4.1 INTRODUCTION

Underutilisation of irrigation potential created by an irrigation work is defined as the failure to irrigate the total area that the work was designed to, in a particular geo-physical setting and under the assumption of a given cropping pattern. The fact that such underutilisation has characterised irrigation development in India has been well documented by a number of All-India reports and commissions\(^1\) as well as by regional studies/surveys, confined to individual irrigation projects.\(^2\) In fact for the first three Plan periods the overall figures for percentage utilisation - 60, 57 and 49 respectively - show a declining trend (Srinivas: 1973). Underutilisation of the major sources of irrigation in the state of Punjab has also been noted.\(^3\)

Further, it is widely observed that the official figures for utilisation underestimate the real extent of the

\(^1\) See, for example, Report, Irrigation Commission: 1972; Report, National Commission of Agriculture: 1976; Committee on Plan Projects: 1966; etc.


problem. Existing evidence points to mounting losses as a result of unrealised potential. In view of this and the critical relevance of irrigation for enhancing agricultural

For example, Vohra points out that "It is important to remember that even where potential is reported to have been "utilised to the extent of 100%, this does not mean that the available supplies are being utilised to the limit of their productive capacity or that the efficiency with which irrigation is being carried out leaves nothing to be desired. In present irrigation parlance, all that "100% utilisation" means is that water is either being actually supplied or has been made available for being supplied to all the lands which were planned to be irrigated in the command area concerned. The responsibility of the irrigation authorities generally ends with the creation of distribution systems which do not go beyond outlets meant to serve blocks of upwards of 100 acres each, and the way in which water is utilised beyond these outlets is not their concern. Further, the frequency as well as the timing of irrigation - both of which are so important from the agricultural point of view - are not at all reflected in the "utilisation" figures - so long as water has been supplied even once to a particular area, it is included in the acreage representing 100% "utilisation". Percentage figures of the "utilisation" of potential are therefore not a satisfactory index of the use to which irrigation water is being put for purposes of agricultural production. On the other hand, they carry the danger of creating a false sense of complacency" (Vohra:1975, p. 51).

It has been estimated that a total capital of Rs. 400 crores was blocked during the first three Plans (Srinivas:1973).

A more recent study of the loss due to the existing unrealised potential of 38 lakh acres in the country, notes that "the cost of creating irrigation potential works out on an average at Rs. 900 per acre. The unutilised potential of 38 lakh acres represents an investment of nearly Rs. 350 crores on which no return is being presently obtained" (Vohra:1975, p. 51).
growth\(^6\), it becomes imperative to study the reasons underlying this phenomena. However, the perception of the problem and its solution by most studies in this context remain essentially technocratic. In contrast to this, our contention in the present thesis is that technical causes apart, the factors inhibiting fuller utilisation of irrigation potential have their roots also in the social organisation and management of their use. In the following two chapters we try to establish this with reference to the major sources of irrigation currently in use in the state of Punjab.

This chapter and the following one discusses the pattern of utilisation of canals and of shallow tubewells respectively, with a view to identifying the associated problems. We also try to show that there exist different modes of utilising the same technical source for different economic categories of cultivators. This has important implications in terms of the operational efficiency and the cost of irrigation faced by the respective groups, and this, in turn affects their production decisions and the ultimate output. An analysis of the impact of irrigation on production therefore, calls for a further classification of the available

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\(^6\) The lack of adequate irrigation facilities has been typically viewed as a major constraint on the further agricultural growth in the country. Following this, policy recommendations calling for increased irrigational investment have been made, the under utilisation of the existing works notwithstanding (see Chapter IX for a further discussion of this aspect).
irrigation sources based on the typical modes of their utilisation. This we refer to as the mode of irrigation which includes not only the technical characterisation of the sources but also conditions attached to utilisation. A discussion of the implications of different modes of irrigation in terms of cost and efficiency follows.

The underlying thrust of the entire discussion will be to focus, first, on the social origin of some of the problems hindering the realisation of the irrigation potential that is technically created and secondly, on the differential economic implications of such under-utilisation for the different economic categories of the users, taking the owned holding size of the cultivators as a rough basis for this categorisation.

4.2 WATER REGULATION AND DISTRIBUTION SYSTEM

The present section focuses principally on the quality of irrigation associated with the mode of canal irrigation. For analytical purpose, we will divide the discussion into two parts - first, dealing with the water distribution from the source of water to the outlet and second, from the outlet till the field.

7 That is from point A to point E in Figure 3.3, Chapter III.

8 From point E to point G, in Figure 3.3, Chapter III. It may be noted, that the operation and maintenance of the canal network upto the water outlet falls under the administration of the Irrigation Department of the State Government.
The basic elements of the structure of the canal system as presently prevalent in Punjab, have already been discussed in Chapter III. It was pointed out that the regulation of water and its ultimate delivery is primarily limited by the pattern of river flows - their quantity and fluctuations. Dams, weirs, and barrages are the various regulating mechanisms. However, provision for storage of water and hence for controlling the river flow, exists solely at the dam sites while the function of the barrage (and the weir) is limited to regulating the flow into the canal from the given flow in the river. The first point of regulation therefore begins with the control of water release from the dam, if it exists.

Given the total quantum of water thus released, while the organisation of water distribution including the maintenance of the water course from the outlet to the field remains the joint responsibility of the share holders of each outlet.

If the dam has not been constructed, as for example in the case of river Ravi in Punjab, the canal supplies are limited by the run of the river supplies - with the resulting, almost certain, shortages of water during the lean period i.e. Rabi season even in a normal year, and more so during a drought year. See for example Table 4.1, which shows the monthly demand and supply of water for the years 1976 and 1979 - a good rainfall and a draught year respectively. The gap in demand for and supply of water for months of September, October, November, December and January is evident. Secondly, while the demand is generally higher in 1979 from September to December, than for corresponding period in 1976, the supply is lower in 1979 than in 1976 during the same period.

In the case of Punjab, the management of the two dams, Pong on Beas and Bhakhra on Sutlej is entrusted to a Technical Committee - comprising of engineers and other government representatives for all the states concerned, and headed by the Chairman of the Bhakhra-Beas Management Board -
the next step at the canal head works is to distribute the same to the different canal systems taking off therefrom. If the supplies fall short of the total demand\(^\text{11}\) then the channels are formed into a number of equal groups, such that the supplies are capable of meeting at least the total demand of one group in a turn. That is, within a period of 8 days - which is the cycle of irrigation supply for each field to be watered - the water should irrigate the entire area required to be irrigated by the particular group of channels - at least once.\(^\text{12}\) If the water supply exceeds requirements of the particular group, then it is passed on to the group identified in the second preference schedule and so on. The supply is thus fed to the various groups by rotation which means that the

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11. The daily estimation of which is communicated telegraphically to the head office.

12. If this is not done, then the tail-enders on the particular group will suffer, as during the following 8 days period, water supply will be diverted to the next group altogether.
maximum time period after which the same field will get the second irrigation is $8$ multiplied by the number of groups.

