the subsoil.

1.6. Tubewell Programme—The question of raising subsoil water for irrigation purposes through tubewell pumping had been engaging the attention of the Punjab Authorities for a long time. Investigations were started as far back as 1910. Experimental wells were sunk round about Amritsar in 1916. The objective of the investigation, was, however, two-fold:—

(*i*) whether tubewells helped in relieving water-logging, and

(*ii*) whether irrigation tubewells could be economically feasible in the Punjab.

The question, however, came up before the Punjab Government more prominently, when a special study was made on the utility of tubewells in areas,

(*i*) where no means of irrigation existed,

(*ii*) where ordinary open well irrigation was practised, and

(*iii*) where flow irrigation from canals was already in operation.

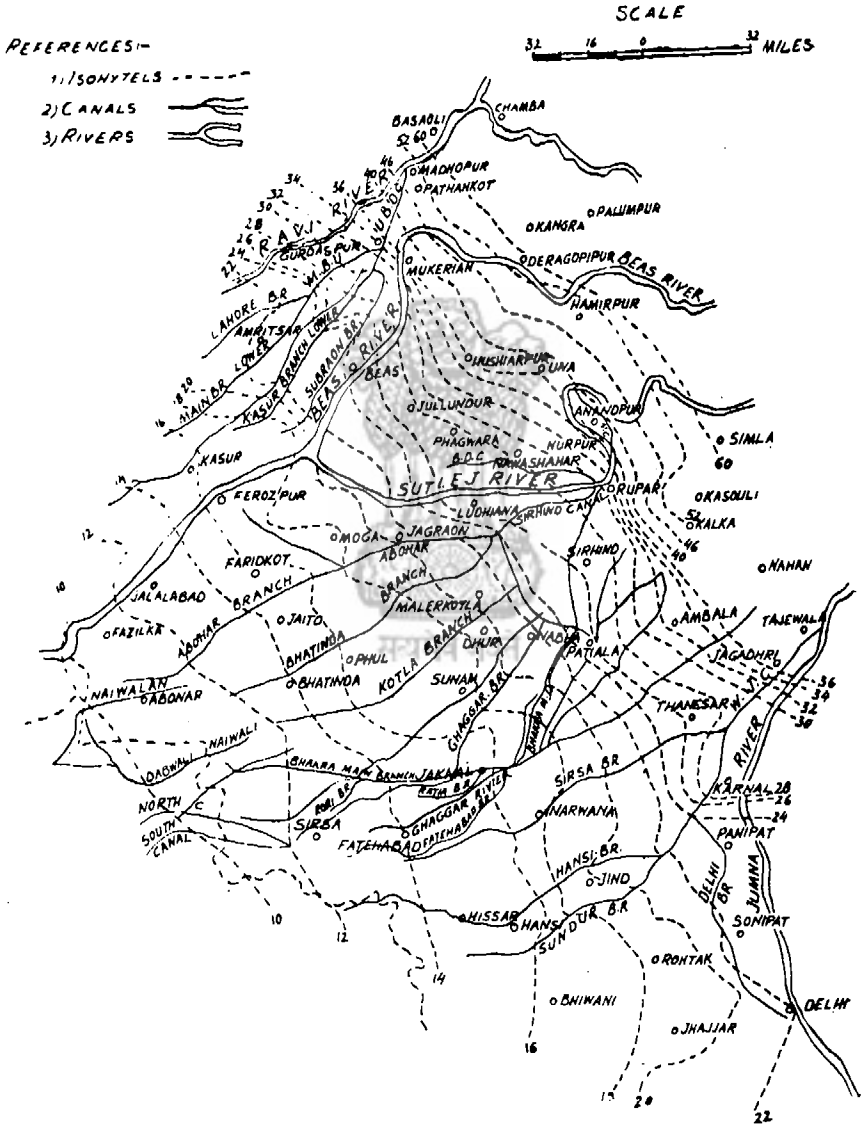


Figure 1.1—An isohyetal map of the Punjab.

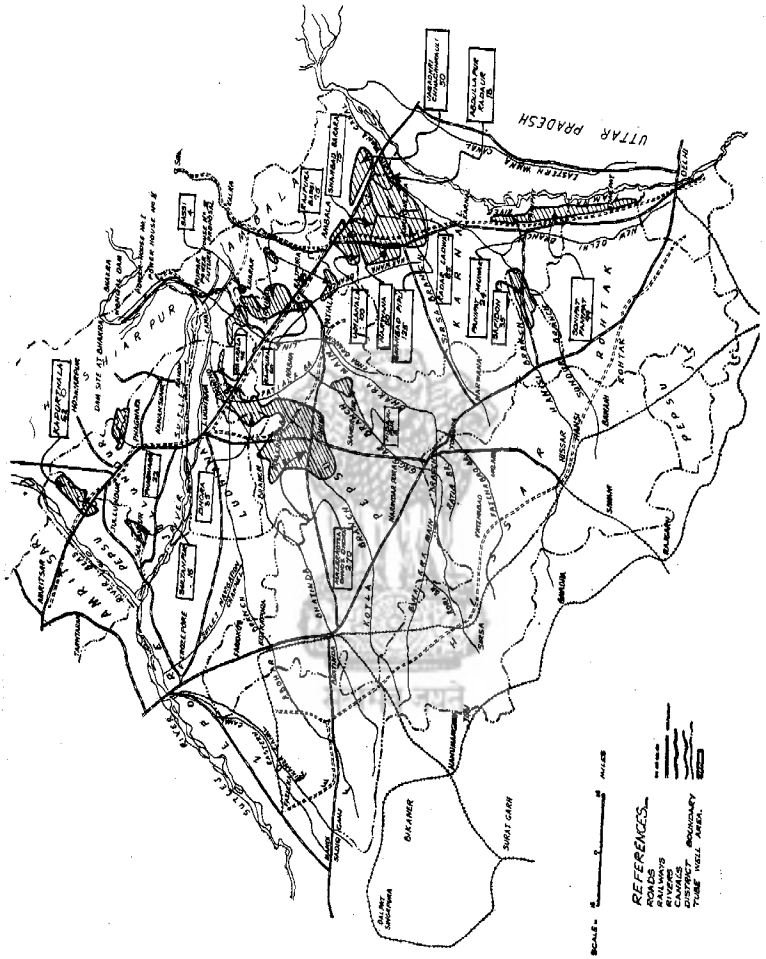


Figure 1·2: Showing Tubewell areas in the Punjab.

The study also included, if tubewells could be built as individual units or in batteries to replace canal irrigation. It was, however, only after partition, that a concerted programme for installing tubewells was taken up. First, 256 canal feeder wells under Jagadhri project were installed under the Grow More Food Campaign of 1950. Later direct irrigation wells were taken up under different programmes, like T.C.A. 1952 Scheme, T.C.A. 1953 Scheme and G.M.F. 1954 Scheme. The present position of direct irrigation tubewells is given in the statement below:

Name of area	*No. of tubewells*	*Name of area*	*No. of tubewells*
1. Kapurthala, Sultanpura	78	11. Shahabad Barara	75
2. Phagwara	22	12. Shahabad Pipli	125
3. Doraha	35	13. Narwana	50
4. Samrala	96	14. Umla Nala	100
5. Malerkotla, Dhuri, Doraha	270	15. Abdullapur Radaur Scheme	18
6. Bassi	4	16. Panipat-Munak Scheme	24
7. Rajpura T.C.A. Scheme	60	17. Safidan	35
8. Rajpura G.M.F. Scheme	95	18. Jagadhri Chhachharauli	50
9. Nidampur	8	19. Sonepat-Panipat	99
10. Radaur Ladwa	85	TOTAL	1,329

1.7. Overall Progress—The progress, however, had not been very pronounced, as will be clear from the number of irrigation tubewells that came into operation in subsequent years, as indicated hereunder:

Year	*No. of tubewells under operation*
1954-55	75
1955-56	322
1956-57	857
1957-58	971
1958-59	1,215
1959-60	1,225

Area irrigated per tubewell and hours run are shown in Figure 1.3.

1.8. Development of Irrigation—The Team gathered that for development of tubewells, irrigated area figures are fixed on the basis of (*i*) first year 15% (*ii*) 2nd year 37½% (*iii*) 3rd year 50%, (*iv*) 4th year 75% and (*v*) 5th year 100% or roughly ⅔ of the commanded area of each tubewell. These figures are said to be based on the practice prevalent in Uttar Pradesh. There is, however, no official authorisation behind these figures. Even if it were a yardstick for development of tubewells in Uttar Pradesh it will be a pity if the same is followed in the Punjab. The keenness among the Punjab cultivators for irrigation is definitely more than in Uttar Pradesh. The average rainfall is also comparatively low. Again, experience in Uttar Pradesh particularly in the Western parts to which the Punjab areas are adjacent go to show that the development period need not extend to five years. The Team, therefore, feels that the targets for development of irrigation on tubewells

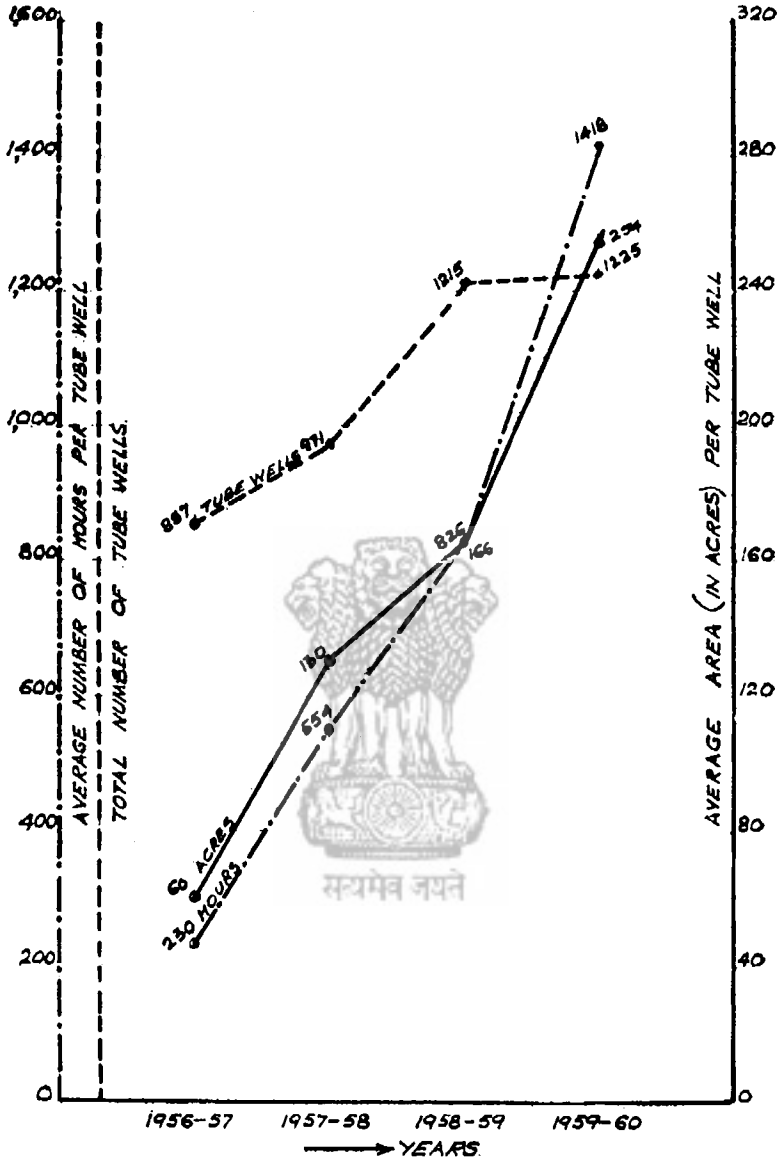


Figure 1·3: *Showing No. of wells, average area irrigated and hours run per tubewe l.*

need to be changed in the Punjab limiting it to a period of three years. Unusual rainfall and other natural conditions can of course, cause exceptions in certain cases.

1.9. Preparedness—It was gathered that no action has so far been taken with regard to development of irrigation tubewells through a process of agricultural Preparedness, which is essential for utilisation of such *Ready At Site* irrigation resources as tubewells provide. Apparently, development organization of the State have not come into field with such specified objectives. If pilot demonstration farms had been established, keen cultivators of the Punjab would have made better use of that knowledge, which might have also acted as a good incentive for intensive development of irrigation. Again on a number of tubewells, land for *pucca* water-courses has not been acquired resulting in poor progress in irrigation development.

1.10. Co-ordination—Tubewells in the Punjab form a sizable unit of irrigation potential. It would seem advisable if the State Agriculture Department is reinforced with a special unit to look after the development of irrigation in tubewell areas, particularly when these tubewells have been built at a heavy cost and involve a considerable share of foreign assistance. Their effect on the production capacity of the State should, therefore, be more spectacular than what has been possible so far. This is possible, only when there is wholesome co-ordination between different departments of the State like Irrigation, Agriculture, Community Development and public institutions like *Gram Panchayats etc.*

1.11. Of late the Punjab Government have decided that no further State tubewells should be installed for irrigation purposes. The funds relating thereto are to be diverted to Agriculture Department for advancing loans to Zamindars for constructing private tubewells. The Team feels that too much emphasis on private tubewells on individual basis need not be laid as individual holdings may not justify installation of tubewells by individual land-owners on account of land ceilings. If, however, the activity is to shift from State sector to private sector, co-operative tubewells should be encouraged. These also should be allowed after ensuring that there is no over-lapping of commands between the existing State tubewells and the new co-operative wells.

CHAPTER II

ADMINISTRATIVE AND ORGANISATIONAL SET-UP

2.1. The general administration of State tubewells in the Punjab is under the Chief Engineer, Irrigation Department. The Circle headquarters are located at Ambala and a Superintending Engineer is exclusively in-charge of all State tubewells. The Circle at present, comprises of four Divisions as given in Table 2.1.

TABLE 2.1

Sl. No.	Name of Division	Number of tubewells planned
I.	TUBEWELL DIVN. NO. I DELHI	
A.	Sonepat Panipat Area	99
B.	Jagadhri Chhachharauli Area	50
C.	Safidan Area	35
D.	Abdullapur Radaur Scheme	18
E.	Panipat Munak Scheme	24
	TOTAL	226
II.	TUBEWELL DIVN. NO. II AMBALA	
A.	Radaur Ladwa Area	85
B.	Shahabad Barara Area	75
C.	Shahabad Pipli Area	125
D.	Narwana Branch Area	50
E.	Umla Nala Area & others	100
	TOTAL	435
III.	TUBEWELL DIVN. NO.III MALERKOTLA	
A.	Malerkotla Dhuri, Doraha Area	270
B.	Bassi Area	4
C.	Rajpura Area T.C.A. 1953	60
D.	Rajpura Area G.M.F. 1954	95
E.	Nidampur Area	8
	TOTAL	437
IV.	TUBEWELL DIVN. NO. IV LUDHIANA	
A.	Kapurthala Sultanpur	78
B.	Phagwara Area	22
C.	Doraha Area	35
D.	Samrala Area	96
	TOTAL	231
	GRAND TOTAL	1,329

2.2. Besides 1,329 tubewells shown in Table 2.1, there are 256 tubewells under Jagadhri tubewell project. They are dealt with separately in chapter V (Para 5.2, Table 5.1) of this Report.

2.3. Sub-Divisional Charge—Each tubewell Division is made up of tubewell sub-Divisions headed by Sub-Divisional Officers. The sub-Division is further divided into sections, under charge of subordinate engineering personnel. It is, however, gathered that for each sub-Division there is only one mechanical supervisor looking into the working of tubewells. It is felt that one mechanical supervisor is not sufficient to look after the whole sub-Division consisting of about 100 tubewells. Possibly, the equipment is, at present new and mechanical defects are not as numerous as they might be after a few years. In any case, it seems necessary to reorientate the personnel more towards mechanical side. It may seem advisable to have among tubewell personnel some agricultural engineers-officers and subordinate staff—who may be conversant with civil and mechanical engineering aspects of tubewell management and operations.

2.4. Revenue Staff—As at present, there is no Deputy Collector attached to the Tubewell Circle. *Ziladars* assisted by *Patwaris* and tubewell operators mostly check up accounts of tubewells. Field-wise checking is not considered necessary because the revenue assessment is done on the basis of units of electricity consumed on each tubewell. Thus only checking of books is done to a great extent. This, however, is not a wholesome practice. Field-wise checking is necessary for maintaining record of crop-wise development on each tubewell as also to stop malpractices.

2.5. There is considerable work involved particularly in the development stage of tubewells, which needs a full complement of revenue staff to be attached to each tubewell Division under a Deputy Collector. Besides, in the Punjab, tubewell *chaks* have yet to be consolidated and water distribution channels have to be laid out. Revenue staff conversant with agricultural practices of the area need, therefore, to be increased to activate the process of intensive agriculture on State tubewells. The State authorities have sanctioned staff for *Warabandi etc.*, on year to year basis. It is also reported that for development of *Zamindara* water courses some *Ziladars* have been provided. The Team feels that this aspect of development should receive greater attention on the part of State authorities.

2.6. Tubewell Operators—The pivot of tubewell operation, however, is the tubewell operator. On him depends, by and large, the efficiency of service and development of irrigation. In Uttar Pradesh, tubewell operators' service, in the beginning, was on a pay-*cum*-bonus system. Free quarters were also provided on each tubewell. Later, however, bonus system was given up and tubewell operators are now borne on a regular full-scale pay roll. On the Punjab tubewells no definite system has yet been evolved. In some Divisions the operators are borne on work-charged lists and in others are taken on regular establishment. The Team had occasion to see some of the quarters remaining unoccupied for a long time.

2.7. As it is, the tubewell operators being educated to a certain standard prefer urban surroundings and quite often cluster into town. As is experienced in many cases they turn up sometime during the day leaving the actual running operation of tubewell to some local unauthorised sub-agent. This is not a very healthy practice. To remedy this practice it would seem advantageous if the work is entrusted to a person appointed with the concurrence of *Panchayats* or Village *Samitis* under disciplinary control of the department. In other words, greater collaboration should be sought from the *Panchayats* and Village *Samitis* in day to day operation of tubewells, so that tubewells operators function more efficiently.

2.8. An advantage of the system will be economy in establishment cost, as the *Kamdars'* pay on an extra-departmental basis will be lower than that of a regular operator. Besides, tubewell operator quarters will not be needed. Being a nominee of the Village *Panchayat* day to day operation responsibility for running of the well will be '*ipso facto*' shared by these organisations. An improvement both in the economy and efficiency of operations is thus likely to result.

2.9. Workshop Facilities—Workshop facilities in the Punjab are limited. There is only one workshop which is located at Karnal. It is working also for other irrigation and drainage schemes. The requirements of tubewells have priority over them. The equipment in this workshop consists of a few lathes, drills, grinders and servicing machines, hydraulic jack, hydraulic press, chain and other supplementary tools. The workshop is, however, not provided with a mobile transport unit, and its operations are not as fast as they should be for a tubewell organisation. Any delay so caused naturally affects development of tubewells.

2.10. Fortunately, in the Punjab there is uniformity in tubewell equipment, as these tubewells have come up only in recent years. As observed earlier the equipment is also new and the pressure of work on the workshop is not yet heavy. But in course of time the work is bound to increase. Besides, for such a vast area extending from Amritsar to Delhi, it will not be sufficient to have only one workshop to attend tubewell requirements. The workshop facilities may be suitably expanded to provide for a speedy and efficient repair and maintenance service to State tubewells equipment.

2.11. To facilitate construction of water channels an amendment to the Northern India Canal and Drainage Act was passed by the Punjab Legislature in 1958 to provide for construction, alteration and reconstruction of water courses in the Punjab. This Act is being applied at present to tubewell channels also. It is yet to be seen how far it adds expediency to the construction of water channels on the State tubewells. The procedure laid down appears deleterious at least so far as tubewells are concerned. A copy of the Amendment Act of 1958 is given in *Appendix I.* The Team feels that water channels on tubewells need special treatment so that speedier action could be caused for utilisation of tubewell supplies available over such a large number of wells in the State. It seems desirable that some sections of the parent Act (of 1873) may be repealed to make the amended Act effective.

CHAPTER III

TUBEWELLS CONSTRUCTION AND THEIR OPERATION

3.1. Cost Break-up—State tubewells in the Punjab were completed by four agencies, namely, State Department units, Associated Tubewells of India Ltd., M/s H. T. Smith and the French Group of Drilling Companies. The general break-up of the cost of a 1½ cusec tubewell is as given below:—

	Rs.
Tubewell construction equipment *etc.*	30,000
Appurtenant works and other charges	15,000
Electrical installation	20,000
TOTAL	65,000

Abstract of estimated cost of a typical tubewell as given in the proforma in one of the sanctioned estimates is as per *Appendix II.*

3.2. Progress—June 1960—Up-to-date progress on three Schemes in hand for construction and energisation of the wells upto end of June, 1960 is given in Table 3.1.

TABLE 3.1

Sl. No.	Name of Scheme	No. of tubewells planned under the Scheme	No. of tubewells		
			Drilled and developed	Completed with pump-sets.	Energised
1.	T.C.A. 1952 Scheme	664	660	659	659
2.	T.C.A. 1953 Scheme	335	328	325	325
3.	G.M.F. 1954 Programme	280	193	193	193
	TOTAL ..	1,279	1,181	1,177	1,177

This does not include 50 tubewells already completed, in Panipat-Munak, Abdullapur Radaur and Nidampur Schemes thus bringing the total to 1,279+50=1,329 as shown in *Para* 1.6 and in *para* 2.1.

3.3. Siting of Tubewells—Tubewell sites are selected mostly on the basis of good situation for commanding the service area, with regard to land slopes and topography. But, proper and land classification survey has not been possible in all cases and a few tubewells got sited in areas, showing water-logging tendencies. With regard to exploitation of subsoil sources, the governing policy in tubewell construction in the Punjab has, however, been to exclude the shallow water table from the extraction zone of the well, and to tap deeper aquifers generally.

3.4. Criterion for Accepting Tubewell—General criterion for accepting tubewells drilled has been a yield of one and half cubic feet of water per second with a maximum pumping lift of about 50 feet, involving a depression of about 20 feet. The wells consist of 12-inch diameter housing pipe and 8-inch diameter plain and slotted pipe appropriately placed according to the finding of different strata.

