CHAPTER - III

SPATIO-TEMPORAL CHARACTERISTICS OF IRRIGATION

1. Need for irrigation
2. Sources of irrigation
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   - ii) Canal irrigation
   - iii) Other irrigation
3. General pattern of irrigation
4. Intensity of irrigation
5. Methods of irrigation
   - i) Furrow irrigation
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In the earlier chapter, an attempt has been made to highlight the physiographic and demographic characteristics (Section - I) of the region. Beside this, cropping is also analysed as a geographical back drop for further investigation viz. irrigation. Present chapter deals with spatio-temporal analysis of irrigation in Phaltan tahsil. The emphases have been placed on the sourcewise distributional patterns of irrigation, its intensity and moreover specific attention has been paid to examine the requirement and development of irrigation in the region. The analysis is made at block level and comparative analysis is attempted for the duration of 1959-63 and 1989-93. Thus, the main purpose of this chapter is to examine spatial and temporal patterns of different aspects of irrigation to understand to what extent and volume the changes have taken place during the last 35 years in the region. The circle level data has been utilized which is obtained from secondary as well as primary sources. The collected data were processed by employing appropriate statistical techniques. The author has used maps, tables and graphs to show geographic relationships.

1. NEED FOR IRRIGATION :

In view of the remarkable variations in space and time of monsoon rainfall the region needs considerable quantity of water for irrigation as the region falls in

rainshadow zone of Western Ghats. Whatever monsoon rainfall, received to the region, is scanty and uncertain as well. Under such circumstances, the entire agricultural landscape requires artificial supply of water in the form of irrigation. During the post-monsoon period, in certain parts, though rainfall is heavy it is concentrated for a short duration which has never affected watertable or water regime favourably. In these areas, provision of irrigation facilities for growing more than one crops in a year is essential (Datta and Sundharam,1974).

Fig.2.3 shows the distribution of average annual rainfall in the Phaltan tahsil. It indicates that the distribution of the rainfall varies from part to part and averages are about 500 mm in the north and east. Near 50 percent area receives 500 mm rainfall and about 48 percent area has 500 to 600 mm rainfall. Remaining 2 percent area receives more than 600 mm rainfall. Fig.2.3 also shows that isohytes run in northsouth direction and rainfall decreases from west to east. Such uneven distribution of rainfall leads for drier requirement of irrigations to agriculture. Due to these variations the region needs irrigation even in the rainy season, particularly, when there is a long gap between two spells of monsoon rain. An assured water supply is one of the conditions which is very essential for crop growth in the region.

Timely distributions of rainfall within the region are also highly uneven (Table 2.2). The region, as a whole,

has 2631.53 mm annual average rainfall. Out of it more than 84 percent is concentrated in five months viz. June to October. The months of November, December, January, February and March are almost rainless. Thus, there is greater need of irrigation after rainy season when growing crops require artificial supply of water with the increase in temperature and consequient dryness during summer months (March,April,May). The requirement of irrigation water is further intensified, particularly for sugarcane cultivation as it consumes more water.

2. SOURCES OF IRRIGATION :

The sources of irrigation in the study region are largely affected by the physical features such as topography, geology, soils, presence of ground water and climatological conditions etc. Presently the region has three different sources of irrigation viz. well, canal and other sources of irrigation (lift and seasonal provisions from percolating tanks). The different modes of irrigation were characterised by the change in their ranking order. Consequently the wells ranked first 63.40 percent, canal second (33.30%) and other sources third (3.30%) during 1989-93 (Table 3.1). Such hierachical position was existing during 1959-63. The well irrigation is dominant in the tahsil occupying about 63.40 percent of irrigated area. This may be due to percolation from the Nira Right Bank Canal system and water percolating

tanks as well. The canal irrigation occupies about 33.30 percent of the total irrigated area. The other irrigation covers nearly 3.30 percent. The distribution of irrigated hectarage, related to total irrigated area and total cultivated area, may therefore, give a more realistic pitucture. Such relations are computed and mapped sourcewise for each of the circles. The volume of change for two different points of times is computed by considering the change in occupancy strength of individual source of irrigation.

Table 3.1 : Phaltan tahsil - Area under different sources of irrigation (1959-63 and 1989-93).

(area in hect.)

Sr. No.	Sources of Irrigation	1959-1963 Average	1989-1993 Average	Percentage change 1959-63 to 1989-93	Absolute increase (Ha.)
1	Wells	21580.38 (59.08)	40629.84 (63.40)	+ 4.32	19049.46
2	Canals	13755.30 (37.66)	21340.53 (33.30)	- 4.36	7585.23
3	Other	1193.42 (3.26)	2150.05 (3.30)	+ 0.10	956.63

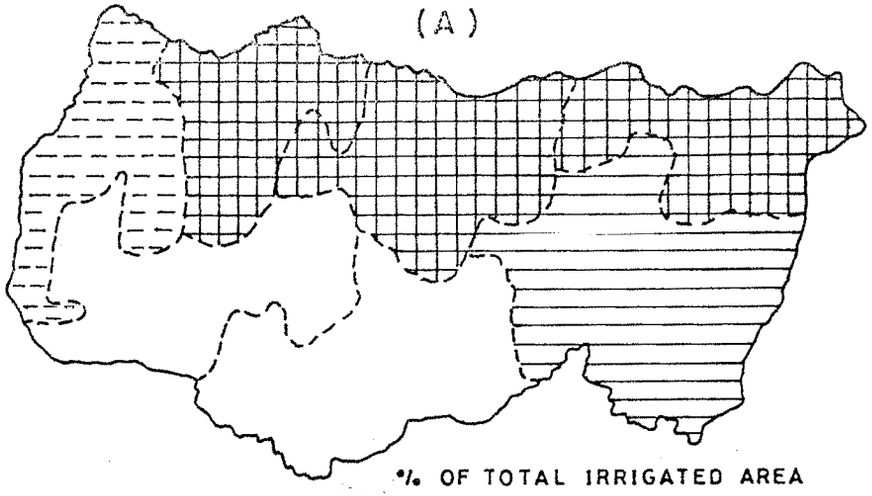
Note : Figures in bracket indicate percentages to total irrigated area.

SOURCE : Compiled by the author, 1995, based on data collected from tahsil office, Phaltan.

PHALIAN TAHASIL

Canal irrigated area 1989-93

(A)



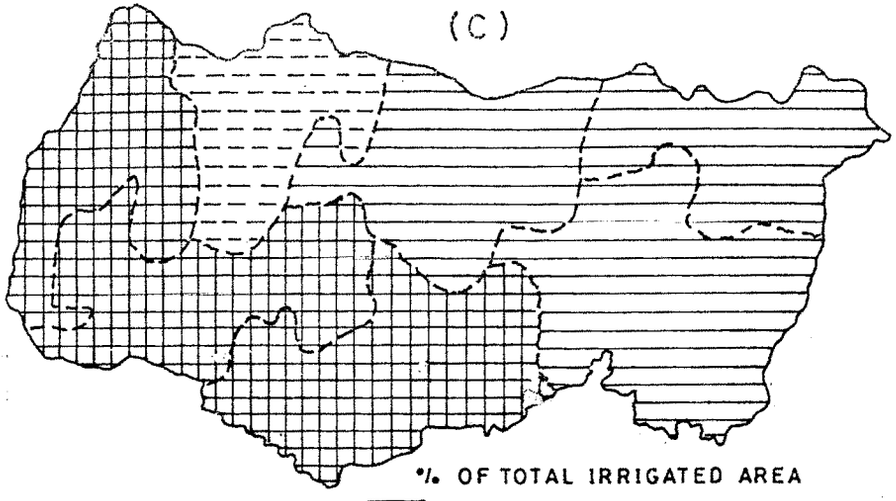
% OF TOTAL IRRIGATED AREA

65·0
40·0
NIL

R.A. 40·18

Well irrigated area 1989-93

(C)