The distribution of water beyond the branch canal lies under the overall control of the Executive Engineer incharge in the field who can use his discretion to distribute the surplus waters as he deems fit - i.e. the surplus water over and above that allotted in the first preference schedule. Finally, the last point of control is at the head of the distributory, beyond which the outlets are merely simple exit points with no regulatory mechanism.

Beyond the outlet irrigation water is supplied to the farmers through the main water course. A schedule of weekly turns, known as 'warabandi', is fixed according to which the users are supposed to irrigate their plots for a given time period in succession. The actual time of each turn is calculated by multiplying the size of the plot to be irrigated by the available water time per week per acre. While allotting this time, allowance is made for the extra time required for

13 That is, at point B in the Figure 3.1, Chapter III.

14 It is at this point of control that significant deviance has typically been observed - depending on the credibility of the officer concerned and the pulls and pressures operating on him from the official and political heierarchy above and the farming community below, or from both.

15 That is, the total number of minutes of water supply in a week divided by the total number of acres to be irrigated by the outlet. Thus the total irrigation is fixed on the basis of the size of holding under the C.C.A. (Culturable Commanded Area) of the outlet.
the water to travel in the watercourse before reaching each field, known as 'bharti', and also for the tail water flow gained by the last shareholder, known as 'nikal'. Water distribution on the basis of time, as opposed to a direct volumetric one, has important consequences for the quantum of water actually reaching the field which then gets determined by the discharge (i.e. flow per unit of time) available in the watercourse during the stipulated period. The discharge available at the outlet, to begin with, is subject to wide variations as pointed above. 16 This supply is further reduced by the losses en route. 17 As a result discharge at the outlet is generally found to be insufficient for irrigating the entire area it is scheduled to irrigate. 18 Further, an additional set of factors operating beyond the outlet,

16 Since it depends on the available sources of water for the entire canal network and the constraints operating on the distribution of the given resources to satisfy objectives, other than those of irrigation.

17 These are aggravated by the poor maintenance of the canal network, illegal canal cuts, 'breaches' of canal banks, water stealing by pipes etc., further add on to the losses. In addition there are an announced closures of the distributaries for inspection/maintenance reasons.

18 Since the irrigation revenue is assessed only for the area actually under irrigated cultivation - the difference between the areas assessed for revenue under each outlet per season, and that commanded, i.e. that which it was supposed to irrigate (in the sense, that it is the total area for which 'wari' or turn was allocated) gives an idea of the extent of water shortage. For example, Table 4.2 shows the C.C.A. of all the outlets, feeding village Chutta in district Bhatinda which was one of those selected for field work, as also the area assessed for revenue for each season. The persistent difference between the two, reflects the extent of water shortage for irrigation in the village, relative to the level of irrigation that is technically feasible.
such as seepage and evaporation losses in the watercourse aggravate this problem leading to a further reduction of supplies reaching the field as well as an increased unreliability of the same. Hence the under-utilisation of the irrigation potential created by canals. In the following two sections, we will briefly discuss the major factors affecting the discharge prior to and beyond the outlet.

4.3 BEFORE THE OUTLET - MAINTENANCE OF CANALS

Adequate maintenance of the main canal network is a critical requirement affecting the delivery of the scheduled discharge at the outlet. However, the actual state of maintenance of the canals in Punjab has been far from satisfactory. The difficulties appear at two levels. First, it has been found that the question of proper maintenance has not been accorded due importance by the government body in charge of financial disbursement. Being a part and parcel of the non-plan expenditure, no special grants are made for this. The allocation is done on a yearly ad hoc basis which

19 The major items of repair and maintenance constitute the following: strengthening of embankments, weed clearance, beam trimming, silt clearance, checking of outlets and flow at the tail ends (see Appendix A.4.1).

20 As mentioned earlier the maintenance and operation of the canal network till the outlet remains the responsibility of the Irrigation Department.
has been found to be far short of the requirements.\textsuperscript{21} For instance it was pointed out that as against a recommendation of the maintenance funds at the rate of Rs. 50.00 per hectares of the Gross Irrigated Area (Resolution 1977), the present rate of expenditure works out to be only Rs. 5.00 per hectare, and even out of that, more than 60 per cent are required to meet the establishment charges. This brings us to the second set of difficulties, arising out of the burocratic functioning of the Irrigation Department which consumes a high proportion of the funds for the organisation, leaving small proportion for the actual execution of the works. Evidence for the resulting deterioration of some of the major canal systems in Punjab, is available from the maintenance section of the Irrigation Department itself (see Appendix A.4.2). Hence the

\textsuperscript{21}This has been repeatedly pointed out in the various reports/memoranda of the Irrigation Department. For instance a recent memorandum states that, "The maintenance and upkeep of irrigation systems in Punjab most of which like U.B.D.C., Sirhind Canal etc. were constructed about 100 years ago, has deteriorated. The position has further worsened because the periodic nominal increases in the annual maintenance allocation have been used up in the form of increase in pay and allowances of regular and work-charged staff employed on the running and maintenance of the irrigation systems" (Memorandum:1976). Further a report of the Department cites that, "the constraints on the resources is the governing criteria and happens to be a continuing and normal feature. No hard and fast norm for the operation and maintenance works exists in the state; but are carried out depending on the exigencies of the work and availability of funds" (Irrigation Department, Note: 1977).
reduction of the discharge available at the outlet, besides the increased unreliability of supply. This further encourages the illegal extractions from the canals, reinforcing the adverse affects noted above, specially during the lean period. Probably the worst affected are the tail-enders, who have to bear the compounded brunt of all these.

In short, although a degree of uncertainty with respect to the quantity and timing of water supply is expected due to the technical problems associated with water regulation, the conditions of operation of the entire system in actual use aggravate this uncertainty much beyond that warranted by purely technical considerations.

4.4 BEYOND THE OUTLET

The Irrigation Department delivers water at the outlet to a group of private individuals - i.e. farmers whose fields are watered by the particular outlet. Beyond this point it is they who are supposed to organise the water sharing, i.e. the sequence of respective turns, laying out the field channels, their subsequent maintenance etc. In the present section we will discuss the problems associated with water use at the level of the water course, which lead to a further deterioration of the available discharge. The two most significant factors in this context are, first, the water losses due to
seepage and evaporation, and secondly the location of 'nakkas' on the watercourse.

4.4.1 Losses of Water

Discussing sources of water loss in the canal system in Chapter III, it was pointed out that losses at the field level - basically due to evaporation and seepage - are significantly influenced by the velocity and volume of flow in the watercourse. Given the fact that most of the watercourses in Punjab are 'Kutcha' or unlined they require periodic clearance of weeds, silt etc., to maintain velocity and discharge.

However, the organisation of this maintenance of the water courses is characterised by the following aspects which

22 These are the fixed exit points on the watercourse from which the water enters the individuals plots of the shareholders (see point F in Figure 3.3, Chapter III).