3.5. Specification—State tubewells in the Punjab are built mostly to a specification requiring a gravel packed type well, bored generally up to a depth of 300 feet below ground. The gravel used for packing is mostly good, hard and well rounded stream gravel obtained from near Chandigarh or Dadupur. After the pipe assembly consisting of blind pipe and slotted strainer pipe is lowered into the bore centred by steel braces spaced through the hole at various depths, the gravel already screened to desirable size is shovelled into the annular space. Care is taken to assure a vertical shaft for the pumping sets, which are mostly turbine type bore-hole pumping units. In a few cases, however, wells have been provided with centrifugal pumps. The pumping sets are generally of standard makes, like Jhonston, Jyoti, Layne and Sume. Details and specifications for tubewell construction as extracted from one of the Contract documents of the Punjab Government are given in *Appendix III.*

3.6. Problem of Sand Pumping—On a number of tubewells in the Punjab, the problem of sand pumping is being faced, particularly in Malerkotla and Rajpura areas. May be some special type of screens or filters would have to be used. In some cases, water contains sand only for a short time and then clears up, if pumping is continued. Where, however, turbidity is not reduced and sand contents in the water are not negligible, the problem may need attention. Sand content causes erosion of the pump impellers in addition to the fact that a cavity develops underground, which may lead to collapse of a sand pumping well. The Team gathered that on one of the wells, No. 98 in Panipat-Sonepat area, a cavity to the extent of roughly 200 cubic feet had developed below the pump house and the well casing sank by two feet. This was later repaired.

3.7. Maintenance—Most of the irrigation tubewells in the Punjab have equipment which is new and is in good condition. Maintenance pressure is not yet heavy on that account. The basic maintenance data, however, needs to be displayed in the shape of charts and tables on the tubewells to provide performance picture of the tubewell to the inspecting officer. The Team was informed by the Superintending Engineer that necessary forms for display are being evolved. It is, however, felt that such display is a primary necessity on developing tubewells. In fact, each tubewell should have on its wall, properly displayed strata chart, discharge and depression-head observations and history of development of irrigation etc.

3.8. Service Roads—The Team also found that in some areas like Panipat-Munak Scheme, tubewells do not have connecting service roads. Tubewells situated on National and State highways or district roads could be exceptions, but to deny other tubewells, not easily approachable at any time of the year by departmental approach roads, is to leave a wide blank in the maintenance plan of the wells. It is felt that this deficiency should be made up as early as possible. It was gathered in some areas that 11 feet wide roads had been built. An eight feet wide single lane traffic approach road provided with adequate side drains, crossings *etc.*, should suffice for the purpose.

3.9. Land around Tubewells—In some cases, the Team observed that the land acquired around tubewell is very inadequate and the well stands almost cramped between the fields under crops on all sides. Even space required for stocking building materials for a supplementary boring, if needed later, or for other purpose is not available. The extra space around tubewells could also serve as small horticultural plot. It is felt that a more liberal

provision of land should be made on State irrigation tubewell sites in the Punjab.

3.10. Development of Irrigation—Even after a tubewell is completed in all respects, it takes time for the maximum acreage of land to come under irrigation. For that purpose the Punjab tubewell authorities are basing their plan of development on the following table as also referred to in *Para* 1.8 :

First year	15 per cent	Of the area assigned to be irrigated out of the culturable commanded area. (Generally 60% of C.C.A.)
Second year	37·5 per cent	
Third year	50 per cent	
Fourth year	75 per cent	
Fifth year	100 per cent	

If, however, there is firm supply of electricity, water courses are built in time and adequately lined, water rates are equitable and there is no unusual spell of rainfall, during the period of development, it is estimated that the rate of development could be as given below :

First year	40 per cent
Second year	60 per cent
Third year	85 per cent
Fourth year	100 per cent

The Team feels that there is scope for reducing development period still further down to three years, if the pace of development is accelerated.

3.11. Factors which have Hindered Development—Of the 1,329 tubewells in operation as on July 15, 1960 quite a number are unable to come up to the standard for one reason or the other. The factors, which have hindered the development of those tubewells in the Punjab are, as given below :

(*i*) Time-lag between completion of different items particularly water-channels.

(*ii*) Inadequate land and farm preparations.

(*iii*) Lack of assured tubewell supply.

(*iv*) Reduced discharges.

(*v*) Seasonal variations like abnormal rainfall.

3.12. Time-lag Between Completion of Different Items, Particularly Water-channels—In the Punjab, it is gathered that a large number of tubewells had to wait for energisation for long periods, up to a couple of years. A few instances of delay are given in Table 3.2. If interim alternative arrangements for electricity, even on a pilot plant basis, had been made, quite a number of tubewells could have been put into commission much earlier than they were actually commissioned. Besides, loss of interest on locked up capital on idle tubewells, the benefits from the irrigation potential created also remained unutilised.

TABLE 3·2

A few instances of delay in energisation of tubewells

Sl. No.	Scheme	Area	T.W. No.	Period of delay (months)	Estimated capital value of T.W. (Rs.)	Interest charges @ 4% per annum for period
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	T.C.A. 1953 ..	Rajpura	7		62,000	4,546·87
2.			10	22	62,000	4,546·67
3.	T.C.A. 1952 ..	Samrala	85	8	66,000	1,760·00
4.			86	10	66,000	2,200·00
5.			93	8	66,000	1,760·00
6.		Sonepat-Panipat	84	13	66,000	2,860·00
7.	..	..	85.	3	66,000	660·00
8.			90	2	66,000	440·00

3.13. Another important time-lag is on the completion of water transmission or distribution channels. In areas like those at Samrala, though the tubewells were completed in November, 1954, it is gathered that even after 3 years only 25% of the lined water courses were ready. Position of lined water courses completed on tubewells up to June, 1960 is given in Table 3·3.

TABLE 3·3

Name of Scheme	No. of wells	Lined (miles)	Unlined (miles)	Total (miles)
T.C.A. 1952 Scheme	664	452	315	767
T.C.A. 1953 Scheme	335	187	129	316
G.M.F. 1954 Programme	280	103	68	171
TOTAL ..	1,279	742	512	1,254

This will go to indicate that against, 1,177 tubewells energised there are so far only 742 miles of lined and 512 miles of unlined water courses leading to an average of 0·63 mile and 0·44 mile respectively of lined and unlined water channels per tubewell. This is considered very inadequate as the average should be about one mile and two miles respectively according to the Project Estimates. In some places, it was gathered that the cultivators had constructed water courses up to the tubewell discharge tank and put the project into operation without any State help. These water courses were unlined. Seepage losses were consequently very high and the cost of water proved very expensive. Tubewells in such circumstances cannot be expected to reach high efficiency quickly. In order to develop irrigation on tubewells, it is essential to have well planned lined and unlined water courses. Unless these are done well in time, the development of irrigation is bound to suffer. In fact, installing tubewells without providing a proper water distribution system is like opening a shop without a counter.

3.14. Certain case studies were conducted to determine the difference in assessment due to differences in the distances of location of fields from the tubewells. Seven tubewells in three different areas were examined. Results are given in *Appendix IV*. The studies reveal that the assessment amount increases as the distance from the tubewell increases leading to an inescapable inference of loss of water in transit due to percolation and evaporation. The Table 3·4 gives the difference in assessment according to situation of the field which is shown as near tubewell, on *pucca* channel and on *kachcha* channel. Care was taken to select such fields as were under the same crop. The results establish the need for an efficient water distribution system from the tubewell. If the channels are lined, the losses are less, and if the channels are unlined the losses are great and the cultivator has to pay more for the same quantity of water. This acts as a deterrent on the development of tubewell, particularly in respect of those fields, which are situated at the end of the command. On tubewells, where channels have not yet been built, the position is worse. Losses on those wells are heavy and the cultivator weighs the advantage with the cost incurred in irrigating his crops from the tubewell. He is, therefore, reluctant to use tubewell water.

TABLE 3·4

Tubewell Area	Tube-well No.	Per acre assessment on field (in Rs. nP.)					Remarks
		Near T.W.	On *pucca* channel	Difference between cols. 3&4	On *kachcha* channel	Difference between cols. 4&6	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Rajpura	7	3·75	4·69	0·94	5·00	0·31	Half of normal discharge
	10	7·81	8·62	0·81	10·00	1·38	
2. Samrala	85	4·28	4·80	0·52	5·50	0·70	
	86	2·60	3·00	0·40	3·30	0·30	
	93	4·21	4·51	0·30	5·41	0·90	
3. Sonepat-	84	2·25	2·56	0·31	No. Irrgn.	—	
. Panipat	89	3·75	4·50	0·75	Do.	—	

3.15. It was gathered that the lining of water courses on tubewells has been stopped *vide* Para 2 of D.O. No. 2770-Irr & EI-58/12887 of 5-9-1958 from Dy. Secretary Government of Punjab to Tubewell Project Administration, Ministry of Food & Agriculture, Government of India, New Delhi. The result has been that at the close of the year 1959-60 the length of both unlined and lined water courses on 1,225 energised tubewells was only 750 miles, which itself is a low average. The same mileage stands at the close of the year 1960-61 for 1,228 tubewells (*Appendix V*). In fact, not even a mile has been added in the aggregate length of lined and unlined channels. It amounts to a standstill position, which is not conducive to speedy development of irrigation on tubewells. The Team feels that construction of water-courses and lining them wherever necessary should be given top priority on tubewells, because water channels on tubewells both lined and unlined should be treated as an integral part of tubewell scheme. The State Government may also explore the possibilities of levying extra cess for extending water-courses and lining them, wherever necessary.

3.16. It was stated that land acquisition was a problem in the Punjab for constructing water channels. If it is difficult to acquire land, an underground water distribution system may be tried in suitable areas as has been done in a number of tubewells in Uttar Pradesh. It is understood that the cost of an underground spun concrete pipe system works out to Rs. 13,000 per mile as against Rs. 8,000 per mile for a masonry lined over ground system. An abstract of estimate of cost is given in *Appendix VI (a)*. Hand spun concrete underground pipe system has been used in some of the areas in Gujarat State, leading water from tubewells to the fields. The cost of this system works out to 0.87 nP. per foot. The break-up of the cost is given in *Appendix VI (b)*. This system is very suitable for tubewells where ground is of rolling nature and where it is difficult to get land and where reclamation and consolidation of holdings are in progress. Overall advantages of the system are enumerated below :

(*i*) This does not require any land acquisition. Land, which would otherwise be occupied by open overground channels is thus available for cultivation.

(*ii*) Percolation losses, which could be of the order of two cusecs on *pucca* channels and eight cusecs on *kachcha* channels per million sq. feet, are saved.

(*iii*) Evaporation losses, which could take place during the period of low humidity, are minimised.

(*iv*) Controlling points could be fixed more efficiently, wherever needed than on overground channels. Use could also be made of Polythene pipes, when they become available in course of time.

(*v*) The system affords greater control on pilferage of water.

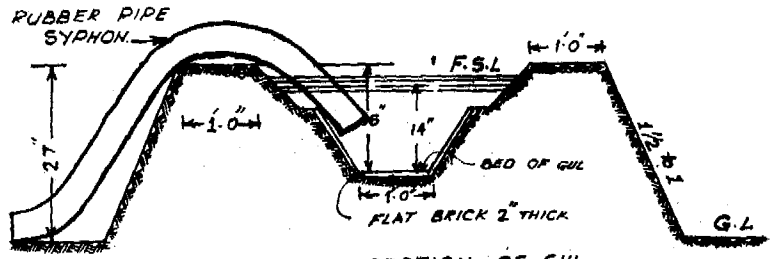
(*vi*) Water would be available at a uniform pressure. This will lead to more efficient distribution of supplies.

(*vii*) Cost of maintenance year after year will be less than on open channels.

3.17. The only drawback pointed out in this pipeline system is that the line may be punctured by interested cultivators, thus paralysing the whole system. But this is a human factor, which could be solved through collaboration and co-operation of *Panchayats*. The system could be developed and improved upon. Cost could also be minimised through the process of standardisation, if this distribution system is adopted on a large scale. The Team feels that a trial should be given to underground water distribution system in the Punjab. It may even be possible to lay down under ground system linking two adjoining tubewells, thus providing adequate pressure all through the system.

3.18. It was gathered from the cultivators that considerable difficulty was experienced by them when extracting water from *kachcha* water channels, where proper "*Nakkas*" have not been provided. Loss of water occurs at such points if *kachcha* channels are breached for letting in water into field ditches. The Team, therefore, feels that syphonic extraction of water should be introduced and popularised, as soon as possible. This involves use of pipes in the shape of syphons, which should be placed with one end in the water channel and the other on to the field requiring water and thus enabling the field being irrigated without making cut in the water channel. This could be operated in suitable locations. It is illustrated as in Figure 3.1.

3.19. Inadequate Land and Farm Preparation—In some areas, there has been undue slackness in preparation of land for irrigated farming on newly



SECTION OF GUL
WATER COURSE
Q = 1½ CUSEC.

(a)

(b)

Figure 3.1

constructed tubewells. In Shahabad and Karnal areas some new land had been brought under command of the tubewells. It was originally covered by bushes and jungle. This land requires speedier clearance, so that it could utilise tubewell supplies in time. Also in some parts of the Panipat-Sonepat area, where land is too rolling to be irrigated, land preparations are urgently called for. Possibly the cultivators need State help in these matters, which should be forthcoming to them. Land preparations will ultimately save water and increase production. The demand for tubewell water will increase, after land preparation is helped through State Plans. The State authorities may explore the possibilities of organising a unit either on State basis or on co-operative enterprise basis consisting of a mechanical equipment which could level up the land for cultivators on cost basis. Such co-operative ventures may be subsidised, if necessary, by the State till they acquire a financially sound basis of operation. These units, while not busy with field operations on tubewells could also be utilised for other engineering constructions. The Team feels that the plans for tubewells should, if possible, include provision for implementing land preparation part of the project also. This will ultimately induce cultivators for proper utilisation of water, which is most important on State tubewells.

3.20. Lack of Assured Tubewell Supply—On a number of areas in the Punjab, particularly in Malerkotla, rationing of electricity supply had been imposed. This had made electricity undependable, besides frequent shut-downs of power supply and discontinuance of tubewell supply. Such a State of affairs naturally comes in the way of tubewell irrigation, as the cultivators cannot tolerate the failure of electricity, when need for watering their crops is the greatest. In other words, an irregular and uncertain electricity supply makes tubewell irrigation a very risky financial venture. It is gathered that in December, 1957 out of the 300 tubewells energised in Malerkotla area, only 128 tubewells could be supplied with electricity for 19 hours out of 24 hours and the electricity could not be used between 6 p.m. and 11 p.m., *i.e.*, during peak load time. Probably, the position will improve when Bhakra Power comes into use. In any case, the Team feels that the greatest possible attention is required to be given to the question of power supply to the tube-wells in order to ensure that irrigation develops all along speedily. The Team also gathered that from the power transmission lines connecting tube-wells, power connections have been given to other consumers, like flour mills and even for rural electrification. This results in drop of voltage on the tube-well end and consequent loss of efficiency of the equipment.

3.21. It is also essential to provide a speedy repair service to deal with mechanical faults and defects, otherwise tubewell will remain out of operation for long and expose the area to unnecessary damage. As at present, the system is not sufficiently stream-lined, due to various causes. Reserve pumping sets and other equipment have to be kept in stock for replacement of damaged ones to prevent any loss of time. With only one workshop and limited mechanical staff, as are at present available in the Punjab, it is feared that the reliability standard with regard to repair of tubewell needs to be improved.

3.22. On canals both in the Punjab and in Uttar Pradesh the Northern India Canal and Drainage Act (Act VIII of 1873) provides for *Warabandi*, *Osrabandi* for regulation of supplies to different irrigators. In the Punjab, Section 68 of the above Act is applicable to State tubewell also, (*vide* Punjab State Tubewell Act 1954, Section 4) *Appendix VII*. The Team feels that there

should be no difficulty in regulating supplies to different cultivators if action in this respect is taken speedily, whenever required.

3.23. Reduced Discharges—In some tubewells discharges are falling. In others there is sand pumping. It should be possible to put the wells with reduced discharges and sand pumping in order. Unless this is done, we will not be able to win the confidence of the cultivators for tubewell irrigation and the tubewells with poor discharges may never succeed. In the case study of Tubewell No. 10 in Ghazipur village of Rajpura area (*vide* item 4 of *Appendix IV*) the discharge has fallen to almost half of the normal discharge and the rate has correspondingly gone up. As a result the cultivators are reluctant to use tubewell water. It was stated that there are also other cases of falling discharges. It is felt that a rationalised rate structure needs to be applied in all such cases, till the falling discharges are restored.

3.24. Seasonal Variations like Abnormal Rainfall—Apart from the factors referred to above, there are seasonal variations, which will affect development of tubewell irrigation. For example, it is gathered that during the past four years in the Punjab, rainfall has been heavier than normal. Abnormally heavy rainfall undoubtedly hinders the development of irrigation.

3.25. It was observed that the area expected to be irrigated on full development of tubewell has been taken as 60 per cent of the commanded area. This is based on the practice obtaining on canals. Thus tubewells in the Punjab have been allotted commands round about 800 to 1,000 acres with an expectation of irrigating 60 per cent of the commanded area. As an instance, tubewell No. 89 in Panipat-Sonepat area has a gross command of 1,039 acres, of which 897 acres are culturable, and the expected figure on full development of this tubewell is 540 acres only. The actual irrigation done on each tubewell will, however, depend on a number of factors, like the proportion between *Rabi* and sugarcane and other *Kharif* crops, weather conditions and rainfall. In normal years, however, a 1½ cusec tubewell should be able to take care of about 360 acres of *Rabi* about 125 acres of sugarcane and 60 acres of other *Kharif* crops. Presuming that wheat will require 88,000 gallons per acre watering, sugarcane 1,10,000 gallons per acre watering on the assumption that the period necessary between successive watering will vary from five to six weeks during the *Rabi* season. This kind of allocation of areas tends to present an unrealistic picture of tubewell service. It would be more factual if the commands are limited to the irrigating capacities of the wells and are not determined as a percentage of a geographically fixed commanded area.

CHAPTER IV

FINANCIAL ASPECT OF STATE TUBEWELLS PERFORMANCE

4.1. State tubewells planned for irrigation purposes during the last decade in the Punjab are included in 6 Schemes. Their budgetary position, expenditure incurred and other financial details are shown in Table 4.1.

TABLE 4.1.

Sl. No.	Name of Scheme	No. of tube-wells planned	No. of tube-wells energised up to July 15, 1960	Average estimated cost per tubewell	Budgeted estimate of scheme / Expenditure up to June 30, 1960 (Rs. in *lakhs*)
1.	T.C.A. 1952	664	659	66,429	441·09 389·40
2.	T.C.A. 1953	335	325	62,218	208·43 165·62
3.	G.M.F. 1954	280	193	59,047	165·33 105·38
4.	Panipat-Munak Scheme ..	24	24	32,750	7·86 6·82
5.	Abdullapur Radaur Scheme	18	18	33,222	5·98 6·47
6.	Nidampur Scheme	8	8	55,625	4·45 2·80
	TOTAL ..	1,329	1,227		833·14 676·49

Of the six schemes as given in the Table 4.1, some tubewells remained to be completed in serial numbers 1, 2 and 3. All the tubewells under serials 4, 5 and 6. *i.e.*, Panipat-Munak Scheme, Abdullapur Radaur Scheme and Nidampur Scheme have been energised. Against an estimated cost of Rs. 18·29 *lakhs* the capital expenditure on the last three schemes is only Rs. 16·09 *lakhs*. The balance left over is meant to be spent on laying of channels and making *chaks*.

4.2. Estimated Expenditure—The average estimate of expenditure per tubewell with appurtenant works including laying of channels varies from scheme to scheme. This variation is partly due to the fluctuation in prices from time to time, and partly due to local conditions of work. By and large, the estimated cost of a tubewell, when executed through contractor is slightly higher than through departmental agencies, as in the project estimates for 355 tubewells (*Appendix II*) under T.C.A. programme of 1952. The cost per tubewell including preliminaries and buildings *etc.*, is shown as Rs. 72,184 through contractor and Rs. 62,937 through departmental agencies; the latter costing 13·1% less. The average (round figure) cost of a completed tubewell

as under T.C.A. and G.M.F. Schemes is about Rs. 65,000 (*para* 3.1). In the case of two Schemes *i.e.*, Abdullapur Radaur and Panipat Munak, the cost per tubewell is stated to be low, because the capital estimate did not include the cost of lined water courses.

4.3. The financial position of working of tubewells in the State, is reflected in the figures below :

	Working expenses	Assessment	Loss
1958-59 (Rs. in *lakhs*)	21·15	10·76	10·39
1959-60 (Rs. in *lakhs*)	31·19	21·62	9·57

The State has thus lost Rs. 19·96 *lakhs* during two years on 1,227 tubewells operating. Loss per tubewell works out to about Rs. 1,762·00 These figures do not include the expenditure on regular establishment in the Circle and Divisions. This charge if debited to the working of tubewells will further add to the losses. It is also gathered that the Tubewell Depreciation Fund has not been started. In fact, Tubewell Depreciation Fund Rules are under consideration of the State Government and it seems necessary that the decision thereon should be expedited. Besides, accumulated interest on capital, if added year after year, will mount up and in course of time the yearly loss may appear intolerable to our "Loans-based" economy.

4.4. Of the 1,227 energised tubewells in the State as on March 31 1960, only 796 tubewells are such as have completed three years developmental period. The area-wise distribution of these developed tubewells and their performance during the year 1959-60 is shown in *Appendix VIII.*

As may be clear from Appendix VIII average figure for an individual tubewell having run for at least a period of three years works out as given below :

Actual area irrigated from a developed tubewell ..	296·10 acres
Hours run per tubewell (on the assumption that 10 kWs. are consumed per hour).	1,688·24 hours
Assessment per tubewell on the basis of 12 nP. per unit ..	Rs. 2,124·34

4.5. Operation Cost Schedule—On the basis of the present fixed charges and maintenance costs a tubewell working even 5,000 hours in a year will not be able to meet its working expenses as shown in *Appendix IX.* This is based on the reduced rate of annas two per unit of electricity consumed as per Government Order of June 29, 1960 given in *Appendix X.* It is stated that water rates are going to be increased to 2½ annas. per unit shortly. A Table worked out for 2½ annas. rate is shown in *Appendix XI.* It does not seem to improve matter much. Normally irrigation projects of this nature should be able to meet not only their working expenses but interest charges as well. As indicated in the project estimate for 355 tubewells under T.C.A. Scheme 1952, the project was framed on the basis of "No profit and no loss" taking into account the interest charges as well. Co-ordinated intensification of agriculture in the area served and a recompensable water rates structure will help balancing expenses with income.

