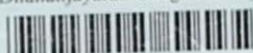


Wardha District Development Paper
IRRIGATION.

1960/61

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IRRIGATION

1

WARDHA

DISTRICT DEVELOPMENT PAPER

WARDHA

District Development Paper

1

IRRIGATION

1960-61

Study Sponsored By

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FOREWORD

I welcome Mr. Patankar's Study of Water resources of Wardha District for a variety of reasons. In the first instance, it brings out, through presentation of detailed data and maps in connection with a variety of problems, the great variations in conditions in regard to such fundamental problems as the availability of water for crop production even in a single district in a State. The monograph emphasises, in this manner; what should have been always known but has unfortunately been largely ignored, that intensive local studies must be undertaken and completed before plans of agricultural development can be properly formulated.

Secondly, Mr. Patankar's careful work indicates the complexity of a number of problems that have to be currently tackled in India. In this particular district, the most important as well as the most difficult problems appear to be those connected with wells. It is clear from the account of Mr. Patankar that it would be wrong to treat the problem of wells, especially of the phenomenon of abandoned wells, as if its causations and characteristics were uniform throughout the district. Physical factors, crop patterns, prices, as well as socio-economic policy all shape the contours of this problem and under different situations the possible approaches to the solution may be widely different.

Further, Mr. Patankar's study should impress forcibly on the reader the very inadequate extent of applied scientific work done so far in this country in relation to problems of agricultural production. Whether it is the problem of grass lands or of contour bunding or of Bandhara irrigation, the work, so far, appears to have been limited to isolated experiments or to limited areas of successful projects. The application of the experimental data or the limited area of experience necessarily involves, in view of the variety of conditions, considerable further work on the ground level in each case beginning with exploratory pilot projects. Remarkably little of this has been done during the last ten years.

One suspects that the surprising neglect of local studies and of local

... iv ...

experimentation during the last ten years has been the result of the manner in which our plans have been formulated, of the over-centralisation in every sphere of administration and of the natural conservatism of superior ranks in administration, even in the technical services. It is hoped that with the new experiment of decentralisation on the district level, consequent upon the formation of Zilla Parishads in Maharashtra, these obstacles will be removed to a considerable extent. However, if the Zilla Parishads take up seriously the work of planning at the district level they will require in a liberal measure assistance of studies like those of Mr. Patankar. Such studies, it is hoped, will in their turn help in discovering the special features and characteristics of local production problems and lead to the relevant experimentation and pilot projects for formulating meaningful programmes of agricultural development.

D R. Gadgil

Gokhale Institute of Politics and Economics,
12th November, 1962.
Poona 4.

PREFACE

Opportunities presented by close associations with what is now termed as 'District Planning Project Wardha', have been the mainsprings of this series of 'District Development Papers'. These papers mainly attempt a reappraisal of development policies and programmes ; and further spotlight the field of investigation and experimentation involved in initiating a process of meaningful planning in the wake of Zilla Parishads which have to be trustworthy forerunners of District Governments of tomorrow.

The present paper covers but one aspect of the studies concerning the Resource Complex of the District. Subsequent papers would discuss such aspects of development as (i) Dry farming and land development ; (ii) Grass lands and forest resources ; (iii) Animal Husbandry and Dairy Farming ; (iv) Surplus labour and trends in urbanization ; (v) Industries for Area-plans ; (vi) Public Utilities under a planned perspective ; (vii) Organisation ; and (viii) Scope of Planning. Publication of these papers would follow this first monograph.

Drafting of these papers has involved consultations with a wide range of persons who can speak on authority in their respective spheres. It is rather difficult to mention them here by their names. However, I take this opportunity to express my feelings of indebtedness, with a profound sense of gratitude to the officials in different walks of governmental activity ; but for whose willing co-operation the reappraisal would have proved a delicate task. This does not, however, mean that the opinions expressed in the following pages, in anyway, represent their views.

At different stages of compilation of this draft, I was fortunate enough, in getting frank and valuable criticism from Dr. K. G. Joshi, Principal, Government College of Agriculture, Nagpur; Engineers of Water Resources Division, Government of Maharashtra, and in particular from Shri B. R. Sardesai, Retd. Executive Engineer, Poona ; and from Shri D. A. Gadkari, Retired Director of Minor Irrigation, Maharashtra State.

...vi...

With great pleasure, I wish to register my sincere appreciation of co-operation received from Shri S. H. Pore and Shri S. W. Muranjan of Gokhale Institute, Poona, who bore the major brunt of field studies, all these days, in the wake of district Surveys and Planning. Exchange of notes with them has all along been an enduring experience. Indeed, I look upon them as co-authors of this Series.

And here at home, it has been an enriching experience to discuss the draft with my colleagues at the Regional Planning Institute. More particularly, I am proud to note that access to the painstaking work undertaken by Shri M. R. Deshpande on consumption of Electricity in Rural areas has made remarkable contribution to this monograph. My thoughts go back to those trainees of first batch who trampled the ploughed fields in the scorching heat of May and helped conduct the 'Condition Survey' of abandoned wells, which has so profoundly influenced the course of this study.

Regional Planning Institute,
Sewagram, (Wardha)

Pandit Patankar

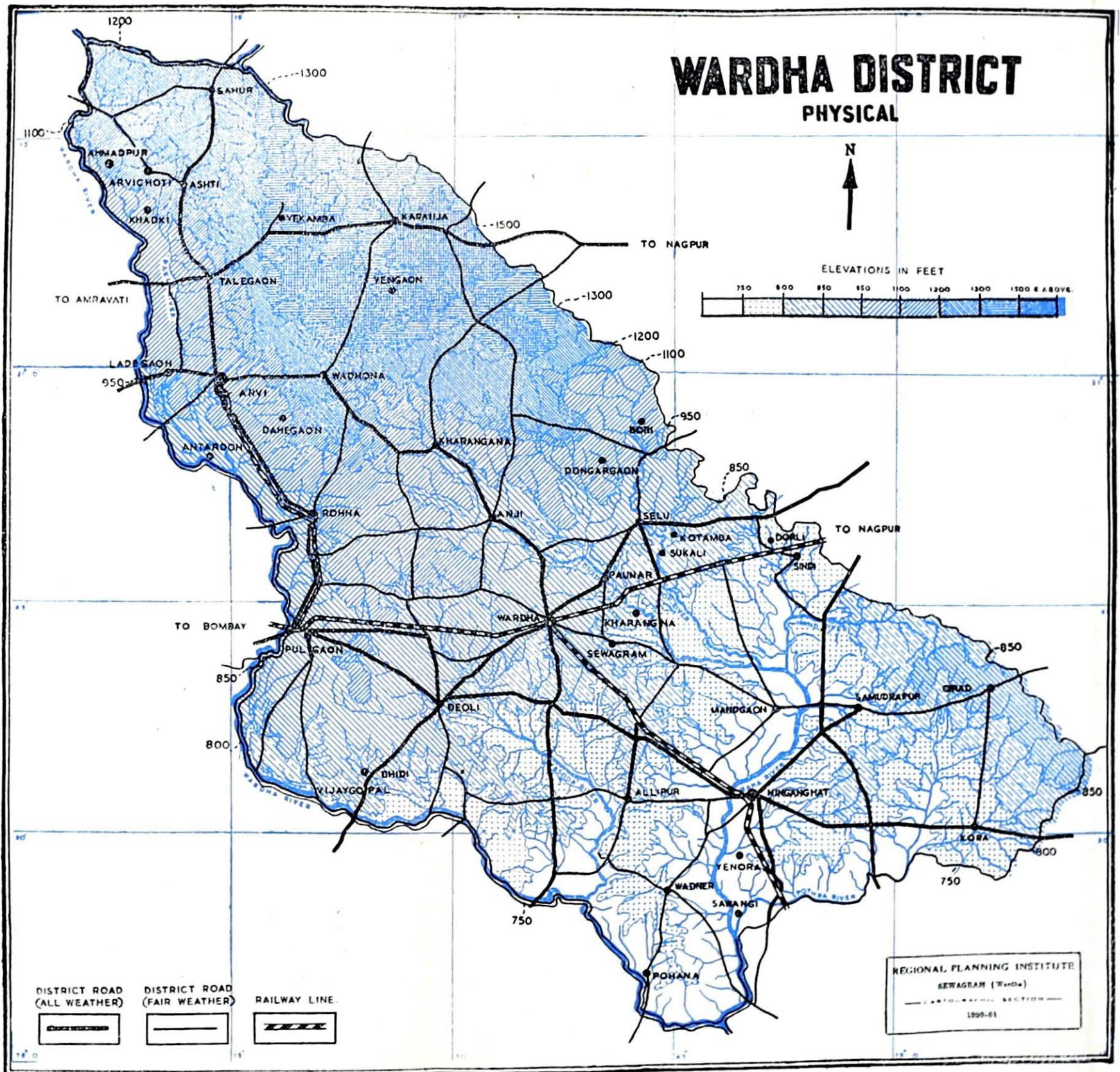
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- B Particulars of wells *in use* in village Yengaon.
- B 2 Particulars of wells *not in use* in village Yengaon.
- C Rural Electrification—consumption of power for water lifting purposes.
- D Baglan system of Bandhara Irrigation.

MAP No. 1



DISTRICT DEVELOPMENT PAPER

IRRIGATION

1 GENERAL

1.1. Physical

The district of Wardha lies between $20^{\circ} 18'$ and $20^{\circ} 21'$ north latitude, and $78^{\circ} 30'$ and $79^{\circ} 15'$ longitude. The north of the district consists of hilly region formed by spurs projecting from the great Satpura chain. Central cluster of these hills with its highest point at Jaitgarh (2086' M. S. L.) actually forms the watersheds of the district. From the north and west of this range numerous small streams make their way towards the river Wardha, while from the South and South-East the Dham, the Bor and the Yesoda rivulets flow down the length of the district in a south easterly direction intersecting the undulating plain. The south and south eastern parts which mark the low-lying areas (700' 750' M.S.L.) conform to the River basins of Yesoda and Wana respectively. Wardha which flows on the western border of the district and Wana which drains the south easterly flows of 3 small rivers, are the two main rivers of Wardha.

1.2. Geology and Soils

The great sheet of trap which covers Berar, underlies the whole of the district. The stratification is regular and continuous and the angle of inclination generally small. Nearly the whole of the area consists of a thin covering of black or dark brown soil formed from basalt rocks. The soil varies in depth from 10 feet to a few inches, the average thickness being about 2 feet. It is generally found intermixed with nodular limestone. The district had a Revision Settlement Survey in 1908-12, which provided the latest information on distribution of soils. These classifications referred to some 7 types. Kali I covered 1%, Kali II, 9%; Morand I, 47%. These were good black or brown soils, Morand II which occupied nearly 27% also rated amongst the good soils of the area. Morand I and II were the commonest of the soils occupying nearly 74%

of the cultivated area. Morand is a black or brown soil generally mixed with limestone grit. It differs from Kali in being composed of large particles which do not stick together so closely. Its clods are less hard and when saturated, it does not turn into fine clay. While in dry weather it cracks less. This is, actually the great wheat soil of the Wainganga Plains. During the time of Ist Settlement 1862-66, there were two major classifications of soils for purposes of assessment. One was wheat land and the other 'Mutfavikat' or land on which wheat could not be grown. Other good lands where actually wheat was not grown were, however grouped with wheat lands. These wheat lands constituted nearly 54% of the cultivated area and the percentage distribution has not, since, been changed to any noticeable proportions. As regards the other 3 classes, 'Khardi' is a poor and shallow dark soil mixed with sand. This extends over 12% of the area under cultivation. 'Bardi' or hilly lands strewn with stones, occupied about 4%; while 'Retari' or regular sandy soil, and 'Kachhar' or alluvial lands on the banks of streams are found in insignificant quantities.

1.3. Rainfall

The average rainfall of Wardha during the 33 years preceding 1899-1900 was 39 inches. Averages for the same period for the three Tahsils Arvi, Wardha and Hinganghat were 35, 40 and 43 inches respectively. The rainfall apparently increases from North to South. The minimum fall registered during the same period was in 1899-1900 when it was only 13 inches. Consequently the season was followed by a severe famine. Maximum fall registered during that period was 66 inches. This resulted in total ruination of Kharif crop. But the Rabi grains gave a fair outturn.

Rainfall during the current century has shown an upward trend. The average has gone up by 5.73 inches. The minimum fall during the last 51 years was 19.06 inches in 1920-21; whereas the maximum fall recorded in 1936-37, was 64 inches. An increase has been recorded even in case of 5 wet months severally. The following table gives quinquennial averages for these two periods.

TABLE NO. 1.

Quinquennial averages of Rainfall for the two periods 1866-1899 and 1909-1959.

1st period-Average 39 inches :

3 years from 1866	5 years from 1869	5 years from 1874	5 years from 1879	5 years from 1884	3 years from 1889
36.5	33.5	38.3	44.1	38.6	43.3

II Period-Average 44.73 inches

<i>5 years from 1909</i>	<i>5 years from 1914</i>	<i>5 years from 1919</i>	<i>5 years from 1924</i>	<i>5 years from 1929</i>	<i>5 years from 1934</i>
44.6	47.6	38.4	40.0	48.6	55.3
<i>5 years from 1939</i>	<i>5 years from 1944</i>	<i>5 years from 1949</i>	<i>5 years from 1954</i>	<i>3 years from 1959</i>	
50.8	42.6	37.21	43.27	41.61	

A fall of 30 inches or even 25 inches, if well distributed should be sufficient to ensure full crops. In 1904-05 when only 27 inches of rains were received, the harvest was good one though 10 inches of this total fall was in June, and was to a large extent wasted. Rice and Jowar gave only half or a little more out-turns, but Cotton and all the Rabi crops were good. Heavy rainfall generally adversely affects the crops. In the current century though there is an upward trend in rains, crops have failed to give even half the out-turn in 17 years for cotton, 13 years for Jowar and about 10 years for wheat. Last year was another bad year for Jowar and Cotton when rainfall was 53.5 inches. It was a worst wet spell of recent years. It is not so much the total fall as its distribution over the period that matters for crops. Suitable distribution makes all the difference between a normal year and a year of famine.