23 These are also more prone to breaches during irrigation leading to a further loss of water. Besides, very often about two to three people are required for surveillance, while availing of an individual turn. While one connects the water to the particular plot (this is also done manually), the others keep an eye on the entire length of the watercourse to plug in any breaches immediately so as to avoid loss of water during his turn. This also pushes up the labour cost of irrigation if family labour is not available. In contrast to this in the lined watercourse - one man can connect the water single handed. The area irrigated per turn also increases by about 15 percent, in case of lining. Lately, there has been some effort in this direction. The PSTC (Punjab State Tubewell Corporation) has taken on the work of lining in some of the South-Western districts, recovering the cost from the beneficiaries in installment, over a period of 7 years. But many farmers expressed that these half-yearly installments were too heavy compared to the increased benefit accruing on account of lining.
adversely effect the discharge. In the first place, it is
done manually. Being a clumsy process, repeated manual clear-
ance upsets the level of the water bed in the course. Conse-
quently, there are depressions where water collects and the
inner surface becomes uneven. This generates resistance to
the water flow affecting velocity adversely and, thereby
increasing losses. Secondly, maintenance remains the joint
responsibility of all the shareholders of the outlet. For
the flow to be maintained to the end, it is imperative for
all the shareholders to contribute to the cleaning operation.
If for some reason, some of the shareholders opt out of
this arrangement, it often leads to a disuse of canals by the
remaining shareholders as well due to the consequent reduc-
tion in discharge. Poor maintenance of the watercourse is
particularly hazardous for the tail enders since they have to
bear the brunt of cumulative losses. 24

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24 Such as, access to alternative (and superior)
source of irrigation.

25 Often water does not reach them at all during their
turn. An idea of the extent of losses systematically suffered
by the tail enders on a 'Kutcha' or unlined watercourse, can
be had from Table 4.3 below, which shows the improvement in
the productivity variables (affected at successive distances
from the head of the watercourse) as a result of lining. In
an obverse sense, it indicates the differential losses that
had been suffered by the shareholders of that outlet, along
the watercourse, prior to lining, i.e. on the 'Kutcha' water-
course. The data relate to a sample of watercourse in the
canal-irrigated tracts of South-West Punjab. A comparison
of Columns 3 and 5 shows that the losses at the tail end
had been almost four times that at the head, since it
reflects a four-fold improvement in most of the variables
after lining, over the improvement at the head of the water-
course.
During the course of our field work in the canal irrigated areas in Punjab, we found that this problem did not assume a serious proportion in the district of Bhatinda where canals were the only feasible source of irrigation and all the shareholders therefore had a vested interest in the efficient operation of the same. However, it was widely prevalent in Amritsar district which was predominantly a canal-irrigated area but where the farmers did have the option of installing their own tubewells (the latter were found to be more conducive to the adoption of HYVs). The development of this alternative source led to the neglect of canal water usage by some shareholders, thereby depriving even the others of canal water since it was not practical for them to clear the entire length of the watercourse. Further, due to this interruption of the water cycle, even sharing arrangements, as in Bhatinda district, were not possible. Hence the deterioration of the position of the small scale cultivator in terms of the access to irrigation sources. Since it is they who are typically dependent solely on canals, being unable to afford the installation of tubewells. The situation for tail enders, particularly the small land owners, is rather

26 That is, the districts of Bhatinda and Amritsar.
27 Agreements regarding water sharing between adjacent shareholders on the same outlet, arrived at, to overcome the water shortage typically associated with canal irrigation.
28 See Chapter VIII for a further discussion of the impact of emergence of tubewells in a canal irrigated area.
dismal. Case studies of some farmers illustrating the impact of water shortages for reasons as above on their economic position, are discussed in Appendix A.4.3 and A.4.4.

The point that needs emphasizing in examples such as these is that in order for the utilisation of canals to be effective it requires a degree of coordination of the efforts of the Irrigation Department and of the shareholders. While the former is responsible for the proper running and maintenance of canals to ensure regular and smooth operation of the same, the latter has the onus of organising its utilisation at the local level by attending to the distribution of water to individual land owners and ensuring the proper maintenance of water courses. If this integration is interrupted at any point, either due to laxity of the canal department or individual shareholders of the outlet opting out of the collective maintenance to adopt a better alternative form of irrigation such as tubewell, the utilisation of canal water by all the shareholders is necessarily impaired. Like the functioning of an organic system, the breakdown of any one part affects the operation of the whole, as a unit.

4.4.2 Location of 'Nakkas'

Given the discharge of the water available in the watercourse a major factor influencing the water reaching the individual field is the location of 'nakkas'. These are fixed points on the common watercourse from where the water enters each individual plot. Their location affects the
water supply to the particular plot in two ways. First, the total irrigation time allocated to a user is supposed to include the extra time, known as 'bharai', required by the water to travel from the 'nakka' prior to the one feeding his plot to the 'nakka' for his plot in the watercourse. In case this allocation is insufficient to cover the actual time taken, the effective time left for actual irrigation gets correspondingly reduced. This, in fact, is the more typical experience of those availing of canal irrigation. The water loss on this account for each shareholder therefore, depends on the distance between the two 'nakkas'. Secondly, this

29 For example, see Figure 4.1 where the owner of plot II will get the water at A. He gets 'bharai' for distance AB, irrigates his land and releases water to plot III at B from where it is carried to C by owner of plot III.

30 An idea of the extent and frequency of this loss of water time in the common watercourse, due to insufficient 'bharai', can be had by looking at columns 5 and 6 of Table 4.4, which shows the difference between the time allotted and that actually taken for the water to travel from prior 'nakka' to that of the particular fragment. The difference between columns 5 and 6 is then deducted from column 3, which shows the total available time for irrigating the plot, which being less than required anyway, is further reduced. Column 4 shows the percentage of area irrigated in one single turn, of the particular fragment, giving an average percentage of 15. Although one does not need to water the entire plot every week, on the average, one needs to irrigate the land at least once a month. That means that during each weekly turn at least 25 percent of the area should be watered. This is on the assumption that full discharge is available
A, B, and C are nakkas of farmers with plots I, II, and III respectively on the water course XY. Arrow shows the direction of water flow.
water loss is further aggravated by certain topographical features, i.e. the relative levels of the watercourse and the field at the 'naka'. If the level of the watercourse is very much lower than that of the field, significant amount of time is lost merely in 'heading' up the water in the watercourse before it is able to enter the field. However, this heading up of water is advantageous to the subsequent shareholder as he gains an extra quantum of water due to the increased velocity of flow resulting from the release of the water head during his turn. In fact, since the chain of consecutive turns is continuous in time, any locational disadvantage that one farmer may suffer, becomes advantageous to the neighbouring plot holder. As a result of these adverse externalities, if a situation prevails, where one particular cultivator is either stuck with an unfavourable location of his

regularly in the canal and there are no stoppages or missed turns. If, however, on the average one turn a month is missed, and the discharge during the other turns varies (i.e. either the farmer gets no water at all or gets less than normal), then in order to rely solely on its own time, the plot should get nearly 50 percent irrigation every week. A brief look at column 4 however, shows this to be a far cry from the actual position. Out of a total of 62 fragments, 20 manage to irrigate less than 10 percent during their own water turn. Out of these 13 fragments get no water at all during their scheduled time. This problem is much more generalised in the Amritsar villages which we surveyed, and has got aggravated with tubewells installation - as discussed later.