4.6. Water Rate Structure—An average tubewell in the Punjab gives a discharge of 1½ cft. of water per second with a total lift of approximately 50 ft. It can irrigate an acre in two hours to a depth of three inches on an average consumption of energy of 10 kWs. per hour. As such the cost of irrigating an acre of land works out to about Rs. 2·50. This in itself is

not a high rate. In U.P. tubewell water is supplied at about 19,690 gallons per ruppee. A three inch depth on one acre works out to 67,500 gallons and the cost per acre of three inch water will be about Rs. 3·50. As such the current Punjab rates are lower than in Uttar Pradesh. Their earlier unpopularity was on account of the Punjab Canal water rates being comparatively cheap. The Team feels that low irrigation rates mean undue subsidy to the cultivators, which may not seem justified in the over-all economic planning of irrigated agriculture in the State. The position therefore, needs to be reviewed, not only from the view point of removing the inequity between canal and tubewell irrigation rates but also to bring about a rational parity between irrigation rates and the profit realised from irrigation by the irrigators and the State.

4.7. Even if the rates of tubewell water are brought closer to that of canal rates, some differences between the user of tubewell water and the user of canal water must still exist. In respect of canal irrigation, water rates vary from crop to crop. In respect of tubewell irrigation, the rate is uniform based on water consumption. If water is charged on the consumption of electricity as in the Punjab, the cultivator also pays for the inefficiency of the department, when the pumping set is not delivering full quantity of water. Cultivators near the well will get more water than those who are located at a distance. Unless water courses are lined, considerable amount of water will go to waste in seepage and percolation. Under these circumstances, it would seem advisable if the water rates in the Punjab are rationalised as they have been done in Uttar Pradesh, where charges for a kW. of electricity are adjusted to make a rate of 16,000 gallons per rupee and with the rebate at present in operation, the charges work out to 19,690 gallons per rupee. Tubewell energised from the hydro-power have cheaper rates than those energised from combustion engines. Comparison made with the charges at present on Eastern Yamuna Canal indicated that the tubewell charges in Uttar Pradesh are close to the canal rates, as shown in Table 4.2.

TABLE 4.2.

Crop	Canal rates per acre	Tubewell rates per acre			
		Gallons used per acre. Av. *Kharif* + Av. *Rabi*		Total gallons	Cost at 16,000 gallons per rupee
Sugarcane	Rs. 32	3,37,500+	1,87,500	5,35,000	32·80
Rabi (Wheat)	Rs. 12	—	1,60,000	1,60,000	10·00

NOTE:(Figures taken from 50 additional tubewells Project of U. P.)

In the Punjab, as it is, the tubewell rates are low, even as compared to what had been envisaged in the project estimates. For example in the project estimate for 355 tubewells in Delhi Division, the assessment rate has been provided for at as./5/- or 31nP. per unit for a "No profit no loss" basis project. But this rate appeared exhorbitant because of the comparatively low assessment rates on canals in adjoining areas. To quote an instance in the Punjab, on Western Yamuna canal, irrigation charges on sugarcane and wheat are Rs. 16·50 and Rs. 5·84 per acre respectively as against Rs. 32 and Rs. 12 per acre respectively on the Eastern Yamuna Canal in Uttar Pradesh, only a score miles away on the other side of the Yamuna. The disparity being

unreasonable to the general irrigation economy of the tract, the authorities had to lower the rates for tubewell assessment also. In fact, there is considerable disparity between the net income per acre derived by the cultivator from irrigated and unirrigated areas. As per farm accounts in the Punjab brought out by the State Economic and Statistical organisation the figure for net income per acre as from irrigated areas and unirrigated areas are Rs. 190·17 and Rs. 61·37 respectively, indicating a gain of Rs. 128·80 per acre in net income as a result of irrigation. In other words Rs. 128·80 represent the extra productive value of an acre under irrigation. The Team, therefore, feels that the State Government may get the whole irrigation rates structure in the State examined by an Irrigation Rates Enquiry Committee, so that tubewells do not remain a losing concern. A wholesome development will take place only, when income and expenditure balance. After all, operational and maintenance efficiency of State tubewells is linked to a great degree on the extent of income, and on the maintenance and operational efficiency of State tubewells depends, the extent of irrigation. Thus one is dependent on the other.

4.8. Two-part Tariff Basis—Also in the *barani* areas of Punjab, where State tubewells are installed in dry areas, growing of crops is a gamble unless assured irrigation is available with a tubewell. In such areas, it should not be difficult to mobilise even a co-operative action on the part of irrigators themselves in so far as development of irrigated agriculture is concerned. Comparison of cost with what obtains elsewhere may not be a wholesome policy in such areas because water is an absolute necessity for farming and the cultivator will pay for it, when he finds that application of water ultimately is profitable to him and when irrigation will mean all the differences between success and failure of his crop production. The water rate structure of tubewell areas in the Punjab could, with advantage, be on a two-part tariff basis consisting of a fixed charge of say Rs. 4 to Rs. 6 per acre and suitable tariff for sale of water on volumeteric basis. This will automatically provide a control on indiscriminate increase in high water consumption crops like sugarcane and rice and will help balancing the agricultural economy of the tract. This two-part tariff would seem justifiable only when culturable commands or CCA on State tubewells are re-determined on a more realistic basis so that all land within the CCA could actually receive water for irrigation from the tubewell concerned. The Team feels that the State authorities may examine the possibilities of imposing tariff like this, if development of irrigation on tubewells does not come up satisfactorily.

4.9. Energy Charges—As per arrangements between Irrigation Department and the Electricity Department, it is reported that the Irrigation Department, accepts debit from the Electricity Board at a rate of 6·77 nP. per unit and the balance of 5·23 nP. is supposed to cover the cost incurred for working expenses by the Irrigation Department itself. It is to be seen if the rate charged by the State Electricity Board could be reduced further, so as to be in line with their actual generation and transmission cost and no profiteering is allowed between the State Irrigation Department and State Electricity Board. That will help Irrigation Department in finding more money for maintenance purposes and for working expenses. In U.P. the rate for 3,200 tubewells operating on Ganga Hydro-electric Grid is 3·5 pies per unit (1·84 nP.) *plus* an annual charge of Rs. 80 per B.H.P. while the rate charged for water is 16,000 gallons per rupee (with a rebate of annas three per rupee at present). This leaves a good amount with the Irrigation Department to meet the working expenses of tubewells.

4.10. The general presumption of the Punjab tubewells is that 10 units of electricity are consumed per hour. This presumption leads to many anamolous conclusions. If 10 units are consumed per hour, an acre of a 3 inch watering will require roughly 20 units leading to an assessment of about Rs. 2·50 per acre per watering. But, actual figures of water consumption and areas irrigated may not justify this presumption.

4.11. During their inspection of Samrala area, the Team observed that on Tubewell No. 86 there was 12·5 H.P. set consuming about 17 amperes of current and yielding a discharge of about 25,000 gallons per hour. On the next well No. 85 in the same area, there was 20 H. P. set consuming about 20 amperes and yielding a discharge of the same order, *i.e.* about 25,000 gallons per hour. This reflects considerable inequity in the rate structure of the wells. Apart from the rates, it also reflects that pumping sets in a large number of cases, are much beyond the water production capacity of the tubewells. This leads to considerable waste of electrical energy, day in and day out, and could be changed by a judicious interchange of pumping plants.

4.12. Division-wise Performance—Details of performance of 1,227 energised tubewells in the four Divisions are available for the years 1958-59 and 1959-60 only. The two years cover four seasons, two of *Rabi* and two of *Kharif*. The table in *Appendix XII* gives a comparative picture of performance of the different Divisions, against which are also the State-wide performance averages. The chart in Figure 4·1 presents a graphic picture. The performance in 1959-60, which is better than of 1958-59 is taken for a comparative study of the Divisions. The Team gathered that these areas are not based on actual field recording of irrigation, but have been deduced from observation of energy consumption etc.

4.13. Per-acre Efficiency—An analysis of the performance of tubewells Division-wise showing their irrigation efficiency on per acre basis is given in Table 4·3.

TABLE 4.3

Sl. No.	No. and Name of Division	Total No. of T/wells energised	Area irrigated per T/well (Acres)	Energy consumed per acre (Units)	Assessment per acre (Rs.)	Working expenditure per acre (Rs.)	Differences between Cols. 6 & 7 (Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.	T.W. Divn. No. I, Delhi	225	259	56	7·00	11·69	(—)4·69
2.	T.W. Divn. No. II, Ambala	388	292	54	6·48	10·32	(—)3·84
3.	T.W. Divn. No. III, Malerkotla ..	383	220	57	7·05	9·56	(—)2·51
4.	T.W. Divn. No. IV, Ludhiana ..	231	239	59	7·73	8·44	(—) 0·71
5.	Punjab State ..	1,227	252	56	7·00	10·08	(—)3·08

The working expenses per acre served, exceed the assessment in all the Divisions. The variations, however, are due to the fact that pay of staff is not charged on a uniform basis in all the Divisions. Also the operator's emoluments are varying from Division to Division. While in Delhi Division they are paid at about Rs. 80 per month, in Ludhiana and Malerkotla their emoluments are about Rs. 50 per month. The Team feels that a uniform policy

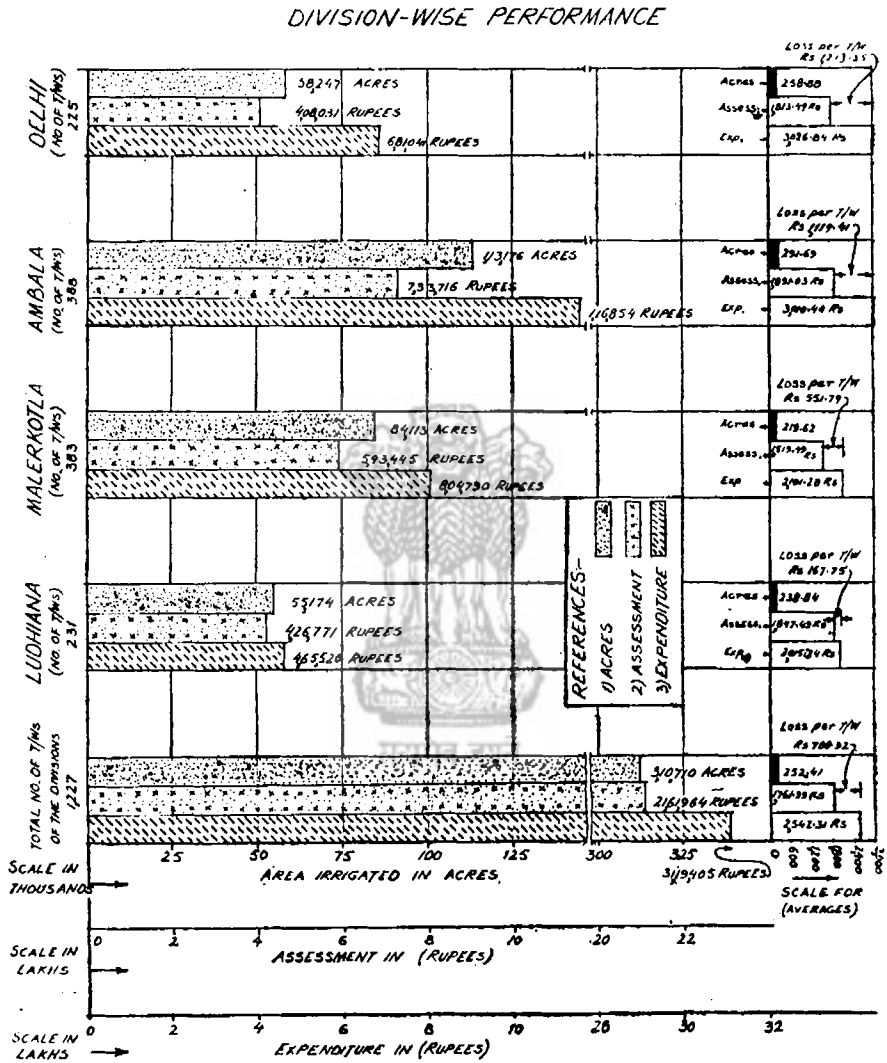


Figure 4·1 Graph showing Division-wise performance for both the seasons Kharif and Rabi of energised Tubewells in the four Divisions of the Punjab.

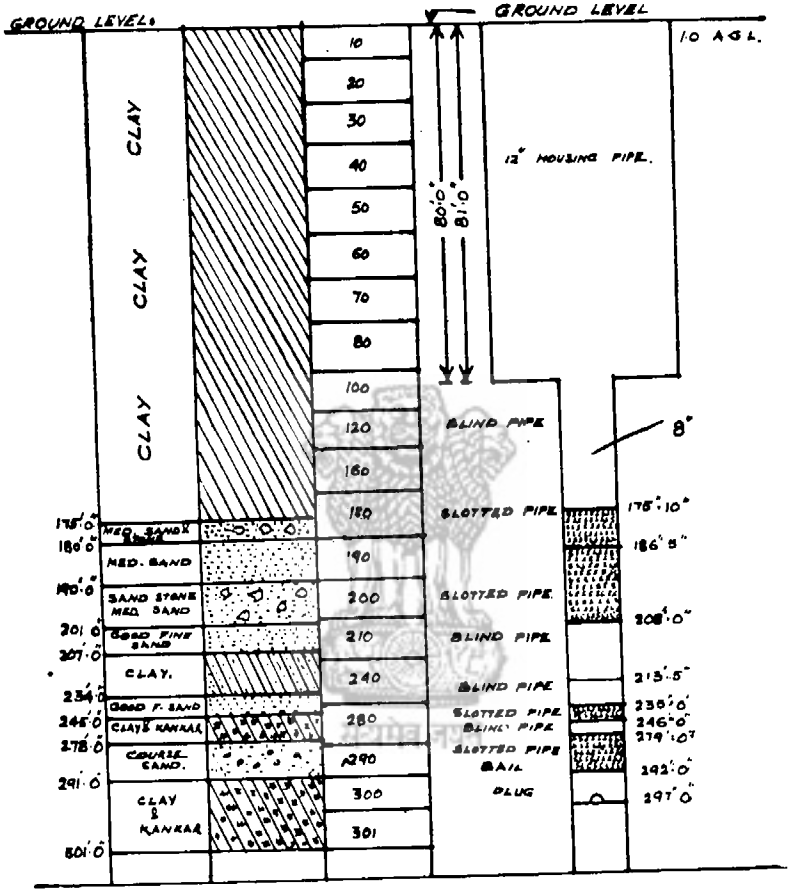
should be adopted in all Divisions and the pay of regular staff including supervisory and administrative should be correctly charged to tubewell operations so that a clear picture of financial performance of State tubewells emerges out of these figures.

4.14. Individual Wells—Apart from Division-wise performance as elucidated above, it will be of interest to study the trend of development of irrigation on individual wells. The performance of individual tubewells in the Abdullapur-Radaur area and in the Panipat-Munak area was examined in respect of actual area served and energy consumed, the details of which (for two years 1958-59 and 1959-60) are given in *Appendices XIII and XIV*. These are developed tubewells as they have been operated for over six or seven years. The Abdullapur-Radaur Scheme of 18 tubewells is one of the oldest and so is the other Scheme with 24 tubewells. In the former Scheme No. I tubewell irrigated the largest area of 324 acres in 1958-59 consuming 91 units per acre, while in the next year No. 3 irrigated the largest area of 719 acres consuming 56 units per acre. The lowest area performance of 49.6 acres in 1958-59 was by tubewell No. 15, which consumed 144 units per acre. The consumption of energy in this case is exceptionally heavy. In the next year, the smallest area irrigated was 195 acres by tubewell No. 16 consuming 123 units per acre. In 1958-59 out of 18, ten tubewells were irrigating below 150 acres. In the next year, an improvement is seen as all tubewells irrigate more than 150 acres; 13 tubewells irrigated more than 300 acres and three among these irrigated more than 500 acres each.

4.15. In the Panipat-Munak area, tubewell No. 18 irrigated just 19 acres consuming 49 units per acre in 1958-59 and had the smallest irrigated area in the next year also with 37 acres with an average consumption of 88 units per acre. Tubewell No. 1 irrigated the largest area in both the years, the respective areas being 380 acres with a consumption of 47 units per acre and 723 acres with a consumption of 48 units per acre. Out of 24 tubewells, 18 irrigated less than 150 acres (5 doing less than 50 acres) in 1958-59. In next year, only five irrigated less than 150 acres (2 doing less than 100); 5 tubewells irrigated 400 acres and more each. The picture as it emerges out of these performances is not of a uniform pattern as may be expected from tubewells of that age group. The differences in well-to-well performance in the same area are also astounding. Of the wells, which have had a period of more than 3 years for initial development, performance records of two areas, namely Panipat-Munak and Abdullapur-Radaur with 24 and 18 tubewells respectively was looked into. Tubewell-wise data giving irrigation figures for the year 1959-60 are given in *Appendices XIII and XIV*. In these areas no *pucca* lined channels have been built. With the exception of a few wells, most of the wells have shown fairly good performance, though they still lag behind the targetted figures. If the water course system had been lined and if incentives had been provided for more intensive irrigated agriculture, it is felt that these tubewells may have attained the targetted figures. All the same, they are clear pointers towords the potentialities of well developed tubewell irrigation in this area.

4.16. Of the new Schemes detailed case study was made about tubewell No. 89 (Figure 4.2). Tubewell No. 89 in Sonepat-Panipat area is situated in Karans village in Panipat Tehsil. Its study illustrates, by and large, the general pattern of performance of tubewells in the Punjab.

Tubewell No. 89 in Sonepat-Panipat area is one of the TCA 1952 Project. It has a gross command of 1034 acres, of which 897 are cultivable. The area



ABSTRACT OF PIPE.

BLIND PIPES	159'·10"
SLOTTED PIPES	56'·2"
HOUSING PIPES	80'·0"
CONC.	1'·0"
TOTAL	297'·0"

Figure 4·2 Showing drilling on tubewell No. 89—T.C.A. 1952—Sonepat-Panipat Area in Village Karans. Drilled with Rotary—Started on 22-9-1954 and completed on 22-11-1954.

expected to be irrigated on full development is taken as 540 acres. The tubewell was drilled up to a depth of 301 feet and was completed and developed on Nov. 22, 1954 as per strata chart shown in Figure 4.2. But pumping equipment (15 H.P. bore hole type) was installed almost 2½ years later in March, 1957. Its test discharge is recorded as 672 gallons per minute *i.e.* about 40,000 gallons per hour.

It has a water course system partly lined and partly unlined. A sketch map of its commanded area and water distributary line is given in Figure 4.3. These water courses have not been built on any Government acquired land. They are, therefore, not as well aligned as they could be. There is no tubewell operator's quarter provided on this well.

The area was mostly *jungle* and it took time before the land was prepared for agriculture. No Irrigation could take place before *Kharif* in 1957-58 as the discharge tank was completed as late as October 11, 1957. With a greater co-ordination in completion of different items the tubewell could have been put into actual operation much earlier. There has, however, been a steady growth in the irrigation figures on the tubewell, as shown in Table 4.4.

TABLE 4·4

Year	Area irrigated (acres)	Units consumed	Hours run
Kharif 1958	60	1,852	185
Rabi 1958-59	191	4,022	402
Kharif 1959	25	2,388	239
Rabi 1959-60	248	8,769	877
Kharif 1960	95	10,394	1,039

The irrigation performance is yet far from the targetted figure of 540 acres per year. The tubewell was also used for non-irrigational purpose like filling ponds *etc.* for which a charge is levied at 38 nP. per unit.

The general crop pattern developing on the tubewell is reflected as given in Table 4.5.

TABLE 4.5

Year	*Rabi*				*Kharif*				
	Wheat	Fodder	Vege-table	Total	Sugar-cane	Cotton	Maize	Fodder	Total
1958-59	191	—	—	191	9	—	—	—	9
1959-60	210	34	11	255	15	—	1	9	25
1960-61	—	—	—	—	81	1	1	—	83

Most of the cultivation is done in the traditional style. Apparently, there has been no pronounced preparedness for utilisation of tubewell water, which would have speeded up the development of irrigated agriculture on the tubewell and might have resulted in better revenue to the State.

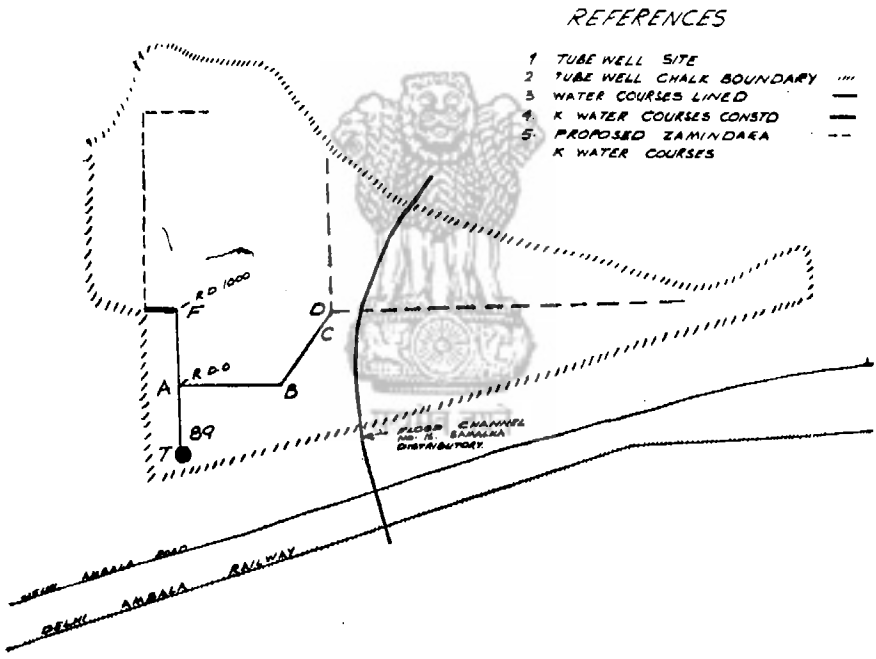


Figure 4.3 *Chak Plan of Tubewell No.* 89 *under T. C. A.* 1952—*Sonepat-Panipat area.*

4.17. Overlapping—There is, however, a remarkable feature on this tubewell. A new (flood channel No. 1L) Samalka distributary has recently been extended. This traverses the command of this tubewell, as shown in Figure 4.3. Though this is said to be a flood channel, it is bound to hamper co-ordinated development of irrigation on this tubewell as the canal is likely to be made perennial. An integrated programme of irrigational development may not have permitted such overlapping. There are reported to be other similar cases. The Team feels that overlapping of irrigation provision could be avoided with greater co-ordination between different administrations of the State not only at State level, but at Divisional and Sub-Divisional levels.