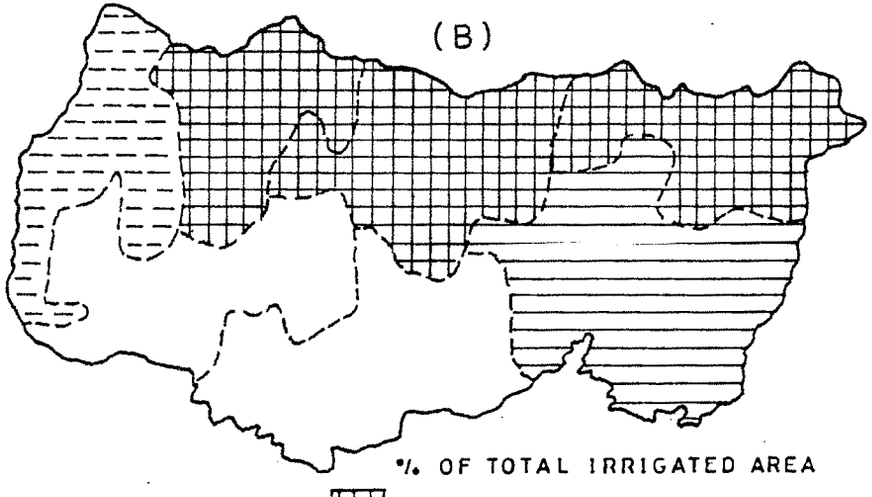
% OF TOTAL IRRIGATED AREA

65·0
30·0

R.A. 63·21

Canal irrigated area vol. of change 1989-93

(B)



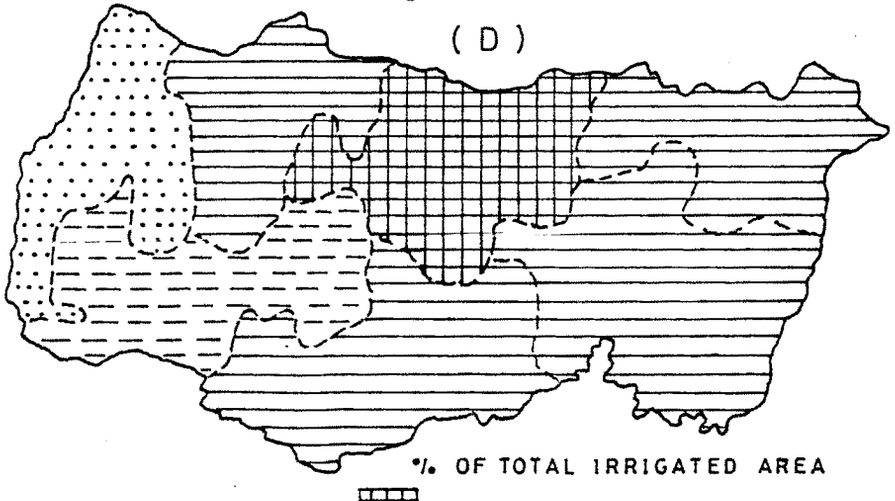
% OF TOTAL IRRIGATED AREA

30·00
15.00
NIL

R.A. 15·10

Well irrigated area vol. of change 1959-93

(D)



% OF TOTAL IRRIGATED AREA

+ 30
+ 10
0
− 15

N

2 0 2 4 6 8 10 KM.

i) Well Irrigation :

Well is the leading source of irrigation occupying 63.40 percent of (40629.84 hect.) of the total irrigated area in the region in 1989-93 as compared to 54 percent of state level. It has been widely practiced in the areas where irrigation by canal is not possible. It is the traditional form of irrigation utilizing ground water.

Well irrigation is not advisable where the depth of the sub-soil water exceeds 30 meters for beyond that depth the cost of lifting water is high as compared to the value of the crops raised (Singh,1976). In the study region the depth of wells ranges between 10 to 15 metres. From this point of view, the well irrigation seems to be suitable during dry period in the south and western parts. The study region receives monsoon rain which is confined only to 2 or 3 months of the year when the monsoon fails the rainfed crops also fails. Hence, this source has predominent place in the western and southern parts of the study area.

Regional pattern -

Fig.3.1-C shows the spatial pattern of well irrigation in 1989-93. The very high (about 65 percent) area, under well irrigation, is observed in Girvi, Adarki and Taradgaon cicles, due to favourable ground water. Phaltan, Aussu and Barad circles have moderate (30 to 65 percent) area irrigated by wells. The low

(below 30 percent) is noted in Hole circle. This is due to reletively high proportion of canal irrigation which have led for intensifying the rate of percolation. The topographical characteristics, especially nature of slope and undulating topography are other important determinants to enrich the watertable of the region.

Changes in Well Irrigation -

The last 30 years have witnessed an increase in well irrigation. It is increased by 19049.46 hectares from 21580.38 hectares (59.08%) in 1959.63 to 40629.84 hectares (63.40%) in 1989-93 (Table 3.1). The high significant positive change in area (above 30 percent) under well irrigation is observed in Phaltan circle (Fig.3.1-D). The moderate (10 to 30%) is noted in Hole, Aussu, Barad and Girvi circles. The low positive change (0 to 10%) observed in Adarki circle. Except few parts, the region has shown positive change in well irrigation which may be attributed to loan facilities though co-operative banks and government agencies. Besides, the farmers are well awared about the changing technology in agriculture to obtain maximum benefits.

Spatial Distribution of Wells -

The behaviour of watertable and the topography determine the physical setting of the well (Pawar,1982). Well irrigation is an important source of irrigation in the region where the irrigation by lift or other source is not possible.

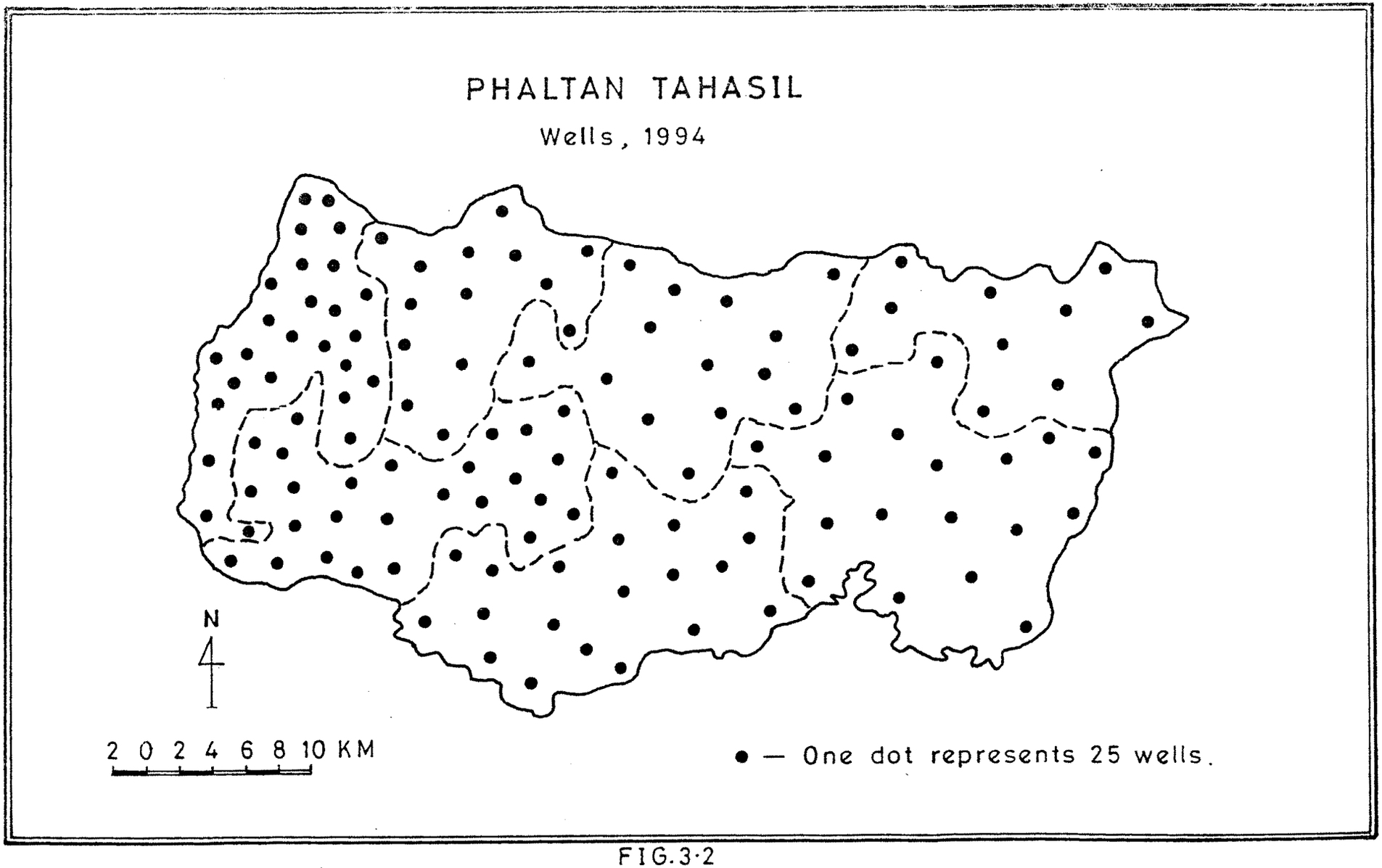

PHALTAN TAHASIL
Wells, 1994
N
2 0 2 4 6 8 10 KM
● — One dot represents 25 wells.