31. The technicalities of this aspect have already been discussed in detail in Chapter III.

32. That is as soon as one farmer's turn expires, the next one's begins.
'nakka', he may find himself unable to alter it due to the resistance offered by the neighbouring shareholder, or if his neighbour succeeds in bringing about a change favourable to him, it may adversely affects the water reaching his own plot. In this constant tussle among the shareholders, the probability of the larger land owners imposing adverse externalities on the smaller ones is higher. This is particularly so in light of the disadvantage suffered by the smaller land holders with regard to their access to the government machinery in their attempts to redress any loss on this account.33 Case studies of individual farmers who have borne the brunt of such problems are discussed in Appendix A.4.5.

33 It may be noted that the location of these 'nakkas' on the watercourse is fixed and can be altered only by applying to the Irrigation Department. However, the entire procedure is rather lengthy and cumbersome, due to the functional inefficiency, characteristic of most governmental organizations. We read from a report from the Irrigation Department (Dhillon;1978) that for instance, according to a random sampling of actual cases disposed off in two typical running canal divisions, the average time taken in the disposal of such a case upto the Divisional Canal Officers and Superintending Canal Officers is 14 and 18 months respectively. Adding another about 5 months taken in implementation of the decision of the competent authority, the total time taken in actually meeting the demand of a farmer is found to be 24 months i.e. two years . . . "but of which more than three fourth is used up for administrative legal matters" and only one fourth for the actual implementation. "With suitable administrative reforms", the same report goes on to show, "that the total time could be reduced to 6-8 months i.e. more than 65 percent of the time is being wasted due to inefficient and careless management". Not only that, every additional 'process' provides the opportunity for the free play of 'contacts, influences, corruption and other such accidental factors'. These in totality, further tend to discriminate against the majority of small landholders.
4.5 MISCELLANEOUS PROBLEMS

The following are some of the typical problems encountered by the farmers in addition to those discussed above, which further hinder the utilisation of canal water beyond the outlet:

(1) By far the most common complaint of the farmers is the unrealiability of the canal water supply. Although the department is supposed to inform them in advance, in event of a closure, this notice never reaches the farmers in time and even if it does, there is precious little they can do about it. This is particularly harmful for those who share their turns, as it further increases the interval between irrigation supplies. Illegal canal cuts, breaches and water stealing by throwing pipes further aggravates his erratic supply - specially in the drought years and during the critical periods of the crop life.

Further, the use of water accelerator, (Chatha or Burma) by some farmers, reduces the water reaching the

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34 These are based on the personal interviews with the farmers in the Bhatinda district.

35 This is discussed further in the following section.

36 This was conducted with the connivance of the irrigation department personnel. It is mostly the rural elite which dominate these illegal transactions while the weaker sections have to bear the brunt of this.
following field. 37 In addition technical factors, such as the level of the outlet relative to that of the distribu-
tory, 38 number of turns in the watercourse, 39 planting of
tree along roads 40 etc. further reduces the water supplies.

Finally the most significant hurdle, in the way of
better utilisation of canals, it appears from the complaints
of all the farmers, is the corruption and inefficiency pre-
vailing in the irrigation department, in redressing their
problems - such as, alteration of the size of outlet, its
level, waterbendi problems, adjusting 'bharai' time, etc. 41
The departmental mechanism to handle such problems was found
to be highly unsuitable. 42

37 This sucks the water from the entire length of the
watercourse, which has to be filled up again during the
following turn, at the cost of irrigation time.

38 This affects the pressure of water flow, from the
outlet. If outlet is at a high level, then the pressure
falls when discharge in distributory falls - affecting water
reaching all the farmers.

39 The flow is better in straight watercourses.

40 Planting of trees, along the roads affects land
within 8 meters radius as its roots suck up most of the irri-
gation water, leaving the crops dry.

41 For example the clerk in D-C's office charges Rs. 20-
30, for expediting the issue of notice for hearing of a parti-
cular case. It takes approximately Rs. 250-300 to get the
'wari' changed.

42 In Bhatinda district for example there was one
officer to handle the problems of more than thirty four thou-
sand farmers. This highly centralised control and authority
vested in one individual gives poor service to the public,
To sum up therefore, we can say that the water distribution through canals is characterised by the following aspects:

(i) It has an in-built rigidity of supply. That is, the user has no control over the timing of irrigation and has to adjust all his other operations according to his fixed weekly turn of water.

(ii) The control over quantity of water supplied also remains very poor. This is partly due to the technical problems associated with regulating river water supplies. However, the problem is further aggravated by losses en route - both till the water outlet, on account of poor maintenance by the Irrigation Department and also beyond the outlet until the field, due to problems associated with the sharing of this water by a collective of private individuals.

(iii) Implicit in this distribution system is a scale effect, such that the adverse consequences deriving from the mode of water distribution are correspondingly greater for the small scale users.

and secondly, enables the misuse of the power and control thus vested. The worst victim of the above were often those who could neither afford the bribe nor did they have the right political connections to exert pressure at the 'top'. Neither was there any social organisation to take up their cause. Isolated and resourceless, their helplessness is often exploited by the petty government officials at every suitable opportunity.
4.6 MODES OF CANAL IRRIGATION

In an attempt to partially overcome some of the problems associated with canal water utilisation, there have emerged different patterns of utilising the same. Typically, three major modes of canal irrigation can be identified. Below we discuss the implications, in terms of cost and efficiency of irrigation of each of these modes.

4.6.1 Irrigation Through Weekly Turn

This mode comprises of irrigating the plot during the regular weekly turn scheduled for it as per the 'warabandi'. As already discussed, the actual water available during the stipulated period depends on the discharge in the watercourse which is typically found to be short of demand, erratic and unreliable.

The cost of canal irrigation, however, is quite low in Punjab. In fact the water rates prevalent in the state are one of the lowest in the country.43 But its efficiency from the point of view of quantum and reliability of supply as well as control over timing of supply remains poor. In order to overcome some of these disadvantages the cultivators have either resorted to installing their own private tubewells

43 For example, in 1970 the lowest per acre cost of canal irrigation (this depends on the crop irrigated) in Bihar was Rs. 12.5 which is higher than the highest per acre rate for Punjab, of Rs. 11.5 for wheat (see, Report, Irrigation Commission Report, Vol. II, 1972, p. 239).
wherever technically feasible or adopted either of the
following options - i.e. sharing of turns and or purchase of
water from other land owners who, for some reason, have spare
canal "water-time". It is to a discussion of the latter two
alternatives that we now proceed, leaving the first to the
later section on tubewells.