CHAPTER V

JAGADHRI TUBEWELL PROJECT

5.1. As different from tubewells for direct irrigation, 256 tubewells were constructed in 1951-52 as an anti-water-logging measure on both sides of the existing Western Yamuna Canal extending from North of Jagadhri to South of Karnal. This group of tubewells is commonly known as Jagadhri Tubewell Project.

5.2. These are two cusec tubewells, bored to a depth of more than 350 feet and provided with 15 H.P. bore hole pumping sets. They are sited on alignments at varying angles to the canal alignment and are built in different groups in various reaches. They are connected to brick lined feeder channels discharging into main Yamuna Canal through appropriate inlet arrangements. Their location is indicated in Table 5.1 and also shown in Figure 5.1

TABLE 5.1

Feeder Tubewells in Jagadhri Tubewell Project

Sl. No.	Reach No.	Group No.	No. of tubewells	Place
(1)	(2)	(3)	(4)	(5)
1.	IA	1	8	Near Abdullapur Rest House.
2.	IB	1	5	Do.
		2	5	Do.
		3	5	Do.
			23	
3.	II	1	13	Near Radaur Rest House.
		2	16	
		3	12	
		4	5	
			46	
4.	IIA	1	11	Near Radaur Rest House.
		2	5	
			16	
5.	III	1	15	Do.
6.	IV	---	60	Indri Rest House in the southern half.
7.	IVA	1	9	Near Radaur Rest House.
		2	12	
		3	10	
			31	
8.	V	1	22	Jhani Rest House
	VA		30	Indri Rest House.
	VB		6 7	Karnal Rest House
			65	
	TOTAL ..		256	

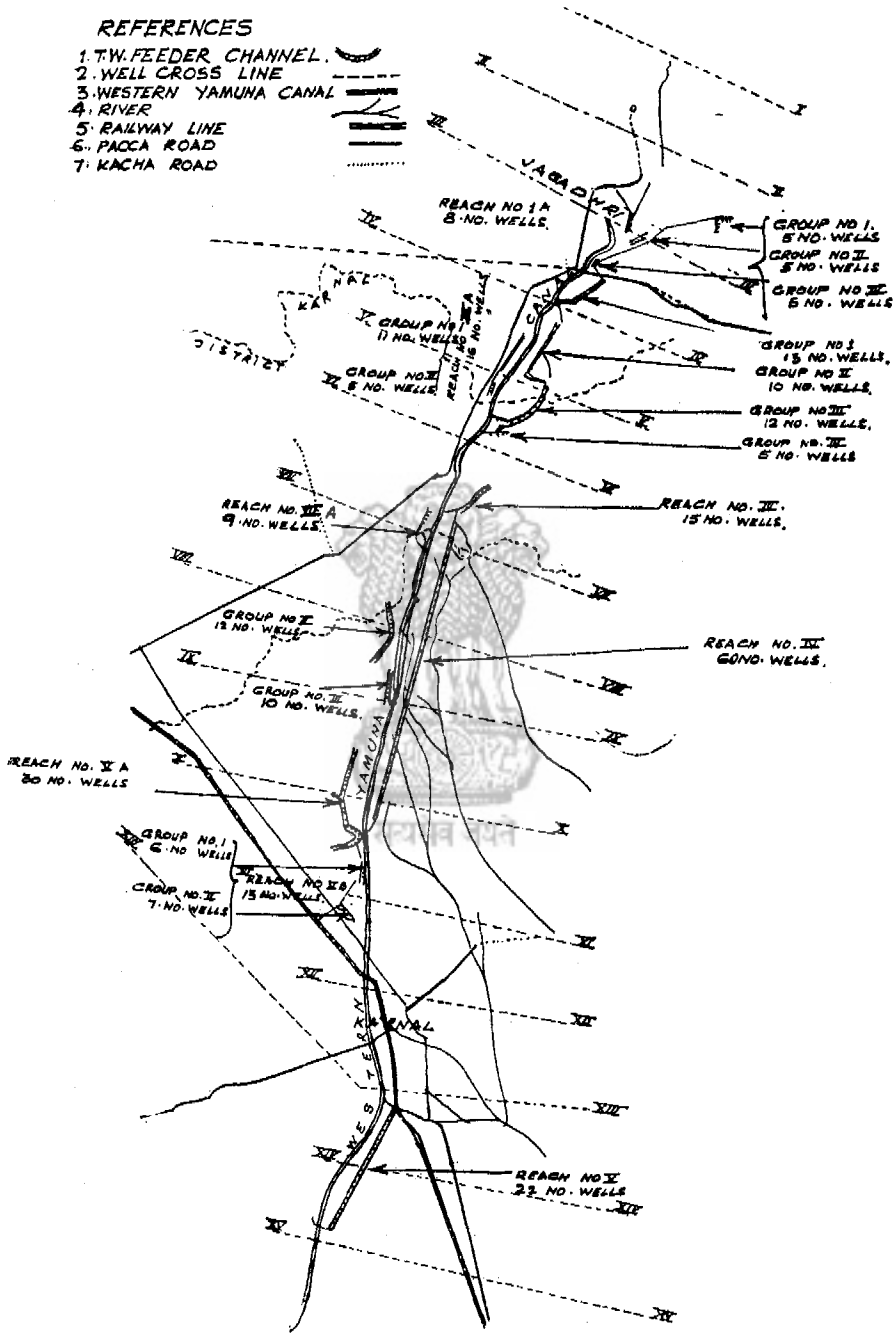


Figure 5.1 Index plan showing Tubewell Feeder Channel in Jagadhri Tubewell Project —Tubewell Division No. 1.

5.3. These tubewells serve a two-fold purpose :-

(*i*) They serve as feeder wells to Western Yamuna Canal contributing 400 to 500 cusecs of water generally from November to June every year.

(*ii*) They exert an anti-waterlogging influence in the areas that they extract water from.

5.4. Functional efficiency of Jagadhri Tubewell Project in respect of the two aspects quoted above cannot be easily judged.

5.5. As feeder wells, water supplied by the tubewells gets merged in the Western Yamuna Canal and is utilised through that canal. Irrigational efficiency of the tubewells of this project cannot, therefore, be determined separately. They are, however, run as an unproductive project. Besides, the capital cost of about a *crore* and a half rupees incurred in their constructions, recurring expenditure of Rs. 8.9 *lakhs* per year is incurred on running these tubewells. Rough break-up of Rs. 8.9 *lakhs* is indicated below :—

	Rs.
1. Electric charges	6,54,848
2. Work-charged establishment	85,123
3. M & R of F. Channel	16,836
4. Repairs and stores	6,806
5. Repairs of pumping sets	22,692
6. Maintenance of buildings	6,863
7. Depreciation charges	97,823
8. Inspection charges	216
9. Others	80
TOTAL ..	8,91,287

The maintenance cost per tubewell = Rs. 3,872.22

5.6. With regard to anti-waterlogging effect of the project, the Team looked into the record of spring level observations maintained for different reaches. While in some reaches there is a pronounced depression in water table owing to pumping, in others, spring level variations are nothing more than seasonal. Observations taken along a line across Reach VA are shown in *Appendix XV*. In fact, the tubewells, as built, are not directly conducive to anti-waterlogging as they are deep tubewells with strainers generally located below 60 feet depth. But the real test of efficiency, however, lies in the fact :-

(*a*) How far land utilisation efficiency has increased during last 9 years of their functioning in the tract where these tubewells have been installed ?

(*b*) How far productivity of the land was increased on account of depletion of high water table ?

5.7. The Team also gathered that in close vicinity of some of these tubewells, there is demand for irrigation; particulars about one of such wells near village Kheri Mansing are given below :

Well No.:—17 Reach VA
Boring :—27 inch
Depth :—390 feet
Date of completion :—December 17, 1952.
H. P. of Pumping set :—15 H. P. (Johnston).
Date of energisation :—March, 27, 1954.
Discharge :—768 gallons per minute.

The cultivators seemed to be very keen to get water from the tubewells for the ensuing *Rabi* crops. Spring level behaviour in the tract is indicated by the observations given in the table in *Appendix XV*. At present the spring level is about 10 feet below ground. The demand for irrigation seems to be coming up in the past few years. It is felt that such areas, as stand in need of irrigation should be served by the tubewells on a direct irrigation basis. Also, the procedural delay that is occuring in implementing such irrigation proposals should be avoided so that the advantage that can accrue to the next *Rabi* crop from these tubewells is not lost.

5.8. The financial performance of these tubewells remains obscure because their benefits are mostly qualitative. Final analysis of their plus and minus effects may show up a balance either way, yet the Team feels that investigation in certain aspects may lead to a more rational approach towards operation of these tubewells and may make them yield greater benefits to the State and to the community. It is, therefore, suggested that :—

(*a*) a land utilisation efficiency survey may be carried out in the tract, based on comparison of areas under plough as in 1949 and 1959, making due allowance for any increase owing to influx of refugee population, if any;

(*b*) where water table has depleted beyond the level of easy exploitation of subsoil water by the cultivator through open wells, pumping from the concerned tube wells should be suitably modulated, so as to let cultivators have the benefit of doing irrigation from open wells;

(*c*) a farm produce survey may be arranged to exhibit how far production has increased per acre on account of reduction in waterlogging tendencies in the area. This may be of great help in forecasting the performance of anti-waterlogging schemes in other areas;

(*d*) tubewells should also be run well in time, so as to relieve waterlogged land of extra water before *Rabi* sowings start. Their present running as from November to June does not help those marginal areas, which can grow *Rabi* crops, if they are relieved of waterlogging towards the close of rainy season *i.e.* October;

(*e*) direct irrigation should be allowed from Jagadhri Project tubewells, wherever there is demand for such irrigation; and

(*f*) the charges debited for electricity for these tubewells by the State Electricity Board are higher than those applied to irrigation tubewells. There seem little justification for such high charges. In fact, these tubewells have a multipurpose aspect and power rates should be suitably reduced as far as possible.

CHAPTER VI

AGRICULTURAL ASPECTS OF TUBEWELL IRRIGATION IN PUNJAB

6.1. Area under Tubewell Irrigation—Punjab has 41 per cent of the total sown area under irrigation, the highest among the States. The area served by tubewells is generally such that it cannot have canal irrigation with reasonable means.

6.2. Crop Yield per Acre—The Table 6.1 gives the comparative acre yields of crops in Punjab under rainfed and irrigated conditions.

TABLE 6.1

Average yield (lbs. per acre) of Principal Crops in Punjab for the quinquenium ending 1956-57.

Crop	Irrigated and un-irrigated combined	Irrigated	Un-irrigated	Increase percentage of irrigated over un-irrigated
Rice	821	932	667	40
Jowar	185	253	163	55
Maize	1,149	1,319	1,018	30
Bajra	321	490	299	65
Wheat	933	1,161	642	81
Gram	673	924	597	54
Barley	803	1,165	623	87
Cotton (*desi*)	200	210	140	50
Cotton (amer)	230	230	100	130
Sugarcane (*Gur*)	2,750	2,960	1,950	52
Groundnut	720	1,010	710	42
Potato	12,500	13,500	8,000	69
Mustard	390	520	340	53
Linseed	260	270	230	17
Toria	600	630	420	50

The figures as given in Table 6.1 and supplied by the Director of Agriculture, Punjab have been derived from the crop sampling experiments, and the samples, for irrigated areas might not be adequate and therefore not absolutely reliable. Still the figures indicate the advantage of irrigation in increasing production. The increases generally are not as high as one would expect and they are particularly so in the case of rice, wheat, *bajra*, sugarcane, potato, *etc.* The increase indicated may be ascribed mainly to irrigation. But combination of improved practices, namely, good land preparation, better seed, fertilizer application, improved tillage *etc.* with irrigation, can increase yields several fold of the crop grown without irrigation. In spite of the large area under irrigation, the acre yields of crops except in a few cases are not high in Punjab as compared to other States. That there has been large increase in agricultural

production in Punjab in recent years may be attributed partly to the provision of irrigation facilities, and partly to the increase in area under crops. It should be interesting to compare acre yields of crops under canal irrigation and tube-well irrigation. With better controlled irrigation under tubewells, as with better controlled conditions under the latter, the yields may be expected to be somewhat higher. It may be stated that in Madras acre yields of paddy grown under wells with lift irrigation, and consequently a limited supply, are generally higher than for paddy grown in the delta with more abundant supply.

6.3. It has been stated that "either too much or too little water and its inefficient use are at present primary limiting factors in India's crop production." Irrigation by tubewells has, however, definite advantages over other sources because the supply is not seasonal and is better controlled. It should be possible to have a more satisfactory water management in tubewell irrigation than in canal irrigation. There is generally less loss of water in conveyance and evaporation than in canals, and the supply is closer to the user. The problems associated with timing of the delivery to the demand of the farmer can also be more easily managed. Tubewell irrigation can also allow a wider selection of crops with known water requirement to be grown. Since water rates are comparatively more for tubewell irrigation than for canal irrigation there is less likelihood of waste due to overuse. However, the prevailing low rate of annas two per unit of electricity consumed may not be conducive to economise water use.

A study was made of the working of the wells in three areas—Malerkotla, Samrala and Karnal. In Malerkotla Division, the total area actually irrigated in 1959-60 by 384 wells is given in Table 6.2 including both *Kharif* and *Rabi* crops.

TABLE 6.2

Total area irrigated by 384 tubewells in Malerkotla Division in 1959-60.

Crop	Area Irrigated (Acres)
Sugarcane	10,118
Cotton	15,844
Paddy	1,490
Maize	2,521
Wheat	26,387
Gram	2,649
Bajra	29
Groundnut	84
Vegetables	720
Fodder	8,554
Miscellaneous	13,367
TOTAL	81,763

The average area irrigated by each well is 213 acres only which is low because of the poor functioning of some of the wells. The table 6.3 gives the area and crops irrigated by 4 of the wells in 1959-60.

TABLE 6.3

**Area irrigated (acres) Crop-wise in 1959-60 under 4 selected wells of Malerkotla Division.*

T. Well No.	Sugar-cane	Cotton	Rice	Maize	Wheat	Gram	Barley	Vegetables	Fodder	Misc.	Total
189 ..	112	89	—	14	108	11	7	—	66	1	408
190 ..	90	79	85	47	273	4	3	19	206	—	806
260 ..	3	14	—	—	14	10	—	—	2	5	48
295 ..	—	11	—	—	15	1	—	—	1	—	28

Well No. 189 approaches the targetted figure whereas the figure for well No. 190 where a model farm is located, appears exceptionally high, and this high level has been reached in the course of four years.

6.4. Intensity of Cultivation—Theoretically, the availability of tubewell irrigation should help intensification of agriculture to the highest degree possible allowing for two or more crops to be grown on the same land in a year. This has become possible in some of the wells but not in others. The Team did come across a farmer, who with 200 *bighas* of land was cropping the whole area both in the *Kharif* and *Rabi* seasons *i.e.* with 200 per cent intensity, 100 per cent intensity corresponding to only one crop in the year either in the *Kharif* or in the *Rabi* season.

6.5. The Samrala area was a big contrast to what was seen in Malerkotla. Here the standard of cultivation was definitely low, and the soils are also comparatively poor. Efficient use is not being made of the available water facility. The standing paddy crop was found weedy and badly in need of water. The fields were kept bone dry at a stage when the ear heads were just forming. One well, No. 46, located in the sandy area has been in existence for nearly two years but the standing crops of groundnut and sugarcane were not irrigated. In this area the main requirement appears to be attention to the improvement of soil fertility alongwith the use of water. Utilising irrigation to grow a green manure crop for incorporating in the soil, every season, could improve the situation. The absence of suitable wind breaks in the sandy areas in causing sand blowing which has upset the field levels and the functioning of the irrigation channels.

6.6. Irrigation in Karnal—This is a predominantly paddy area which receives tubewell irrigation to supplement the rains. The channels in this area are not lined at all and the paddy cultivators give as many as four irrigations, 6 inches each time, and spend about Rs. 20 per acre as irrigation charges. The absence of water distributaries is causing considerable wastage of water. Since paddy is the main *Kharif* crop, the crop apparently benefits by the plentiful supply of water. It may be mentioned that Karnal is one of the areas where the level of subsoil water has significantly risen in recent years and the seepage of irrigation supplies is also contributing to it. If the present position is allowed to continue, paddy could be the only *Kharif* crop for a greater part of this area. The farmers do adopt intensive methods and get about 2,000 lbs. of paddy (17 *maunds* of rice) per acre.

6.7. Co-ordination Between the Agriculture and the Irrigation Departments—The general position in tubewell irrigated areas was that with exceptions, water was not being utilised fully, and the standard of cultivation was capable

*Data supplied by the Executive Engineer, Malerkotla Division.

of improvement. Tenancy laws, absentee landlordism, scattered holdings, lack of capital for the farmers and lack of co-operation among them might all be mentioned as possible causes for this position, but these exist everywhere and need not be special to the tubewell areas. The Team did however take into account that, part of the present tubewell area was land newly brought under cultivation, and that tubewell irrigation was itself only a few years old in Punjab. Punjab farmers are traditionally keen and hard working and it should not be difficult for them to take to intensive farming in the tubewell areas. The main problem was to tackle the existing difficulties with a view to removing them by a joint attempt by the Agricultural Department and the Engineering Department dealing with tubewell irrigation.

6.8. Demonstration—The Team was informed that the Agricultural Department had carried out a large number of demonstrations in the tubewell irrigated areas, for the benefit of the farmers, but the Team could not see any evidence of it except the large increase in irrigated area under well No. 190. Success in irrigated farming depends upon a suitable cropping pattern combined with intensive cultivation using good seed, enough manures and fertilizers and a judicious use of water. Farmers used to dry farming might not realise the potential which irrigation offered for diversification and shift of enterprise. They need and appreciate helpful advice on crops to be grown, on the preparation of land, time of sowing, rates of seeding, fertilizer requirements and most of all, water application. The change for a farmer from non-irrigation farming to irrigation farming would be a slow process unless the benefits of irrigated farming are effectively demonstrated to him as well as the practices necessary to obtain these benefits.

6.9. In addition to demonstration and technical guidance, the farmer may also require subsidies in the form of loans or direct payment to meet immediate cost of adequate land preparation and water transmission structures. To quote from the Report of the Ford Foundation Team "Money is generally made available directly to Irrigation Department for the construction of irrigation projects. On the other hand, no adequate funds are provided from the large funds spent on minor irrigation projects, for the necessary research, demonstrations and technical assistance required to get maximum benefits from the projects in terms of production", and their recommendation is "Research, Experiments and Demonstrations should be greatly expanded to deal with the proper combination of :

(*a*) water management,
(*b*) fertilizer and green manures,
(*c*) good seeds, and
(*d*) other cultural practices necessary for high production."

6.10. The Team therefore recommends the immediate establishment of demonstration farms in tubewell areas which should have for their objectives :

(*i*) efficient use of water, relating application to crop requirements ;
(*ii*) adoption of all known improved agricultural practices including land preparation and use of efficient implements along with efficient use of water; and
(*iii*) determination of the most suitable cropping patterns out of the available food and cash crops and adjusting the cropped area between *Kharif* and *Rabi* crops in relation to the local conditions.

6.11. For the establishment of the demonstration farms the Team recommends that, using the available information with the agriculture depart-

ment, the tubewell areas may be broadly classified into a few groups on the basis of soil condition and one demonstration farm established for each of the above groups. Where a particular group covers a very extensive area there might be more than one farm for such a group. It is visualized there may be need to have 8 to 10 farms for the whole of the tubewell areas.

6.12. Each of the demonstration farm should cover an area of 25 acres and be located in one of the selected tubewell areas by agreement with the owners of the area. The actual running of the farm will be by the Agriculture Department with the full co-operation of the Department of Irrigation and the Department of Community Development. There should be a suitable subordinate technical staff member of the Agriculture Department in immediate charge of the farm, and the general supervision of the working of all the farms must be entrusted to an officer of the department not lower in rank than that of the District Agricultural Officer. The results of the demonstrations should be discussed periodically among the three co-operating departments and brought to the notice of the farmers in tubewell areas. Occasionally, arrangements should also be made to assemble local farmers in the demonstration farms to show them the valuable results coming out of the demonstrations.

6.13. While the demonstration will itself form one aspect of extension, large scale adoption of the recommended practices by all the farmers would naturally involve additional expenditure on their part towards buying fertilizers, pure seed etc. for which there is provision for obtaining loans. There is, however, one aspect connected with land preparation and use of special or improved implements involving additional investment, and the Team recommends that a suitable loan per acre may be made available to the farmers in the tubewell area towards adopting improved cultural practices recommended by the Agriculture Department.

6.14. Cropping Patterns—With perennials irrigation available under tubewells the intensity of cropping should be very high. It should be quite easy to introduce some catch crops like vegetables, green manure, etc. in addition to the main *Kharif* and *Rabi* crops. In Formosa, for example, three to four crops are raised on the same land in a year by practising interplanting which consists of planting a new crop in between the lines of the standing crop before it is harvested. Even in parts of South India where well irrigation is avilable two to three crops are grown in the year. The only limitation against following such a practice extensively in Punjab might be the severe winter and rather low temperature conditions between December and March as this can limit the choice of crops to those capable of making satisfactory growth when sown in winter.