FIG.3·2

As the cost of construction of well is comparatively low, they are well suited to poor and marginal farmers.

There are 3251 wells in the region but their spatial distribution is very uneven. Tardgaon, Adarki, Girvi, Barad circles have the high concentration of wells. This could be attributed to the favourable watertable, moderately sloping land and medium fertile soils. Assu circles has less number of wells (Fig.3.2).

Scope for Development -

The region has greater potential for well irrigation. There is plenty of scope for digging additional wells in the region. The technological and financial aid should be provided to the farmers in a cheaper but careful manner so that there will not be any isuse of aid. The government agencies should provide the information regarding the watertable and geological structure at the location of wells. Recently, it is observed that the small farmers and marginal farmers have received financial aids through Jawahar Yojana, under Central Government funding systems. Howerver, extreme southern hilly part presents physiographic constraint for the development of well irrigation. The individual farmers are largely involved in boosting up well irrigation.

ii) Canal Irrigation :

It is another source of irrigation in the region in which water is utilised by gravity flow. It requires almost plane topography having less degree of slopes. The canal irrigation is the most significant source, due to its certainty water. It is developed along the river Nira, where deep black soils, moderate slope of the land and perennial source of water are available. It contributes about 33.30 percent (21340.53 hect.) in 1989-93 (Table 3.1) of the total irrigated area in the study region. The government has developed canal system along the Nira river in 1957-58 where the Veer Dam was constructed on the river Nira at Veer village. The Nira right bank canal runs in the study region.

Regional pattern (1989-93) -

The canal irrigation shares 33.30 percent (21340.53 ha.) of the total irrigated area in the region (22.59% state average). The canal irrigation is confined to the northern parts of Phaltan tahsil and its regional development is uneven. There is comparatively higher proportion (above 65%) of the irrigated area by canal, mainly in Hole, Phaltan and Aussu circles of the study area (Fig.3.1-A). Moderate (40-60%), by this source, is observed in Barad circle whereas low proportion (below 40%) is observed in Taradgaon circle. Girvi and Adarki circles has no canal irrigation due to their unfavourable physiographic conditions.

The regional pattern of canal irrigation is mainly linked with the physiographic favourabilities.

Changes in the Canal Irrigated Area -

During the period under review, the area irrigated by canal has increased by 7585.23 hectares. However, as compared to the development of other sources it has lost its share by 4.36 percent (Table 3.1).

The positive high change (above 30%) is observed in Hole, Phaltan and Aussu circles. Whereas moderate (15 to 30%) change is noted in Barad circle and low (below 15%) change is observed in Taradgaon circle (Fig.3.1-B). The awareness among the farmers to undertake commercial farming of sugarcane has led for the more water requirement, mainly from the canal.

iii) Other Irrigation -

The recent years have witnessed technological advancement in irrigation. The close network of rural electrification has made possible to set high capacity pumpsets along the river or water sources and water is lifted and made available to farms through pipes. This is mainly a modern device but it has become popular on co-operative basis because of its benefits over other sources of irrigation.

The term lift irrigation refers to lifting of water from the surface flow of nala, river, canal, tank, lakes etc.

with mechanical power and supplying to nearby farms through cement or plastic pipes. The sources of lift irrigation schemes depend upon perennial nature of the rivers. The obstacle of slope is eliminated here as the water is supplied to the fields for a distance ranging from 3 to 10 km from the river bank. The present lifts are operated on Nira river banks in the study area by constructing Kolhapur type weirs. There are 37 lifts with the capacity ranging from 10 to 40 Hp. They are in operation on co-operative basis. Besides some individuals have also set up lift irrigation schemes. However, poor indivisuals are unable to afford them due to high cost. The farmers co-operative lift irrigation societies have helped to bring large areas under irrigation.

Regional pattern (1989-93) -

In the tahsil, about 3.36 percent area is irrigated by other sources (about 6 percent) (Fig.3.4-A). High proportion is found in Hole circle. The moderate proportions (5 to 6%) are confined to Aussu circle where the canal and well irrigation are equally dominant. The low percentage (0 to 5%) is noted in Phaltan circle where canal and well irrigation are dominant but Barad, Girvi, Adarki and Taradgaon circles have poor share of this type of irrigation due to physiographic barrier and lack of perennial streams.