1.4. Climate

Wardha is believed to be slightly cooler than Nagpur. The yearly maximum and minimum temperatures of Nagpur are 114° and 39° F. The climate is variable and the extremes of temperatures are pretty widely separated. Both, summer and winter are equally severe. Even the variations in the same day are considerable at all times of the year, and the rapid change from the heat of the day to a cool night is particularly remarkable in summer months. This is one of the reasons why orange cultivation has taken roots in this part.

1.5. Cropping Pattern

Except in the wheat tract—to the south-east of the District, cotton and jwar are the main crops to which the Wardha cultivator looks for his living. Where cotton and jwar could not be grown, as in case of Pan-basan areas, a little Rabi is sown. Only 17.3% of the total cropped area is under Rabi crops and the area sown more than once is hardly 0.4%. Exclusive cultivation of cotton and jwar is carried to its utmost extreme in certain cases upto 99% - in the northwest of the district. It is only when one proceeds towards south-east the character of cropping becomes more varied. Rabi becomes more and more common. The following table gives, average area under different crops during 42 years ending 1951—52 :

Graph No. 1

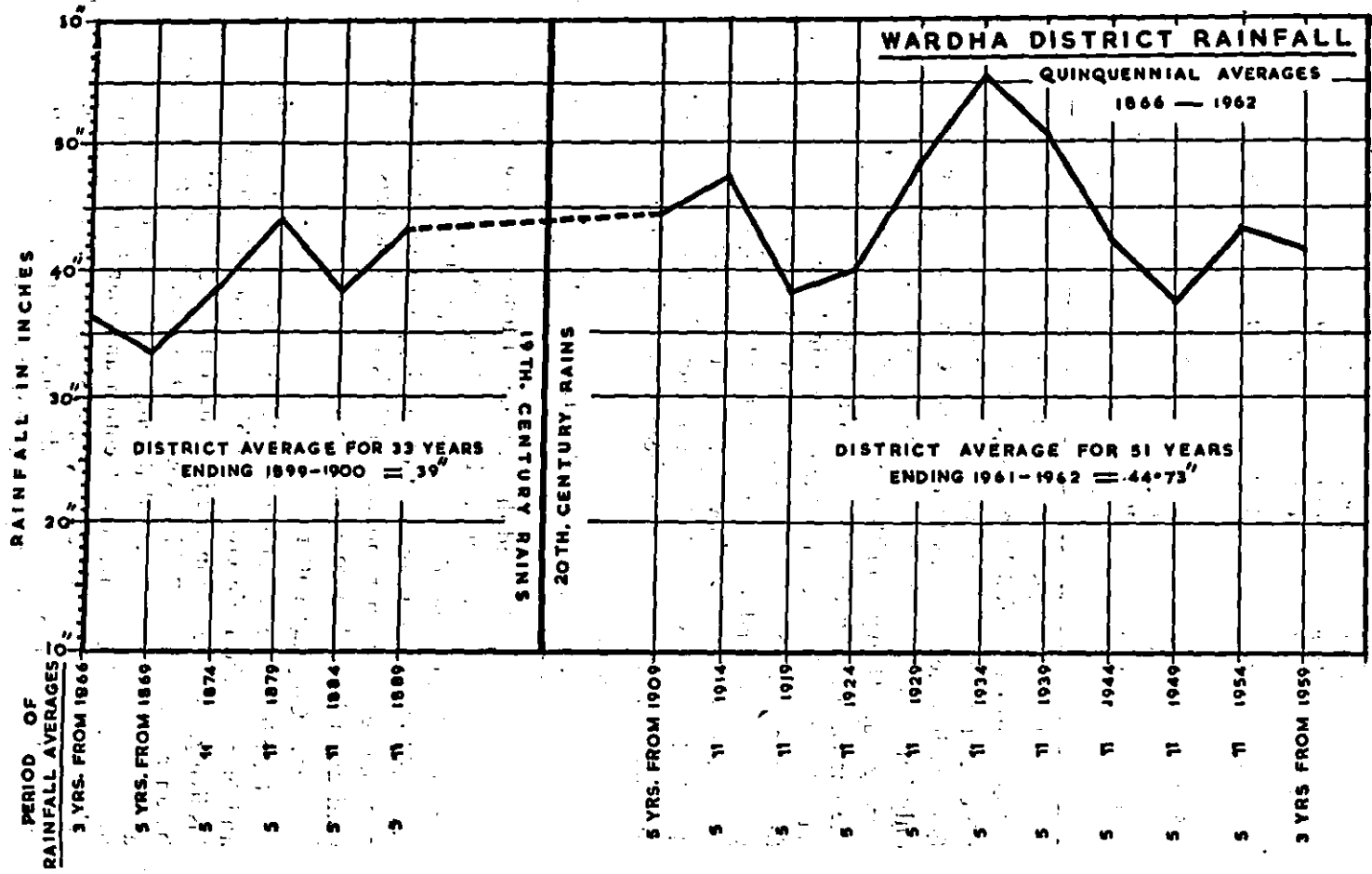


TABLE NO. 2.
Statement showing Average Area under different Crops and range of variations.
(Figures in thousand acres.)

Main crops	Average Area		Maximum Ever		Minimum ever		Maximum Variation between two successive years	
	Area	%	Area	Year	Area	Year	Difference	Years
Kharif	840.5	83.1	950.3	1924-25	751.0	1940-41	71.2	1943-44 1944-45
Rabi	174.4	17.3	230.9	1912-13	107.4	1924-25	63.7	1939-40 1940-41
Area cropped more than once	4.4	0.4	12.8	1944-45	1.8	1924-25	6.3	1942-43 1943-44
Cotton	371.7	36.8	493.3	1925-26	274.7	1939-40	97.0	1931-32 1932-33
Juar	327.3	32.4	401.1	1943-44	260.1	1911-12	85.1	1915-16 1916-17
Tur	70.0	6.9	82.5	1914-15	48.2	1950-51	11.3	1950-51 1951-52
Til	13.0	1.2	29.7	1921-22	6.3	1917-18	19.7	1921-22 1922-23
Wheat	107.0	10.6	149.2	1934-35	51.1	1947-48	41.0	1946-47 1947-48
Linseed	36.70	3.6	92.3	1912-13	12.6	1924-25	37.00	1912-13 1913-14

There has been wide variations in area under Gram, the minimum being 4,200 acres in 1924-25 and the maximum-24,200 acres in 1949-50. Similarly area under groundnut, has shown extreme fluctuations. During last 20 years the minimum reached was 3,600 in 1942-43; whereas its peak year was 1949-50, when it was 23,400. Area under rice, also, has been 3,500 acres in 1952-53 and 12,400 acres in 1944-45. On this backdrop one has to appreciate and understand the Irrigation practice prevalent in the District.

2 PATTERN OF IRRIGATION

With its barely 1.2% of irrigated area, Wardha presents a poor spectacle in these days of rapid economic development. But as the following statement reveals, the district is not far too behind on the run,

TABLE NO. 3.

District-wise percentage of gross area irrigated by all sources and by wells alone to gross cropped area (Vidarbha Region.)

Districts	By all sources inclusive of wells	By wells alone,
Buldhana	1.0	1.0
Akola	0.4	0.4
Amravati	0.8	0.8
Yeotmal	0.3	0.3
Wardha	1.2	1.0
Nagpur	4.5	2.4
Chanda	15.7	0.2
Bhandara	24.9	0.5
Divisional Total...	5.3	0.8

Wardha stands next to Nagpur and is ahead of all districts except Nagpur in well irrigation (See appendix 'A' for performance of other districts in other divisions).

Irrigation Wells

2.1. The district has about 6,912 irrigation wells under use (1960-61), of which only 4872 are masonry constructions. The remaining are Kuccha. Well sinking has been a game of chance. This is, perhaps, evident from the exceptionally huge figure of abandoned wells, which is as high as 10,624—nearly 64% of the total. As a result small, narrow wells not exceeding a diameter of 12 feet have become a common pattern. No wonder if the average area irrigated per well does not exceed 1.7 acres. Wardha, unlike Nagpur, Chanda and Bhandara, mainly depends

on well irrigation. In 1960-61 out of a total of 12,282 acres of land irrigated in the district, only 43 acres were irrigated by tanks, as against 11,827 by wells. Remaining 412 acres were irrigated by other sources which meant in this case lifts mainly on rivers.

Distribution

2.2. Let alone the small percentage of irrigated area. Its distribution over the entire district has not been even. Map No. 2. illustrates this more strikingly. Arvi Tahsil has been a major beneficiary. Wardha would come next. Percentage of irrigated area in these two tahsils comes to 1.7 and 1.3 respectively. Whereas in Hinganghat it has been only 0.4. Of the total number of irrigation wells 41.9 and 39.7 per cent are located in Arvi and Wardha alone. The remaining 18.4 have been the share of Hinganghat. Proportionately there are more unused wells in Hinganghat than in other two tahsils. However in absolute numbers Arvi and Wardha keep the lead. Revenue Inspectors' circlewise distribution of irrigated area, together with total number of unused and used wells, helps weed out still further the areas that are very inadequately served by irrigation. (See Table No. 7 & 7A.)

Irrigated Crops

2.3. Orange, Chillies, Vegetables and Bananas are the main irrigated crops of the district. Small plantations of Betel leaves are reared around Ashti in Arvi Tahsil. Irrigation to Rabi wheat, also, is practised. Recently Kharif cotton is irrigated but on a very small scale. Average area under irrigated crops for the period 1955—56 to 1960—61 is given under Table No. 4 on next page.

During this period area under fresh fruits not only has held ground, but also has been steadily enlarged in size, year after year. During the course of last six years it has increased by, nearly 18 per cent. A similar trend is discernible in irrigated cotton. The area under this crop is relatively very small though. It has grown from 287 in 1955—56 to 716 in 1960—61 nearly an increase of 149 per cent. Irrigation to cotton is as yet a novelty and in course of time would show more vigorous growth than is visible at present. Similar rise can be seen in other crops too. For instance area under vegetables has shown a net increase of 18 per cent, whereas that under chillies, 57 per cent. But the increase in case of these two crops has not been as steady as that of fruits. A small portion of the area in this latter case has either remained under irrigation or dropped out, mainly in the nature of eventual adjustment with the performance of monsoon; or as an effort to maintain a balance in favour of the normal cash economy of farming desired by the cultivator.

Size of Irrigation farms

2.4. With a view to assess the size of units under irrigation farming denoting a higher rate of frequency, a sample of 239 cultivators who reared

TABLE NO. 4.

Average area under irrigated crops in Wardha.
(1955-56 to 1960-61)

Crops	Irrigated Area (in acres)	Percentage to total
1. Banana	491	3.9
2. Oranges	3,553	20.6
3. Other Fresh fruits	821	6.7
4. Fresh vegetables	1,407	11.4
5. Other Vegetables		
Winter	224	1.9
Summer	197	1.6
6. Onions	1,070	8.6
Total under fruits and Vegetables	6,763	54.7
7. Rice	55	0.4
8. Wheat	1,141	9.1
9. Juar	17	0.1
10. Gram	68	0.5
11. Sugarcane	109	0.8
12. Cotton	496	3.9
13. Chillies	3,551	28.7
14. Turmeric	62	0.5
15. Fodder crops	39	0.3
16. Misc. Food crops	24	0.2
17. Misc. Non-Food crops.	95	0.8
Gross area irrigated	12,420	100.0
Area cropped more than once	571	4.5
Net irrigated Area	11,849	

irrigated crops on their farms was taken. These farmers were operating on an irrigated area of about 800 acres and were rearing almost all the crops common to Wardha. It would be of great interest to know that though the district average of irrigated area per working well was as low as 1.7 acres, nearly 50% of the above irrigated area was distributed on irrigation farms exceeding 5 acres in size. It was operated by 19 per cent of the total number of cultivators. To the other extreme, 21 per cent of the cultivators were operating 4.2 per cent of the total irrigated area with farm units less than 1.5 acres in size. Another 27.5 per cent of the area was distributed on farm units with their size ranging between

3 to 5 acres. This was lying with about 26.5 per cent of the cultivators. The size of remaining units being within the range of 1.5 to 3 acres. Greater frequency was observed on units bigger than 3 acres in size. Where one well did not provide for it, they had harnessed more.

Choice of Crops

2.5 Likewise, this sample provided a clue to choice of crops as would be seen in this district. As much as 29% of the area was devoted to perennials like Oranges and Bananas. 11 percent, and 30 percent respectively to two seasonals like cotton and chillies. Only 3.8 per cent to paddy; and about 11 per cent to Rabi seasonals. Vegetables covered 8 percent. It would be seen that this sample had a poor representation of vegetable area and a more liberal one of cotton and Rice, as compared to the overall proportions of irrigated crops of the district.

The following table provides classification of these 239 farmers, who reared either single or a multiple of irrigated crops, in frequency groups of size of irrigated land. It will be seen that as many as 41.5 percent of the irrigation farmers preferred to rear single crop.

TABLE NO. 5.

Table showing extent of multiple-crop pattern in Irrigation farming by size of unit.

Size of Irrigation unit	1 crop	2 crops	3 crops	4 crops	5 & above	Total
acres						
0.1—0.49	10	—	—	—	—	10
0.50—1.00	27	8	3	—	—	38
1.01—2.00	33	22	11	1	—	67
2.01—3.00	11	14	14	4	—	43
3.01—4.00	12	10	5	4	—	31
4.01 & above	6	12	18	11	3	50
Total	99	66	51	20	3	239
Per cent	41.5%	27.6%	21.4%	8.3%	1.2%	100%

Electricity for Irrigation

2.6. In the year 1953-54 electricity was available to cultivators in rural areas for irrigation purposes. To day it is mainly utilised for lifting water from wells. As many as 864 cultivators from 57 villages were taking benefits of this new scheme in the year 1960-61. Electricity as a source of power for lifting water has meant reduction in irrigation costs on farm economy. On rough calculations the cost of 30 feet of lift per thousand gallons of water by different devices will be as follows :-

<i>Mode of lift</i>	<i>Per 1000 gallons</i> <i>Rs. n. P.</i>
i) By Mhote ...	1.25
ii) By Oil Engine Pump ...	0.62
iii) By Electrically operated Pump ...	0.37

Moreover electricity meant economy on hands required to be employed. One man could operate at both ends. However, availability of water in wells has been a factor limiting the capacity to consume. The following table gives an idea as to how a big number was failing to consume power to their full advantage on account of paucity of water.