4.6.2 Sharing Turns

This is an arrangement whereby two cultivators -
having land on the same outlet, exchange their water-turns.
For example two farmers having a weekly turn of X minutes -
enter into a private arrangement of irrigating their fields
for 2 X minutes every alternate week. A significant amount of
irrigation time, and that too the initial time, is wasted en
route and makes practically no productive contribution to the
output. But this 'wastage' is a necessary prerequisite for
the water to reach the crops. Hence the farmers' preference
for getting water in a lumpsum - although at the cost of increa-
sing the interval of irrigation from one to two weeks.

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44 For example, consider Figure 4.2 of a typical field
(DEGF) situated on a water course AB, with the 'nakka' at B.
The water losses during transit from A to B have already been
discussed. Beyond the point B the farmers usually make their
own internal water channels, for better distribution (i.e.
Bee'). There is some water and time loss in these channels
also. Although at this point relative levels can be better
manipulated by the owners, being their private plots however,
the initial water flowing into these is mostly consumed by
wetting the soil and seepage etc. - and does not contribute
to irrigation as such. It is therefore, the latter flow that
feeds the cropped area and hence, actually irrigates.
However, it may be noted first, that these arrangements are, by and large, entered into by the smaller cultivators, largely due to the following reasons. First, the above mentioned losses are higher on a per acre basis for the smaller land holders to the extent that every turn has a minimum time loss involved (i.e. the losses are analogous to minimum 'over-head' charges). All other conditions remaining the same, the relative need for sharing is therefore more acute for them. Secondly, being in an economically privileged position, the bigger land-lords can avail of better options to cut down the shortage. Finally it is not always possible to arrive at such arrangements, since it affects the surrounding plot holders. For instance consider plot holders, on watercourse A, B, as shown in Figure 4.3. Now, while 4 himself may not share with 3, he can also object to 3 sharing with 2 or, 3 can object to 2 and 4 sharing. No one will share with 5, because, being at the tail end, his irrigation time is reduced to account for the extra water which drains into his field from the entire watercourse, when the cycle is restarted. Mostly the water fails to drain on

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45. The proportion of area actually irrigated (a) per turn, to area for which water time is allocated (x) is directly related to x.

\[ \frac{a}{x} \propto x \]

46. Such as purchase of extra water time on annual basis, appropriating the special and limited quota of irrigation time meant for orchards etc.
account of depressions and level problems of the watercourse. Therefore, no one would like to share the tailender's loss. 47

Finally, as regards the cost and efficiency implications, it may be noted that sharing turns in case of canal irrigation does not affect the cost of irrigation to the cultivator, compared to the usual rates charged. But the crucial implication for efficiency is the consequent increase in the interval of irrigation, particularly for the smaller sized fragments. 48

47 Taking an example from our survey, consider the case of one Pollo Singh of village Ghudda, owner of 1.75 acres, who has his plot located as at 2 in Figure 4.4, which is at a higher than normal elevation. Therefore when he irrigates plot 2, he has to head up the water to a total height of 3.5 ft., while 1 ft. is the normal height of water in the watercourse. After his turn expires, the water rushes to C with increased speed, as plot 3 needs a lower level than plot 2 for the water to enter. Therefore, while time is lost by Pollo to head up water at B, its advantage goes to owner of plot 3 who is therefore not interested in sharing with owner of plot 2. Neither will he let the owner of plot 2 share with that of 1, as in that case, every alternate week - there will be no heading up, at B - to the 'loss' of owner of plot 3.

48 This can be explained as follows: If one of the partners in the deal has a smaller plot and therefore lesser time to exchange, he may have to forego more than one turn - before irrigating his field - in order to make up his contribution to the total time. In fact, the smaller his own plot, the lesser his weekly time, the greater will be the number of turns he will have to miss on a regular basis. Thus increasing the interval of irrigation by one week per additional turn missed. If, as is likely, there is a canal cut, the number of weeks missed consecutively can be hazardous for his crops. This can best be illustrated by considering the example of Pollo Singh from village Ghudda, who owns a total of 1.75 acres in two fragments of 1.25 and 0.5 acres. For the bigger fragment he shares with one other household, and waters his field every second week. But for the 0.5 acre plot he has to miss his turn for 4 weeks, and irrigates
Superimposed on this systematic increase in the interval between irrigation are the usual factors mentioned above, like canal closure, breaches etc. which further increase this interval. Very often it is after 3 to 4 weeks that a farmer may actually get his turn. With this added unreliability, the position of the farmer in such an arrangement, is rendered more vulnerable which is the price he has to pay for getting the marginal benefit of obtaining water in a lumpsum. With respect to this aspect therefore, the efficiency of such an irrigation arrangement, is poorer than the first alternative of weekly irrigation turns.

4.6.3 Purchasing Water

There are basically two forms of water time purchase. First, an annual agreement is reached between the buyer and seller, whereby the purchaser gets 't' minutes in the regular cycle every week. If the canal is closed on that particular day then of course the loss is his but his scheduled weekly quota is enhanced. It therefore represents an improvement in efficiency over the first alternative of scheduled weekly

---
every 5th week if the canal runs every week without interruption. He gets total of 4.5 minutes for his plot, plus 4.5 minutes for 'bharai', while in fact it takes 8-9 minutes for the same. Therefore, it takes say 8.5 minutes merely to bring water to his field while the total time with him is only 9 minutes, leaving only 0.5 minutes for actual irrigation. However, with sharing he gets a total of 22.5 minutes or effectively 22.5 - 4 = 18.5 minutes, every 5th week which waters the entire plot. Sometimes, even this is not sufficient due to low discharge. He has to miss an additional turn and water his field every 6th week. It, therefore, becomes very difficult for him to 'absorb' a canal cut or missed turn unlike those with weekly turns and lower intervals of irrigation.
tums, in so far as it affects the total quantum available. However, the reliability and control over the supply of this quantum remains the same, though better than the second alternative (i.e. of sharing turns) since the cycle remains a weekly one. The availability of increased quantum makes it possible to have a greater flexibility in the distribution of water within the plot affording a higher overall irrigation security, with a suitable mix of crops.

The second form of purchase is that of an individual and isolated transaction - conducted whenever, for some reason, spare water time is available for sale with a farmer. There is absolutely no certainty of its availability or prior commitment by the seller, the understanding being, that he will sell if and only if, his own needs are first satisfied. Therefore if, for example, the canal flow is less or there was no water during the preceding week, the seller is perfectly within his right to refuse. It follows that this irrigation facility is least likely to exist when the need is most acute. Hence a farmer dependent on this mode have the maximum insecurity, because if he fails to get water during the critical juncture in the crop life, his investment on the earlier irrigations as well as on other inputs (fertilisers, seed, pesticide, labour etc.) goes waste. Cost-wise also, paying on a per-irrigation turn basis turns out to be the most expensive. From the point of efficiency and cost therefore, this mode remains the worst among all above.
## TABLE 4.1
Total Demand and Supply of Water at UBDC Headworks (cusecs)

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<th>1976 Supply</th>
<th>1979 Demand</th>
<th>1979 Supply</th>
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Source: Office of the Superintending Engineer (Canals), Irrigation Department, Punjab Government, Amritsar.
**TABLE 4.2**

Area Assessed for Revenue (1970-71 to 1979-80) for Outlets for Village Ghuddha, District Bhatinda (acres)

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* Kharif  
\( ^{\text{\textdegree}} \) Rabi

**Source:** Office of the Executive Engineer (Canals), Irrigation Department, Punjab Government, Bhatinda.
### TABLE 4.3
Impact of Lining of Watercourse on Productivity Variables

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<th>Sl. No.</th>
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<td>4.</td>
<td>Water use efficiency**</td>
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*In terms of percentage improvement over the pre-lining level at corresponding location on the watercourses.