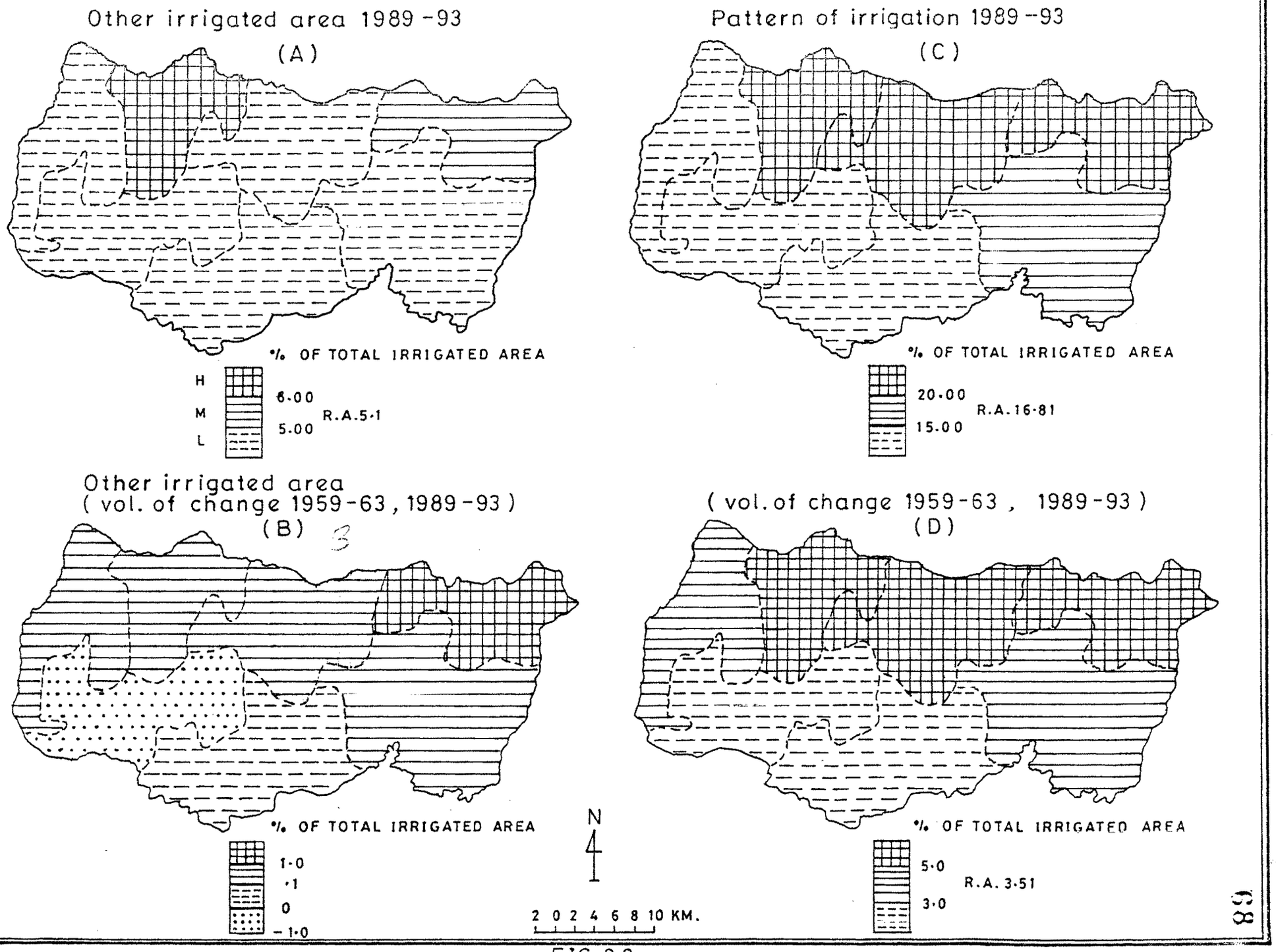

Other irrigated area 1989 -93
(A)
% OF TOTAL IRRIGATED AREA
H
M
L
6.00
5.00
R.A.5·1
Pattern of irrigation 1989 -93
(C)
% OF TOTAL IRRIGATED AREA
20.00
15.00
R.A. 16·81
Other irrigated area
(vol. of change 1959-63 , 1989 -93)
(B)
% OF TOTAL IRRIGATED AREA
1·0
·1
0
- 1·0
(vol. of change 1959-63 , 1989-93)
(D)
% OF TOTAL IRRIGATED AREA
5·0
3·0
R.A. 3·51
N
2 0 2 4 6 8 10 KM.

FIG. 3·3

Changes in other irrigation (1959-93) -

The area under other irrigation has increased from 1193.42 hectares in 1959-63 to 2150.05 hectares in 1993. The positive change in area (above 1.0%) is recorded by Hole and Aussu circles. This may be attributed to the close vicinity of Nira river on which lift irrigation schemes have been installed recently on co-operative basis. The moderate (0.1 to 1.0%) change is noted in Taradgaon, Phaltan and Barad circles. These circles, except Taradgaon, have an advantage of canal irrigation whereas the areas which do not receive the canal water have brought under such irrigation. Taradgaon has to depend mostly on lift schemes as it is deprived of canal irrigation. Low change is noted in Girvi circle and negative change (below 1.0%) is observed in Adarki circles due to lack of perennial supply of water (Fig.3.3-B) and moreover these are away from the river source. Whatever water percolating tanks exist, they have covered a few cultivated land seasonally.

3. GENERAL PATTERN OF IRRIGATION :

The proportion of irrigation is not uniform in the study area. In fact, it is controlled by the prevailing physio-socio-economic conditions. Irrigation is usually meager in areas where irrigation is only needed as a standby to overcome the moisture paucity (Singh and Dhillon, 1984).

The tahsil can be grouped into three zones based on the categories of irrigation proportion as below.

Zone of High Irrigation -

This zone comprises the northern parts covering 21340.53 hect. area of three circles (Fig.3.3-C). The high proportion of irrigation (above 20%) is observed in the Hole, Phaltan and Aussu circles of the study area. Here, canal and lift irrigation facilities are developed, as this part has moderate slope and availability of perennial source of water. A good response for irrigation from black and deep black soils may be another reason. The establishment of two co-operative sugarcane factories, positive role of co-operative movement and innovative nature of farmers are also responsible for the development of lift irrigation (Fig.3.3-B). The sugar co-operatives have recently undertaken the works of lift irrigation in their command areas though their funds for availing more sugarcane. This has resulted into the increase in lift irrigation schemes.

Zone of Moderate Irrigation -

This covers about 20340 hect. of area in the extreme eastern part. The moderate proportion of irrigation (15 to 40%) is observed in Barad circle of the study area. The well irrigation is the major source of irrigation. The watertable

is low in many parts of the region developing the problem of scarcity of water for irrigation in the months of April and May. Hence, the region is noted for moderate irrigation. This zone is irrigated partly from canal and partly from lifts and wells.

Zone of Low Irrigation -

It covers area of 17335 hect. of three circle which are hilly in nature. The poor proportion of irrigation (below 15%) is noted in Girvi, Adarki and Taradgaon circles of the Phaltan tahsil. Hilly and undulating topography, infertile soils, unfavourable watertable have set the limits for the development of irrigation in this zone. Besides, as this zone is away from Nira river, the lift irrigation facilities have not been reached largely here. Adverse slope is perhaps the main constraint for the development of irrigation.

The regional variations in the distributional patterns are mainly controlled by the topographic constraints and water availability.

Changing pattern (1959-93) -

The changes in the proportion of irrigated area, during the period under investigation, are shown in Fig.3.3-D. It is increased from 3 percent to 5 percent of the total irrigated area. The changing trends of irrigation portray man's dynamic

attempts to overcome the environmental limitations in the transformation of physical attributed of the areas into agricultural resources (Singh,1976). The proportion of irrigation has also been increased predominantly in the northern parts of the study region.

The positive change however (over 5%) is noted in Hole, Phaltan and Aussu circles. This zone has witnessed sound development of canal and lift irrigation schemes. The moderate increase (3 to 5 percent) is observed in Taradgaon and Barad circles of the study regions. This circle has the dominance of well irrigation (less than 3 percent). Negative change is registered in the Girvi, Adarki and Taradgaon circles due to unfavourable topography.

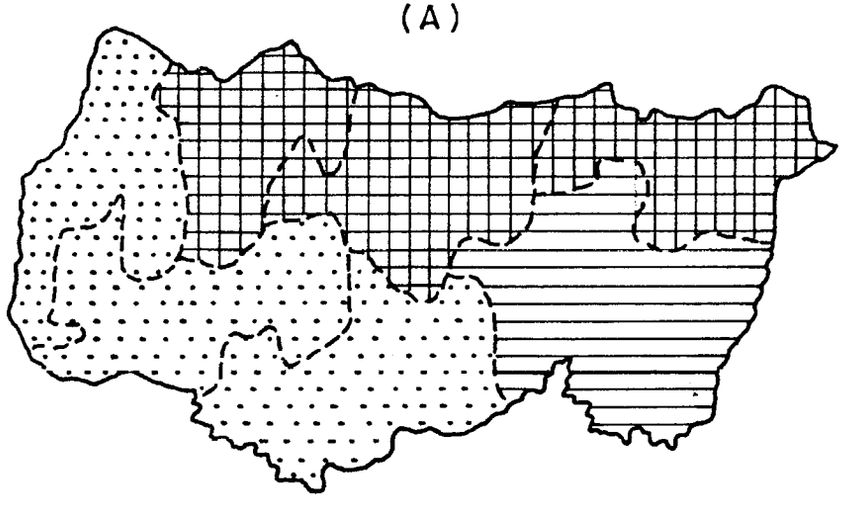
4. INTENSITY OF IRRIGATION :

The intensity of irrigation from all sources, varies remarkbly in the region (Fig.3.4-A). Surch regional imbalance in the development of irrigation facilities might be due to the restrictions put by the physico-socio-economic conditions. The present intensity of irrigation, as a whole, is about 81.91 percent. The study of intensity of irrigation refers to the proportion of irrigated area to net sown area (harvested) which seem to be the best indicator to determine agricultural development. The overall development of agriculture is related to the intensity of irrigation. The intensity of irrigation promotes

PHALTAN TAHASIL

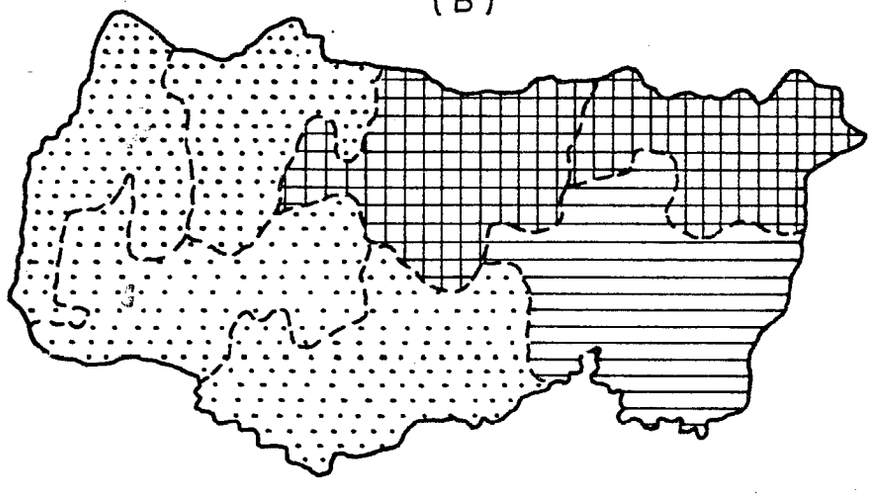
Intensity of irrigation 1989 - 93

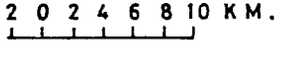
(A)



Intensity of irrigation (1959-63 1989-93)
Vol. of change 1959 - 93

(B)





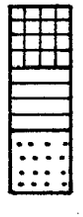


FIG. 3-4

the use of various inputs, enhance the productivity and increase the income level of farmers. In view of this, the spatial pattern of intensity of irrigation and the demarcation of the zones are attempted in the analysis.