TABLE NO. 6.
Variations in pattern of consumption of electricity used for lifting water from wells in 57 villages in Wardha District
July 1960 to June 1961.

<i>Extent of Consumption</i>	<i>By seasons</i>			<i>Yearly</i>
	<i>Monsoon</i>	<i>Winter</i>	<i>Summer</i>	
1	2	3	4	5
Totally idle*	273	112	83	65
Below prescribed Minimum**	525	272	366	440
Above prescribed Minimum	66	480	415	359

* Number includes new customers given connections during the year.

** A minimum charge for 100 Units of electricity irrespective of actual low consumption. It was charged @ -/2/- per unit, and constituted as such part of the contract which did not expire for 5 years.

It will be seen that only 359 or 41.5 per cent of the consumers could utilise it above the prescribed minimum. Others had to pay Rs. 150/- per year, even though their consumption of power was much lower. Here the totally idle did not necessarily represent the number of idle units. Some were quite new fittings.

In a sample survey it was observed that Electric Pumps on 212 wells had replaced 184 Mhotes, 5 persian wheels and 13 Oil Engines, whereas 10 wells were new entrants in irrigation field. The sample covered 28 villages and about 166 cultivators using Electric Pumps. Out of these 166, nearly 150 expressed their opinion that electricity had meant less expenditure on irrigation. 2 felt that there had been hardly any noticeable change. Whereas for seven, electricity had added to the existing size of expenditure. The last category mainly represented those who had

inadequate supply of water and who had to pay the minimum charges prescribed without actually consuming the same. The second group represented small holders who had to maintain the old bullock establishment in addition to the new pump and its investment.

Progress of Wardha cultivator on irrigation economy over last 50 years, though of a halting nature has not necessarily been very slow as one would be inclined to think. Poor percentage of irrigated area, is nothing more than an indication of the necessity for intensive efforts. Traditional aversion to irrigation of wheat cultivation was mainly at its root. In fact, all along it has been a search for a suitable crop pattern. A pattern at once commensurate with returns promised by an unirrigated cash crop like cotton and with the poor sources of water he has failed to augment. The six thousand and odd wells which he has commissioned so far and which hardly irrigate acreage double their size, in fact, pose this searching question.

TABLE No. 7

Statement showing well irrigation as classified by Revenue Inspector's Circle in WARDHA District (1959-60.)

Sl. No.	Revenue Inspector's circle.	Total area by village papers (in acres)	Total cropped area (in acres)	Net irrigated area (in acres)	% of Col. 5 to Col. 4	Total no. of irri. wells in use.	Percent to the dist. Total	Irr. area per well in use.	No. of wells in use per sq. Mile.	No. of unused wells.	Percent to the dist. Total	Ratio of unused wells to one well in use.	Total No. of villages Electrified.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Ashti	1,17,565	70,871	846	1.19	548	9.33	1.53	2.9	950	9.33	1.73	...
2.	Karanja	98,599	59,950	2,228	3.76	883	15.04	2.55	5.7	1,044	10.25	1.18	...
3.	Kharangana	92,401	48,698	588	1.20	304	5.09	1.92	2.1	636	6.24	2.09	1
4.	Arvi	67,078	49,299	855	1.72	373	6.35	2.27	3.5	568	5.58	1.52	9
5.	Rohana	84,048	37,239	779	2.08	313	5.33	2.47	2.3	455	4.47	1.45	5
6.	Pulgaon	1,04,096	76,706	842	1.09	379	6.45	2.20	2.3	6,648	6.36	1.71	3
7.	Deoli	98,597	80,516	868	1.08	333	5.68	2.60	2.1	630	6.19	1.89	6
8.	Wardha	72,796	55,903	980	1.75	446	7.59	2.19	3.7	604	5.93	1.35	5
9.	Seloo	1,23,663	76,075	2,099	2.39	805	13.72	2.26	4.1	1046	10.27	1.30	18
10.	Sindi	1,09,702	89,271	1,156	1.16	553	9.42	1.87	3.2	722	7.09	1.31	9
11.	Allipur	95,558	76,295	574	0.74	222	3.78	2.54	1.4	795	7.81	3.58	...
12.	Wadner	90,738	68,485	429	0.61	237	4.03	1.77	1.6	586	5.76	2.47	...
13.	Hinganghat	80,616	60,150	310	0.50	176	2.99	1.70	1.4	620	6.09	3.52	1
14.	Girad	93,947	67,725	169	0.26	175	2.98	1.00	1.2	560	5.50	3.20	...
15.	Samudrapur	96,437	61,460	184	0.20	122	2.08	1.00	0.8	317	3.11	2.60	...
Total :		14,26,013	9,78,643	12,907	1.26	5,869	—	2.1	2.5	10,181	—	1.7	57

TABLE NO. 7 A

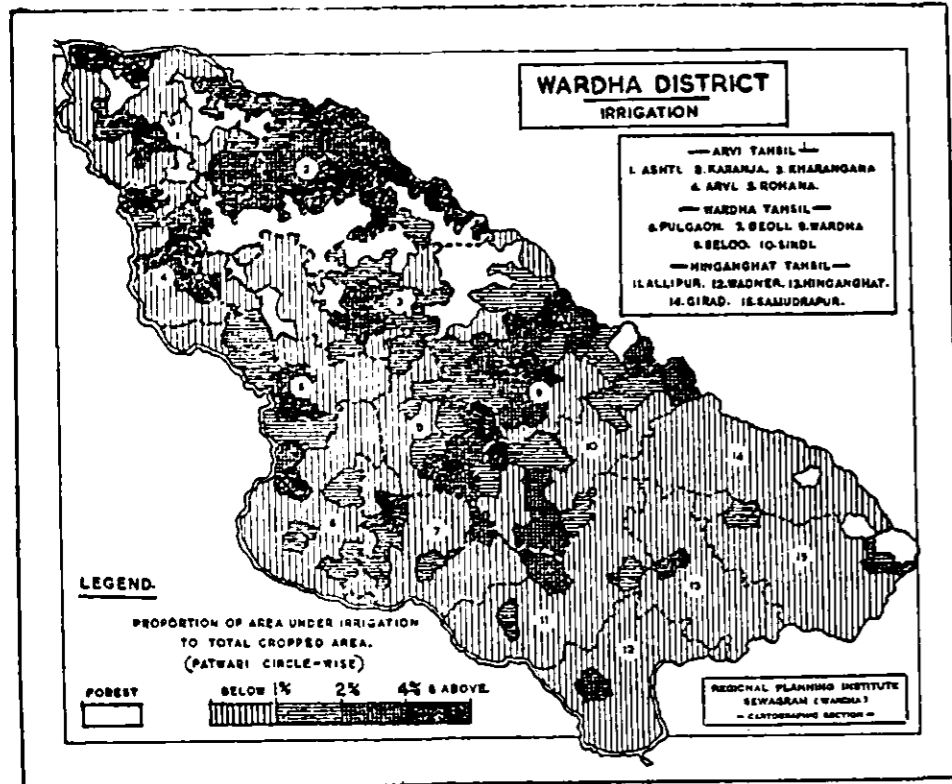
Statement showing Revenue Circle-wise area under Main Irrigated Crops.

(1959-60)

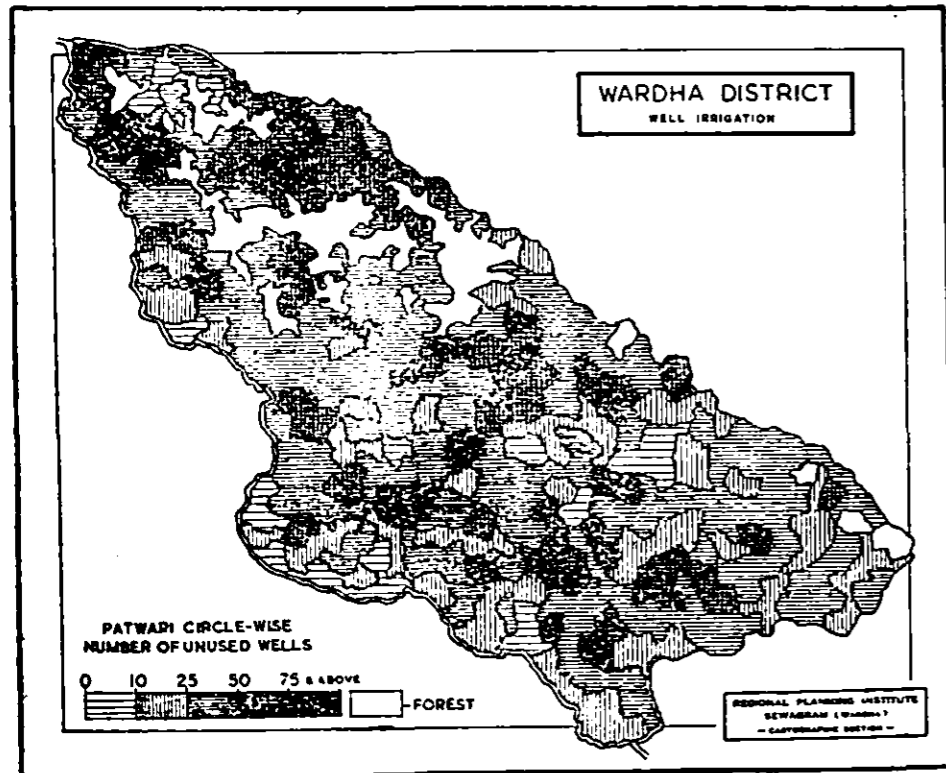
Revenue Inspector's circle.	Banana	Oranges & other fruits	Chillies	Vegetable	Wheat	Onions	Cotton	Misc.	Total			Total area under irrigation
									Kharif	Rabi	Perennials	
1	2	3	4	5	6	7	8	9	10	11	12	13
1. Ashti	8.39	130.71	240.80	43.81	116.81	65.57	28.09	32.43	320.37	207.14	319.10	846.61
2. Karanja	1.57	1164.13	288.37	98.97	432.69	78.42	68.51	93.82	421.22	640.56	1165.70	2227.48
3. Kharan-gana	5.80	129.77	189.05	54.00	55.35	52.90	81.80	19.26	312.59	139.77	135.57	587.93
4. Arvi	38.99	290.98	189.74	92.38	43.33	120.34	28.96	50.71	315.85	209.61	329.97	855.43
5. Rohana	30.59	113.75	386.74	52.61	88.34	42.87	50.78	13.74	494.63	140.45	144.34	779.42
6. Pulgaon	17.44	77.48	237.69	158.62	77.03	77.58	120.41	75.44	518.00	228.77	94.92	841.69
7. Deoli	1.91	35.13	446.13	141.65	48.15	102.44	68.84	23.23	601.22	229.22	37.04	867.48
8. Wardha	44.81	113.34	264.01	155.98	89.05	153.54	69.62	89.89	504.08	318.01	158.15	980.24
9. Selu	444.92	396.60	446.91	232.65	162.05	240.64	82.34	92.87	710.50	546.96	841.52	2098.98
10. Sindi	16.93	156.00	274.98	257.84	116.98	159.31	103.63	70.52	489.26	494.00	172.93	1156.19
11. Allipur	11.77	27.75	194.60	91.34	29.76	100.21	92.17	26.78	358.84	176.02	39.52	574.38
12. Wadner	1.30	39.95	124.07	87.17	43.49	88.34	23.94	20.62	165.16	192.47	41.25	428.88
13. Hingan-ghat	0.58	46.73	64.14	49.95	35.51	45.38	14.21	53.11	129.46	132.84	47.31	309.61
14. Girad	0.33	13.73	44.77	33.89	17.12	36.38	14.87	7.66	65.56	89.13	14.06	168.75
15. Samu-drapur	0.22	11.98	12.92	35.90	29.85	33.23	0.02	59.83	68.74	103.01	12.20	183.95
Total :	625.55	2929.03	3404.92	1586.76	1385.51	1397.15	848.19	729.91	5505.48	3847.96	3553.58	12907.02

...14...