**The time taken to irrigate one hectare.

### TABLE 4.4

Area Irrigated per Turn and Time Loss for 'Bharai' Under Canal Irrigation in District Bhatinda

<table>
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<tr>
<th>Household No.</th>
<th>Size of fragment (acres)</th>
<th>Total 'wari' for the fragment (mins.)</th>
<th>Proportion of area irrigated per single 'wari'</th>
<th>Time for 'Bharai' (mins.)</th>
<th>Actual</th>
<th>Allotted</th>
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<td>5</td>
<td>10</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

| 23. | 4   | 20  | 25  | 10  | 3   |

| 24. | 22  | 124 | 7   | 15  | 0   |

| 25. | 3   | 15  | 8   | 18  | 10  |
| 12  | 60  | 8   | 8   | 3   |
| 6   | 30  | 20  | 18  | 8   |

| 26. | 3   | 15  | 16  | 8   | 2   |
| 9   | 40  | 11  | 10  | 0   |
| 8   | 40  | 13  | 10  | 0   |

| 27. | 4   | 20  | 13  | 9   | 7   |

Source: *Field Survey, District Bhatinda, 1980.*

This fragment is a part of the Harijan co-operative land, for which all water is delivered at one point, without allotting any extra time for internal distribution of this water.

'Wari' is the amount of time allotted to a particular plot, during which the discharge available in the watercourse can be used for irrigation of the plot.
MAJOR ITEMS OF REPAIR AND MAINTENANCE OF CANALS

1. **Strengthening of the Embankments**: This involves maintaining the specified width and slopes of the channels and the masonry works and keeping the banks free of any growth. Breaches of weak sites can cause large scale damage to life and property.

2. **Weed Clearance**: A problem particularly associated with the Bhakhra canals carrying silt free water. Excessive weed growth reduces the carrying capacity of a channel and adversely affects the water distribution, specially for the tail-enders.

3. **Berm Trimming**: Berms are formed by the deposit of fine silt in the channels and though they help to guard against the bank breaches, their haphazard growth can obstruct smooth flow and reduce the water reaching the tail end. Normally it should be done about once in 5 years.

4. **Silt Clearance**: This is one of the major maintenance works, the implications of which have already been discussed. However, it should be done only after ascertaining the need for it—silt deposit and scouring are both harmful and the right balance had to be maintained.

5. **Checking of Outlets**: Periodic check has to be maintained to see that it draws its authorised supply, no more and no less.
6. The proper functioning of a channel is always testified by the condition and flow at its tail. The record of discharge at this point is required to be kept regularly to ascertain whether the flow en route has been as designed.\(^1\)

A violation of most of these requirements has been observed in the case of canal networks in Punjab particularly in the UBDC and SC systems, i.e. the canals that irrigate areas in Amritsar and Bhatinda districts (see Appendix A.5.2).

\(^1\)For further details see Irrigation Department Letter (1964).
APPENDIX A.4.2

STATE OF MAINTENANCE OF CANALS

The poor state of maintenance of canals in Punjab as well as the inadequate financial allocation for the same can best be gauged from a review of a sample of the correspondence dealing with the subject. Below are given extracts of correspondences in the Irrigation Department which graphically report the situation.

1. Letter from the officer incharge of the U.B.D.C. Circle 1 to the Chief Engineer (Irrigation Department, Letter: 1979a)

"During the inspections of the various channels of Upper Bari Doab Canal, it has been observed that the general condition of the channels is extremely bad. Not to speak of distributaries and minors, even the main canals and branches, at some of the vulnerable points are in a very precarious condition. Some of the breaches are badly scoured reducing the bank width at top to hardly 10 feet against the designed width of 20 feet. Such sites are liable to breaches any time. If such a catastrophe arises, vast stretches of land shall be submerged causing huge damage.... Actually during the last 5 years due to the paucity of funds, no substantial reconditioning and repair work has been done on these channels. The beldars employed on canals at the rate of one beldar for three miles can hardly cope with the work of watching and closing small cuts caused by cattle trespassing.

I am enclosing herewith a list of vulnerable sites along the main canals, and branches and distributaries where the banks are extremely weak and liable to breach any time. The total cost of repairs would be Rs.21.0 lacs. No work has been done in these breaches during the last 5 years.

The distributaries and minors have also silted up badly and silt clearance have not been carried out during

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1 These are administrative divisions of the Irrigation Department dealing with separate canal networks.
the last 5 years. The berm formation has also been enormous. The bed width has been reduced considerably. It is very difficult to feed the tail outlets. The demand is very keen and enormous because the cultivators have started sowing crops which need high delta. During the last kharif when the rain failed, it was very difficult to give authorised supply to all the outlets. A large number of cuts and cases of unauthorised irrigation took place during that period. This led to enormous increase in the number of complaints received from the irrigators.... The total cost therefore comes to Rs.95.0 lacs. Against this requirement, the total allotment for the current year was Rs. 34.0 lacs only. This would show that this allotment is very meagre. It will not be out of place to mention here that the budget grant has practically remained the same i.e. Rs.30 lacs in 74-75 and Rs.34.0 lacs in 79-80 whereas the price index has nearly doubled during the last 5 years”.

Further.

“It was requested that Rs.60.00 lacs over the normal maintenance budget should be arranged so as to carry out urgent repairs to the channels in U.B.D.C. tract, which have remained neglected due to inadequate funds in the past. These urgent repairs should not be spread over a period of three years as these have remained neglected already for a considerable period. In case of any mishap in a branch or main canal, the damages may amount to lacs of rupees. These works therefore should not be delayed further.

In addition to above urgent repairs, the maintenance grant should be adequately increased so that channels are never allowed to reach such a stage of negligences. In spite of the best efforts, it has not been possible to trace out any norms which have been fixed for the maintenance of the running canal system. An attempt has been made to frame such norms on the basis of the experience gained on the maintenance of these channels. Normally a channel needs repairs after a period of about 6 years. These repairs are due to the constant running of water in canals, stress passing by cattle and the weather action e.g. rains, wind etc. This wear and tear also depends on other factors such as intensity of rainfall, the height of the embankment and quality of soil. Where the channels are in high filling and the intensity of rainfall is also high, the damage to canal banks will be more than in places where there is less rainfall or where the channels do not run in heavy filling. Similarly, the canal banks are prone to more repairs in Kailar or sandy areas than in areas where the soil is better textured. The size of the channels is another important factor. The damage to banks is more on smaller channels as compared to
bigger channels. The regular gangs employed on the channels
at the rate of 1 beidar for 1½ miles for main canals and
branches and one beidar for 3 to 4 miles for distributaries,
and minors are just sufficient to keep a watch on the chan-
nels, repair cuts caused by cattle trespassing, maintain
the roads and jungle clearance etc. They are not capable of
undertaking the heavy repairs which occur in a period of
about 5 years.... The inflow of silt is very heavy in case
of U.B.D.C. system. It has been experienced that in small
distributaries and minors with discharge upto 100 cusecs,
the berm cutting becomes essential in period of about 2
years. Special funds shall have to be earmarked for the
maintenance of headworks, such as repairs to under sluiceds
and barrage after every flood season, painting of gates and
steel structures, replacement of wooden deckings, repairs
to the protection works in the river etc. Only a lumpsum
provision can be made for these works. An amount of
Rs.10.0 lacs would be needed every year.