Following equation is employed to calculate the intensity of irrigation at circle level for which data for the years 1959-63 and 1989-93 have been collected from the published records.

$$IG = \frac{Pas}{Div} \times 100$$

Where, IG = Intensity of irrigation

Pas = Net harvested area

Div = Irrigated area in the areal unit

Analysis :

Based on this three zones are considered.

The Region of Low Intensity :

Low intensity of irrigation (below 70%) is noted in the large parts of the region, comprising the southern, western and south western sides of the region (Fig.3.4-A). The western and southern hilly tract has traditional source (wells) of irrigation which covers 246331 hect. of region. The rugged topography in the west and steep the slopes of the north and

and the east ranges do not encourage any type of irrigation. In the extreme south-west, the intensity goes down to zero where there is insignificant development of water resources.

The Region of Moderate Intensity :

Another belt of moderate intensity (70-90%) is located in the south-eastern portion of the study region. It comprises the canal and well irrigated areas where wheat and sugarcane crops are grown. It has acquired 8502.03 hectare of the area.

The Region of High Intensity :

Covering nearly 35 percent of the cultivated land, the zone comprises the area of 123661.59 hectares of Hole, Phaltan and Aussu circles. In this belt, village like Gunaware (100%), Vedani (100%), Aussu (96%) have recorded very high intensity of irrigation. This belt has comparatively fertile and level plain with sufficient water resources. Due to canal irrigation and nearness of the river Nira, the lift irrigation has become dominent in this area.

Relative Increase in the Intensity of Irrigation :

The relative increase in the intensity of irrigation is calculated in terms of percentage (Dhillon,S.S. and Sandhu, D.,1979).

$$\text{Relative Increase} = \frac{Ic - Io \times 100}{Ic}$$

Where, Ic = Net irrigated area 1989-93

Io = Net irrigated area 1959-63

Fig.3.4-B shows the relative increase in the intensity of irrigation. A high (above 80%) relative increase is confined to extreme northern and northeastern portions of the region which is resulted from the increase in canal and lift irrigation after 1959-63.

The moderate relative increase (50-80%) is noted in the south-eastern parts of the region. This has been resulted from the increase in well and canal irrigation after 1959-63. This zone includes the areas of Mathachiwadi, Nimbalak, Barad, Pimprad and Shereshindewadi.

In the remaining parts, mainly in the south and west and south-west, have very low relative increase below 50 percent. The watertable is very deep and natural water resources are also least important.

5. METHODS OF IRRIGATION :

The region under investigation has witnessed different methods of irrigation. It refers to the procedure by which water is provided to fields. The information was collected through fieldwork. Moreover, these methods have been influenced by traditions which have been practised from generation to

generation. Although modern methods of drip and sprinkler are introduced but they cover very insignificant areas due to heavy cost.

These methods are mainly concerned with the plant growth and the availability of water. The methods of application of water should be based on the fact that the water should be provided according to the needs of plants without wastage of water and damage to crops or agricultural land. It is observed in the study region that the water is provided to crops irrespective of their requirements. The lack of awarness among the farmers, some misconcepts about the use of water are the reasons for this.

Generally, the methods by which irrigation is applied to the plant depend upon the ideal conditions of individual land features such as the slope of the land, the crops to be raised, the nature of the water supply and the ability of soil to absorb and to hold water (Cantor,1967).

According to author's observations, in case of canal and lift irrigated areas, due to less frequency of irrigation turns, the farmer intend to use rather more quantity of water leading to excess use of water.

The economic use of water depends on the methods of irrigation practised by the farmers. There are various methods of irrigation prevailing in the region. Surface, underground

and overhead. The surface irrigation method including furrow and flood have been practiced in the study region. This information was collected through shedules, questionnaries and field observations.

i) Furrow Irrigation :

The furrow irrigation method is very dominant in the study region. It is observed in the northern part of the plain region. The furrow irrigation in which water is regulated through furrows. By this method water is applied to the crops like sugarcane, maize and vegetables. Furrow irrigation is very common because it is adaptable to a great variety of land slopes and soil textures and can be used with either large or small streams of irrigated water. Although this method is comparatively economic the water loss through evaporation and leaching is more. In fact, due to ignorance, the water is excessively used by the farmers leading to the development of saline problems particularly in black irrigated soils. The circles of Hole, Phaltan, Aussu are having such practice of irrigation. Since the water is available from the canal perennially. The farmers never care to use water economically. Besides, prolonged break in turns of irrigation also leads for such practice.

ii) Flood Irrigation :

Flood irrigation is practiced at very small scale, particularly for wheat and vegetables. Such method carries

demerits of high rate of evaporation. During the rabi season wheat and vegetables are grown by adopting flood irrigation when the water is in abundent quantity. However, such practice seems to be unfruitful as water is supplied to the land irrespective of the requirements of crops. Consequently, the excess water supply has led to the development of saline lands in the region.

iii) Drip Irrigation :

It is the modern technique of irrigating lands which requires technical know-how and heavy capital investments. However, it eliminates the demerits of other traditional methods viz. evaporation and excess water supply.

This method of irrigation has been practiced on a very small scale where water availability is por. This method is mostly useful for horticultural crops and is a very costly affair. The captial investment is not within the reach of small farmers. Beside, only rich farmers have adopted such system. The absence of awareness about this method and water management among the farmers, are major constraints for the development of such methods. The drip irrigation is practiced in Girvi, Saskal, Nirgudi, Bhaduli, Thakurki village lands. There is 147.30 hectares of land brought under such system. In view of the development of soil problems in irrigated tracts, scarcity of water in major parts, the farmers have to adopt drip irrigation in near future. This may also lead to increase

in irrigated area with existing water supply. Presently, the state government has offered subsidies for drip irrigation in order to save valuable resource and to use it economically for high yields. If drip irrigation is adopted to sugarcane areas, the increase in irrigated land will be tripled.

6. IRRIGATION REQUIREMENTS AND DEVELOPMENT :

The water, for irrigation, is unevenly distributed on the earth surface. In view of the erratic nature of Indian monsoon, in time and space, the region with high variability of rainfall needs irrigation for crops. The development of irrigation is inevitable in such areas. The areas where there is acute need of water should have first priority. There are many regions which are dry and oftenly visited by famine conditions possess high requirements of water for agriculture.

Many attempts have been made by scholars of different disciplines to measure water requirements of crops. The Geographers are more concerned with such studies as spatial pattern of agricultural landscape is largely influenced by irrigation facilities. Circle level studies is paramount importance to understand the regional pattern of irrigation needs and priorities.

METHODOLOGY :

More and Mustafa (1984) have developed a method to quantify the need for irrigation facilities. According to them, theree basic factors, viz. annual average rainfall, rural population density and percentage of area cultivated, determine the requirements of irrigation facilities of the region. It is largely true that greater the annual rainfall lower is the need for irrigation. Obviously, greater the rural population density higher is the percentage of cultivable area and more is the need for irrigation. In view of this, the main objective of the present analysis is to identify the areas of varying irrigation requirements and to demarcate the priority zones for irrigation in Phaltan tahsil.

The data pertaining to cultivated area and rural population were collected for each circles from the tahsil office. The data, related to average annual rainfall, were collected from irrigation department. The index values, thus derived, were arranged in desending order, indicating lower value for minimum requirement and vice-versa.

The formula is :

$$In = \frac{Pr \times Ac}{R}$$

Where,

In = Need of irrigation
Pr = Rural population
Ac = Percentage of cultivated area of the areal unit
R = Average annual rainfall

Table 3.2 : Scheme for determining priority.