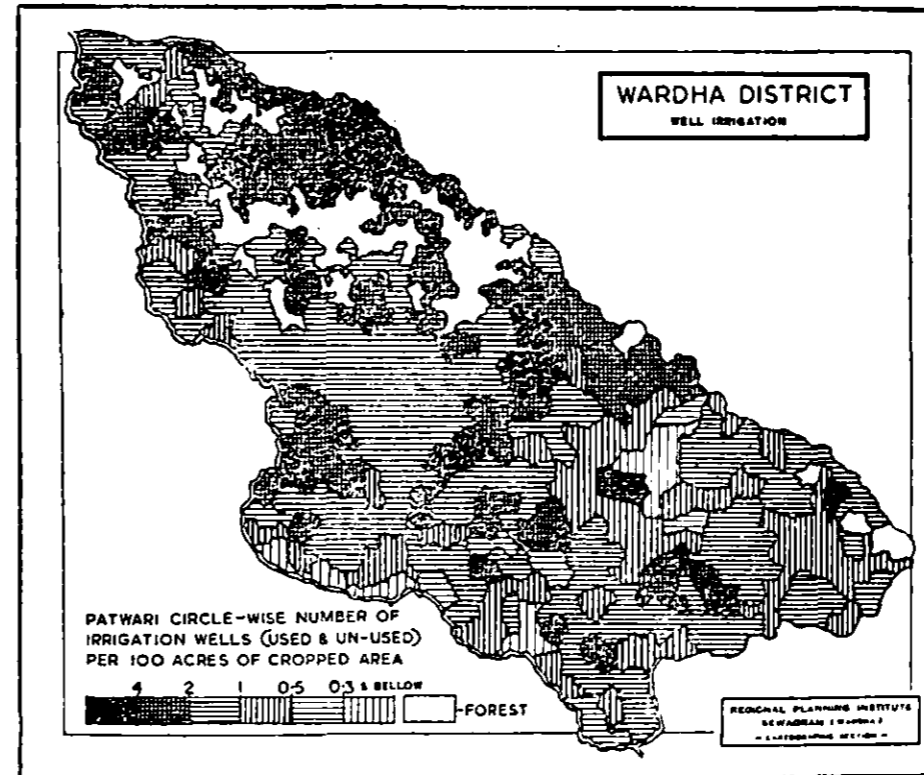
Map No. 2



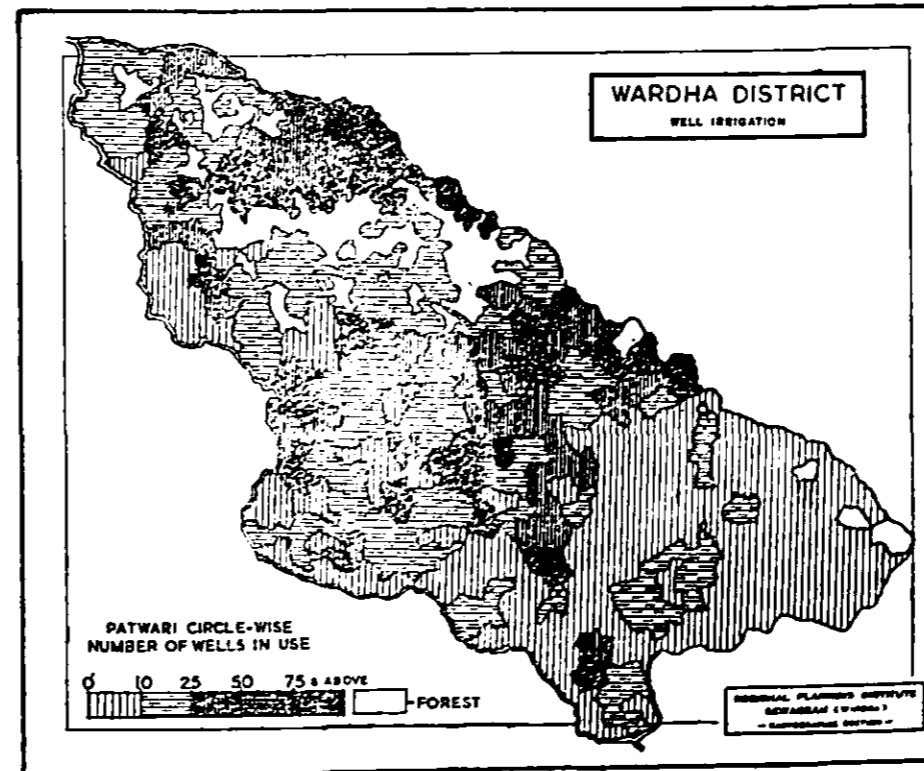
Map No. 4



Map No. 3



Map No. 5



Pattern of Well Irrigation

Communications and markets have influenced irrigation farming considerably. Irrigation has mainly developed around Amravati-Nagpur Road and Pulgaon-Wardha-Nagpur Road. But areas having higher proportion of irrigated farming, surprisingly show higher incidence of abandoned wells. (Compare Map No. 2 with Map No. 4). Karanja R. I. Circle No. 2 and Selu R. I. Circle No. 9. bring out this fact more strikingly. It is this aspect, in particular, that calls for an organizational approach to well irrigation in Wardha. Maps Nos. 2 and 5 illustrate how Hinganghat Tahsil has remained far behind in well irrigation. Tables Nos. 7 and 7-A provide further information on well-irrigation. Map No. 2 outlines the respective Revenue Inspectors' Circles.

3 THE PHENOMENON OF ABANDONED WELLS

Yet another question appears to be more pertinent but equally relevant. What about those ten thousand and odd wells which are abandoned by the cultivators? Does this not indicate want of a strong desire to use water—whatever comes its way? Or should it be interpreted as a supreme effort of the Wardha cultivator in favour of Water? That way can it, then, be interpreted as paucity of underground supplies of water? Or would it be attributed to just a craze for water unaccompanied by a simultaneous search for suitable crop pattern? Or is it just to be brushed aside as a normal phenomenon commonly occurring over a dry farming tract, where small wells are looked upon as 'Reserves' for a 'bad season'?

3.1 : Temporary Irrigation

Well irrigation in the district has been aptly described as 'temporary' in old records. Mr. Smith's report on Survey and Settlement of the district throws light on a very interesting phenomenon. The report indicates that whereas the number of irrigation wells was increasing on one hand, the area under irrigation was decreasing on the other. In the year 1862 the number of irrigation wells was 947; and the area under irrigation was 5499 acres. In 1892, when the number of wells was increased to 1250, the area under irrigation climbed down to 3048 acres. Again in the year 1912, the number of irrigation wells was further increased to 2163, whereas the area under irrigation showed a further drop. It was only 2953. With a rise of nearly 128 per cent in the total number of wells, there was a drop in area under irrigation to the tune of 46.4 per cent. Strange though, it appears to be as old and as common a phenomenon as well irrigation itself. Later on the Central Provinces introduced a system of keeping records on wells under two sub-heads, (i) temporary and (ii) durables, and separately under each, the number of of used and unused wells was reported. Unfortunately this record as kept separately was not readily available for scrutiny. It would have been a great help in analysing the causative factors. In the beginning of the century there were as many as 1405 temporary wells in Wardha.

Here 'temporary' meant, perhaps, Kachha construction. Nevertheless this did not throw any light on the causes. There appears to be no serious note taken by Government., at any time, of these wells remaining unused. In the year 1952-53, Government had deputed an officer on Special Duty to submit a forecast report for Revision Settlement. Even in that report there is no mention whatsoever of this aspect of irrigation economy. Reports apart, the trend showing increase in the number of abandoned wells continued till very recently. It appears, sometime in fifties it has been arrested. To-day as has already been stated, the number of unused wells is 10,624—nearly 64 per cent of the total.

3.2 : Abandonment elsewhere

This feature of abandoning of irrigation wells appears to be common to entire Vidarbha region. More so even to other parts of Maharashtra. Information given under Appendix A helps blunt the edge of the element of dismay, which grapples one immediately on reading the unusually high figure of wells not in use. Here, in Nagpur Division, though Nagpur tops the list in absolute numbers, the ratio of abandoned wells to wells-in-use appears to be strikingly adverse in case of Wardha.

TABLE No. 8.

Unused wells in Vidarbha Region

District	Number of wells in use	Number of wells not in use	Gross area irrigated by wells (acres)
1	2	3	4
Buldhana	12,693	6,417	16,500
Akola	2,872	12,325	6,700
Amravati	10,109	3,818	12,700
Yeotmal	3,588	2,822	5,100
Wardha	5,725	10,372	10,200
Nagpur	18,746	15,744	31,300
Chanda	6,399	2,686	2,700
Bhandara	8,410	2,717	6,400

3.3 : Wells as 'Reserves'

While giving his evidence before the Royal Commission on Irrigation 1901-03, Mr. F. G. Sly, Commissioner on Settlements and Agriculture, Central Provinces, has made a passing reference to this aspect of wells being kept out of use. He said :

" In 1896, there were about 5,000 wells in the District (Nimar). 643 cut in the rock, 2251 dug in the soil and lined with bricks and 2103 merely ' Kachha '. But of the total number only 2/3rd are in actual use for irrigation. Of the remaining 1/3rd, some are falling into

disuse because the sides have caved in, some are simply used for drinking and some are held in reserve to supplement the ordinary supply”.

A point that needs to be cleared at this stage concerns the term ‘abandoned’ used to record unused wells. According to the definition given in Revenue Code of Madhya Pradesh *a well which was once in use for irrigation purposes and has since been continuously not used for a minimum period of three years is an abandoned well.* Taking hint from Mr. Sly’s statement this appears to be indeed a sound definition helpful in recording genuine cases of abandonment. But unfortunately this distinction has not been kept up. Wells which were failures and that way never utilised for irrigation purposes; or wells which were specifically constructed for drinking purposes of cattle, have been mixed up with the present number. It is not quite known if ever there were any separate records of ‘failures’ in wells, or of such dug-outs which were never intended to serve irrigation. Nevertheless, the mixing up of all these categories into one has led to more of confusion than clarity to serve any purpose of keeping records on wells.

3.4: Rainfall & Irrigation :

That a sizable portion of these wells was looked upon as ‘reserves’ in face of a bad season, appears to be a more plausible version. Graph on the next page clearly illustrates how possibly the behaviour of monsoon might have influenced the size of area under irrigation. The following table, which is an extract from the evidence before the Royal Commission on Irrigation, also, fairly corroborates with the graphic illustration.

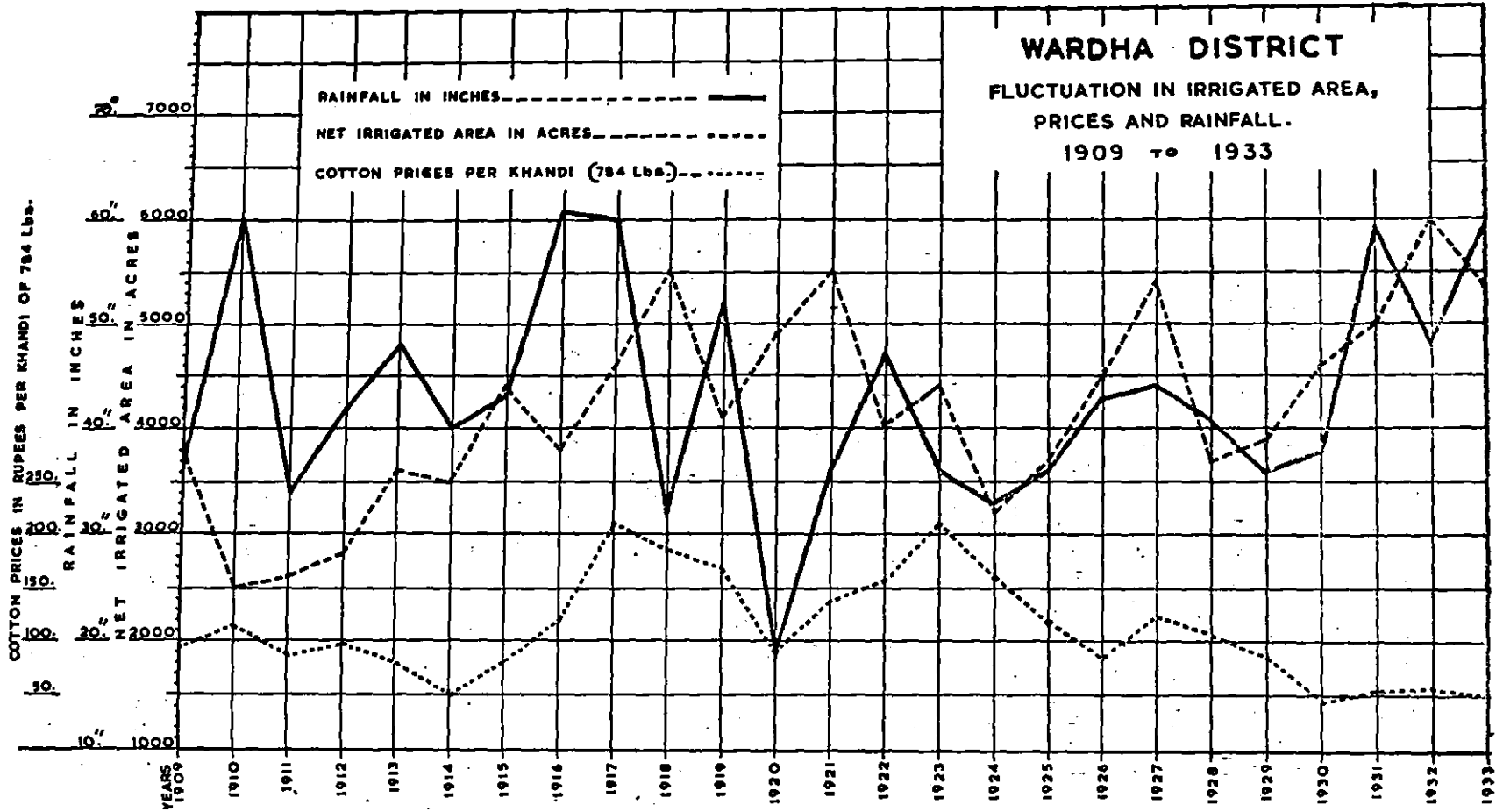
TABLE NO. 9.

* *Rainfall and its influence on Irrigated area*

District	Rainfall variations in inches.				Percentage of gross area irrigated on normal areas sown		
	Normal	1895	1896	1899	Normal Year	Early Cessation of rains	Year of Drought
		—96	—97	-1900	1895—96	1896—97	1899-1900
Wardha	39.8	42.1	38.9	14.1	0.3	0.4	0.3
Nagpur	45.9	51.3	46.4	15.5	2.0	1.9	0.8
Betul	42.2	34.5	38.6	15.9	1.2	1.8	1.0
Chhindwara	39.3	33.4	33.9	14.4	1.1	1.3	0.9

* Source—Report of Royal Commission on Irrigation 1901—1903

Graph No. 2



Here, in this case, conspicuously different behaviour of Nagpur in 1896—97 could mainly be attributed to the large portion of its irrigated area deriving its source of water from Tanks. As many as 1150 tanks were irrigating 13,000 acres during that year. This has been virtually absent in case of other three districts.

3.5 : Influence of Cropping Pattern

Once Wardha had its major wheat economy. In fact major classification of lands for assessment purposes was based on wheat and non-wheat lands for the 1st Settlement. From its 199 thousand acres of wheat in 1862, the area under wheat came down to mere 78 thousand acres in 1951—52. This period was, indeed, marked by a major switch over to cotton. During this period, area under cotton rose from 226 to 376 thousand acres—with its peak — 479 thousand acres in 1921—22. A major switch over to cotton cultivation in the face of its promising returns, and that way ultimate link up of the future of irrigation economy to the prospects of these returns, appears to have, no doubt, influenced the total size of irrigation in the district. But not so much the use or unuse of wells. The price line on the same graph does not help trace a direct and distinct influence of cotton prices on the fluctuations in irrigated area. That there has always been a 'Reserve' of such wells to be used in bad season, therefore appears to be a more plausible explanation for a number which has fluctuated on either side. However such behaviour of wells does not seem to have exceeded 3,000 in numbers anywhere.

3.6 : Impact of Taccavi.