The amount for the maintenance and repairs for the
U.B.D.C. system, on the above norms comes to Rs.108.0 lacs.
Adding Rs.25.0 lacs for the A.M. & R. estimates i.e. emolu-
ments of workcharged staff, running of vehicles and provi-
ding uniforms etc., the entire amount comes to Rs.133.0 lacs.
This amount is based on the present price index. In case of
further increase of index, the amount shall have to be
increased accordingly.

It will be of interest to note that the present
allotment for maintenance and repairs is hardly Rs.34.0
lacs against a requirement of Rs.133.0 lacs. The quality
of maintenance can be well imagined for these figures
(Irrigation Department, Letter:1980b).

Further,

"During my inspection of part reaches of main branch
lower, and K.B.L. of your circle, it was found that the
maintenance of the channels was far from satisfactory and
the condition of some reaches was dangerously poor. The
banks are scoured at a number of sites. In long stretches
even the berm are not formed. These short-comings threaten
the safety of the channels and make them unfit to run to
their full supply.

Dowel and distance marks in long reaches are missing.
Inspection roads are poorly maintained, embankments in the
sections are danger for driving even for inspections.

Non-inspection banks are in worst conditions and
do not appear to have ever been visited by officers/officials"
(Irrigation Department, Letter:1979b).
2. From the officer incharge of Porezpuri Circle to the Chief Engineer (Irrigation Department, Letter:1980a)

"The perusal of the Maintenance Grant indicates that it had been too meagre for the last few years, with the result, requisite maintenance works could not be undertaken. The general condition of the channels particularly from maintenance point of view is far from satisfactory. The works of strengthening weak banks/berm cutting, silt clearance etc. are required to be done. Under these circumstances, the channels do not remain fit to carry their authorised discharge at the tail ends. Similarly, due to weak reaches, breaches do occur, which not only wastes the precious water which comes from stored sources after travelling a distance of 150 miles, but the irrigation is also adversely effected. It is therefore, of utmost importance that the channels are kept in good shape so as to ensure authorised and dependable irrigation supplies to the irrigators.

Central Water Commission had already fixed norms for maintenance of the canal systems where Rs.60.00 per hec. of C.C.A. or an area irrigated whichever is greater, has been recommended. In accordance to the above norms fixed by the Central Water Commission, the amount required for maintenance and allocated (average for the last 5 years) are tabulated below:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Head of account</th>
<th>C.C.A. (lac)</th>
<th>Average allocation for the last 5 years Rs.(lacs)</th>
<th>As per recommendation of CWC Rs.(lacs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>333-I.N.D. &amp; F.C.P.A. Irrigation Project (Commercial) N-Plan Five Year Project</td>
<td>2.96</td>
<td>24.39</td>
<td>148.24</td>
</tr>
<tr>
<td>2.</td>
<td>333-I.N.D. &amp; F.C.P.A., Irrigation Projects (Commercial) N-Plan, S.V.P. (Maintenance)</td>
<td>1.48</td>
<td>23.31</td>
<td>73.75</td>
</tr>
<tr>
<td>3.</td>
<td>332-M.P.R.P., A-Bhakra Nagal Works (Commercial) N-Plan, Makhu Canal System</td>
<td>1.08</td>
<td>8.35</td>
<td>54.29</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5.52</td>
<td>56.05</td>
<td>276.29</td>
</tr>
</tbody>
</table>
From the perusal of the above table, it is abundantly clear that the maintenance grant of this circle is insignificant when compared with the norms fixed by the C.W.C."

Further,

"As we are aware, Ferozpur Feeder stands extensively scourcd/damaged down-stream rail-road bridge at R.D. 5700 Ferozpur Feeder, where a scour to the extent of 45 ft. below the bed of the canal has occurred. Special repair works so as to protect the banks from being cut flanked by way of erosion and bed so as to save bridge of National Highway No. 15, are required to be taken, which may cost about Rs.10.00 lacs" (Irrigation Department, Letter:1080c).

3. Similar evidence is available for the canals of the Patiala Circle, as per the following memorandum (see Memorandum:1981)

"Maintenance of irrigation channels over the years has been constantly suffering deterioration with the result that a stage has come that this whole aspect of transport and distribution of water through ill maintained systems needs to be thoroughly gone into and over-hauled to bring these channels into reasonable shape for efficient regulation and distribution of supplies through various networks in the State. The main reasons responsible for the above state of affairs are listed as hereunder:

(i) Since the independence of the country these canals, their banks and inspection roads have got thrown open to the village populations and public in general settled along or across the various canal networks. The canal embankments are excessively subjected to cattle trespass for giving water to the animals, day and night. Washing of clothes on the banks is also a regular feature these days. The inspection roads too which were previously exclusively used for inspection vehicles only are now being widely misused through trespass by tractors, bullock-carts and all sorts of vehicles at the time of sowing, as well as harvesting. This has very much eroded bank section of canal network over besides forming dangerous ghat points at all bridge sites as well near village abadis.

Unfortunately frequent attention and proper upkeep of channels has not been possible because the maintenance funds over the years have practically remained stagnant whereas the cost of earth work since independence has gone
up nearly 20 times. Position in respect of masonry works is no different either. On the other hand the labour rates as well as the pays of the workcharge establishment has gone up ten fold with the consequence that it has directly resulted in the widespread deterioration of canal embankments and their capacity to carry authorised discharge.

This has also encouraged cultivators to disrupt supplies through frequent cuts and put the blame on the weak embankments. Sometimes breaches also do occur which puts additional strain on the meagre maintenance expenditure besides disturbing the water distribution to a large population of cultivators whose sole dependence, most often, is on the canal supply with high value inputs already invested in their crops".
APPENDIX A.4.3

WATER SHORTAGE - CASE STUDY I

A farmer from Fatehpur village in district Amritsar has his only plot of 4.5 acres at the end of outlet no. 25089/R on this Amritsar distributory, for which he has a total 'wari' of 7 hours. However, for the last five years this time is not sufficient to water even one acre, although earlier he could irrigate 2-2.5 acres during a single turn. This water shortage is largely on account of the following:

First, the 'bharai' is allotted at the rate of 5 minutes per acre while in fact it takes 10 minutes for the water to travel the same distance. Secondly, the irrigation department has altered the bed of the distributory in such a manner as to have a sudden sharp incline in order to increase the water speed to enable it to reach the tail end. However as a result of this the water pressure at the outlet is quite low, affecting the discharge in this particular watercourse - and therefore, the water reaching the tail end of this watercourse. Thirdly, the bed of the distributory has scoured due to repeated silt clearance\(^1\) lately, further reducing the head at the outlet. Fourthly, due to the reduced pressure at the outlet, the larger land owners have resorted to the

\(^{1}\) As the contract for clearing the silt had been auctioned off to a brick kiln-owner nearby, who used the silt for brick making.
practice of erecting temporary dams across the distributory to head up the water during their turn (of usually over 20 hours). These dams are removed after their turn expires, which leads to a sudden reduction of the water level in the watercourse. The total time required by this particular farmer to again erect the dams and re-raise the water level, would totally exhaust his turn.