6.15. The Punjab Agriculture Department has prepared a pamphlet giving crop patterns suitable for the new canal irrigated areas, which are divided into eight zones, of which zones 1 to 3 represent area with perennial irrigation corresponding to tubewell areas. In the patterns which have been drawn for farms of 12.5 acres, the total cropped area amounts to only 7.75 acres, 3.44 acres under *Kharif* and 4.31 acres under *Rabi* crops, and the intensity of cropping is only 124 per cent. The actual area under food crops amounts to only about four acres. It is learnt that farmers actually adopt an intensity of 160 to 170 per cent. An area of 4.75 acres, is apparently fallow which may be partly deliberate and partly due to difficulty of sowing the crops in time. Fallows should be considered inconsistent with intensive cultivation aimed at maximising production. Cotton, though a *Kharif* crop, remains in the land until January when it may be too late to plant a *Rabi* crop. By growing an early maturing cotton it should be possible to follow it with gram or gram-wheat

mixture in the *Rabi* season. Adjustment of the sowing time for the *Kharif* crops could also help in getting them out early and sowing the *Rabi* crop. For example, using irrigation, groundnut can be planted early enough in the *Kharif* to follow it with wheat in the *Rabi* season.

6.16. The cropping patterns suggested by the Agriculture Department as suitable for the tubewell areas do not appear realistic. Out of the total area of 81,763 acres under tubewell irrigation in Malerkotla Division, about 52,000 acres are under *Rabi* cropping and 30,000 acres under *Kharif* cropping. Cotton and wheat are the main crops of the *Kharif* and *Rabi* seasons respectively and occupy 50 per cent of the area in the particular season. The Team is of the opinion that there is scope to increase the area under food crops other than paddy which will be confined only to low areas in the *Kharif* season. Maize, particularly hybrid maize, could be a very profitable crop, and more area could be devoted to it than now. Groundnut is another crop which can be grown more extensively than at present. It can give high yields with limited irrigation, and experience available all over India does indicate that groundnut benefits the cereal following it in the rotation. There is thus scope to change the existing or suggested crop patterns and also add to the list of crops mentioned in the departmental leaflet. Green manures should be considered particularly important for Samrala area. The different crops that may be grown and from which suitable cropping patterns could be derived are given below :

Kharif :	Maize, jowar, cotton, sugarcane, groundnut, sweet potato, tobacco and paddy for low areas only.
Rabi :	Wheat, barley, gram, toria, sarson.
Fodders :	Jowar, maize, oats, turnip, berseem, lucerne, clover, guara.
Vegetable :	Onion, potato, brassicas, chillies.
Green manures :	Guara, san-hemp, dhaincha.

The Team recommends that the Agriculture Department draw a few typical cropping patterns out of the large number of crops including fodders, vegetables and green manures that can allow maximum utilisation both of the land and the water supply in *Kharif* as well as in *Rabi* seasons. The selected patterns considered suitable for particular areas must be adopted in the demonstration farms located there.

6.17. The general rise in water table can limit the crops to be grown to those which can thrive under such conditions. Paddy is the most suitable crop under those conditions, and this is the reason for the large increase in the area devoted to this crop in recent years. Next only to paddy, sugarcane is another crop which can tolerate a high water table. The Team considers that devoting more and more area to paddy may not ultimately prove good to Punjab agriculture. Growing paddy, in the way it is usually done, should limit the area to be cropped in the *kharif* season. Futhermore, paddy growing in the midst of crops which cannot tolerate a high water table could only aggravate the existing situation. The Team recommends that paddy should generally be cut out of the cropping patterns for adoption on tubewell areas, and its cultivation should be confined to areas which already have a high water table as in Karnal.

6.18. The decision on particular crop pattern suitable for particular areas will, to a large extent, depend upon the nature of the soil. The Team therefore recommends that a detailed soil survey and soil classification might be undertaken for the tubewell areas as has been done in the case of areas newly brought under canal irrigation.

6.19. When an ideal cropping pattern suitable for a particular area has been drawn up, and its value also demonstrated, the adoption of the same successfully by all the farmers within a tubewell area will need co-operation and agreement among them to follow a predetermined plan for the use of water. Now that a scheme to organise farms in different parts of the country to carry on experiments on Co-operative Farming is under active consideration, the Team recommends that a few selected tubewell areas of Punjab be utilised for the establishment of Co-operative Farms, all the area commanded by one well constituting a single farm.

6.20. Water Management—Loss of water due to seepage in conveyance has been referred to in earlier chapters. Preparation of the land and the method of applying the water also need study. Some of the methods of applying water include flooding, furrow system, strip system etc. Such studies can lead to economy in the water used or increase production or do both. Where application is only by flooding even after proper levelling of the soil, the field has to be divided into smaller beds, and the optimum size of the bed has to be determined for each crop. For example, in the case of cotton, beds of 1/8 acre in area have given in the best results, and beds of a larger size have proved wasteful in the use of water.(1) Furrow system of irrigation which is very common in South India, particularly where lift water is used for irrigation, is not practised in Punjab as much as it might be. With ordinary flooding, the distribution of water cannot be uniform and the crop yields are also not uniform. Flooding method may also cause excessive leaching in some parts. It can be said without fear of contradiction that one of the contributing factors for phenomenal yields of paddy in Japan is the efficient water management practised there.

6.21. Investigations on methods of water conveyance and its application to fields are important. The Ford Foundation Team have in their Report laid special emphasis on this subject and have even recommended provision of a staff of technicians in soil and water conservation for direct technical assistance to cultivators and groups of cultivators. The tubewell areas of Punjab might prove a suitable centre for initiating action to give effect to this recommendation. Investigations on water conveyance might also include the testing of the utility of large size alkathine pipes in place of unlined irrigation channels.

6.22. Sprinkler Irrigation—One of the members of the Team had an opportunity, to see sugarcane on an area of 2,000 acres being irrigated entirely by overhead spray. Records available indicated that the sugarcane crop was maintained in a healthy condition with much less water than would be necessary with surface irrigation. The Team considers that the utility and economics of sprinkler irrigation for agricultural crops might be investigated in one of the selected tubewells. This could become feasible in a co-operative farm when one is established as recommended earlier. Such an investigation could provide valuable data on the combined use of metal pipes for conveying water and of overhead irrigation.

6.23. Water Requirements of Crops—Knowledge of the amount of water needed to irrigate a certain area of each crop land adequately is important. The quantity of water to be applied will depend upon the crop, as the objective is to get the soil up to a depth corresponding to the root zone of the particular crop. Considerable research has been done in the West, particularly in U.S.A. to arrive at correct water management techniques on the

(1)Monograph on Cotton, Vol II, Indian Central Cotton Committee.

farm, utilizing meteorological data and data from irrigation experiments. We have in India some information on water requirement of crops, mainly from irrigation experiments in the field, and not from simultaneous studies of the physiology of the plant (evapotranspiration). The information on daily water requirements of a particular crop has no reference to the moisture status of the soil. Our knowledge about water management as suited to the requirements of crops grown and the soils in which they are grown must be considered very limited. Even the existing information cannot be properly utilised in ordinary canal irrigation system where time of water application is often determined by the availability of water or some other basis and which may not have relation to the needs of the crop. This limitation, fortunately, does not apply in the case of farming under tubewell irrigation as water is always available, and water application can be timed on the basis of crop needs and moisture content in the soil.

6.24. Every crop has critical periods of growth when application of water is most essential. Even with a water loving plant like paddy, there are two critical periods, and the water supply can be very much reduced at other periods, leading to water economy and even to improved soil fertility. One of the critical phases in paddy, namely the ear-forming stage may also be applicable to wheat and other cereals. In the case of cotton,(2) the most critical stage for water is the peak of the flowering phase when many bolls have formed in the plant, and too much watering in the earlier stages is definitely harmful to the crop. The indiscriminate growing of American cotton under all conditions has already shown that in areas where the subsoil water level has risen up to five feet from the surface, the crop is suffering, and there is a tendency for the farmers to switch over to the growing of *desi* cotton.

6.25. Investigation into Water Requirement—There is great need in the country for critical investigations into water requirements of all principal crops as related to the physiology of the plant, and to the soil in which the crop is grown. The information coming out of such investigations would be of significant importance in water management practices under tubewell irrigation not only for Punjab but also elsewhere. Although tubewell irrigation has been in practice in Uttar Pradesh for a very much longer time than in Punjab, no serious investigations of the type proposed have been carried out. Some aspects of these investigations could also apply to canal irrigated areas. There is no doubt that the results of the investigations could also lead to improvement in cultural and manurial practices as applied to irrigated agriculture. It is possible that some aspects of the proposed investigations are already receiving attention at the Irrigation Research Institute, Amritsar, Punjab. Research on water requirements is also in progress at some centres in States. The information already available should therefore be utilised in drawing up plans for undertaking the investigation in Punjab.

6.26. The Team recommends that investigations on water requirements of crops be undertaken on a co-ordinated plan jointly drawn up by a team of experts consisting of the Soil-Chemist, Plant Physiologist, Agronomist and Irrigation Engineer. The centre of investigation might be located in Ludhiana on an area commanded by tubewell supply. The investigations to be undertaken should cover the following points:

(*i*) water requirements of crop plants as related to the needs of the plant during its different growth phases and with reference to the moisture holding capacity of the soil;

(2)Monograph on Cotton, Vol. II, Indian Central Cotton Committee.

(*ii*) relative efficiency and economics of different methods of applying water to the crop including overhead sprinkler irrigation;

(*iii*) study of water table and changes in soil fertility conditions in relation to different methods of water application; and

(*iv*) special soil cultivation and cultural practices in relation to efficient water conservation and management.

The results of the investigations should be first utilised in the demonstration farms and later passed on to farmers all over the tubewell areas.

RECOMMENDATIONS

State tubewells in the Punjab have mostly been installed under three distinct programmes, namely T.C.A. 1952 Scheme, T.C.A. 1953 Scheme and G.M.F. 1954 Programme. They have, however, not yet got inter-woven into the agricultural economy of the tract. The State authorities too, appear sceptic about their financial soundness, as a State undertaking. An all-out effort towards their development, therefore, does not seem to have been mobilised so far. Leaving the broad policy issue, regarding extension of State tubewells Scheme to the State authorities themselves, the Team limited its study to the existing State tubewells. Suggestions, with a view to maximise the benefits from the existing tubewells to the cultivators as well as to the State, as emerge out of the Team's study, are contained in the recommendations given below:—

I. The period set for development of irrigation on the Punjab tubewells should be changed from five years to three years. (*Para* 1·8)

II. A co-ordinated programme for development of irrigation on tubewells should be scientifically planned on the basis of preparedness. It should then be implemented through the co-operation of concerned departments like Agriculture, Community Development and *Gram Panchayats*. (*Para* 1·10)

III. Construction and operation of private tubewells should be so regulated that they do not interfere with the development of irrigation on State tubewells. (*Para* 1·11)

IV. A full complement of Revenue and Agriculture staff should be provided the activate the process of intensive agriculture on State tubewells. (*Para* 2·5)

V. Repair and service facilities should be suitably expanded for the Punjab State tubewells, to provide for a speedy repairs and maintenance service. (*Para* 2·9)

VI. Charts giving details of tubewell construction and its performance, including history of development, should be displayed in tubewell kiosk. (*Para* 3·7)

VII. A liberal provision of land should be made on State tubewells in the Punjab so as to provide space for stocking of materials etc. (*Para* 3·9)

VIII. Time-lag between completion of different items should be minimised, particularly the construction of water courses. (*Para* 3·12)

IX. An underground spun concrete pipe system at a cost of Rs. 13,000 as against Rs. 8,000 per mile for lined overground system may be given a trial on the Punjab tubewells. On *kachcha* water channels too, proper '*nakkas*' should be provided. Syphonic extraction of water should be introduced and popularised. (*Para* 3·16 & 3.18)

X. State help may be provided to the cultivators for land preparations at cost basis, so as to enable them to derive maximum benefit from tubewell irrigation. (*Para* 3·19)

XI. Tubewell power connections and transmission lines should be so maintained that there is no undue drop of voltage at tubewell end, which impairs the efficiency of the tubewell operation. (*Para* 3·20)

XII. The irrigation targets of tubewells should be based on the irrigating capacity of the tubewells and not on a percentage of geographically fixed culturable commanded area (C.C.A.). (*Para* 3·25)

XIII. Financial returns from tubewells should be worked out including all expenditures thereon, along with depreciation charges so as to reflect a correct picture of tubewell performance financially. A depreciation fund should be started as early as possible. (*Para* 4·3)

XIV. Tubewell and canal rates should be rationalised so as to remove the existing disparity in the general economy of irrigated agriculture in the State. (*Para* 4·6 & 4·7)

XV. Two-part tariff consisting of a fixed charge of Rs. 4 to Rs. 6 per acre on commanded areas and a varying charge according to the volume of water used may be introduced on State tubewells. (*Para* 4·8)

XVI. Energy charges for tubewells should be fixed more or less in line with the actual generating and transmission cost of energy. (*Para* 4·10)

XVII. Where pumping sets are beyond water producing capacity of wells necessary adjustments should be carried out so as to improve their operational efficiency. (*Para* 4·11)

XVIII. A uniform policy should be adopted in all the Divisions in respect of pay and allowances of regular staff. (*Para* 4·13)

XIX. Overlapping of tubewell and canal service should be removed. This, otherwise, will affect the performance of tubewells adversely. (*Para* 4·17)

XX. (*a*) A land utilisation efficiency survey may be carried out in the tract served by Jagadhri Tubewell Project based on comparison of areas under plough as in 1949 and 1959, making due allowance for increase owing to influx of refugee population, if any.

(*b*) Wherever water table has depleted beyond the level of easy exploitation of subsoil water by the cultivators through open wells, pumping from the concerned wells should be reduced so as to let the cultivators have the benefit of doing irrigation from these open wells.

(*c*) A farm produce survey may be arranged to exhibit how far production has increased per acre on account of reduction in waterlogging tendencies in the area served by Jagadhri tubewells. This may be of great help in forecasting the performance of anti-water-logging Schemes in other areas.

(*d*) Tubewells in Jagadhri Project should be run well in time, so as to relieve waterlogged land of extra water before *Rabi* sowings start.

(*e*) Direct irrigation should be allowed from Jagadhri tubewells, wherever there is a demand for such irrigation taking care that excess watering is not allowed.

(*f*) The charges debited for electricity for Jagadhri tubewells by the State Electricity Board should be in line with the rates applied to irrigation tubewells. (*Para* 5·8)

XXI. Demonstration farms with the following objectives should be established in tubewell areas. (*Para* 6·8)

(*i*) Efficient use of water according to the crop requirements;

(*ii*) adoption of all known improved agricultural practices including land preparation and use of improved implements; and

(*iii*) evolving a cropping pattern suited to local conditions and striking a balance between *Kharif* and *Rabi* areas.

XXII. Suitable loans may be given to farmers in tubewell areas to encourage adoption of improved cultural practices recommended by the Agriculture Department. (*Para* 6·13)

XXIII. Co-operative Farming may be organised on a few selected tubewells in the Punjab, the C.C.A. of each tubewell constituting a single unit. (*Para* 6·19)

XXIV. Investigations into the usefulness and economy of sprinkler irrigation should be undertaken, preferably on areas selected for co-operative farming. (*Para* 6·22)

XXV. (*a*) Investigations into water requirements should be undertaken according to a co-ordinated plan jointly drawn up by a team of experts consisting of Soil Chemist, Plant Physiologist, Agronomist and Irrigation Engineer covering the following points:—

(*i*) water requirements of crops during the different stages of their growth bearing in mind the moisture holding capacity of the soil;

(*ii*) relative efficiency of different methods of applying water to the crops, including overhead sprinkler irrigation;

(*iii*) the effect of water table and different methods of irrigation on soil fertility; and

(*iv*) special soil cultivation and cultural practices to help efficient water conservation and management.

(*b*) The centre of investigation may be located in Ludhiana and investigations should be conducted in tubewell areas.

(*c*) The results of investigations should be utilized first in demonstration farms and later passed on to farmers in all tubewell areas. (*Para* 6·23 *to* 6·26)

TERMS OF REFERENCE OF THE MINOR IRRIGATION TEAM

(*Vide COPP Memorandum No. COPP*(4)/17/58, *dated August* 4, 1958)

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

(*a*) Works which are now being constructed.
(*b*) Works already in existence.

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*) Methods 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*) Costs 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.

APPENDICES

I. The Northern India Canal and Drainage (Amendment) Act, 1958. **(2·11)**

II. Abstract of break-up of cost of a tubewell. **(3·1 and 4·2)**

III. Details and specifications for tubewell construction as extracted from one of the contract documents of the Punjab Govt. **(3·5)**

IV. Statement showing results of case studies of seven tubewells. **(3·14 and 3·23)**

V. Statement showing yearly progress of construction of *kachcha* and lined water courses on Punjab State tubewells. **(3·15)**

VI. (a) An abstract of estimate of cost for one mile pipe water course **(3·16)**

(b) An analysis of the cost of the under ground pipe line laid out on Taluka Seed Farm Jagudan, Dist. Mehsana (Gujrat State). **(3.16.)**

VII. The Punjab State Tubewell Act, 1954. **(3·22)**

VIII. Statement showing area-wise performance of tubewells of more than three years standing (Developed) in 1959-60. **(4·4)**

IX. Financial-*cum*-operational schedule of performance of a State tubewell with assessment @ 2 as. per unit of energy consumed by occupier of holding. **(4·5)**

X. G.Os. of the Punjab Government fixing and reducing rates on consumption of energy of tubewells. **(4·5)**

XI. Financial-*cum*-operational schedule of performance of a tubewell with assessment @ 2½ as. per unit of energy consumed by occupier of holding. **(4·5)**

XII. Division-wise performance of energised tubewells in the Punjab. **(Para 4·12)**

XIII. Tubewell-wise area or actual land area irrigated in first watering—Abdullapur Raduar Scheme.. **(4·14 and 4·15)**

XIV. Tubewell-wise area or actual land area irrigated in first watering—Panipat Munak Scheme. **(4·14 and 4.15)**

XV. Observations of spring level on a line across Reach V-A. **(5·6 and 5·7)**

XVI. Proceedings of a discussion held at Chandigarh on 14th June, 1961.

XVII. Summary record of a meeting held in Yojana Bhavan on 6th December, 1961.


सत्यमेव जयते

The Northern India Canal and Drainage (Amendment) Act, 1958.

(SEAL)

Punjab Government Gazette Extraordinary Published by Authority
Chandigarh, Thursday, July 10, 1958.
(*Asadha* 19, 1880 *Saka*)

LEGISLATIVE DEPARTMENT
NOTIFICATION

(*The* 10*th July*, 1958)

No. 26-Leg/59—The following Act of the Legislature of the State of Punjab received the assent of the President on the 3rd July, 1958, and is hereby published for general information:—

PUNJAB ACT NO. 21 OF 1958

The Northern India Canal and Drainage (Amendment) Act, 1958.

AN

ACT

To provide for construction, alteration and realignment of water-courses in the State of Punjab and for certain ancillary matters be it enacted by the Legislature of the State of Punjab in the Ninth year of the Republic of India as follows:—

Short title

1. This Act may be called the Northern India Canal and Drainage (Amendment) Act, 1958.

Amendment of Section 3 of Act VIII of 1873

In clause (1) of section 3 of Part I, of the Northern India Canal and Drainage Act (hereinafter referred to as the "Principal Act").

(*i*) The following shall added after clause (*d*):—

"(*e*) a field drain for purposes of section 70 of this Act"

(*ii*) After sub-section (8), the following sub-sections shall be added, namely:—

(9) "Shareholder" means a person who is interested in the land which is irrigated or likely to be irrigated by canal and also includes a person who is interested in a field drain.

(10) "Field drain" includes drains, escape channels and other similar works formed or maintained by landowners themselves.

(11) "Culturable commanded area" means that portion of the culturable irrigable area which is commanded by flow irrigation from an irrigation channel or outlet.

3. In Part III of the Principal Act, pertaining to "Construction and Maintenance of Works", the following sections shall be inserted after section 30, namely:—

30 (1) Notwithstanding anything contained to the contrary in this Act and subject to the rules prescribed by the State Government in this behalf,

the Divisional Canal Officer may, on his own motion on the application of a shareholder, prepare a draft scheme to provide for all or any of the matters, namely:—

(*a*) The construction, alteration, extension and alignment of any water-course or realignment of any existing water-course,

(*b*) Reallotment of areas served by one water-course to another,

(*c*) The lining of any water-course,

(*d*) Any other matter which is necessary for the proper maintenance and distribution of supply of water from a watercourse.

(2) Every scheme prepared under sub-section (*i*) shall, amongst other matters, set out the estimated cost thereof, the alignment of the proposed water-course of realignment of the existing water-course as the case may be, the site of the outlet, the particulars of the shareholders to be benefited and other persons who may be affected thereby, and a sketch plan of the area proposed to be covered by the Scheme.

30-B (1) Every scheme shall, as soon as may be, after its preparation be published in such form and manner as may be prescribed by rules made in this behalf inviting objections and suggestions with respect thereof within 30 days of the publications.

(2) After considering all objections and suggestions that may have been received by the Divisional Canal Officer, the Divisional Canal Officer shall submit the scheme with such amendments as he considers necessary together with his remarks on the objections and suggestions received by him to the Superintending Canal Officer for his approval.

(3) The Superintending Canal Officer may direct the Divisional Canal Officer to furnish such information as he may require for the purpose of approving the scheme submitted to him under this section.

(4) The scheme submitted by the Divisional Canal Officer may be approved by the Superintending Canal Officer either as it was submitted to him by the Divisional Officer or in such modified form as he may consider fit.

30-C. The Divisional Canal Officer shall, as soon as may be, after the approval of the Superintending Canal Officer, publish the particulars of the scheme and call upon the shareholders to implement it at their own cost within the period to be specified and in the manner prescribed.

30-D(1) The Divisional Canal Officer may, either of his own motion or on the application of a shareholder, publish in the manner prescribed a notice of his intention to acquire any land for implementation of the scheme.

(2) Any person interested in the land notified under sub-section (1) may, within fifteen days from the publication thereof apply to the Divisional Canal Officer by petition stating his objections to the proposed acquisition of his rights.

(3) After considering the objections, the Divisional Canal Officer may proceed to take the occupation of the land so retired on behalf of the shareholders.