Yet another explanation seems equally plausible which refers to a process of abandonment consequent upon availability of good alternate source of water — preferably a new well with rich water supply. Table No. 10 makes a pertinent reference to this process. Yearly figures for used, unused and total number of wells alongwith the area it irrigated are available for two sets of years 1946—47 to 1952—53; and of 1956—57 to 1960—61. They are presented in the following table :—

TABLE NO. 10

*Rate of use and unuse of wells in Wardha District — 1st period
(1946—1952)*

<i>Years</i>	1946	1947	1948	1949	1950	1951	1952	Variations over base year. (1946-47)
	-47	-48	-49	-50	-51	-52	-53	
Wells used								
during the year	5,362	5,768	5,724	5,901	6,029	5,904	5,447	+85
Wells unused	9,276	9,427	9,764	10,560	10,468	10,812	11,335	+2059
Total no. of wells	14,638	14,819	15,513	16,461	16,497	16,716	16,812	+2174
Irrigated area (in acres)	9,400	10,600	9,800	10,500	11,200	10,800	9,000	-400

Rate of use and unuse of wells in Wardha — IInd period
(1956—60)

Years	1956-57	1957-58	1958-59	1959-60	1960-61	Variations over base year. (1956-57)
Wells used during the year	5,689	5,766	5,870	6,303	6,912	+1,223
Wells unused	10,372	10,670	10,465	10,713	10,351	-21
Total no. of wells	16,061	16,436	16,335	17,016	17,263	+1,202
Irrigated area (in acres)	10,299	10,816	11,256	12,106	12,282	+1,983

Towards the end of 1st period though there was a net decrease in irrigated area by 400 acres, after allowing sufficient margin for year to year variations in irrigated area due to influence of monsoon, the average rise over the base year appears to be of the order of 700 acres. Whereas the number of additional wells dug during the same period was as high as 2,174. In fact this addition to the original total was virtually nullified by an addition of nearly the same size of abandoned wells (2059) during this period. May be the additional wells in this case included some which were constructed by taking Government Taccavi. Between 1947—48 to 1950—51 Taccavi for construction of 656 new wells was disbursed in Wardha. What can explain, then, the huge number of additionally abandoned wells during this period? May be a new process of deserting old uneconomic small wells commenced the moment new good size wells became available. Actually it did happen in a number of cases. This was noticed at the time of survey and was supported by the conditions existing in Karanja and Seloo Revenue circles. They have the largest percentage of irrigated area (3.76 and 2.39 respectively). The proportion of irrigated area to one well in use is also fairly high (2.55 and 2.26). And it is here that the number of unused wells, also is very high. In fact they top the list of 15 circles of the district. (Table 7 P. No. 13) Other explanation, if any, could be attributed to possible over reporting in the face of inducement of getting loans for repairs.

It appears, from the village records, that from the year 1949—50 the total number of temporary wells started decreasing from 7993 to 7842 in 1952—53. During the same period, number of temporary wells used during the year, also, came down from 2149 to 1863. Similarly the number of abandoned wells (temporary) came down from 5744 to 5619. May be a process of transfer of wells from 'Temporary' to 'durable' ones was initiated during this period. This could be explained by the Government help made available to the cultivator in the form of Taccavi during the period for repairs of old wells. As many as 496 wells received taccavi meant for repairs to old wells, during the 1st period.

This trend appears to have continued during the IInd period as well. Separate records of temporary and durable wells are not available for

this period. There appears to be some wrong 'reporting somewhere. The total number of wells for the year 1956—57 appears to have decreased by 751 which has not been explained anywhere. With due allowance for this error one can still observe a marked change in the use and unuse pattern. Instead of adding to the original totals of abandoned wells this period seems to have been marked by the utilization of some from the stock, and of having reduced the total by 21. Moreover the area irrigated per additional well has also been considerably increased. As against an increase of 700 acres for an addition of 2174 wells, during the 1st period, this time an increase of 1983 acres was secured with an addition of only 1202 wells. This remarkable change in utilisation pattern could be attributed, again, to the Government help made available in the form of taccavi. During the 10 year—period ending 1957, taccavi was received for new constructions numbering 1161 (wells). In 1956—57 and 57—58 alone, Government had received as many as 590 applications for loans of which 225 were approved.

3·7 : Failures

In a sample survey conducted by the Gokhale Institute of Poona which covered 231 cases of abandoned wells, it was observed that 39 per cent of these un-used wells were dug during last 15 years, and 44% of these recent constructions had received Government taccavi ranging between 500 and 2000. This at once raises a question about effectiveness of Taccavi. The size of this help was either small or the help was not rendered to the deserving cases. Perhaps both were true. The Technical Committee on wells scheme, conducted a sample survey wherein it was revealed that nearly 14·1 per cent of the wells, which had received taccavi either for new constructions or for repairs, were on improper sites.

This question of rendering Government help to deserving cases assumes, in fact, strategic importance. No one can deny the necessity of such help. Nor can one blindly say : help all those who ask for it. Can some objectivity be laid down as a guiding principle ? Cannot this incidence of failure be considerably reduced ? Cannot a major portion of unused wells be commissioned back to effective use ? Cannot a more stable and broad based irrigation economy be introduced in a tract marked by relatively high and assured rainfall ? These are some of the pertinent questions to which the district has to address itself if well irrigation has to have a coveted place in the agricultural economy of Wardha.

4 LOCATION OF SUITABLE SITES

4.1 : Deccan Trap & Well Waters

Guidance on the selection of proper site for wells, particularly in such areas where underground water is not spread evenly over the agricultural lands, assumes utmost urgency. Both in the face of the percentage of failures which well sinking has been accompanied with and on the background of the cultivator's sustained interest over decades together in pursuing this path notwithstanding the risks. While giving evidence before the Royal Commission on Agriculture, 1927, Mr. F. J. Plyman, Director of Agriculture, Central Provinces and Berar had pointed out the necessity of studies to help render such advice, in following terms :

“ In some parts of this province, particularly in Berar and plateau districts, irrigation is largely done by wells. The supply of water from this source is of such importance that I consider the employment of a specialist to deal with this question, is essential. He should investigate the whole subject of underground water and the conditions which govern its availability for irrigation purposes. This is particularly necessary in areas where the ‘ Deccan trap ’ is the prevailing geological formation, as the occurrence of water in this rock is generally a very uncertain matter. ”

4.2 : The piece-meal advice obtained at present from local diviners, or expert outsiders can hardly be called satisfactory. Perhaps it would be of interest to put the claims of each type to a searching test and to weed out the relatively less effective. But what is really required to be done is to put intelligent and experienced workers on the solution of this problem; which must be considered from two angles :

- (i) Rainfall and its distribution - precipitation ; Gradient of the area and run off ; Distribution of streams ; character of vegetation, and evaporation ; and
- (ii) Hydrological character of the trap - porosity and permeability of rocks; sub-soil flows; Transmission and recuperation.

Dr. N. V. Kanitkar, in his treatise on 'Dry farming in India' has worked out a rough formula on the lines stated in (i) above. He says that "Quite a large part of precipitation in excess of 1" per day is retained by the soil load. A part is taken up by crops and a part is let off in streams by way of run off, a part is lost by way of evaporation... and a part is carried by underground percolation. The most pessimistic estimate for this last will be 6" (as against a total of 25" of precipitation). This is retained by Zeolitic Murum ... and is ultimately available in wells ... Even if we assume that 2" of this (i. e. $\frac{1}{3}$ only) as the quantity tapped in wells, the conditions are as follows ... From 100 acres of agricultural land, we will have 200 acre-inches available in wells annually. Assuming a well to irrigate (on an average) 1 acre of two seasonals and two acres of seasonal crops (equivalent to 5 units of seasonals) the quantity needed for irrigation (excluding rains) will be 35 acre inches. Therefore, the number of wells possible in 100 acres will be 5.7 on an average."

4.3. Though the annual rainfall in Wardha is as high as 44" a straight assumption would be wrong that quantity of water carried over by underground percolation must necessarily be high. The structure of soils and rocks and the distribution of rains will have to be systematically studied to see if supply of well waters could, in any way, be augmented, or if the number of wells in any particular area exceeds a normally permissible number. Study of run off and computation of percolation to underground layers by measuring the seasonal variations in depth of the water column in selected wells as has been attempted by the Technical Committee (appointed by the Government of Maharashtra to assess the extent of work done under the wells scheme) is one of the pragmatic ways to get going with this idea. Though the samples taken by the Committee were too sketchy to establish the approximate size of under ground supply, it certainly indicated the lines on which a searching enquiry of the problem could be made. Findings recorded by the said Committee for various regions, do not necessarily bracket Nagpur for inadequate supplies. Its performance is almost on par with other regions of present Maharashtra State.

TABLE No. 11.
Average Depth of Wells and availability of water :

Division	Average depth of well in ft.	Average height of water column in feet in		
		Monsoon	Winter	Summer
1. Bombay	27.0	18.0	13.9	8.4
2. Poona	30.9	19.7	13.7	7.3
3. Aurangabad	31.5	20.5	14.9	9.9
4. Nagpur	32.1	19.7	12.9	7.0

Source : Report of the Technical Committee appointed to assess the extent of work done under the wells scheme (1960),

4.4 Location of Sites :

The conditions suitable for accumulation of water in the Trap rock being the weathered porous and permeable portion of the rock, or the fissures and joints which are spread few and far between, the ground water usually occurs in isolated patches. Moreover, ground-water does not exist in the form of a closed body so that if it is not tapped it remains in the same place. Ground water after sinking to the lowest of the porous portion, begins its downward journey over the impervious rock. In his paper on 'Prospecting for water in the Deccan Trap region' Shri B. G. Deshpande of the Indian Bureau of Mines has indicated probable course of this journey, in the following terms :—

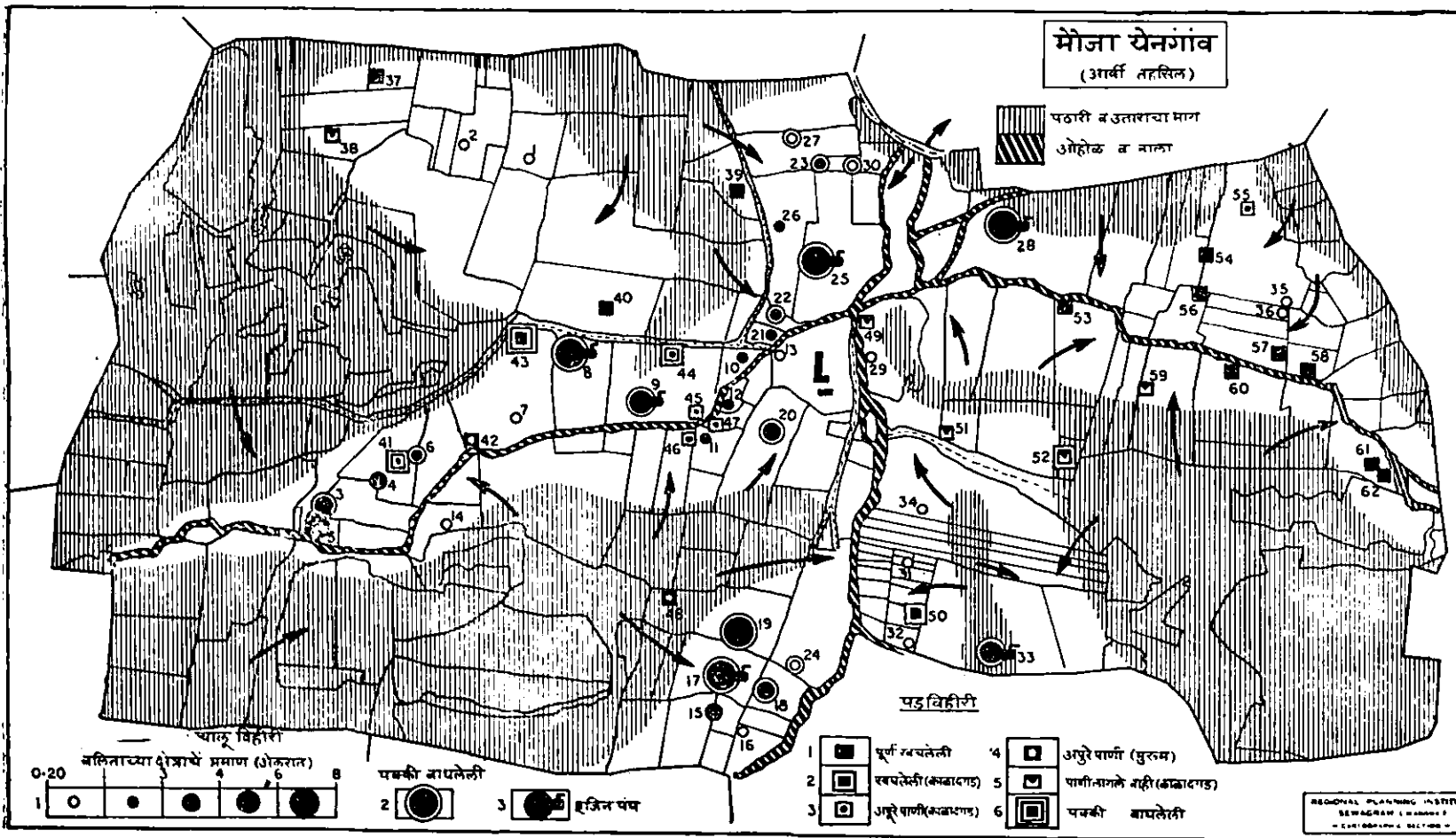
"It is found that the course of underground water is usually the same as the surface streams and rivers. After the monsoon most of the smaller streams over Deccan Trap areas are dry, but water is generally found in wells situated closer to the streams or in pits sunk in stream beds. Similarly wells situated closer to the streams have more water, better recuperation and longer life than those located higher up and further away from the streams. Luxuriant vegetation along the banks of dry streams is a further corroborative evidence of the ground water following practically same course as surface streams. When a stream meanders into a semi-circular bend, the ground water will be found to take the shortest course, provided the rock is favourable for its transmission. If unaltered rock or a dyke crops out in the bed of a stream, the ground water is affluxed whereby the up-stream portions of the nallah become favourable sites for wells. The prospects of water are better down stream of a confluence of streams than above it ... These generalisations apart ... unlike in stratified formations there is no well defined water table in the Trap Rock."

4.5 Appreciating fully the difficulties in predicting supplies of underground water, the Technical committee has suggested a pragmatic course of action. They have recommended that :

"In regard to the question of the selection of a particular well, the Committee desires, that based on the information available from wells already in existence, as well as data on underground water supply available, with the Geological Survey of India or State Government, areas should be marked out on village maps, where adequate supply of water for irrigation purposes can be anticipated. Similarly, the natural drainage channels such as rivers, rivulets and nallahs which are potential areas for location of successful wells should also be marked ..."