His utilisation of canal water, therefore, had been reduced to zero and he was forced to depend on tubewell water. However, he mentioned that he did not find it economical to install an electric tubewell of his own partly due to the delay in getting an electric connection, with the consequent blockage of deposit money (approximately Rs. 500) for a lengthy period but predominantly, it was due to the prospective under-utilisation of the tubewell following from the small size of his holding. The other alternative of purchasing water from another electric tubewell nearby was also found to be uneconomical due to the high rates charged for the water, which had increased lately (nearly Rs. 4 per hour at the time of the interview) in spite of the fact that the flat rates charged for the electricity had in fact, declined from Rs. 95 (per month for a 5 H.P. motor) in 1975 to Rs. 65 in 1979. Besides, this farmer complained of having to perform unpaid labour on the land of those who sold tubewell water. Finally, the only effective alternative open to him was to install a diesel operated tubewell, in which case also, he complained of the lack of availability and high price of
diesel, as the major constraints on its utilisation. The monthly ration quota of 25 litres was sufficient only for a day for him and he had to satisfy the rest of the demand by resorting to the black market, paying three to four times the official price of diesel (Rs. 1.73 per litre in 1980). As a result of the diesel shortage at the required time, his rice crop on 3/4 of an acre was totally destroyed, entailing a loss of the following investment he had already carried out:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Ploughings</td>
<td>Rs. 72.00</td>
</tr>
<tr>
<td>11 water sluashing(^2)</td>
<td>Rs. 60.00</td>
</tr>
<tr>
<td>Seedlings</td>
<td>Rs. 80.00</td>
</tr>
<tr>
<td>Diesel (50 litres)</td>
<td>Rs. 82.00</td>
</tr>
<tr>
<td>Sowing (labour)</td>
<td>Rs. 42.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Rs. 336.00</strong></td>
</tr>
</tbody>
</table>

\(^2\)This is a process whereby the water and soil is mixed together by ploughing a heavily watered plot. It is required for soil preparation for rice cultivation.
APPENDIX A.4

WATER SHORTAGE - CASE STUDY II

Another farmer from village Ibben Kalan, having a 5 acre plot at the end of another watercourse (25202/L) taking off from the same distributary mentioned that water does not fill even one acre of his tail end plot in his total turn of 10 hours while earlier on it used to take about 3 hours to fill an acre. The situation has deteriorated since 1973-74. He therefore uses all his 'wari' for another plot of 5 acres in the middle of the watercourse, using tubewells on the other fragment. For this second plot also it takes 10 hours to water one acre. In addition to the canal supply he has a 1/3rd share of an electric tubewell for this plot. Given the unreliability of canal water, he mentioned, that the cultivation survives primarily on tubewell irrigation, with the former playing more of supplementary role.
APPENDIX A.4.5

LOCATION OF 'NAKKA' AND IRRIGATION

Case Study I: Baldev Singh of village Ghudde in district Bhatinda owns a plot of 2 acres (Z) at a distance of 5 acres from the water outlet, as shown in Figure A.4.1.

Two other landlords owning X and Y plots of 5 and 10 acres respectively are relatively located as shown in Figure A.4.1. The order of water turns is as follows. Owner of X which has its nakka at A has the first turn. It gets water at A and leaves it off at A when its turn expires. Next turn is for plot Z, whose owner has to bring the water from A to B and water his plot from B, from where the owner of plot Y takes on directly as B is situated on his land. The burden for carrying the water from A to B therefore falls entirely on the owner of plot Z. The time allotted for the water to travel from A to B is only 10 minutes while in fact it takes 30 minutes. Out of a total of 60 minutes for plot Z, 20 minutes are lost en route. Secondly, the level of his land (i.e. plot Z) is higher than the watercourse and even with use of 'chattha' he can water only 1/8 of his plot per turn of 40 minutes. Although the owners of both Y and Z water their fields from B, the loss at a higher per acre rate for plot Z falls entirely on the small holder, while owner of the 10 acre plot (i.e. Y) has the advantage of getting water delivered right at his field, thus escaping all the losses.
Fig. 1

Distributary

watercourse

X (5 acres)

Y (10 acres)

Z (2 acres)

Fig. 2

Distributary

watercourse

X

Y

Z
Baldev Singh had applied to the Irrigation Department for a change of the order of turn (i.e. owner of Y should take water after the turn of plot X), as well as getting water somewhere between A and B, so that owner of Y shares at least part of the loss in transit. It has taken him 3 years and cost him Rs. 1200 in addition to the harassment of making frequent trips to the head quarters but the case is still pending and nothing has been done so far. With the alterations, he feels he could manage to get 20 mls. of grain from the plot whereas at present he gets only 3 mls.

Cast Study II: The same Baldev Singh has another 1 acre plot (Y) on a different water course, as shown in Figure 2. He has a total turn of 11 minutes for his plot, in addition to 5 minutes to get the water from A to B i.e. a total of 16 minutes. The order of turns is as follows. First plot Y brings water from A to B irrigates from B. Then, owner of plot X irrigates from B followed by owner of plot Z who takes water from B to C and irrigates from C. However due to the high level of plot Y it takes at least 20 minutes for the water to head up at B and start entering plot Y at B. That is, in a total of 16 minutes, the water does not even enter his field at B. He is unable to cultivate his plot altogether and instead sells his water to owner of plot Z at C. But it takes 8 minutes for water to travel from B to C. Therefore only 8 minutes which are left over are sold to owner of plot Z @ Rs. 1000 per year for
1 hour/week; that is he gets either Rs. 125/- per year or equivalent grain from owner of plot Z. Owner of plot X however, continues to take water only at or after point B and not before, i.e. between A and B. Baldev Singh feels that if owner of X takes his turn before him and gives water - say at D, he would be able to cultivate 0.5 acre of his 1 acre plot every season. Assuming an average yield of 10 quintals/acre of wheat and paid costs of a maximum of Rs. 400/- per acre and Rs. 117/- per quintal as the price of wheat, he could get a net profit of Rs. 770/- per acre or Rs. 385/- per season on his half acre. As against this possibility, he gets only Rs. 62.5 per season by selling his water, suffering a potential loss of Rs. 322.5 every season.