(4) Compensation, to be fixed by the Divisional Canal Officer on the principles set out under section 23 of the land Acquisition Act, 1894 shall be payable by the shareholders in proportion to the culturable commanded area under the scheme held by each one of them to the owner or occupier of any

land for such acquisition and on failure of payment, the amount shall be recoverable as arrears of land revenue.

(5) A person aggrieved from the order of the Divisional Canal Officer in respect of compensation may prefer an appeal within thirty days of the passing of the order to the Collector whose decision shall be final.

30-E. On failure of any shareholder to execute the work within the period specified in the notice under section 30-C the Divisional Canal Officer may proceed to carry out the work himself and the cost in proportion to the culturable commanded area under the scheme held by them shall be recoverable from the shareholders as arrears of land revenue.

30-F. On execution of the scheme, the Divisional Canal Officer shall, by requisition in writing, direct the shareholders to take over and maintain the water-course and on failure of the shareholders to comply with this direction, he shall make arrangements for maintenance of the water-course at the shareholders cost in proportion to the culturable commanded area under the scheme held by them and the same shall be recoverable as arrears of land revenue.

30-G. Notwithstanding anything contained in this Act or any other Law for the time being in force, no Civil Court shall have jurisdiction to entertain or decide any question relating to matters falling under section 30A to 30F.

Amendment of Section 57 of Act VIII of 1873

4. In part VII of the Principal Act pertaining to "Drainage" the following section shall be added after section 57, namely:—

"57-A The provisions contained in sections 30A to 30G shall apply to Field Drains as well."

APPENDIX II

Abstract of Break-up of Cost of a Tubewell

Particulars	One Tubewell by the Firm (Rs.)	One Tubewell by the Department (Rs.)
1. DIRECT CHARGES		
A. Preliminaries	150	150
K. Buildings	2,310	2,310
V. Water courses		
(*i*) L. Earthwork	9,450	9,450
(*ii*) F. Drainage Crossings	210	210
(*iii*) G. Bridges	840	840
T. Tubewells	35,988	22,725
Special T & P	2,016	13,520
I—Works ..	50,964	49,205
P. Maintenance	510	492
Losses of stock	50	50
II. Establishment	3,220	3,220
III. T & P	765	738
Receipt on Capital account salvaged value	—1,835	—9,260
Total direct charges ..	53,674	44,446
2. INDIRECT CHARGES—		
(*i*) Audit at 1% on I-Work—B-Land	510	492
(*ii*) Capitalized as abatement of land revenue	—	—
Total indirect charges ..	510	492
Total direct and indirect charges	54,184	44,938
Electrification charges	18,000	18,000
Grand Total ..	72,184	62,937

Abstract from estimate for 355 tubewells in Delhi Division, under T.C.A. Programme of 1952.

Details and Specification for Tubewell Construction

Extracted from Tubewell contract of the Government of Punjab

The work at each tubewell will comprise of:—

(1) Drilling to include boring the well, taking the well log and installing the casing complete with slotted pipes, gravel packing and the extraction of drill pipes wherever used.

(2) Developing with the object of bringing the well into production of a safe yield of 1·5 cusecs of water at 15 ft. net depression.

(3) Equipment installation, foundation construction, setting the pump and motor, supplying its starting switch gear and conducting tests.

(4) Supplying 15 KVA transformer to the Government which will arrange to install the transformer and lay the cable from the LT bushings of the transformer to the starting switch gear.

Drilling

Each well shall be constructed by the hydraulic rotary method and the drilling diameter shall be 27 inches. Drilling will normally be done to 300 feet depth and in case more or less drilling is required, adjusted rates will be paid as specified in *Appendix 'B'*.

A careful and accurate record of strata encountered and also actual sample of the same shall be maintained at the site of well during the period of its construction and submitted to the Government when the well is handed over. Records shall be completed on the standard tubewell form required by and provided by the Government and shall show:

(*a*) Spring level below ground level.

(*b*) Morning and evening levels in each stratum with date of observation and daily progress of boring. Alternate data satisfactorily furnishing the water yielding capability of each stratum will be accepted wherever all these observations are not possible.

(*c*) The strata encountered.

(*d*) The aquifers opposite which it is proposed to place slotted pipes, also positions of joints on blind and slotted pipes should be shown in prescribed tubewell forms. Samples of each aquifer along with sieve analysis chart shall be submitted to the Government for approval of the design of the tubewell before the tube is installed in the presence of representative of the Government.

(*e*) Samples of stratum taken at every 10 ft. or oftener if the strata change, shall be carefully preserved at site in a sample box of design to be specified by the Government and shall be available for inspection by the Government or its representative together with the strata chart. Improved methods of logging and latest technique of formation sampling shall be adopted. If necessary the Government

will arrange for electrical loggers at their cost. Pilot borings upto a maximum depth of 400 ft. not exceeding 10 per cent of the total number of wells under this contract and to be designated as such by the Government will be done by the contractors at their own cost for collecting and examining strata samples in advance of the regular tubewell drilling hereunder. If any pilot boring after completion is selected by the Government for conversion to a production tubewell it shall be considered a tubewell within the total number contracted for and to which all contract terms and specifications shall apply.

Approval in writing of the Government to the design of the tubewell shall be obtained before installation. The Government will arrange for this approval promptly.

Installation

This will consist of:—

(*a*) 12-inch housing pipe and 6-inch plain and slotted pipes as described in this paragraph.

(*b*) Pump and electrical equipment described hereafter.

The 6″ internal diameter tube shall have a bail plug at the bottom of slotted pipe, screwed and socketed to plain pipes. The 6″ tube thus made up will be inserted to the 12″ housing pipe. The bottom of the housing pipe, which should be 80 ft. in length, should preferably be in a firm strata. Additional length of housing pipe if requested by the Government shall be paid for as provided in Appendix 'B'.

The housing pipe shall have to be placed vertical and a tolerance of not more than half an inch in 60 ft. will be accepted for any deviation from the plumb. The clamp fixed on the housing will be embedded in the foundation concrete of the pump set. The 6″ and 12″ pipes shall be connected with a grouted overlap of at least 8 ft. or other acceptable connection. The bail plug shall consist of the lower 6 to 8 ft. of blind tube with the bottom plugged or capped. The cap shall be fitted with an iron U-hook at least 4 ft. long or $\frac{3}{4}$″ to $\frac{7}{8}$″ diameter mild steel rod suitably fastened to the bottom of the bail plug cap. The tube shall finally rest on clay bottom or landing of rammed gravel having a thickness of 6 ft.

All tubes both blind and slotted shall be either seamless on electrically or gas welded conforming to American or British Standard Pipe Specifications or equivalent acceptable specifications. All joints shall be screwed and socketed. Any alternative method of jointing may be adopted by mutual agreement. The weight of the 6″ inside diameter pipe will not be less than 15 lbs. per ft. and all sockets will conform with British or American Standard Pipe Specifications or equivalent acceptable specifications. The housing pipe shall have an inside diameter of 12″ weigh not less than 41·5 lbs. per ft. all sockets conforming to British or American Standard Pipe Specifications or equivalent acceptable specifications.

The 6″ tube shall be centred in the drilled hole by means of steel spiders at reasonable intervals on the blind pipe 100 feet of 6″ dia. pipes with lineal slots of suitable size to give an open area of not less than 10 to 18% per lineal foot of pipe surface as prescribed by Government will be used. The slotted pipes may be used in any lengths required by the water bearing strata but no piece shall be less than 5 ft. in length. The slots should have been milled and

not punched previously. No slotting with oxy-acetylene flame nor perforation after the liner has been placed will be accepted.

Gravel Filter

The gravel filter shall be placed by suitable gravelling method to be approved by the Government, the placing of the gravel in the annular space between the well pipe and the drilled hole, shall start at the bottom of the well and extend upward to ground level. All gravel shall consist of hard well rounded particles suitably graded and shall be of size determined after sieve analysis of the strata sample and approved by the Government. Where gravel packing is done in a hole drilled by the hydraulic rotary method a flushing with clear water of any mud must be arranged. The construction of the gravel filter once started will be continuous operation until it is finished.

Development

Each aquifer opposite which slotted pipes are placed shall be developed either by surging, including washing and agitation, or by pumping and backwashing with or without an air lift. This development process shall be continued, until the stabilisation of sand and gravel pack is completely assured. The final discharge (at 20 ft. net depression) that is obtained at the well should be free from sand at the operational test run, with a tolerance upto ten parts of sand by volume in one million parts of water in a water sample collected after an hour of continuous run. The analysis of sand contents will be carried out only in case of difference of opinion and will be at Government cost. The contractor shall overdevelop to the extent of 20% in excess of the actual discharge at 20 ft. depression but in any event to a *net* depression of 25 ft.

Measurement of Discharge

The discharge during development shall be measured at minimum intervals of four hours over a V-notch weir (or by other suitable method that may be accepted) and a record kept as previously provided. Sand pumped during development shall be measured or the volume estimated for comparison with the total volume of gravel added during development. This observation will be continued till no further feeding of gravel is found necessary and the discharge is free of sand within the requirements of specifications.

Pump and Electrical Equipment

After the well has yielded a sand free discharge of a satisfactory foundation block of a design approved by the Government shall be laid for the pumping set. The pump bowl shall be of diameter not more than $9\frac{5}{8}$". The pump bowl should be free from the sides of the housing pipe and minimum annular clearance of $\frac{3}{4}$" should be provided all round the pump bowl. The number of stages and setting of the pump should be based on the hydraulic data obtained during the final stages of development. The pump should further meet with the standard practices adopted for an automatic feed oil lubricated type pump. The water column shall be of standard steel pipe in lengths of 8 to 10 ft. with flanged for screwed connections. The internal diameter of the water column pipe shall be not less than 6 inches. Guides or spiders shall be installed at predetermined distance in the water column.

The oil line enclosing the line shaft shall be of extra heavy steel pipe of diameter recognised by the pump manufacturers as standard in relation to the diameter of the pipe. A positive seal shall be provided upon the main bearing to prevent the entrance of water, sand or other foreign materials into

the oil line. In addition a collar should be provided at the bottom and of the pump shaft and above the outlet case bearing.

Supplying 15 KVA Transformers

The transformers will be oil natural-cooled step down transformers, 3 phase, 50 cycles, rating 15 KVA, for no load/voltage ratio 11,000/440V. provided with externally operated tapping switch on H.T. side capable of 5 and + 10% voltage adjustment. The winding should be delta star connected in accordance with vector group 41 Dy 11.

The transformer should be designed and manufactured in accordance with British Standard specifications 171/1936 except that the temperature rise should not exceed 45°C. by resistance of windings and 35°C. as measured by thermometer in oil after continuous run at full rating over in ambient temperature of 50°C.

Care should be taken in the design and manufacture of transformers to take account of tropical conditions, such as high temperatures, excessive humidity, dust and salt laden atmosphere etc.

The transformer should be contained in an outdoor pole mounted type tank provided with the following fittings:—

3 H.T. Porcelain Bushings with arcing horns.
L.T. Weatherproof Link Box of approved design.
L.T. cable box of approved design.
Portable type oil gauge.
Lifting lugs.
Angles for platform mounting.
Rating and diagram plate of brass.
Earthing terminals.
Drain Plug (Taper Seat Type).
Thermometer pocket.
Breather.

The transformer will be delivered dried and oil filled at Governmental store.

Schedule of Price Variation

The basic price for each standard tubewell of 300 ft. depth constructed and fully equipped as specified in Appendix 'A' will be lump sum price of Rs. 26,100 per well. For individual variations in the depth of drilling and other jobs of supply and installation the following schedule of price variations will hold good:—

(1) For variations in depth greater than 300 ft. below ground level a price of Rs. 25 per ft. for drilling and Rs. 10 per ft. for liner will be added including the cost of the liner and any necessary extraction of drill pipe wherever used. This price will be up to maximum of 500 ft.

(2) For variations in depth less than 300 ft. below ground level a rebate of Rs. 20 per ft. will be made subject to a minimum charge as would be applicable to a well of 150 ft. depth. This rate is inclusive of the length of the liner.

(3) Abandonment of tubewells during construction.

In any case where a tubewell construction shall be abandoned before completion and unless such abandonment has been caused by the

negligence of the contractors, then the contractors shall be paid on the following basis for all such abandoned tubewells :

	Rs.
(*a*) Abandonment during drilling per lineal ft. drilled with a minimum charge as per 150 ft. depth.	22
(*b*) Abandonment during development per lineal ft.	28
(*c*) 6″ Steel cable pipe (where irrecoverable) per lineal ft.	10

(4) For slotted pipe in excess of 10 ft. *add* Rs. 4 per ft. used.

(5) For increase in total lift for pumping greater than 50/65 feet requiring one or more additional stages a price of Rs. 500 per additional stage.

This will be exclusive of any additional water column etc. that is required in consequence.

(6) Change in set of impellers beyond 50 ft. for working up 65 ft. head Rs. 270 per set.

(7) For increase in total lift pumping requiring the pump to be set lower into the well, for each 8-10 ft. length of column assembly including column pipe, shafting, oil tubing bearings complete, a price of Rs. 400 per 8-10 ft. column assembly. For each 4-5 ft. length of column assembly including column pipe and shaft Rs. 250 per 4-5 ft. of column assembly complete.

(8) For electric motor of larger H.P. if required the increase being to 15 instead of $12\frac{1}{2}$ H.P. .. .. *add.* Rs. 110 per well

(9) For electric motor of larger 20 H.P. instead of 15 H.P. .. .. *add* Rs. 400 per well

(10) Supply 25 KVA transformer instead of 15 KVA transformer .. .. *add* Rs. 250 per well

(11) For using 12″ housing pipe less than 80 ft. .. .. *Substract* Rs. 25 per ft.

(12) For using 12″ housing pipe more than 80 ft. *add* Rs. 25 per ft.

The line shaft shall be of ground carbon or Tata Mild Steel and the diameter shall be such as to provide a factor of safety in transmitting the required horse power at the operating speed of the pump. The bearings for supporting the line shaft and which serve as coupling for the oil line, shall be of the best grade gearing-bronze installed at intervals of 4 to 5 ft. Grooves shall be provided in each bearing to transmit the lubricant.

The impeller shaft shall be of stainless steel with a diameter equal to or the next standard size greater than the diameter of the line shaft.

The impeller shall be of the enclosed type made of hard bronze securely fastened to the impeller shaft.

The bowls shall be of close grained cast iron equipped with replaceable wearing ring which shall be made of hard bronze to prevent the abrasive action sand on the bowl. The pump bowls shall have flanged ends for coupling with

each other. The suction pipe shall be standard steel pipe having a minimum length of 5 ft. and a diameter equal to the diameter of the suction nozzle of the pump.

An airline of galvanised or solid drawn iron $\frac{1}{4}$" in diameter shall be installed in the pump and shall be complete with air pump, fittings and guage so as to record the water levels in the well.

The pump will be coupled with a 12$\frac{1}{2}$ H.P. verticle hollow spindle or flexible coupled drip proof, 3 phase, 50 cycles, 400/440 squirrel volts cage induction motor with a speed of 1440 R.P.M. A device to protect the pump against reverse rotation shall be incorporated. The motor would be rated in accordance with BSS 168/1936 and shall be safe for use in a maximum ambient temperature of 50° C. at an altitude not exceeding 3,300 ft. above sea level in humid tropical climate. The pump discharge will be conducted through a 6" sluice valve and the necessary length (18-22 ft.) of 6" pipe to the V-notch chamber. The pump set will be capable of lifting 1·5 cusecs over a total head of 50 ft. with a guaranted overall wire to a water efficiency of 65%. All rotating parts of the pump as installed shall be in dynamic and static balance.

After the installation of the pump set and the testing, the pump house construction will be undertaken by the Government. The starting switch gear along with the approved conduit wiring to the motor terminal and the meter will be handed over at the time of the test by the contractors to the Governments' representative at the tubewell site.

The starting switch gear for the pump set shall comprise of an air break star/delta starter of robust construction suitable for a 12·5 to 15 H.P. induction motor fitted with magnetic type overload releases with time lag settings, no-volt release and a single phasing preventor. In addition an ammeter and an oil circuit-breaker complete with overload short circuit and no-volt releases with a range of 40 amperes will be supplied. The starting switch gear will also include a disconnecting switch which will be so interlocked that motor cannot be restarted unless the starter handle is brought back to neutral position by the operator.

Testing

An operating test will be carried out by the contractors with their own mobile generating plant in case no other source of electricity is available at the well site. This test will be continued for 6 hours at the expense of the contractors. Before acceptance of the well the Government may at its cost carry out a final test up to 72 hours of continuous pumping.

Showing result of case studies of Seven Tubewells

S.No	District	Tehsil	Village	T.W. No.	Horse Power of pumping set	Particulars of field investigations				Distance of field from tubewell			Energy consumed in first watering (units)	Energy consumed per acre (units)	Assessment per acre @ 2 as. per unit of consumption	Remarks
						Name of Village	Name of cultivator	Area (acres)	Name of crop grown	Lined (feet)	Unlined (feet)	Total (feet)				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1.	Patiala	Rajpura	Bhadak	7	20	Bhadak	Sh. Rounki	4.00	Wheat	—	—	—	120	30.0	3.75	
2.	Do.	Do.	Do.	Do.	Do.	Do.	Sh. Jarnail Singh	4.00	Do.	4,500	—	4,500	150	37.5	4.69	
3.	Do.	Do.	Do.	Do.	Do.	Do.	Sh. Avtar Singh	10.00	Do.	4,500	1,350	5,850	400	40.0	5.00	
4.	Do.	Do.	Ghazipur	10	Do.	Subad-kheri	Sh. Pooran Singh	4.00	Do.	—	—	—	250	62.5	7.81	Discharge of this tubewell has reduced to almost half of the normal discharge
5.	Do.	Do.	Do.	Do.	Do.	Do.	Sh. Hans Raj	5.00	Do.	3,200		3,200	345	69.0	8.62	
6.	Do.	Do.	Do.	Do.	Do.	Ghazipur	Sh. Sharan Singh	1.00	Do.	3,300	1,440	4,740	80	80·0	10.00	
7.	Ludhiana	Samrala	Kalaran	85	Do.	Kalaran	Sh. Gurbaksh Singh	.73	Do.	—	—	—	25	34.2	4.28	
8.	Do.	Do.	Do.	Do.	Do.	Ballam	Sh. Prem Singh	2.71	Do.	4,974	—	4,974	104	38.4	4.80	
9.	Do.	Do.	Do.	Do.	Do.	Ballam	Sh. Mangat Singh	1·0	Do.	4'962	2,700	7,662	44	44·0	5 50	
10.	Do.	Do.	Kanzla	86	12½	Kalaran	Sh. Ujagar Singh	.73	Do.	—	—	—	15	20.8	2.60	
11.	Do.	Do.	Do.	Do.	Do.	Rampur Mehrauli	Smt. Poorni	1.04	Do.	4,956	—	4,956	25	24.0	3.00	
12.	Do.	Do.	Do.	Do.	Do.	Do.	Sh. Jagat Singh	2.08	Do.	4,956	2,400	7,356	55	26.4	3.30	
13.	Do.	Do.	Moranda	93	20	Moranda	Sh. Hazoora Singh	.83	Do.	—	—	—	28	33.7	4.21	
14.	Do.	Do.	Do.	Do.	Do.	Dholam-majra	Sh. Niranjan Singh	4.16	Do.	5,832	—	5,832	150	36.1	4.51	
15.	Do.	Do.	Do.	Do.	Do.	Do.	Sh. Labh Singh	2.08	Do.	5,832	3,000	8,832	90	43.3	5.41	
16.	Karnal	Panipat	Jorasi-khalsa	84	12½	Jorasi-khalsa	Sh. Zilla Singh	1.00	Do.	150	150	300	18	18.0	2.25	
17.	Do.	Do.	Do.	Do.	Do.	Do.	Sh. Chitta Singh	0.40	Do.	4,000	—	4,000	8.2	20.5	2.56	
18.	Do.	Do.	Karans	89	15	Karnas	Sh. Daya Nand	2.00	Sugarcane	60	—	60	60	30.0	3.75	
19.	Do.	Do.	Do.	Do.	Do.	Do.	Sh. Maha Singh	3.00	Do.	3,500	—	3,500	108	36.0	4.50	

APPENDIX V

Statement Showing Yearly Progress of Construction of Kachcha and Lined water Courses on Punjab State Tubewells.

Year	Total No. of Tube-wells energised	Length of water-courses constructed upto end of the previous year in miles			Length of watercourses constructed during the year in miles			Total length of water-courses constructed in miles			Average length per tubewell in miles			Remarks
		Kachcha	Lined	Total	*Kachcha*	Lined	Total	*Kachcha*	Lined	Total	*Kachcha*	Lined	Total	
1956-57 ..	857	Not available.			—			—			—			
1957-58 ..	971													
1958-59 ..	1,215	Upto 5/58 697	453	1,150	(—)100	233	133	597	686	1,283	0·50	0·56	1·06	
1959-60 ..	1,225	597	686	1,283	(—)23	64	41	574	750	1,324	0·47	0·62	1·09	
1960-61 ..	1,228	574	750	1,324	—	—	—	574	750	1,324	0·47	0·61	1·08	

minus (—) figures denote *Kachcha* watercourse subsequently lined.