Sr. No.	Actual irrigation development	Need of Irrigation	Priority
1	Very high	Very high	No
		High	"
		Moderate	"
		Low	"
2	High	Very high	Third
		High	No
		Moderate	Third
		Low	No
3	Moderate	Very high	Second
		High	Third
		Moderate	No
		Low	No
4	Low	Very high	First
		High	First
		Moderate	Second
		Low	No

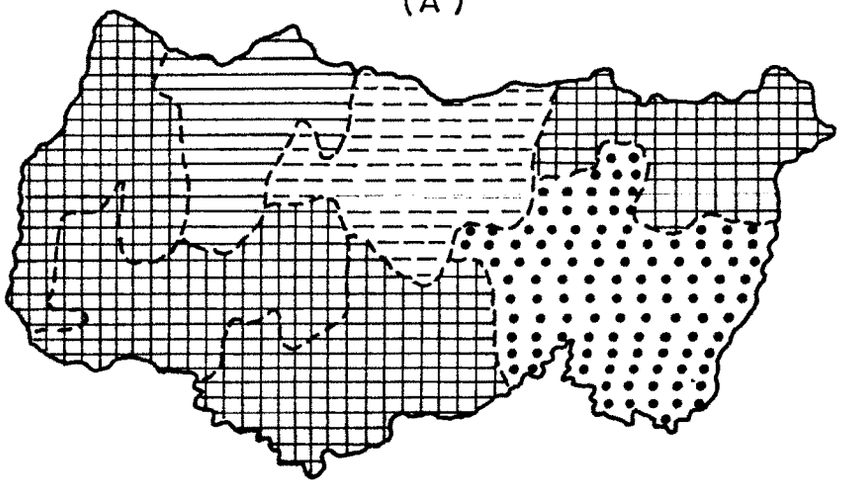
SOURCE : Mustafa and More, Transaction, July 1984,p.75.

The index values were represented by suitable cartographic technique to show spatial pattern of irrigation requirements. Further, the maps showing irrigation requirement and actual development of irrigation were compared to determine the zones of priority for development of irrigation facilities. The above scheme (Table 3.2) has been employed here to determine the irrigation priority of Phaltan tahsil.

PHALTAN TAHASIL

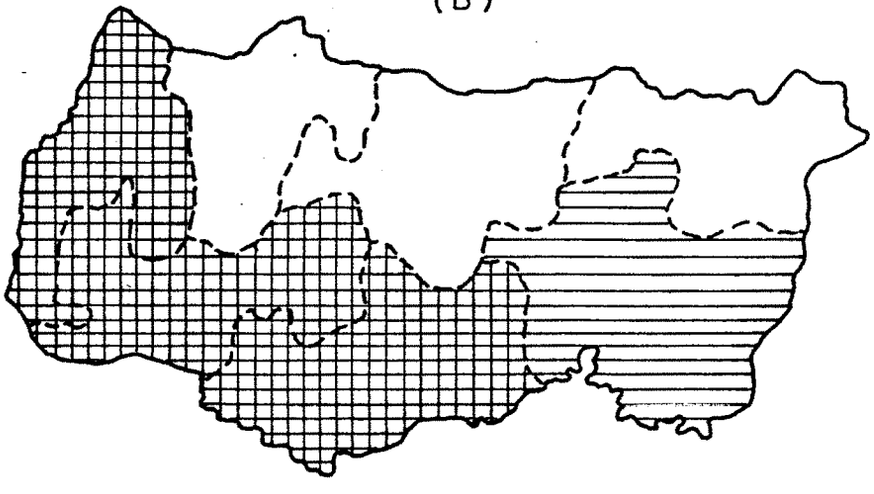
Irrigation requirments 1993

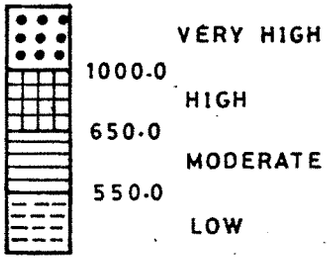
(A)

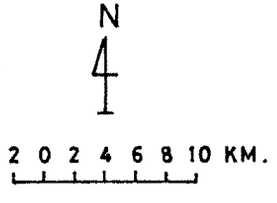


Priority for development of irrigation 1993

(B)







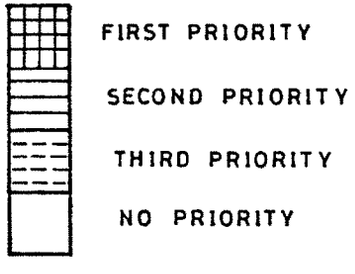


FIG. 3·5

ANALYSIS :

The composite picture of both, irrigation requirement and present development of irrigation, the priority zone of irrigation facilities have been determined. Based on the superimposition of Fig.3.4-A and Fig.3.5-A and employing the Table 3.2, the following priority zones for irrigation have emerged out in Phaltan tahsil (Fig.3.5-B). Accordingly, the region can be divided into three distinctive zones.

i) First priority zone -

It comprises the circles of Taradgaon, Adarki and Girvi which is already deprived of canal irrigation. Although well irrigation seems to be developed recently, a few areas have been covered under well irrigation. The undulating topography and scanty rainfall conditions have adversely affected the cropping pattern and its productivity. This zone has 3842 hect. of cultivated area (30%) recording 589 mm annual average rainfall. Of the total population this part has 36.36 percent (18558) population. This certainly indicates that attentions has to be paid to develop water resources in this part and divert the water to the field by adopting suitable measures.

ii) Second priority zone :

This zone constitutes the parts of Barad circle with 33088 population (15.32%) and 8502.03 hect. of cultivated land

(13.27%) with 617.60 mm annual average rainfall. This circle falls in the zone high requirements of irrigation. Though irrigation developments are moderately observed this circle should get second priority as far as the irrigation developments are concerned. Well irrigation is dominant (12.55%) which is partly followed by canal irrigation (15.06%). However, much of the land (72.39%) is still waiting for irrigation.

In the above two zones, the attention will have to be placed on the development of irrigation facilities in two ways. Firstly, by adopting modern methods (drip or sprinkler) so as to make economic use of water. Secondly, through the development of lift irrigation schemes on Nira river and extending to this part of the region irrespective of physiographic constraints. Besides, the natural sites should be utilized to store the rainfall water. Thus, a chain of water percolating tanks will be fruitful to irrigate this part, atleast for the rabi season.

iii) No priority zone :

This part of the region comprises the areas of Hole, Phaltan and Aussu circles with 123661.59 hect. of cultivated area (33.33%), 104360 population (48.85%) and 761 mm rainfall. Based on these criterion, this part indicates requirement of irrigation. However, 15859.46 hect. (74.32%) of land has been

irrigated by Nira right bank canal system which has minimised the priority of this zone. Despite an extensive land under canal irrigation and devoting it to sugarcane crop, this part faces certain problems due to misuse of water for irrigation. The negative effects of irrigation will be discussed elsewhere. However, this part has no priority of irrigation due to sound water supply from the canal system.

The above analysis reveals the fact that there is considerable imbalance in the development of irrigation facilities. The present development of irrigation is not according to the need of the areas. The priority for irrigation should be given to those areas where there is greater requirement of water for agriculture such studies are useful and significant in the planning process so as to avoid the regional imbalances in the development of agriculture.

7. ECONOMICS OF IRRIGATION :

In view of increasing pressure of population and resultant scarcity of food, use of modern technology has become essential. Irrigation happens to be one of the basic components of modern technology in agriculture. However, such basic in put has to be used carefully which may otherwise lead to adverse effects. The farmers, in irrigated tracts, try to take increasing returns by adopting single cash crop pattern as heavy capital investment has been

made for irrigation facilities. Therefore, the farmers are always aware about the profit to be obtained from the field crops. The records of investment made and the profits received to them, have not been maintained by them.

With the big investment made in irrigating the land, the farmer induces changes in cropping pattern leading the profit oriented agriculture. Although significant efforts have been made to develop the irrigation potential of this country, through major and minor irrigation, yet there has been rather inadequate awarness of the economics of irrigation through different sources (Joshi,1987).