मौजा येनगांव (आर्वी तहसिल)

पठारी व उताराचा भाग
ओहोळ व नाला



पडविहीरी



पक्की बाघलेली

इंजिन पंप

- | | | | |
|---|----------------------|---|-------------------------|
| 1 | पूर्ण बाघलेली | 4 | अधुरे पाणी (पुढम) |
| 2 | खचलेली (काढादाड) | 5 | पाणीनागले नदी (काढादाड) |
| 3 | अधुरे पाणी (काढादाड) | 6 | पक्की बाघलेली |

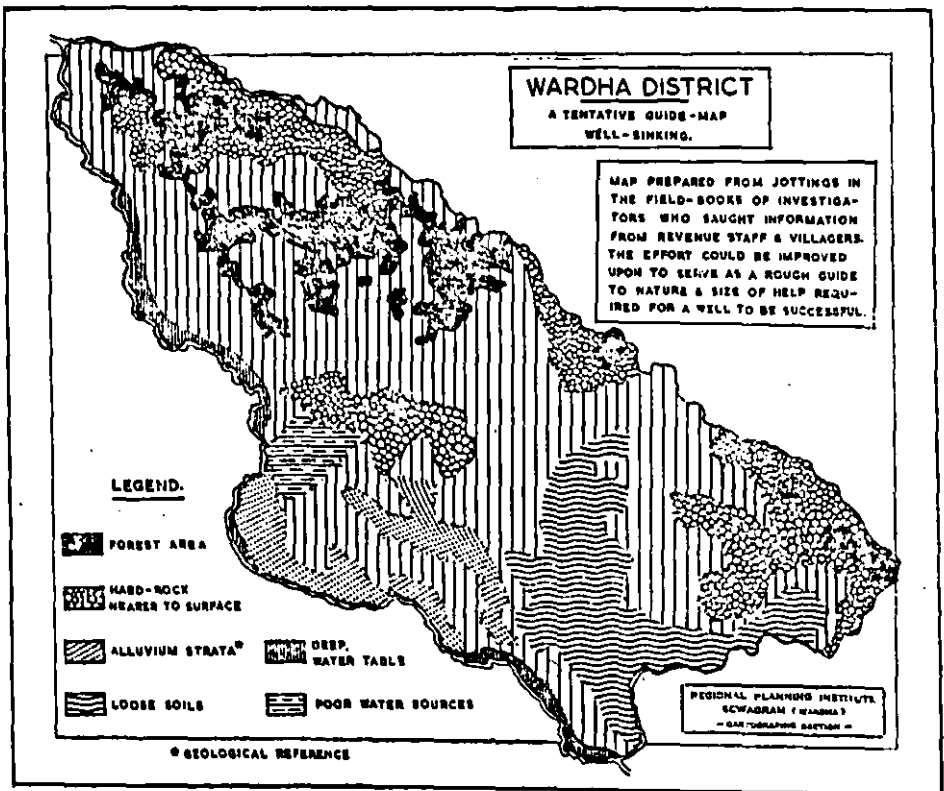
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- CHRISTIANITY & SOCIETY -

For reference to numbers, see Appendix B

4.6 An attempt, to locate on the village maps working wells with their size of irrigation, crops, natural drains and ridge areas and a broad classification of soils, was made by the Regional Planning Institute through a 'condition survey' of wells in 4 villages spread in 4 different tracts. One such map for village Yengaon in Karanja Revenue circle is given on page No. 25. The map presents location of wells in use by the size of irrigation they support individually. This is indicated by size of circles. The shaded portions represent Pathari and slopy areas ; whereas arrows indicate direction of the slopes. The black chord running across, represents rain water drains and Nallah beds. Location of unused wells is shown by rectangular symbols. They represent :—

- (1) In total ruins ; (2) In ruins but had struck hard rock. (3) Inadequate water (hard-rock struck). (4) Inadequate water (Murum bed) ; (5) Water not struck (hard-rock bed) ; (6) A lined well not in use. (For period of construction, present condition of the construction,

Map No. 7



availability of water and main reasons for having to remain it unused, see Appendix 'B'). It is based on the spot studies,

... 27 ...

So for the efforts made at securing relevant geological data from departments have not been met with much of success. However, a tentative map (No. 7) based on information given by other Revenue Inspectors and prominent cultivators does give a broad though workable indication of geological formations as encountered by well sinking programme in those respective areas. Particularly in Yengaon as could be seen from the map, on page No. 25, supply of underground water has remained inadequate in the north and east of the village. It also indicates that any sweeping generalizations regarding occurrence of underground water are risky. Nevertheless, the map does indicate relatively more risky zones. Main purpose in narrating the experience of this 'condition survey' is to underline the fact that given proper scope the task as recommended by the Technical Committee does not lie far beyond the comprehension of present day village leadership and Revenue staff, who recommend loan applications. The purpose of education it serves of both the Revenue officials at village level and of the villagers in general simply remains unmarvelled.

5 POTENTIAL FOR DEVELOPMENT

A. Sub-Soil Waters :

5.1 Considerations that actually weigh in assessing the development potential of a basic resource like water for irrigation, hinge mainly upon three factors (i) Organization of utilisation (ii) Economics of returns and (iii) Scope of technical feasibility. It has been the experience on a number of projects that water remained unutilised for a considerably long period. It was not the sugarcane but its ultimate linkup with sugar industry that ensured effective use of water in Western Maharashtra. What was true of (Canal) irrigation projects appears to be equally true of well irrigation. It has to be borne in mind, in case of well irrigation, that the problem is not merely of 'finding' water, but that of finding it at workable depths, in adequate quantities and of suitable quality so as to be economically available for use. Cropping pattern makes considerations of economic availability more plastic, It is generally the economics that govern the scope and shape of organisation. The problem of unused wells, or that way the entire problem of irrigation wells, it appears, is mainly a problem of inadequate supply of water, and can mainly be tackled through a co-ordinated approach in matters of developmental policies and programmes that will help augment the under ground supplies; and secondly through a suitable organisation at the village or group of village level which will ensure its most efficient use.

5.2. Un-used Wells :

While assessing the development potential of the present stock of un-used wells through a sample survey, it was observed that nearly 35 percent of these wells were abandoned for reasons of paucity of water. Another 28 percent were, so to say, incomplete projects handicapped for want of either long-term finance or faced tough problems connected with well-sinking, like hard rock, loose soils etc. Thus as many as 63 percent of the abandoned wells were either incomplete projects or failures on account of inadequate supply of water.

Of the rest nearly 8 percent were abandoned for want of bullocks and such other necessities. Another 14 percent related to problems mainly

connected with field of management-like lack of reliable manpower, complications emerging out of tenancy legislations, uneconomic working of irrigation economy etc. Yet another 7 percent were not used because of litigations and disputes among families. In fact this second group of 29 percent represented a different category of wells. Wells which could have been used provided the organizational and financial problems were absent.

Then there was a third category where wells did have water but either suitable land around the well was not available for the owner, or they were away from village sites, and that way, were difficult to manage ; or the owners did not have any desire to use them, since they had other good wells on their farms. Nearly 6 percent represented this category. But in this case, too, non-availability of water was not the real problem.

Remaining 3 per cent were never intended to be irrigation wells. They were small dugouts with diameters not wider than 6 feet and had no traces of water-lifting platforms. These dugouts were located at places rather far away from village sites, and even from good working wells. Evidently they were meant for drinking purposes for cattle.

5.3 Condition of Wells :

Thereafter a ' Condition Survey ' of these wells was conducted. Therein it was observed that out of 174 wells, examined on the spot, as many as 157 were irrigation wells. Of them 85 were lined with either stones or bricks, and 33 required minor repairs. It was only 28 out of 174 that required major repairs. 52 were in perfectly good condition. The following table gives frequency of their total depths and heights of actual water columns as measured during 3rd week of May in the year 1961.

TABLE No. 12

Depths of unused wells with their heights of water columns in 4 selected villages

Height of water columns.	By actually measured depths of the Wells						Total No. of unused wells by water column.	Percent
	Below 10	11 to 15	16 to 20	21 to 25	25 to 30	30 and above		
No water	5	10	6	2	...	3	36	20.7
Below 5'	3	9	12	12	12	1	49	28.1
6' — 10'	—	4	13	18	14	6	55	31.7
11' — 15'	—	—	2	3	6	13	24	13.8
15' and above	—	—	—	—	—	10	10	5.7
Total by depths	18	23	33	35	32	33	174	100.00
Per cent	10.4	13.2	19.0	20.1	18.4	18.9	100.0	—

It would be seen that nearly 20 percent of these wells had summer water-columns with their heights ranging between 10 to 15 feet. In fact 5.7 per cent had it more than 15 feet ; and as many as 108 wells which had water, were not more than 30 feet deep. Out of those 36 which did not have any water column only 3 were deeper than 30'. In Wardha on an average water is tapped below 25'. This fact renders yet greater significance to these readings on summer water columns.

The reasoning :

While ascertaining causes for keeping these wells idle it was seen that 59 were not used on account of paucity of water, and 13 for want of major repairs. As regards others the following reasons were advanced :

TABLE No. 13.

Classification of 174 abandoned wells according to the main reason as advanced by the owner.

<i>Reasons for keeping the well out of use</i>	<i>No.</i>	<i>Per cent</i>
1. Unmanageable distance ...	4	2.3
2. Non-availability of finance ...	28	16.1
3. Tenancy troubles ...	7	4.0
4. Absentee management ...	12	6.9
5. Major interest shifted to other occupations ...	3	1.7
6. Economics of irrigation not favourable ...	5	2.8
7. Inadequate family man power to undertake irrigation farming ...	6	3.4
8. Changes in crop pattern ...	4	2.3
9. Negligence ...	15	8.6
10. Inadequacy of water ...	59	33.3
11. Unmanageably damaged construction ...	13	7.4
12. Misc. like lack of knowledge of irrigation, want of only minor repairs like desilting etc. ...	18	10.2
	174	100.00

The following four village were selected for this 'Condition Survey' : (i) Karanja ; (ii) Ashti ; (iii) Erandgaon ; (iv) Selu (Hinganghat). Condition of unused wells differed from place to place. But in general it may be said with certainty that a sizable percentage of these wells can be commissioned back to use provided some measures organizational in nature are employed. Other aspect of the problem related to the general problem of augmenting the sub-soil water of the terrain. That way a major portion of the 63 percent failures, mentioned earlier, may give a positive response.

5.4. Core of the problem :

A certain degree of improvement in the present day situation can be brought about by providing long term loans for repairs. But likelihood of loans being misused is more in case of ensuring repairs. In Ashti, a village in Arvi Tasil, which had as many as 92 unused wells, this aspect of the problem was discussed with the cultivators. They suggested that a scheme of improving these wells may be implemented departmentally, as has been the case with bunding programme in soil conservation works. They were hinting at probable misuse of help. But departmental approach to this type of work is more fraught with uncertainties and handicaps than the present approach of 'Individual Risks'.

Moreover, as earlier stated under Paragraph No. 3-6, Taccavi loans for as many as 737 wells were given ; and as many as 2174, new wells were constructed, but an addition of nearly an equal number of unused wells to the original stock was observed. This gives an indication of a process where wells with relatively less water fall out of use, once relatively good source of water became available to cultivators. Any organizational approach has to reckon itself with this aspect in a more realistic fashion.

5.5. Organization :

The situation has to be effectively dealt with. A village body devoted to ensuring higher production and helping development of basic resources may have to be encouraged to make effective use of this water, wherever it is found feasible, in a co-operative way, without disturbing the ownership pattern. The owner of the well would have his first claims on water if he is desirous of using it; and the next would be that of the neighbours. Provision of water can be made against payment of normal rates of water lifting, plus management expenses, and the interest on capital investments required for deepening the well, lifting device and such other necessities. Experiment on this line in a few selected villages with people's initiative appears to be possible. Legal provisions, if need be, may follow in their own train of logic.

In Karanja area it was observed that Co-operative use of well-water was practised by a few cultivators. As many as seven cultivators were using waters from one well which was irrigating $7\frac{1}{2}$ acres of land in Karanja. Similar approaches can be encouraged in case of those 35 per cent of wells which were lying unutilised for mainly organizational reasons. It would facilitate use of waters even for small cultivators. It would also mean possibilities of augmentation of well waters by further deepening or widening if need be, by providing for the security required for getting adequate loans.