APPENDIX VI(a)

An abstract of estimate of cost for one mile of pipe water-course

			Rs. nP.
(i) *Manufacturing* 50 *pipes and collars or* 400 *Rft.* :—1 : 2·25 : 2·25			
(*a*) 1. Cement bags within one mile carriage	30 nos.	Rs. 7·06 each	211·80
2. Shingle with one mile carriage ..	83 cft. @	Rs. 85·00%cft.	70·55
3. Haldwani Sand within one mile carriage	50 cft. @	Rs. 45·00%cft.	22·50
4. Ramganga Sand	33 cft. @	Rs. 25·00% cft.	8·30
5. Asphalt in mould joints etc. ..	L.S.		8·00
			321·15
For 51 *Collars*			
(*b*) 1. Cement bags with 1 mile carriage	3 nos. @	Rs. 7·06	21·18
2. Shingle with 1 mile carriage ..	8 cft. @	Rs. 85·00% cft.	6·80
3. Haldwani Sand with 1 mile carriage	5 cft. @	Rs. 45·00%cft.	2·25
4. Ramganga Sand	3·3 cft. @.	Rs. 25·00%cft.	0·85
5. Asphalt in mould joints etc. ..	L.S.		5·00
			36·08
(*c*) Contractor's profit on items (a) 4, 5 and (b) 4 & 5	22·15 %@	10·00%	2·20
			359·43
		Or say Rs.	359·00 only.
(*ii*) *Plant, carriage, erection, dismantling, repairs and depreciation*	1 Job.	Rs. 50·00	50·00
(*iii*) *Labour*			
1. Beldars for erecting materials ..	2 Nos. @	Rs. 1·75 each	3·5
2. Beldars for collecting materials ..	2 Nos. @	Rs. 1·75 each	3·5
3. Beldars for fixing materials	2 Nos. @	Rs. 1·75 each	3·5
4. Beldars for opening pipe drums ..	4 Nos. @	Rs. 1·75 each	7·0
5. Beldars for opening pipe mould to machine	2 Nos. @	Rs. 1·75 each	3·5
6. Beldars for putting pipes in tanks ..	4 Nos. @	Rs. 1·75 each	7·0
7. Beldars for cleaning moulds	2 Nos. @	Rs. 1·75 each	3·5
8. Beldars for Blacksmith	2 Nos. @	Rs. 4·00 each	8·00
9. Black smith for making threads ..	2 Nos. @	Rs. 4·00 each	8·00
10. Moulding mistries	2 Nos. @	Rs. 4·00 each	8·00
11. Beldars for taking pipe etc.	4 Nos. @	Rs. 1·75 each	7·00
12. Oil, grease and other contingencies ..	L.S.		20·00
13. Energy per day	8 units @	Rs. 0·10 per unit.	0·80
14. Supervising mistri	1 No. @	Rs. 4·00 each	4·00
15. Cost of water for tank		—	20·00
16. Testing of pipes		—	10.00
17. Contractor's profit on Rs. 117·00 10%		—	11·00
			129·00

(iv) *Laying of* 400 *ft. of pipe-line*

1.	Cement bags with 15 miles carriage ..	4 Nos.	@ Rs. 7·94 each	31·76
2.	Sand	20 cft.	@Rs. 25·00% cft.	5·00
3.	Asphalt drum	1/13 Nos.	@Rs. 250·0 each	19·20
4.	Jute bags	10 Nos.	@ Rs. 1·5 each	15·00
5.	Coal of heating	L. S.		5·00
6.	1 : 4 : 8 blocks 4M × 4M × 4M at every 4 ft. (2 under each pipe) 100 Nos. ..		—	10·00
				85·96
			Or say Rs. ..	86·00 only..

(v) *Labour*

1.	Beldars for cleaning trench	2 Nos.	@ Rs. 1·50 each	3·00
2.	Beldars for taking pipe	2 Nos.	@ Rs. 1·50 each	3·00
3.	Beldars for lowering pipe	2 Nos.	@ Rs. 1·50 each	3·00
4.	Beldar for cleaning trench	1 Nos.	@Rs. 1·50 each	1·50
5.	Beldars for boiling asphalt jute ..	2 Nos.	@ Rs. 1·50 each	3·00
6.	Beldars for putting asphalt jute ..	2 Nos.	@Rs. 1·50 each	3·00
7.	Mason for linking	2 Nos.	@ Rs. 4·00 each	8·00
8.	Mason	4 Nos.	@ Rs. 4·00 each	16·00
9.	Contractor's profit on item 2 to 6, in (iv) and 1 to 8(b) 94·00 @ 10·00% ..		—	9· 40
				49·90
			Or say Rs.	50·00 only.

Complete Cost of 1 *mile pipe-line*

1.	Manufacturing 5,280 rft. of pipe with collars at Rs. 359 per 400 ft. as item (i)	—	4,738·80
2.	Plant as per item (ii) 5,280 @Rs. 50·00 per 400 rft.	—	660·00
3.	Labour as per item (iii) 5,280 @ Rs. 129·00 per 400 cft.	—	1,702·80
4.	Carriage 15 miles average 5,280 rft. @Rs. 0·25 n.P. per pipe per mile ..	—	2,475·00
5.	Laying pipes as per item (iv) and (v) 5,280 rft. @ R.s 136·00 per 400 rft. ..	—	1,795·00
6.	Breaking on item 1 to 5 @ 5% on Rs.11,372	—	568·00
7.	Earth work 16 sft. sectionX5,280 rft. in digging and filling 84,480 cft. @Rs. 16·00% cft.	—	1,352·00
			13,291·60
		Or say Rs.	13,300·00 per mile.

An analysis of the cost of the underground irrigation pipe-line laid out on Taluk Seed Farm Jagudan, Dist. Mehsana (Gujarat).

The underground pipe-line, having total length of 1,560 feet has been laid out on the Taluk Seed Farm Jagudan to bring the entire area of the farm, which is 36 acres, under irrigation under the command of the main well, situated in the central Block and, which is low-lying area. The details regarding break-up of cost item-wise and materials used are given as under:—

(1) Each piece of pipe-line is of 3 ft. in length, and 9″ in diameter. The thickness of the pipe is 1″. For laying out 1,560 ft. pipe-line, in all 540 pieces of 9″ diameter pipe have been prepared, while laying out the pipe, the distance between two Kundies, provided for taking out water for irrigation in different areas, is 300 ft. wherever, Kundies were not required at a distance of 300 ft. for outlet of water the same are not provided, but to reduce pressure of air in the pipe, syphon is provided at a distance of 300 ft. of the pipe-lines.

(2) In laying out 1,560 ft. pipe-line, the following numbers of Kundies have been provided for controlling irrigation waters. One main Kundi of bricks on the well to take water directly from the pump. Four R.C.C. Kundies of 3 ft. diameter have been provided at the required distances. The size of these Kundies is 3 ft. diameter, having thickness of wall 3 inches, height depending upon the level.

(3) The details regarding the materials required for preparing pipe-line and R.C.C. Kundies are as under:-

(*1*) *Pipe-Line.*

For preparing 10 pieces of 3 ft. size pipe-line, the following materials will be required.

One bag of cement.

10 Ghamellas of small size *kankar.*

10-11 Ghamellas of sand, depending upon the size of *kankar.*

(*2*) *For preparing R.C.C. Kundies of 3 ft. diameter.*

The materials required for one Ring (*i.e.*, Mould, locally known as Farm), of 3 ft. diameter 3 ft. height with 3″ thickness will be as under.

One bag of cement.

20 Ghamellas of medium size *kankar.*

12 Ghamellas of sand.

The material required for the preparation of Kundies and pipe-line was supplied by us and a contract for preparation of pipe-line, and for joining the pieces of pipe-line, was given to skilled labour and the rate was Re. 0-9-10 (0·56 nP.) per piece.

The break-up of the total cost is as under:-

	Rs.nP.
(A) *Cost for preparation of* 540 *pieces of pipe-line;*	
(*i*) Cement bags.54	357·00
(*ii*) *Kankar*—225 B. Mds. *i.e.* about 3 brasses. Rate per 50 B. Mds.Rs.30/-	135·00
(*iii*) Sand and 3 brass	50·00
(*iv*) Labour charges of preparation of pieces 540 of pipe-line @ Re. 0·56 per piece .. .. (This includes the labour for laying out pipe in the ground & fixing the same. Pipe-moulds are also to be brought by the contractor.)	302·40
(*v*) Labour for supplying material and sprinkling water on the pipe-pieces. 40 labourers @ Rs. 1·50 each	60·00
	904·40
(B) *Cost of preparation of* 4 *R.C.C. Kundies*	
(*i*) Cement—8 bags	54·00
(*ii*) *Kankar*—75 Mds. about one brass @ Rs.30/- per 50 B. Mds.	45·00
(*iii*) Sand 3/4 brass @ Rs. 17·00 brass	12·50
(*iv*) Labour charges of contractor for filling 8 moulds in all 4 Kundies @ Rs. 3·50 per mould	28·00
(*v*) Daily labourers—2 @ Rs. 1·50 per day	3·00
	142·50
(C) *Cost for laying out the pipe-line*	
(*i*) cost for digging 1,560 ft, long-2 ft. wide and 2 ft. deep drain for laying out pieces of pipe-line—36 labourers Rs. 1·50 each	54·00
(*ii*) Cement required for joining pipe joints–14 bags ..	94·50
(*iii*) Sand 25 ft.	4·16
(*iv*) Labour given in help to the contractor for joining pipe-line—10 @ Rs. 1·50 per day	15·00
	167·66

The cost of main Kundi constructed on the well is not included in this cost, as it is constructed with the well.

Thus the total cost for laying out 1,560 ft. underground pipe-line of 9 size with 4 R.C.C. Kundies of required height (In this case 6 ft.) comes to Rs. 1,213·56 nP. as per the details above. Thus the cost of pipe-line per foot arrives at Re. 0—87 nP.

The pipe-line cost will vary to some extent according to local conditions and cost of aggregates available at the destination, and also to some extent, the number of Kundies, coming in the pipe-line with their depths etc.

Pipe-line on four other seed farms are also laid and the cost has not exceeded Rs. 0·87 nP. per foot.

The Punjab State Tubewell Act, 1954

(PUNJAB ACT NO. XXI OF 1954)

(Received the assent of the Governor of Punjab on the 10th May, 1954 and was first published in the Punjab 1954)

AN

ACT

to provide for the construction, improvement and maintenance of State Tubewell Irrigation Works in Punjab.

It is hereby enacted as follow :—

Short title, extent and commencement

1. (1) This Act may be called the Punjab State Tubewell Act, 1954.
   (2) It extends to such local areas in Punjab as the Government may from time to time by notification direct.
   (3) It shall come into force on such date as the Govt. may by notification in the official Gazette direct.

Definitions

2. In this Act, unless there be something repugnant in the subject or context,
   (*a*) "Government" means the State Government of Punjab.
   (*b*) "Prescribed" means prescribed by rules made under this Act.
   (*c*) "State Tubewell" means a tubewell hitherto constructed, maintained or controlled or which may be hereafter constructed, maintained or controlled by the Government, and includes all mechanical and electrical appliances, tools and structures appertaining to it and necessary for the abstraction of water from it.
   (*d*) "Tubewell" means any device for lifting water from below the surface of the ground by mechanical means operated otherwise than by human or animal power.
   (*e*) "Underground Water" means water under the surface of the earth regardless of the geological, it does not include water flowing in artificial structure in which it is standing or moving, but under ground streams.

Application of the Act.

3. The Government may, by notification in the official Gazette, declare that any tract of land is a tract to which this Act will apply with effect from a day to be named in the notification not being earlier than three months from the date thereof.

Application of the Act VIII of 1873 to State Tubewells

4. In respect of any State Tubewell the provisions of the Northern India Canal and Drainage Act, (VIII) of 1873 (hereinafter

referred to as the said Act), shall be deemed to apply in like manner as if such State tubewells were a canal within the meaning of the said Act, except the provisions of Section 1, clause (4) of Section 3, Section 5, and parts VI and VIII of the said Act.

Provided that for the purpose of such application the said Act shall be subject to the following modifications :—

(1) In Section 6 of the said Act, for the word "so named the words named in notification under section 3 of the Punjab State Tubewell Act, 1954, " shall be deemed to be substituted and for the words "such application or use of the said water" the words "the application or use of underground water for the purpose of a State Tubewell" shall be deemed to be substituted.

(2) In Section 8 of the said Act clauses (a) and (c) and the reference thereto in clause (i) shall be deemed to be omitted, in clause(g) for the words "through any natural channel which has been used for purposes of irrigation" the words "in any well which has been used" shall be deemed to be substituted and in the last paragraph for the words and brackets clause (a), (b) and (c) the word and brackets "clause (b)" shall be deemed to be substituted.

(3) In Section 32 of the said Act :—

(*i*) In sub-clause (i) of clause (a), the words "and with the previous sanction of the State Government" shall be deemed to be omitted.

(*ii*) Clause (d) shall be deemed to be omitted.

(4) In Section 68 of the said Act, for the words "Such officer shall thereupon give notice" the words "On receipt of such application or when in the opinion of the Divisional Canal Officer any such difference is likely to arise he shall give notice" shall be deemed to be substituted.

(5) In Clause (2) of Section 70 of the said Act, the words "except by the construction of a tubewell" shall be deemed to be inserted before the word "interferes" and clauses (6) to (9) of the said Section shall be deemed to be omitted.

APPENDIX VIII

Statement showing area-wise performance of Tubewells of more than three years standing (developed) in Punjab in 1959-60

Sl. No.	Name of Scheme/Group	No. of tube-wells in operation on 31-3-60	Tube-wells which came into operation after 31-3-57	No. of tube-wells for which average is worked (Col. 3-4)	Average irrigated area per tube-well (1959-60)	Average hours per tube-well	Average assessment per tube-well
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I.	*T.C.A.* 1952 *Scheme*						
	(*a*) Sonepat Panipat Area ..	98	42	56	274	1,632	2,040
	(*b*) Radaur Ladwa Area ..	85	2	83	254	1,726	2,158
	(*c*) Samrala Area	96	2	94	166	1,758	2,637
	(*d*) Shahabad Barara Area ..	73	49	24	372	1,690	2,448
	(*e*) Malerkotla, Dhuri, Doraha and Bassi Area	307	24	283	259	1,458	1,823
II.	*T.C.A.* 1953 *Scheme*						
	(*a*) Shahabad Pipli Area ..	125	1	124	302	1,677	2,096
	(*b*) Narwana Branch Area	50	28	22	481	2,353	2,941
	(*c*) Kapurthala Area ..	78	31	47	278	1,736	1,795
	(*d*) Phagwara Area	22	6	16	273	1,218	1,522
	(*e*) Rajpura Area	45	45	—	—	—	—
III.	*G.M.F.* 1954 *Programme*						
	(*a*) Jagadhri Chhachharauli Area ..	49	49	—	—	—	—
	(*b*) Umla Nala Area and others	54	54	—	—	—	—
	(*c*) Rajpura Area	51	51	—	—	—	—
	(*d*) Safidan Area	35	35	—	—	—	—
IV.	*Abdullapur Radaur Scheme*	18	—	18	381	2,506	3,133
V.	*Nidampur Area*	8	3	5	237	1,137	1,422
VI.	*Panipat Munak Scheme* ..	24		24	264	1,399	1,749
				796	296·10	1,688·24	2,124·34

APPENDIX IX

Financial-cum-operational schedule of performance of a State Tubewell with assessment @2 as. per unit of Energy consumed by occupier of holding

Running hours during one year	Fixed over-head charges including mainten-ance & fixed Elecy. charges (excldg. interest)	Cost of energy at 6·77 nP. per unit at 10 units per Hr. (assumed)	Total Cost Col. (2+3)	Income at -/2/- per unit	Cost per hour in pumping Col. 4 / Col. 1	Gain (+) or loss (—) per T/W per year (Col. 4-5)	Percentage return, loss (—) or gain (+)
(Hours)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Nil ..	3,316	—	3,316	—	—	(—)3,316	(—)100·0
500 ..	3,316	339	3,655	625	7·3	(—)3,030	(—) 82·9
1,000 ..	3,316	677	3,993	1,250	4·0	(—)2,743	(—) 68·7
1,500 ..	3,316	1,016	4,332	1,875	2·9	(—)2,457	(—) 56·7
2,000 ..	3,316	1,354	4,670	2,500	2·3	(—)2,170	(—) 46·5
2,500 ..	3,316	1,693	5,009	3,125	2·0	(—)1,884	(—) 37·6
3,000 ..	3,316	2,032	5,348	3,750	1·8	(—)1,598	(—) 29·9
3,500 ..	3,316	2,370	5,686	4,375	1·6	(—)1,311	(—) 23·0
4,000 ..	3,316	2,708	6,024	5,000	1·5	(—)1,024	(—) 17·0
4,500 ..	3,316	3,047	6,363	5,625	1·4	(—) 738	(—) 11·6
5,000 ..	3,316	3,385	6,701	6,250	1·3	(—) 451	(—) 6·7

Break-up of fixed Charges

	Rs.
Establishment	1,845
Maintenance	510
Depreciation charges	961
Lambardari fee @ 1% of revenue realised	

NOTE.—Rate per unit for the year 1961-62 is proposed to be charged at 2·5 annas.

APPENDIX X

Order of the Punjab Government fixing annas two as the rate per unit of energy consumed by State Tubewells for irrigation purposes

Public Works Department Irrigation Branch

NOTIFICATION

Dated Chandigarh the 29th June, 1960.

No. 7189-Irr. & EI-60/17847.—In exercise of the powers conferred by Section 31 of the Northern India Canal and Drainage Act, 1873, read with Section 4 of the State Tubewell Act, 1954, the Government of Punjab is pleased to prescribe that, for the supply of water from State Tubewell, the Irrigation shall be charged at the rate of two annas per unit of electricity consumed on such supply, for the period commencing from 1st April, 1960 to 31st March, 1961.

Sd/- S. N. BHANOT,
Deputy Secretary to Govt. Punjab,
Irrigation and Power Department.

No. 7189-Irr. & EI-60/17848, *dated Chandigarh the 29th June*, 1960.

Copy forwarded to the Chief Engineer, Irrigation Works, Punjab, for information and necessary action with reference to his communication noted in the margin.

2.—This reduction in the rate has been made as an experimental measure in order to popularise the use of tubewells for irrigation purposes. The position is to be reviewed in March, 1961. Monthly progress reports should be sent to Government to show the progress in tubewell irrigation owing to this reduction in rates. The whole position should be reviewed well in time and the case submitted to Government in December, 1960 for obtaining further orders.

Sd/-
Under Secretary to Govt. Punjab,
Irrigation and Power Department.

No. 7189-Irr. & EI-60/17849, *dated Chandigarh the 29th June*, 1960.

Copy forwarded for information to :—

(1) The Financial Commissioner, Revenue, Punjab.
(2) The Financial Commissioner, Development, Punjab.
(3) The Secretary to Govt. Punjab, Finance Department (F.I.A. Branch).
(4) The Secretary to Govt. Punjab, Agriculture Department.
(5) Planning and Development Commissioner and Secretary to Government, Punjab, Planning Department, Chandigarh.

Sd/-
Under Secretary to Govt. Punjab,
Irrigation and Power Department.

No. 7189-Irr. & EI-60/17850, *dated Chandigarh the 29th June,* 1960.

Copy with five spare copies forwarded to the Under Secretary to Government of India, Ministry of Food & Agriculture, Department of Agriculture, New Delhi for information .

Sd/-

Under Secretary to Govt. Punjab,
Irrigation and Power Department.

No. 7189-Irr. & EI-60/17851, *dated Chandigarh the 29th June,* 1960.

Copy forwarded to the Controller of Printing and Stationery, Punjab, Chandigarh with the request that the above notification may be published in the next issue of the Punjab Government Gazette, Part I and twenty off-take copies of the said notification supplied to this Department.

Sd/-

Under Secretary to Govt. Punjab,
Irrigation and Power Department.

APPENDIX XI

Financial-cum-operational schedule of performance of a State Tubewell with assessment @ 2½ as. per unit of energy consumed by occupier of holding.

Running Hours	Fixed overhead charges including maintenance & fixed elecy. charges (excluding interest)	Cost of energy at 6·77 nP. per unit at 10 units per Hr. (assumed)	Total cost	Income at -/2/6 per unit	Cost per hour in pumping Col. 4 / Col. 1	Gain (+) or loss (—) per T/W per year (Col. 4-5)	Percentage return loss (—) or gain (+)
(Hours)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Nil. ..	3,316	—	3,316	—	—	(—)3,316	(—)100
500 ..	3,316	339	3,655	781	7·3	(—)2,874	(—)78·6
1,000 ..	3,316	677	3,993	1,562	4·0	(—)2,431	(—)60·9
1,500 ..	3,316	1,016	4,332	2,344	2·9	(—)1,988	(—)45·9
2,000 ..	3,316	1,354	4,670	3,125	2·3	(—)1,545	(—)33·0
2,500 ..	3,316	1,693	5,009	3,906	2·0	(—)1,103	(—)22·0
3,000 ..	3,316	2,032	5,348	4,688	1·8	(—) 660	(—)12·3
3,500 ..	3,316	2,370	5,686	5,469	1·6	(—) 217	(—)3·8
4,000 ..	3,316	2,708	6,024	6,250	1·5	(+) 226	(+)3·8
4,500 ..	3,316	3,047	6,363	7,031	1·4	(+) 668	(+)12·3
5,000 ..	3,316	3,385	6,701	7,812	1·3	(+)1,111	(+)22·0

Break-up of fixed charges

	Rs.
Establishment	1,845
Maintenance	510
Depreciation charges	961

APPENDIX XII

Division-wise Performance of Energised Tubewells in the Punjab

1959-60

Sl. No.	Item	Delhi	Ambala	Malerkotla	Ludhiana	Total Divisions
1.	No. of energised tubewells up to 31-3-1960	225	388	383	231	1,227
2.	Total area irrigated in first watering	58,247·00	1,13,176·00	84,113·00	55,174·00	3,10,710·00
3.	Average of area irrigated per tubewell	258·87	291·69	219·62	238·84	252·41
4.	Total No. of units consumed	32,64,297·00	61,14,302·00	47,83,117·00	32,33,150·00	1,73,94,867·00
5.	Average No. of units consumed per tubewell	14,507·98	15,758·51	12,488·60	13,996·32	14,176·75
6.	Total amount of assessment per tubewell	4,08,031·00	7,33,716·24	5,93,445·29	4,26,771·59	21,61,964·12
7.	Average of assessment per tubewell	1,813·49	1,891·03	1,549·49	1,847·49	1,761·99
8.	Total working expenses	6,81,041·00	11,68,054·00	8,04,790·00	4,65,520·00	31,19,405·00
9.	Average of working expenses per tubewell	3,026·84	3,010·44	2,101·28	2,015·24	2,542·31
10.	Average loss per tubewell	1,213·35	1,119·41	551·79	167·75	780·32

APPENDIX XIII

Statement Showing Tubewell-wise Area (Actual Land Area) Irrigated

(ABDULLAPUR RADAUR SCHEME)