Irrigation has important bearing on the qualitative and quantative nature of agriculture. Irrigated farming raise the per hectare cost of cultivation which is debit side and the credit side includes the farm output per hectare.

The cost of output per hectare differs in different irrigated crops and also of different sources of irrigation i.e. well and canal. The benefits are also different in case of well and canal irrigations. Further, the cost-benefit of different irrigated crops differ spatially in well and canl irrigated areas.

The present work highlights the spatial variation in economics of cost-benefit of sugarcane and wheat raised under different sources of irrigation in the study region. The economics of irrigation refers to the difference between per hectare

cost incurred for growing irrigated crops and the per hect. output converted in money value. This shows whether the irrigation is profitable to the farmer or not. Thus, present attempt is to assess the spatial variations of economy of well and canal irrigation in Phaltan tahsil.

The cost-benefit analysis of two irrigated crops may certainly highlight the fact that whether farmer is benefited from wells or canal irrigation and which crop is suitable economically in the given structure of irrigation.

METHODOLOGY :

The data required for proposed analysis has been collected through fieldwork. The author has analysed cost benefits of two major irrigated crops viz. sugarcane and wheat under well and canal irrigation. Sugarcane is major irrigated crop which occupies 45.51 percent (29166.03 hect.) of the irrigated area. Wheat is second dominent crop occupying 23.28 percent (14918.77 hect.) of irrigated area (Table 2.4). Therefore, these two crops are selected in the present study. Sugarcane is a perennial crop and wheat is seasonal crop.

Three representative villages have been chosen to assess the cost benefit of sugarcane and wheat. These villages are Gunaware, Padegaon and Velashi (Fig.3.6). The intensity of well and canal irrigation, however, differs in

these villages. Gunaware village area, for example, has been irrigated mainly by Nira right bank canal system. The area of Padegaon village is, however, partly irrigated by wells and partly by canal. Further, village of Veloshi is having the dominance of well irrigation. Thus, the irrigation sources are different. Five farm families were selected for interview from each village and based on the information and data collected (sourcewise and cropwise average) cost-benefits were calculated.

The average of different items of cost benefit in a village are considered to analyse the pattern of the economy of well and canal irrigation. The net returns per hectare are calculated by using the following formula.

$$NH = Ih - Pc$$

Where,
NH = Net returns per hectare
Ih = Annual income per hectare
Pc = Cost of production per hect.

The cost include human and labour cost, animal cost, material cost, energy charges, maintainance and repair charges, government taxes, other cost and farmers who use their own equipments in cultivation on farm, are also accounted for and their values are also compaired with market rates.

COST STRUCTURE :

i) Labour cost -

Any farming system, dry or irrigated farming, requires labour cost. The human labour requirements are increased with the availability of irrigation facilities, particularly at the time of harvesting period. The family labour is not sufficient for agricultural operations. Therefore, farmer takes hired labours and he also uses animal labours. All such labour cost has been considered here.

ii) Material cost -

Material cost includes chemical fertilizers, manures and pesticides per hectare.

iii) Energy charges -

Electric pump sets or disel engines are used for water lifting in agriculture. The energy charges of electric pumps and expenditure for disel engines are also calculated according to electric bills and price of disel oil respectively.

iv) Maintainance and Repair charges -

The farmer spend money for the maintainance of well, pipelines, electric pumps and oilpumps etc. and their repairs are calculated according to crops raised i.e. sugarcane and wheat per season.

v) Other charges -

It includes government taxes, transport cost etc. The government taxes include land revenue charges, education tax for cash crops.

vi) Net profit -

The benefit is calculated according to market rates. The net returns for particular crop are obtained by deducting the total cost per hectare from the total output per hectare.

i) Economics of Well Irrigation :

The economics of well irrigation for sugarcane and wheat is different in villages.

Cost structure -

i) Labour cost :

Table 3.3 shows that per hectare labour cost for sugarcane is Rs.5600, Rs.5500 and Rs.1950 in villages Gunaware, Padegaon and Veloshi villages respectively. The labor cost is high at Gunaware due to high labour charges and dependance on hired labourers. Each farmer, in Gunaware village, has some irrigated land. There is scarcity of hired labourers which has led for increase in labour cost. Same is the case of wheat cultivation in these villages.

Table 3.3 : Cropwise per hectare cost benefit of well irrigation, 1993-94.

(Figs in Rs.)

Sr. No.	Villages	Sources	Crops	Labour cost human + Animal	Material cost			Energy charge	Maintainance + repairs	Other charges	Total cost	Output	Net profit
					Seed	Chemical ferti. + Pestiside + Manures	Total						
1	Gunaware	Well	S.cane	5600	5000	20900	25900	1500	300	500	33800	120000	86200
		"	Wheat	2200	900	9200	10100	750	233	110	13393	30000	16607
2	Padegaon	Well	S.cane	5500	5000	13000	~~23500~~	1500	250	500	31250	109000	77750
		"	Wheat	1750	800	5750	6550	650	130	110	9190	24000	14810
3	Veloshi	Well	S.can	1950	3000	11950	14950	1660	325	500	19375	60000	40625
		"	Wheat	1050	400	4550	4950	500	100	110	6710	12000	5290

SOURCE : Compiled by the Author, 1993-94

(Based on intensive fieldwork).

ii) Material cost -

The material cost for sugarcane per hectare is Rs.25900, Rs.23500 and Rs.14950 in Gunaware, Padegaon and Veloshi villages respectively and for wheat Rs.10100, Rs.6550 and Rs.4950 respectively. Since the quantity of chemical fertilizers for sugarcane is relatively high, the cost of chemical fertilizers per hectare for sugarcane is also high i.e. Gunaware Rs.20900, Padegaon Rs.13000 and Veloshi Rs.11950. Such cost is related to the availability of irrigated water from the well. The wells face the problem of scarcity of water during dry season. The cost of fertilizers is, therefore, decreased in Veloshi village (Table 3.3).

iii) Energy charges -

Energy charges mostly depend upon the availability of water in well and use of electric pumpset or oilengines. The energy charges per hectare for sugarcane are high (Rs.1650) at Veloshi which is followed by(Rs.1500)in Padegaon. The high energy charges in Veloshi can be attributed to the absence of rural electrification and more use of disel engines.

iv) Maintainance & Repair charges -

Maintainance and repair charges depend on the use of electric pumpsets and oilengines which is about Rs.300, Rs.250 and Rs.325 in Gunaware, Padegaon and Veloshi respectively. In case of wheat it is Rs.233, Rs.250 and Rs.100.

v) Other charges -

Per hectare other charges accounts for Rs.500 for sugarcane and Rs.110 for wheat which are equally observed in all the villages (Table 3.3).

Output and Net profit :

The average output per hectare for sugarcane is high in Gunaware (Rs.120,000) followed by Padegaon (Rs.109,000) and Veloshi (Rs.60,000). The percolation of water from canals have enriched watertable which is further utilized for well irrigation. The water from wells, in Gunaware village, is sufficiently available even during summer season. However, the wells in Veloshi have faced the scarcity of water during the months of April and May.

Despite the high total cost, the wells in Gunaware earn more per hectare than the wells in Padegaon and Veloshi i.e. Rs.86200 in Gunaware, Rs.77750 in Padegaon and Rs.40625 in Veloshi. Same is the case of wheat which offers more benefit in Gunaware village than Padegaon village and followed by Veloshi. In well irrigated areas of Gunaware village the farmers who cultivate their land intensively, get maximum production, sufficient water, particularly in summer months. They use chemical fertilizers due to which net benefit is multiplied. In case of Veloshi, scarcity of water in summer,