This aspect of well sinking and repairs provides yet another avenue where Co-operative Organisation can help economise on costs ; and promote efficiency so badly needed on jobs which have a technical conno-

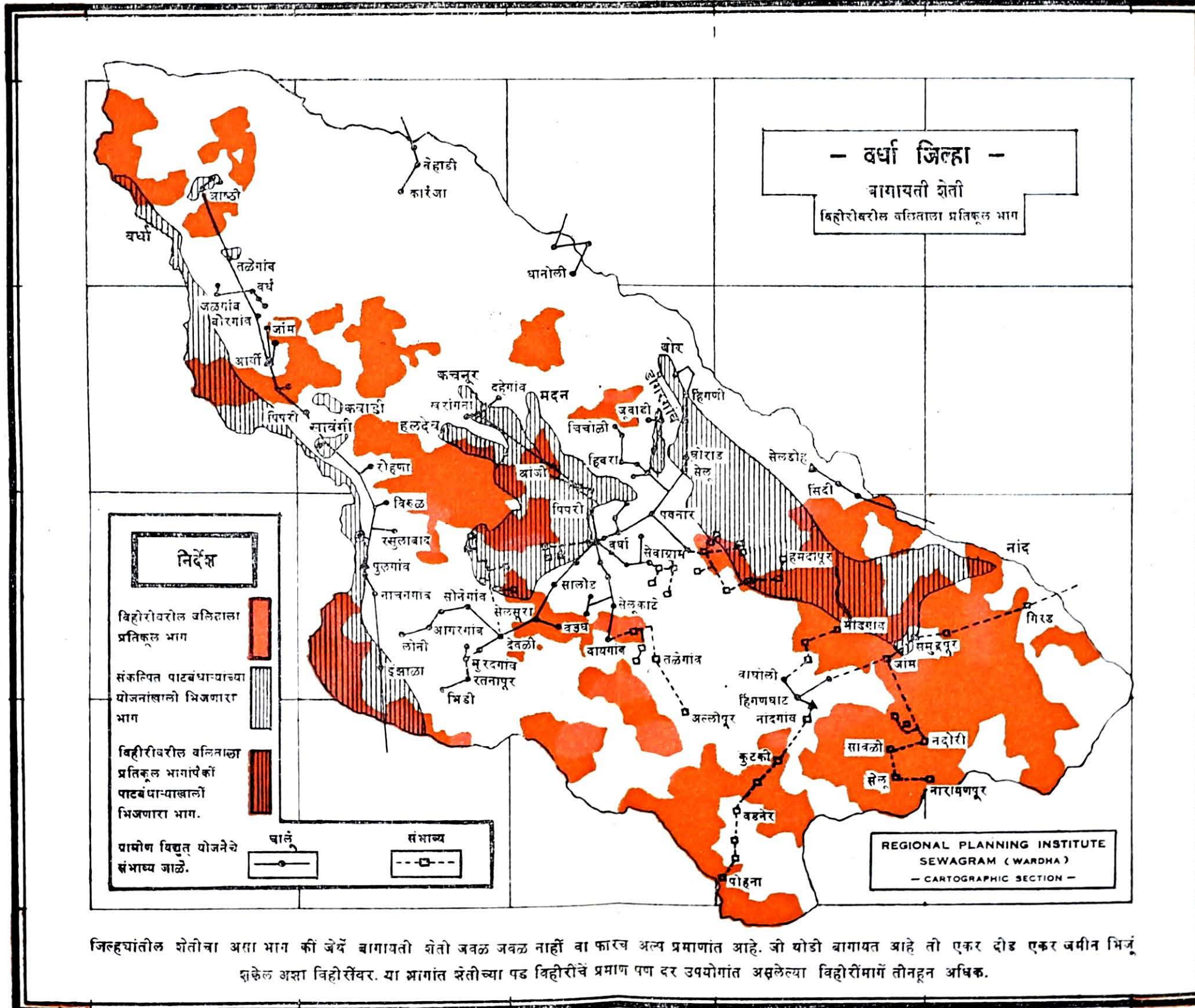
tation. Entire task of well sinking and construction over compact areas, can be handed over to Co-operative Societies—modelled on the lines of Housing Co-operatives. The loans would be handled by the Society. The Society would commission services of skilled workers required for the task, along with the machinery, wherever it is necessary ; and would handle the job of material supplies on a centralised basis. Since the works would be located on compact areas, or so to say, since they would be undertaken and operated area-wise, it would ultimately result in economy and in promoting efficiency. This aspect of organisation was successfully tried in Aurangabad district last year.

5.6. Cropping Pattern :

Another factor that would ensure fuller utilization of well-waters, relates to changes in cropping pattern. Prospects of these changes are conditioned, mainly, by factors which govern marketing and organization of production. In Wardha all wells generally register a fairly assured supply of water till mid-February. Crops that do not require waterings after that period and have a promise of better returns, at the same time, would obviously help increase area under irrigation. Crops like Chillies, Vegetables, Paddy, Wheat and Fodder crops can be listed in this category. In a sample survey covering 233 irrigation farmers from 54 villages, it was observed that as many as 68 per cent of these cultivators had their preferences for Chillies. Next came vegetables. In most cases these seasonals were reared in combination with some perennials—usually fruits like Banana or Oranges. But there were 8 percent cultivators who reared only perennials and did not have very significant or any acreage under seasonals. Cultivation of vegetables does provide greater scope for fuller utilization of water. But dependence on market actually sets scale to their scope of operation. Moreover scale of operation determines prospects of movements that may be required for marketing over long distances. Efficient organisation of marketing would mean a world of difference in stabilizing vegetable production in this area. Fodder grasses, too, provide another avenue on similar lines. Organization of dairy industry would help promote cultivation of fodder grasses, as has been the case around Wardha today. The Milk producers' Co-operative Union, here, has created a marketable value to fodder grasses. Consequently fodder grasses have proved to be better seasonals, and have ensured more effective utilization of problematic lands like Pan Basan areas. (See Paragraph No. 5-11 for experiments conducted at Sewagram.)

5.7. Rural Electrification :

Availability of electricity for lifting water from wells has tremendously influenced the pattern of use and unuse of wells in the District. In a village, Kharangana, near Sewagram as many as 7 wells lying idle were commissioned back to use immediately on getting electricity. Of



REFERENCE

The Map Illustrates :

1. Areas which have not very favourably responded to well irrigation (Red Colour).
2. Areas which could be served by Canal Irrigation from Projects so far surveyed (Shaded portion).
3. Areas which have not responded favourably to well irrigation but could be served by canal irrigation (Red with shaded portion).

The classification of area as 'not responding favourably' is essentially based on present day socio-economic conditions. It has no hydrological or geological bearing.

For further particulars of surveyed projects see paragraph Nos. 5.12 to 5.14.

the 166 cultivators interviewed in the sample survey to which mention has been made earlier under paragraph No. 2·6, 30 had already launched upon projects of deepening the wells, another 40 expressed their desire to further deepen them. Only 13 had water more than they could use, and 8 were sharing their surplus with their neighbours.

The State Board of Electricity had expected that consumption of power would go up year after year. However the present low rate of consumption, it is feared, might belie their estimations. (See table No. 6 on page Eleven). Evidently the Board is anxious to see that the cultivators who have electrically operated pumps are helped by Government to further deepen their wells and augment the supplies of water. Unless a programme of deepening of wells is sufficiently encouraged in such areas, Rural electrification would founder on the same rocks as did the Taccavi programme. Moreover all possible avenues of augmenting sub-soil water have to be tapped to lead the programme to success. This is about the areas which are already served by Electricity. As regards future spread of electricity, areas where other programmes of soil and water conservation have been initiated, or areas that would respond quite favourably to such measures should receive priority. The present line running between Arvi and Ashti presents a case to show that such considerations have not weighed in adequate measure. A line running on the Eastern banks of Bakli River would have ultimately meant more use of electricity. The considerations of road communications, do influence these decisions, which it seems, has been the case with the line in question. The line has followed the Arvi-Talegaon Road, instead. But this itself underlines the significance of a co-ordinated approach to all these matters, which aim at spreading socio-economic overheads anew. Map No. 11 gives a rough indication of priorities dictated by such considerations.

5·8. Augmenting the supplies :

The summation that more wells will bring about more irrigation does not necessarily come true in all cases. With limited supplies of underground water a new deep well may bring in more water, but probably at the cost of water from other existing neighbouring wells. Who knows, wells that have been abandoned on account of paucity of water are not now abandoned as a corollary of this process itself? It is true that the sample survey conducted by the Technical Committee, established that in no way Nagpur division lagged behind in its response to irrigation through new wells. In fact Nagpur had fared far better than other divisions. Table No. 14 gives division-wise average area irrigated under a new well and additional area irrigated per old repaired well.

But can it be taken for sure that these new wells were drawing upon only unused supplies of underground water, and not on the existing supplies available for other wells?

TABLE No. 14

<i>Division</i>	<i>Average area irrigated per new well (in acres)</i>	<i>Average additional area irrigated per old repaired well (in acres)</i>
(1)	(2)	(3)
Bombay ...	2.90	1.50
Poona ...	3.31	1.34
Aurangabad ...	2.62	1.50
Nagpur ...	3.50	1.39
Average Maharashtra ...	3.08	1.43

Source : Report of the Technical Committee on wells.

5.9. Govt. help and returns :

True, Government help, in facilitating sinking of new wells and deepening them further by providing for long-term loans and air-compressors, has great contribution to make in augmenting the supplies of water and thereby in making well irrigation more stable. Since 1950-51 Rs. 25,19,205 were disbursed as loans in favour of 3,129 wells—both new as well as old. All this has led to an increase of about 1,732 acres under irrigation, or an expenditure of approximately Rs. 1,500/- per acre. In fact this increase in irrigated area cannot be entirely attributed to Government loans alone. There should have been some investment of private capital for securing these results.

Similarly in the year 1959-60 services of one Air-compressor were harnessed in Girad Area of Hinganghat Tahsil, where it was believed that wells strike rich water sources but layers of the hard rock had rendered traditional methods of deepening ineffective. Unfortunately since the use of compressor was not preceded by any Hydrological studies, out of 50 wells thus deepened only 25 proved successful.

5.10. A co-ordinated approach :

A wiser course would have been to co-ordinate this Government help with such measures, which generally help augment the underground supplies of water. Particularly in such areas where incidence of unused wells is very high, and where even in the face of this incidence the cultivator has not budged in and has kept his irrigation practice going. Karanjai is one of such typical areas. In this circle, as against 883 wells in use the number of unused wells stands as high as 1044. This area has perhaps the highest ratio of area irrigated per well in use (2.55 acres), and has the maximum area under irrigation—2254 acres or 3.76 percent. Ashti and Seloo are two other circles faring on similar lines. Though in Ashti per well irrigation is not quite promising (Seloo comes under commanded

area of Bor Project. Eventually the problem of augmenting water supplies there does not assume any urgency at the moment). If such areas were given priorities in implementing programmes of soil conservation works, which would be supplemented by other measures particularly aiming at water conservation, performance of well irrigation in general would be far different than what is being achieved by distribution of mere Taccavi. Its immediate impact could have been seen on the present high incidence of unused wells. It is this aspect on which the Government programme on wells has failed to make any significant impact so far. There is no reason why an integrated programme of soil and water conservation, undertaken on water-shed basis, will not bring about desirable results. While making a strong recommendation of this approach to areas of inadequate supplies of underground waters, the Technical Committee on Wells Scheme has observed that —

“ Contour bunding, specially in shallow and medium soils has helped in raising the level of sub-soil water and this should be undertaken where feasible. Similarly bunding of nallahs and construction of percolation tanks will also be found helpful in augmenting the water supplies. At present, the cost of contour bunding is recovered from the cultivators *pro-rata* as per Bombay Land Improvement Schemes Act. In case of bunding of nallahs, as there is no direct benefits, the cultivators may not be prepared to bear the entire cost of the construction and as such only 50 percent of the cost be recovered from cultivators from both the catchments adjoining the nallah, by amending the Act if necessary...Where the present inadequacy of water supply cannot be economically improved or augmented, the cultivators will have to depend mainly on rain water. Well construction should not, however, be encouraged in such areas. ”

The causeways and submersible bridges which abound in numbers, all over the terrain could also be harnessed in the cause of irrigation. Indirectly they can help augment supplies of subsoil waters too. This would involve a little extra cost covering extension of pillars to allow insertion of planks for impounding part of post monsoon flows. Government, in recent years, have shown a keen awareness of this aspect of development of irrigation potential. They have issued one G. R. as well. But nowhere in the district this experiment has been given a fair trial. At Sewagram, it appears, Sarva Sewa Sangh tried without any success to induce the Roads Division, of the P. W. D. to raise the level of one District Road, which would have served the cause of well irrigation. Sangh was prepared to bear the loss of the submerging lands. But on the plea that costs and benefits of the works were not commensurate with the specifications laid down by the department, the idea was abandoned. That way a nice opportunity was lost to demonstrate the efficacy of the programme. A co-ordinated approach in matters of policy decisions alone does not seem to bring about conducive results. The approach

will have to percolate at the surveying and estimating stage of such projects.

There is yet another method that can be employed in augmenting sub-soil waters. It has a geological bearing. Mention has already been made earlier while presenting extracts from Mr. B. G. Deshpande's paper, wherein he has referred to small streams in Deccan Trap area, the beds of which in post monsoon period go dry, but water is generally found in wells situated closer to the streams or in pits sunk in stream beds. Such sandy beds of medium depth—say 10 to 15 feet, which have a flow of water underneath could be effectively tapped for augmenting the underground supplies of wells situated upstream on both sides. The layer of the sand may be opened across the stream and the murum below be excavated 2 to 3 feet deep. This channel of 3 feet wide and about 2 to 3 feet deep can be filled with clayie soils in that area so as to present an impervious diaphragm. This diaphragm be raised upto a height lower than the normal level of the bed by 2 to 3 feet. Once this is done the sand can be spread as before and the normal bed restored. Expert opinion maintains that this impervious diaphragm would help augment underground supplies of water in wells upstream by effectively checking a downward drain. Areas with relatively lesser gradient would be more suitable for experiments on such lines.

5-11. Sewagram Experiment :

A review of irrigation farming at Sewagram on lands belonging to Sarva Sewa Sangh, was quite revealing. It strongly vindicated a co-ordinated approach to well irrigation programme. There were in all 19 wells on these lands. However only 7 had been in use for irrigation purposes in 1958-59. The rest had remained either totally unutilized or were used for domestic purposes. These 7 wells irrigated about 21.50 acres upto mid-February and only 13.50 acres during summer months. Irrigation pumps operated on Electricity had been installed on 3 wells and the remaining 4 were operated on Persian wheels. Electricity was introduced on all 7 wells during 1960-61 and during summer months a programme of deepening was undertaken. As a result the area under irrigation had increased by nearly 62 percent in winter and by 44 percent in summer. It was 35 and 19.50 acres respectively. Next year a second operation of deepening was undertaken on 4 of the 7 wells. An estimated acreage under irrigation appeared to be 40.00 and 20.50 acres or an increase of 86 and 58 percent respectively in winter and summer months.

A small percolation tank was commissioned into service in the year 1960-61. Run off from a catchment area of about 25 to 30 acres was partially impounded under this tank. For effective percolation during successive years outlets were provided to ensure waterless conditions before mid-February. Most outstanding influence of this tank was directly visible on a large size well situated on lands belonging to Kasturba

Hospital. During the year 1957 one electrically operated pump was installed on this well. Area under irrigation, then, was 6.50 and 2.50 acres respectively during winter and summer months. However, waters from a supplementary well had to be harnessed to maintain this irrigation. The well was further deepened. As a result only one well irrigated about 7 acres in winter and 2.75 acres during summer. But ever since the construction of percolation tank, supply of water has increased so as to irrigate an estimated acreage of 12 to 15 acres in winter and 4 acres in summer. However, this well does not have enough land under its command. Consequently winter irrigation has not exceeded 7 acres in actual practice. Pipe lines are being laid to carry the water to adjoining lands. Marked rise in the water levels of monsoon months has been another indication of the influence of percolation tank. This has happened notwithstanding the shortage in rainfall, this year, as against that of the last season.