Tube-well No.	Date of energi-sation	1958-59						1959-60					
		Kharif		*Rabi*		*Total*		*Kharif*		*Rabi*		*Total*	
		Area (acres)	Power (Units)	Area (acres)	Power (Units)	Area (acres)	Power (Units)	Area (acres)	Power (Units)	Area (acres)	Power (Units)	Area (acres)	Power (Units)
1.	4-11-52	118	20,102	206	9,464	324	29,566	176	19,158	140	17,037	316	36,195
2.	15-9-52	82	14,636	92	4,238	174	18,874	181	13,938	125	6,906	306	20,844
3.	1-10-52	182	12,300	28	2,289	210	14,589	467	22,183	252	17,947	719	40,130
4.	4-12-52	108	15,258	107	4,337	215	19,595	294	15,048	158	9,015	452	24,063
5.	29-3-52	101	25,919	163	11,412	264	37,331	304	22,456	127	14,254	431	36,710
6.	22-10-52	71	8,958	53	2,970	124	11,928	307	14,947	137	8,587	444	23,534
7.	8-11-52	70	12,242	69	2,713	139	14,955	253	13,864	157	9,439	410	23,303
8.	13-1-53	72	13,233	71	2,744	143	15,977	227	13,042	161	9,742	388	22,784
9.	22-4-52	98	16,851	105	4,399	203	21,250	364	17,881	267	15,838	631	33,719
10.	24-4-52	62	14,988	101	5,465	163	20,453	166	15,952	202	13,422	368	29,374
11.	12-12-52	45	10,821	27	787	72	11,608	83	8,564	165	6,084	248	14,648
12.	9-9-52	43	6,739	59	1,987	102	8,726	135	12,142	117	5,598	252	17,740
13.	20-11-52	48	6,474	85	2,234	133	8,708	302	14,591	196	8,458	498	23,049
14.	30-9-52	49	9,883	110	2,820	159	12,703	314	9,978	187	8,231	501	18,209
15.	14-11-52	40	7,480	15	457	55	7,937	205	10,112	86	3,385	291	13,497
16.	26-10-52	12	10,014	45	4,302	57	14,316	40	14,049	155	9,903	195	23,952
17.	28-10-52	38	13,618	69	5,915	107	19,533	36	15,484	169	7,903	205	23,387
18.	10-10-52	28	11,315	126	4,698	154	16,013	227	18,374	192	10,909	419	29,283
	TOTAL	1,267	2,30,831	1,531	73,231	2,798	3,04,062	4,081	2,71,763	2,993	1,82,658	7,074	4,54,421
	AVERAGE PER TUBEWELL	70	12,824	85	4,068	155	16,892	227	15,098	166	10,148	393	25,246

APPENDIX XIV

Statement Showing Tubewell-wise Area (Actual Land Area) Irrigated
(PANIPAT MUNAK SCHEME)

Tube-well No.	Date of Energisation	1958-59						1959-60					
		Kharif		*Rabi*		*Total*		*Kharif*		*Rabi*		*Total*	
		Area (acres)	Power (Units)	Area (acres)	Power (Units)	Area (acres)	Power (Units)	Area (acres)	Power (Units)	Area (acres)	Power (Units)	Area (acres)	Power (Units)
1.	18-11-52	133	11,094	247	6,889	380	17,983	329	14,088	394	20,938	723	35,026
2.	18-11-52	54	5,550	75	4,447	129	9,997	139	6,649	88	6,460	227	13,109
3.	3- 3-53	136	12,609	212	7,237	348	19,846	294	16,911	202	13,967	496	30,878
4.	18-11-52	71	6,730	75	3,150	146	9,880	173	11,345	84	9,209	257	20,554
5.	20-12-52	54	5,271	110	2,628	164	7,899	106	6,893	144	6,867	250	13,760
6.	9-12-52	119	13,726	23	457	142	14,183	268	13,821	164	8,521	432	22,342
7.	14-12-52	70	4,707	30	703	100	5,410	134	4,071	155	4,948	289	9,019
8.	21-11-52	60	3,288	23	572	83	3,860	100	3,361	185	5,021	285	8,382
9.	21-11-52	35	2,168	88	1,970	123	4,138	55	3,363	133	6,180	188	9,543
10.	21-11-52	47	3,164	63	1,421	110	4,585	90	4,547	104	6,826	194	11,373
11.	21-11-52	115	8,821	62	1,852	177	10,673	201	10,111	294	11,463	495	21,574
12.	18-11-52	102	5,588	81	1,875	183	7,463	240	8,468	137	8,923	377	17,391
13.	9-12-52	135	8,782	75	2,325	210	11,107	213	9,532	199	6,816	412	16,348
14.	13-12-52	56	3,708	83	1,808	139	5,516	158	5,596	3	215	161	5,811
15.	16-11-52	Nil	Nil	46	1,315	46	1,315	157	9,723	116	7,912	273	17,635
16.	16-11-52	24	1,678	19	468	43	2,146	38	3,244	77	5,499	115	8,743
17.	28-11-52	23	2,055	7	161	30	2,216	79	4,326	59	4,415	138	8,741
18.	13-12-52	19	923	Nil	Nil	19	923	17	1,922	20	1,350	37	3,272
19.	16-11-52	22	3,577	41	1,059	63	4,636	71	5,410	144	7,230	215	12,640
20.	9-12-52	101	5,813	46	1,974	147	7,787	110	8,957	109	6,621	219	15,578
21.	25-11-52	40	3,782	26	830	66	4,612	105	5,330	42	4,851	147	10,181
22.	16-11-52	83	5,469	34	1,743	117	7,212	94	4,770	98	5,512	192	10,282
23.	16-11-52	41	2,853	64	2,422	105	5,275	64	4,116	89	4,017	153	8,133
24.	25-11-52	19	1,661	13	334	32	1,995	29	2,133	34	3,261	63	5,394
	TOTAL	1,559	1,23,017	1,543	47,640	3,099	1,70,657	3,264	1,68,687	3,074	1,67,017	6,338	3,35,704
	AVERAGE PER TUBEWELL	65	5,126	64	1,985	129	7,111	136	7,029	128	6,959	274	13,988

Table Showing Observations of Spring Level on a Line Across Reach VA

(ABDULLAPUR DIVISION KARNAL)

Measurements in June

Reduced Levels

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
1.	11·60 / 825·1	11·5 / 825·2	13·4 / 823·2	12·6 / 824·1	12·8 / 824·5	13·8 / 822·9	12·9 / 823·8	12·5 / 824·2	13·0 / 823·7	11·80 / 824·9
2.	18·2 / 818·2	17·6 / 818·8	17·9 / 818·5	18·6 / 817·8	17·8 / 818·6	17·0 / 809·4	17·0 / 819·4	18·4 / 818·0	18·0 / 818·40	18·12 / 818·28
3.	10·9 / 812·6	9·3 / 814·2	10·5 / 813·0	10·9 / 812·6	10·4 / 813·1	10·3 / 813·2	9·5 / 814·0	9·5 / 814·0	11·40 / 812·10	10·6 / 812·9
4.	10·3 / 811·2	9·8 / 811·7	11·4 / 810·1	11·7 / 809·8	10·8 / 810·7	9·8 / 811·6	9·0 / 812·5	8·3 / 813·2	10·70 / 810·80	8·8 / 812·70
5.	9·5 / 810·9	8·7 / 811·7	7·5 / 812·9	7·8 / 812·6	7·7 / 812·7	7·3 / 813·1	6·5 / 813·9	7·9 / 812·5	9·8 / 810·60	8·0 / 812·4
6.	11·1 / 810·5	10·6 / 811·0	12·0 / 809·6	12·3 / 809·3	11·4 / 810·2	11·3 / 810·3	11·3 / 810·3	10·1 / 811·5	10·8 / 810·80	8·9 / 812·7
W.S. of river Jamuna ..	818·1	812·0	813·1	812·7	812·3	814·2	815·4	—	—	—
Deepest Bed ..	809·9	808·0	808·2	807·5	807·8	—	—	—	—	—

*Observed in August, 1955.

—Not observed.

Table Showing Observations of Spring Level on a Line Across Reach VA

(ABDULLAPUR DIVISION KARNAL)

Measurements in October

Reduced Levels

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	R.L. of measuring
1.	6·6 / 830·1	8·4 / 828·3	7·0 / 829·7	8·7 / 828·0	10·0 / 826·7	4·5 / 832·2	6·0 / 830·7	7·1 / 829·6	2·5 / 834·2	1·2 / 835·5	836·7
2.	9·1 / 827·3	10·9 / 825·5	11·8 / 824·6	10·7 / 825·7	11·8 / 824·6	6·3 / 830·1	5·0 / 831·4	6·4 / 830·0	7·6 / 828·8	9·4 / 827·0	836·4
3.	7·1 / 816·4	10·0 / 813·5	10·8 / 812·7	9·8 / 813·7	11·3 / 812·2	2·6 / 820·9	1·5 / 822·0	0·1 / 823·4	1·7 / 821·8	3·6 / 819·9	823·5
4.	8·9 / 813·5	11·0 / 810·5	11·6 / 809·9	10·2 / 811·3	11·2 / 810·3	5·1 / 816·4	4·0 / 817·5	3·1 / 818·4	3·0 / 818·5	4·9 / 816·6	821·5
5.	8·1 / 812·3	10·9 / 809·5	10·7 / 809·7	9·5 / 810·9	10·7 / 809·7	6·5 / 813·9	5·0 / 815·4	4·0 / 816·4	2·9 / 817·5	4·7 / 815·7	818·0 / +2·4
6.	7·6 / 814·0	9·8 / 811·8	9·4 / 812·2	8·2 / 813·4	9·6 / 812·0	3·8 / 817·8	3·0 / 818·6	4·0 / 817·6	3·1 / 818·5	5·1 / 816·5	821·6
W.S. of river Yamuna ..	815·6	813·0	811·11	812·12	813·2	814·3	816·0	813·57	—	814·4	
Deepest Bed ..	809·6	809·6	808·11	809·0	809·8	812·3	813·2	807·37	—	806·4	

APPENDIX XVI

Committee on Plan Projects

(Minor Irrigation Team)

PROCEEDINGS OF A DISCUSSION HELD AT CHANDIGARH ON 14TH JUNE, 1961 WITH STATE OFFICERS ON THE DRAFT REPORT ON STATE TUBEWELLS IN THE PUNJAB.

Minor Irrigation Team, Committee on Plan Projects was represented by Shri Baleshwar Nath, Member assisted by Shri J. R. Kumar, Research Officer.

The Punjab State was represented by S/s Ishwar Chandra, I.A.S., Secretary, Irrigation and Power Department; R. K. Nayar, Chief Engineer, Electricity; V. P. Goyal, Chief Engineer, Irrigation; Ardaman Singh, Superintending Engineer, Tubewells, Ambala; Dr. G. S. Cheema, Joint Director, Agriculture; B. R. Mahajan, Dy. Secretary I & P Department; and Shri P. S. Dhillon, Executive Engineer.

I. After welcoming the Team Shri Ishwar Chandra, Secretary, Irrigation and Power Department, Punjab Government stated that they have studied the Draft Report and find it indeed, constructive and helpful. It provides an appraisal based on actual field study reflecting on engineering, agricultural and economic phases of tubewell programme in the State. He considered the Report to be a rare document, so different from the conventional type and expressed his gratitude for the labour put in by the Team in presenting such a Report.

He further stated that they had not been able to give due attention to the tubewells before 1958. Since then, however, they have tightened up the organisation and the progress now was not far from satisfactory. He hoped that the discussion would lead to elucidation of many suggestions and recommendations of the Team and will also enable the Team to appreciate the view points of the State authorities. He ultimately hoped to place the Report before the Working Group of the State for causing implementation of the various recommendations contained in the Report.

II. Member, Minor Irrigation Team Shri Baleshwar Nath first conveyed the apologies from the other two Members of the Team, namely Dr. Ramiah and Shri Mahavir Prasad, who could not join the discussion at Chandigarh, on account of illness and urgent preoccupation respectively. He stated that the Team's Report as framed presents a detached view providing a factual appraisal of the operational and economic performance of the projects examined. If some modifications emerge out of our discussion, they will be incorporated in the Report, as necessary, after being considered by the Leader and other Members of the Team.

III. He requested the State authorities to provide para-wise comments on the Draft Report so that the report could be finalised in the light of the same and of the discussion that they were holding.

IV. Shri V. P. Goyal, Chief Engineer, Irrigation also joined with the Secretary, I. & P., in expressing his gratitude for the Draft Report, which he considered very educative and hoped that the recommendations contained therein will lead to a wholesome development of the tubewells in the State.

**Para* 1.8

V. Taking up the Draft Report para by para, the first observation made was with regard to *para* 1.8 (Development of Irrigation). The State authorities considered that the period of 5 years for full development of tubewell should stay as such, and that a changeover from 5 to 3 years may prove to be unrealistic.

VI. Member, Minor Irrigation Team explained that irrigable commands in the case of tubewells should be fixed on an intensive agriculture basis and not on an extensive agriculture basis. He pointed out that the area of serviceability of tubewell should be judged from the irrigating capacity of the tubewell and the actual irrigation achieved. It would be observed that in a very large number of cases the actual irrigated area is more or less clustered round the tubewell itself. This will indicate that areas at distances do not get as much service as areas in the closer vicinity of tubewells. There is thus a case for restricting command of tubewells from the point of optimum utilisation of the land and water resources for getting optimum production therefrom. He further said that this eventually would reflect on the period of development, which could be reduced considerably and should not normaly exceed a period of 3 years. He quoted examples of the oldest Scheme in the Panipat-Munak area, where the tubewells have not done their targetted figure though they are more than 5 years old.

Shri Ardaman Singh, Superintending Engineer, said that the development of tubewells was taking place at a faster rate, where refugees have settled down. On some of the tubewells he stated that more than 50,000 units of electricity have been consumed in a year.

VII. Member, Minor Irrigation Team thereupon suggested that those tubewells should be picked up and study should be made with regard to the factors, which have contributed towards their development. Similar conditions could be created on other tubewells, which may be conducive to a speedy development of irrigation.

Shri Ardaman Singh further stated that if all the water courses etc. were laid well in time, it was not difficult to attain full development of tubewell within 3 years. This criterion, however, cannot be applied to wells already installed as a period of 3 years has more or less, already passed.

Para 1.11

VIII. Considering *para* 1.11 of the Draft Report, Secretary, Irrigation and Power explained why the State authorities considered banning further tubewells to be taken up as a State venture. He said that the State was losing money on tubewells. On the other hand, if the Government advances loans to the people and provide them necessary know-how with regard to tubewell construction, tubewells might work more economically.

Member, Minor Irrigation Team stated that it would mean that the State favours a policy of shifting the activity from public sector to private sector.

Secretary, Irrigation and Power thereupon stated that they had actually wanted to dispose of their tubewells to Co-operatives or *Panchayats*, but did not succeed.

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*Paragraph Nos. referred to in these proceedings relate to the First Draft Report.

Shri Ardaman Singh, Superintending Engineer stated that the specifications of State Tubewells are very stiff and the cost was, therefore, very high.

Member, Minor Irrigation Team, however, suggested that the private tubewells should not come in such a manner as to encroach upon the State tubewells. This was agreed to.

IX. Taking up *para* 2.7 (Two tier system) the State authorities felt that it would not be desirable to entrust the operation of tubewells to a *Kamdar*, who would not be under proper disciplinary control of Government.

On being explained that the suggestion did not mean any *Kamdar* independent of the control of the State officers, it was felt that collaboration of the village *Panchayats*, should be sought. This could be done if the operator works on the direction of the *Panchayats*, though administratively under the control of State officers.

Member, Minor Irrigation Team stated that the recommendation could be reconsidered in the light of the above suggestion.

Paras 2.11 & 2·12

X. It was felt that the time had not yet come when legislative measures to prevent excessive extracting of water from the subsoil would be necessary. Besides, it was stated that for relieving waterlogging conditions a policy of increased extraction of water from the subsoil has to be followed in many parts of the State.

Secretary, I .& P. stated that the question of amending the new provisions of the Act in order to make them more effective and expeditious is receiving the attention of the State Government and, if necessary an Amending Bill would be brought forward on this behalf.

Para 3.6

XI. Since certain cases were under consideration of arbitration, it was expressed that it need not be commented upon in the Team's Report.

Para 3.7

XII. On being explained by Member, Minor Irrigation Team that the suggestion contained was only with regard to certain areas where artesian conditions were met, it was felt that this paragraph may remain as such.

Para 3.11

XIII. In view of cost and difficulty for acquisition of land, it was expressed that the recommendation as made in the Report may be amended.

Para 3.17

XIV. With regard to lining of water courses, the Secretary, I. & P. stated that it was not stopped but because of indiscriminate action having been taken in this regard, the G.O. only sought to rationalise the process. The provision of the Amendment of Canal Act now provides that lining at the cost of beneficiaries could be done.

Member, Minor Irrigation Team explained that the lining of channels was an essential item for tubewell irrigation. A field study made out on unlined water courses showed that the cost of irrigation to the cultivators situated at a distance works out to be high, as compared to lined watercourses.

If the watercourses are lined, the irrigation proves to be more equitable. Besides, the distribution of water also takes place satisfactorily. Leaving it to the cultivator will mean delay in the development of irrigation on the tubewell. It was for this reason that in Uttar Pradesh each tubewell is provided with at least one mile of lined water course. He stated that the possibility of using underground water supply system should not be ruled out. In fact, in Gujarat it has been found that hand moulded concrete pipes can be laid on water distribution at the cost of Rs. 5,000 per mile, which may be worthwhile trying partly or wholly.

Para 3.18

XV. Member, Minor Irrigation Team explained that the suggestion was with regard to use of small pieces of pipes for extracting water from channels instead of making cuts in the channels. The idea was appreciated by the State Irrigation officers, and they promised to give it a trial.

Para 3.21

XVI. It was explained that experiment on the lines comparable with the suggestion of the Team was tried in the Punjab sometime ago. That experiment did not succeed. Secretary, I & P, however, suggested that financial assistance to the land owners concerned may be provided for levelling up the lands, wherever necessary in the form of loan or subsidies.

Paras 4.6 *and* 4·7

XVII. The State authorities stated that the question of water rates had very wide repercussions. They thought that the Team should base its observations mostly on tubewells. It was stated by the Secretary, I & P that the reduction in tubewell rates was not ordered to bring them at par with canal rates, but as an incentive for the increased use of tubewell water. He stated that the rates have since been increased to 16 nP. per electric unit during the current year. The intention of the Government was, however, to increase the rates gradually so as to render the scheme self-supporting.

The State authorities stated that their present system of assessment on electric meter on tubewells was working satisfactorily. Member, Minor Irrigation Team, however, explained that this system was tried first in Uttar Pradesh, but had subsequently been rationalised to volumetric basis. If the cultivator is charged by the electric meter, he is unnecessarily taxed for inefficient running of pumping set, if any. He cited instances of tubewells Nos. 84 and 86 of Samrala area, which were consuming electricity at widely different amperage, still discharging the same quantity of water. The cultivator actually purchases water and his rate should be related to the quantity of water supplied and not to the electricity consumed.

Shri Goyal, Chief Engineer stated that if volumetric system was introduced in tubewells, cultivators from canals may also clamour for the same.

Secretary, I. & P. said that there were cases of pilferage of electricity on the tubewells. Probably introduction of volumetric system may lead to more pilferages. Member, Minor Irrigation Team, however, did not agree to this view and reiterated that volumetric sale of water based on properly designed V-notches was more or less a fool-proof system provided necessary check-up is done by supervising officers from time to time. This system is already in vogue in Uttar Pradesh, where they have about 6,000 tubewells.

Para 4.8

XVIII. The suggestion of the Team to introduce two-part tariff seemed acceptable to the State authorities. They, however, did not want a sliding tariff for different types of crops like sugarcane, rice etc.

Para 4.9

XIX. The State authorities felt that there was no occasion yet to introduce concessional rates during slack period.

Para 4.10

XX. Shri Nayar, Chief Engineer, Electricity stated that taking the lead factor into consideration as also the fixed charges levied per B.H.P. in U.P., the rates for electric energy in the Punjab compare favourably with those in Uttar Pradesh.

Para 5.8 (*b*)

XXI. With regard to Jagadhri tubewells Secretary thought that they did not form part of the minor irrigation scheme. Member, Minor Irrigation Team, stated that the observations on tubewells were of technical nature and further improvement regarding their performance and utility should be sought. The suggestion had been made from this point of view.

XXII. There was general concurrence expressed by the State authorities with regard to other recommendations of the Team. Member, Minor Irrigation Team, however, once again requested that after written comments had been received on different paragraphs of the Report, the report will be finalised in the light of those comments and the discussions held at Chandigarh. If any discussions were required thereafter, they could take place after the matter has been considered by the Leader and other Members of the Team.

APPENDIX XVII

Committee on Plan Projects

(*Minor Irrigation Team*)

SUMMARY RECORD OF A MEETING HELD IN YOJANA BHAVAN WITH SARDAR GIAN SINGH RAREWALA, IRRIGATION MINISTER, PUNJAB AND MINOR IRRIGATION TEAM, C.O.P.P. ON DECEMBER 6, 1961.

Present

Shri M. Thirumala Rao, *Leader.*
S. Indarjit Singh, *Secy. COPP.*
Shri Baleshwar Nath, *Member.*
Sardar Gian Singh Rarewala, *Irrigation Minister, Punjab.*

In Attendance

Shri J. R. Kumar, R.O.
Shri P. C. Kalia, Engineer.

Following points emerging out of the discussion with the Punjab State Officers on the Draft Report of Punjab Tubewells, were taken up one by one:

1. *Further installation of State tubewells*—It was considered that tubewells as co-operative venture could be sunk wherever possible, as individual holdings may not justify installation of tubewells by individual land-owners on account of land ceilings.

2. *Enactment for governing extraction of water*—It was not considered necessary at this stage to have such an enactment. This point was decided to be dropped.

3. *Repealing of Sections of Northern India Canal and Drainage Act of* 1873—It appeared desirable to repeal some of the Sections of the old Act to make provisions of new Amended Act effective. The Minister stated that action thereabout, was already being caused.

4. *Relaxation of contractual obligation*—It was considered that reference to that point was unnecessary in the Team's Report.

5. *Building up of channels and pucca water-courses*—It was considered desirable to provide these as an integral part of tubewell scheme. It was suggested that the State Government may consider levying extra cess for construction of water courses, wherever necessary, if thought proper.

6. *Rationalisation of tubewell rates*—It was considered that it will be more desirable to supply water to the cultivator on a volumetric basis. The Team could demonstrate the procedure to the State authorities, if necessary.

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