PHALTAN TAHASIL

Location of selected villages 1993-94

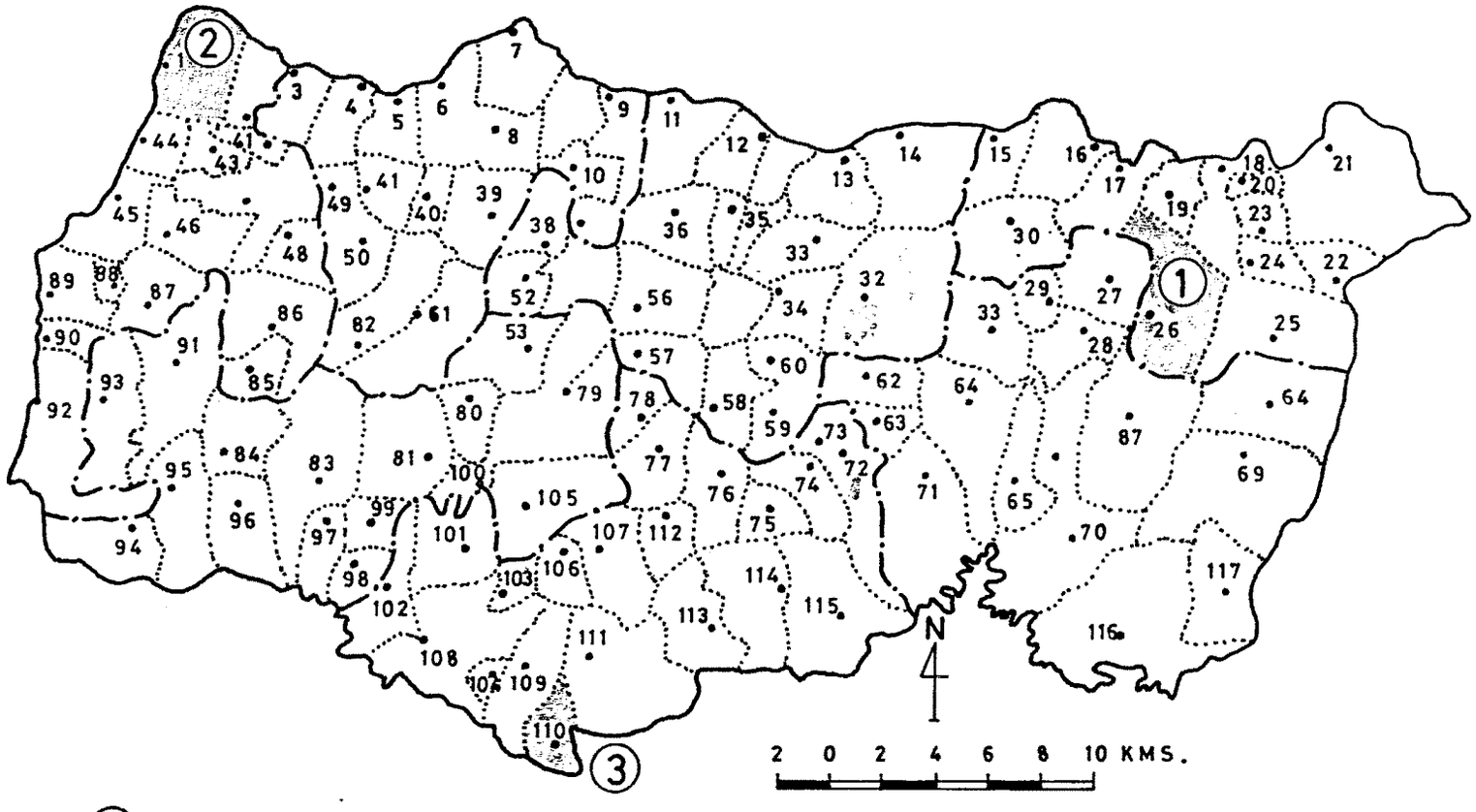


FIG. 3·6

the poor soils put the limits for output. Therefore, it ranks third in regards to net benifit received to them.

ii) Economics of Canal Irrigation -

This part proposes to examine the economics of canal irrigation observing cost benefit of sugarcane and wheat crops in the same selected villages. Table 3.4 exhibits cropwise and villagewise variation in the economics of canal irrigation.

Cost structure -

i) Labour cost -

The labour cost for sugarcane is high in Gunaware (Rs.5500) which is followed by Rs.4925 in Padegaon. The reason is same to that of well irrigation where labour charges are high and farmers have to depend on hired labourers.

ii) Material cost -

The material cost, incurred for sugarcane, is high in Gunaware village (Rs.28000) followed by Padegaon (Rs.23450). For wheat it is about Rs.9150 and Rs.7100 in Gunaware and Padegaon villages. The inputs includes mainly the chemical fertilizer, pesticides and manures in varying quantity in these villages. It depends upon the availability of water mainly from canal. The differences in the use of seeds, sugarcane in Gunaware are Rs.5000 and Rs.500 in Padegaon. This may be due to the fact that Gunaware is away from Padegaon sugarcane research centre where

seeds are developed on modern techniques. There is also villagewise variation of material cost for wheat crop (Table 3.4).

iii) Energy charges (water charges) -

Per hectare charges for energy consumption and water use account for Rs.1250 for sugarcane and Rs.450 for wheat which are equal in both villages.

iv) Other charges -

Other charges for sugarcane in canal irrigation are Rs.500 and Rs.450 for Gunaware and Padegaon respectively (Table 3.4). In Gunaware village, the sugarcane farms are located at a long distance which is resulted into increasing cost for transporting the inputs required.

Cost Composition :

Table 3.4 indicates that the total cost for sugarcane accounts for Rs.32,250, Rs.30,050 in Gunaware and Padegaon villages respectively. The total cost for sugarcane in Gunaware seems to be increased due to high use of fertilizers. In case of wheat the total cost however, is Rs.12025 in Gunaware and Rs.9630 in Padegaon villages. These variations in the cost could be attributed to irrational use of inputs viz. fertilizers and water.

Table 3.4 : Cropwise per hectare cost benefit of canal irrigation, 1993-94.

(Figs. in Rs.)

Sr. No.	Villages	Crops	Labour cost human + animal	seed	C.ferti- + Pesti- cide + manures	Total	Charges for Energy+ water - charges	Other charges	Total cost	Output	Net Profit
1	Gunaware	Sugar-cane	500	5,000	17,500	28,000	1,250	500	32,250	100,000	64,750
		Wheat	2,250	900	6,000	9,150	450	150	12,025	24,000	11,975
2	Padegaon	Sugar-cane	4,925	4500	18,925	23,425	1250	450	30,050	89,600	59,550
		Wheat	1,850	750	6,350	7,100	450	230	9,630	21,000	11,370

SOURCE : Compiled by the author, 1993-94,
(Based on intensive fieldwork).

Net Profit :

The total output, by canal for sugarcane is Rs.100,000, Rs.89,600 in Gunaware and Padegaon villages respectively. Per hectare yields of sugarcane are high in Gunaware (125 metric tonnes), whereas it is 112 metric tonnes in Padegaon. Such considerable output has been resulted from the substantial use of chemical fertilizers and water according to the requirements. The output cost is Rs.24000, Rs.21000 in Gunaware and Padegaon respectively.

Obviously, the per hectare net profit for sugarcane is high in Gunaware village (Rs.64,750) and Rs.59,550 in Padegaon village. For wheat it is Rs.11,975 in Gunaware and Rs.11,370 in Padegaon. These variations are closely related to the regional distribution of favourable physical and socio-economic components in these villages.

REFERENCES

1. Cantor, G.M. (1967) : A World Geography of Irrigation, Oliver Boyd, London, p.29 and 32.

2. Dhillon, S.S. and Sandhu, D. (1979) : Irrigation development in Panjab - It's potential and limitations. Geographical Review of India, Vol.41.

3. Joshi, A. (1987) : Economics of Irrigation. Ganga Publishers, Ludhiyana, p.9.

4. More, K.S. and Mustafa, F.R. (1984) : Irrigation requirements and development in Maharashtra. Trans. Insti. Indian Geographer, Vol.6, No.2, pp.73-78.

5. Pawar, C.T. (1985) : Regional disparities in irrigation development - A case study of Maharashtra. Unpublished project, submitted to Shivaji University, Kolhapur, pp.19-26.

6. Pawar, C.T. and Shinde, S.D. (1986) : Irrigation in Maharashtra - A spatial-temporal perspective. The National Geographical Journal of India, Vol.32, No.2, p.107.

7. Singh, Jasbir (1976) : An agricultural Geography of Haryana, Vishal Publications, Kurushetra University, pp.131-157.

8. Singh, Jasbir and Dhillon, S.S. (1984) : Agricultural Geography. Tata McGraw Hill Publishing Co.Ltd., New Delhi, pp.235-238.

9. Sinha, B. and Bhatia R. (1982) (Forward) : Economic appraisal of irrigation in India, Agricol Publishing Academy.