On Sarva Sewa Sangh lands, in the year of survey, out of 19 wells, 17 had electrically operated pumps ; and as many as 12 amongst them were harnessed in favour of irrigation farming. Consequently area under irrigation had increased from its base figure of 21.50 and 13.50 in 1958-59 to 60.5 and 23.0 acres respectively in winter and summer months. Bulk of the wells were deepened, in certain cases twice.

Fodder grasses.

Recourse to cultivation of fodder grasses as part of irrigation farming and greater reliance on seasonals like wheat, paddy, onions etc. have also contributed in a large measure to the increase in area under irrigation. Following tables provide a comparative picture.:

TABLE No. 15

Statement showing change in cropping pattern as observed on lands belonging to Sarva Sewa Sangh.

Year of cultivation	Perennials					Total
	Oranges	Banana	Grapes	Misc. Fruits	Fodder Grasses	
	Area %	Area %	Area %	Area %	Area %	
1	2	3	4	5	6	7
1958—59	3.5 26	2.5 18.5	— —	2.5 18.5	5.0 37.0	13.5 100
1962—63	3.0 13	13.0 56.5	0.8 3.5	2.0 8.7	4.2 18.3	23.0 100

TABLE No. 15 A

Year of Cultivation	Two Seasonals		Seasonals			Total	G. Total							
	Cotton	Chillies	Cereals	Onions	Vegeta- bles	Fodder grasses	Area %							
	Area %	Area %	Area %	Area %	Area %	Area %	Area %							
1	2	3	4	5	6	7	8							
1958—59	1.5	7.0	1.0	4.6	9.0	41.9	1.0	4.6	5.0	23.3	4.0	18.6	21.5	100
1962—63	6.0	10.0	0.2	0.3	30.0	49.6	0.3	0.5	8.0	13.2	16.0	26.4	60.5	100

Last year, on a Pan-basan plot 'Kadyalu' was sown in the month of May. Two waterings had to be given before the onset of monsoon. A reasonable dose of fertilizer and manure ensured a bumper crop. A second ratoon crop was taken with an additional dose of fertilizer. Yields from the two successive cuttings came to about 900 mds. (450 mds. per cutting). Once this was removed the plot was used for wheat cultivation. Wheat yields were slightly reduced as compared to last year when it was grown after paddy. The dairy at Sewagram purchased the 'Kadyalu' @ Rs. 1.25 per maund. After deducting the costs, the crop gave a clear 50 percent net income. Similar results have been observed with cultivation of Paragrass too.

Controlling the seepage.

Another point commended attention : Recently earthen pipes have been laid down in place of open channels to ensure economy of water while in transit. So far 10,000 ft. of earthen pipe line has been laid. Extra costs involved in providing for the pipes, amounted to not more than Rs. 1,000 per acre of additional area irrigated.

Granting all this, the problem of irrigation economy still remains unsolved. Per acre costs of irrigation (inclusive of water lifting charges) tend to be rather prohibitive. Reliance on wells as a major source providing irrigation even after reducing the present risks of failures to the minimum, that way sounds uneconomic. At the most such garden crops which require light irrigation can hope to depend on this source of supply, but certainly not the programmes of production of food grains. Recourse to canal irrigation becomes imperative.

B. GROUND-WATER RESOURCES

5.12. Canal Irrigation

Canal irrigation in Wardha is conspicuous by its total absence. This is partly due to some apprehension in the mind of Wardha cultivator

about the effects of irrigation to wheat lands. The following extract from the evidence given by Sri Gangadhar Rao Madho Chitnavis of Nagpur, before the Royal Commission on Irrigation, throws ample light on this aspect. On being questioned if he would recommend making of storage works in tracts where rice was not cultivated, he replied : " I would rather hesitate to make any such recommendation. Because I am not quite sure whether people would care to irrigate their fields. I fear that in course of time rust may spoil the crops (wheat) ... Similarly in cotton and Juar tracts availability of water will not induce them to convert cotton cultivation into rice. Cotton is a more paying crop than rice and as such is more welcome. "

Much water has flown since the days of Royal Commission. Now rust resisting strains of wheat have become commonplace. Similarly possibility of getting a bumper cotton crop through irrigation has changed the situation completely. In fact, these two factors have awakened the cultivator to irrigation needs. Now he is in a mood to agitate for more water.

5-13. Bor project :

It is roughly estimated that minor irrigation tanks and medium size projects on Rivers would help impound water which will suffice irrigation requirements for nearly 80 to 90 thousand acres. So far work on two projects—one on River Bor and the other on one tank near Ashti has begun. The former project envisages construction of a storage reservoir of 5600 M. cft. gross storage capacity by harnessing the waters of Bor river in two stages. The water is drained in from a catchment area of about 147 sq. miles. An earthen bund 3800 feet long is proposed to be put up across the river just near the village Bori. A left Bank Canal with discharging capacity of 360 cusecs at the head will run for a length of 14 miles and bring under its command an area of 45,000 acres in all, out of which 26,250 acres will be irrigated annually in the first stage ; (when the storage will be 3400 M. cft.) and 33,000 acres in the second stage. The estimated cost of the project is Rs. 212,00,000. A provision of Rs. 85,00,000 has been made in the 3rd Plan. So far an expenditure of Rs. 127,00,000 has already been incurred. It is quite likely that water will be impounded in 1964, and not in 1963 as was anticipated last year. Cost of the scheme per acre of irrigation has been computed at Rs. 753, whereas the overall costs will rise to Rs. 808 per acre.

5-14. Tank projects :

The tank under construction near Ashti has a storage capacity of 58 M. cft. This tank will irrigate an area of about 900 acres comprising of 5 villages. Its estimated cost runs into Rs. 9,11,000 or about Rs. 1012 per acre. Water from the tank for irrigation will be available in 1964. The following table gives information on irrigation potential of surveyed sites ;

TABLE No. 16
(River Projects)

Statement showing irrigation potential on River-projects

Name of the project	Site	No. of benefitting villages	Storage in (M. cft.)	Culturable command (in acres)	Area to be irrigated (in acres)	Estimated costs in (Rs.)
1. Bor (inclusive of 2nd stage)	Bori	65	56,00	45,000	33,000	*212,00,000
2. Dham	(Kachnur)	23	2100	17,000	15,000	—
3. Upper Wardha	Karajgaon	Left Bank Canal not incorporated.				
4. Nand	—	21	Survey incomplete.			
5. Panchdharu	Near Ridhora	A possible site from topo sheet with capacity to irrigate 3 to 4 thousand acres.				

*Cost covers only 1st stage of construction.

TABLE No. 17

Statement showing irrigation potential of tank sites surveyed so far by the Irrigation Department.

Tank site	No. of benefitting villages	Storage in M. cft.	Culturable command (in acres)	Area to be irrigated (in acres)	Estimated costs (Rupees)
1. Ashti*	5	57.8	1406	900	9,11,000
2. Dongargaon	13	163.1	5400	2,650	19,75,000
3. Madan	12	405.0	—	5,400	—
4. Sawangi	3	68.8	1563	1,000	9,09,000
5. Kawadi	2	—	1329	800	—
6. Talegaon	2	—	720	550	—
7. Haldeo	7	—	3329	2,025	—
Total	44			13,325	—

*Work in progress.

It appears that the costs and benefits of Tank Projects in Wardha, do not quite fit in with the prescribed departmental norms (Rs. 700 to 750 per acre). On an average the costs, here, exceed by Rs. 300-350 per acre. A reconsideration of departmental policies in this respect would be desirable, at least, for areas which do not respond favourably to well irrigation. If such areas are being served by tanks, a readjustment of the norms should not be very difficult, since wells scheme to-day is a subsidised programme. What is lost one way could be gained by the other. Moreover, average costs of construction of wells in Nagpur Division has

been worked out to be Rs. 1399·78 by the Technical Committee on wells. In Wardha average area irrigated per well-in-use comes to about 1·7 acres ; or Rs. 823 per acre. Here failures in wells have not been taken into account. Broadly speaking, on wells programme an investment of not less than Rs. 1500 per acre of area irrigated is being made today. No doubt this is a private sector investment as against public sector one on Tanks and River Projects. However the entire aspect of costs structure and water rates has been recommended for reconsideration by the Irrigation Commission of Maharashtra State (1960-62). Under such circumstances factors governing exploitation of ground water resources, provide much wider scope for reconsideration.

5·15. Bandhara Irrigation :

This traditional avenue of exploitation of ground water resources, at once cheap and within reach of the cultivator's capacity to harness, has been grossly neglected so far. Perhaps for reasons similar in nature which hindered progress of storage works in the district. The well scattered post-monsoon flows need be harnessed with a concerted drive and with a sense of urgency. There is another aspect, equally valuable, to this method of irrigation. It has an element of group effort within its fold. This should be considered as an additional reason why greater emphasis on this aspect be laid in the overall scheme of development. An extract from Beales' Report (Part I) and from the Report of M. Visvesvaraya Committee of 1938, which recommended Baglan system of Bandhara Irrigation is reproduced towards the end under Appendix D. It indicates the direction in which the programme shall have to move.

It is rather difficult to assess precisely the potential for irrigation on this account. Survey of all such sites through departmental machinery falls far beyond the scope of workable proportions. The cultivator has to be sufficiently oriented for recommending sites. What is needed for considering a site as favourable is (i) a rock bed ; (ii) a shallow (not very steep) bank ; and (iii) an irrigable area down stream. Streams having reasonable flows upto February may be considered eligible for this programme. Even a rough estimation of flows indicated by their width and depth at normal points of flow should suffice to ascertain the potential. This is a task essentially for the cultivators and their organizations to undertake. Departmental scrutiny would follow with a view to ascertain the soundness of the project. Work geared on this line will ensure people's education and speed simultaneously ; and bring about better results.

5·16. Bandharas without Rock-Foundations :

Another hitch that stands in the way of initiating a programme of Bandhara irrigation, relates to striking rocks for foundation. In fact, nearly 50 per cent of the so far surveyed sites do not have hard rock foundations. Technical opinion, however, maintains that Bandharas could be constructed even on ordinary murum foundations. Departmental

circulars, also, have been issued to undertake experimental works on such sites. However, inspite of repeated efforts, one thoroughly investigated site near Sewagram has remained unattended to. Importance of experimental work on this line can hardly be overemphasised. Success in devising a technique would not only mean provision of irrigation at a low rate of investment, it will also mean serving certain unserved areas. Hinganghat tahsil has been neglected so far in providing irrigation, mainly because of the reasons given by Mr. Gangadhar Rao Chitnavis. Well irrigation also has a limited scope in this area. The track lying to the south of Bombay Nagpur Rail line and towards south west of Wardha Kazipet line can best be served by this device, provided Bandharas on sites other than hard rocks are made feasible. Per acre costs of such projects may not exceed Rs. 400 which is self-rewarding in itself. Moreover the operational costs covering repairs, need not exceed even those of the pumps operated on electricity. The following sites have been surveyed by the minor irrigation branch of the P.W.D. till so far, some of which are under active consideration of the department.

TABLE No. 18

Statement giving list of surveyed sites for Bandhara Irrigation

Location of site	Tahsil	Villages benefitting from the water	Approx. area to be irrigated (In acres)
1. Wadhona	Arvi	Wadhona	50
2. Dahegaon-Mustafa	Arvi	Dahegaon-Mustafa	50
3. Kotamba	Wardha	Khadki (200) ; Shahapur (200) ; Sukli (600) Arvi (200)	1200
4. Bakli	Arvi	Rudrapur, Amdabad, Nawabpur, Agapur ; 125 acres each.	500
5. Khadki	Wardha	Khadki	100
6. Dorli (near Sindi)	Wardha	Dorli	100
7. Sewagram	Wardha	Sewagram	150
8. Deoli (on river Yesoda)	Wardha	... ..	900
9. Yenora (near Hinganghat)	Hinganghat	... ..	600
10. Sawangi (on Pothra river)	Hinganghat	... ..	600
11. Ekamba (near Karanja)	Arvi	... ..	150
Total			4,400

Note :— Only first 6 sites have rock foundations. Costs of those without rock foundations might increase by Rs. 50-75 per acre.

5-17: Lift Irrigation :

Lift irrigation on Rivers and Nallahs has a great role to play in the irrigation economy of the district. There are number of natural storage sites (Dohas) on Rivers. Prominent among them are located at (i) Ladegaon ; (ii) Dahegaon ; (iii) Antardoh ; (iv) Babapur and (v) Sirpur on Wardha River. Many more would come to notice once work on exploiting these known storage sites gets going. Similar sites have been reported on River Dham and Bor as well. Major handicap in harnessing a broad based programme of lift irrigation, appears to be of a twofold nature. Firstly the costs of lifting water by pumps operated on oil engines appear to be prohibitive. In fact it was on this account a society which was in the formative stage at Ladegaon last year, has been dissolved. They insisted on using electricity in preference to oil engines. No doubt electricity means further economy on costs. But there are already four hundred and odd oil engines operating on wells. What about that ? The real difficulty sounds to be want of adequate trust in the co-operative management. That way nearly a score of pumps on rivers are operating even today. But they are all on individual basis. A second difficulty appears to be one arising out of a fright which the cultivator has taken about the dislocations involved at every stage in successfully operating oil engines. It particularly refers to difficulties encountered in ensuring timely repairs.

5-18. Mehkar Experiment :

The Taluka Agricultural Association, Mehkar (District Buldhana) operated one scheme of renting out oil engines and pumps with pipe fittings to needy cultivators. Provision for drivers and for day-to-day repairs, also, was made by the Association. 5 H. P. coupled engines with $2\frac{1}{2} \times 3$ " pumps were employed in lifting water from Nallahs having post-monsoon flows. Wheat fields lying within a range of about 1000 feet on either side of the stream were, thus, irrigated. Flood irrigation practised in this case required 8 hours operation of the pump on an average, for irrigating 1 acre of wheat land. The cultivator had to pay about Rs. 20 per day which included all charges. The scheme was quite popular during 1958-61. But later on the Association could not meet the growing demand from places situated far away. Moreover they were working on no profit no loss basis. Evidently activities could not be enlarged beyond a point. Any other service operated to serve similar interest but on business lines would certainly have charged a higher rate than Rs. 20, since the engines remained unutilized except for 2 months in a year.

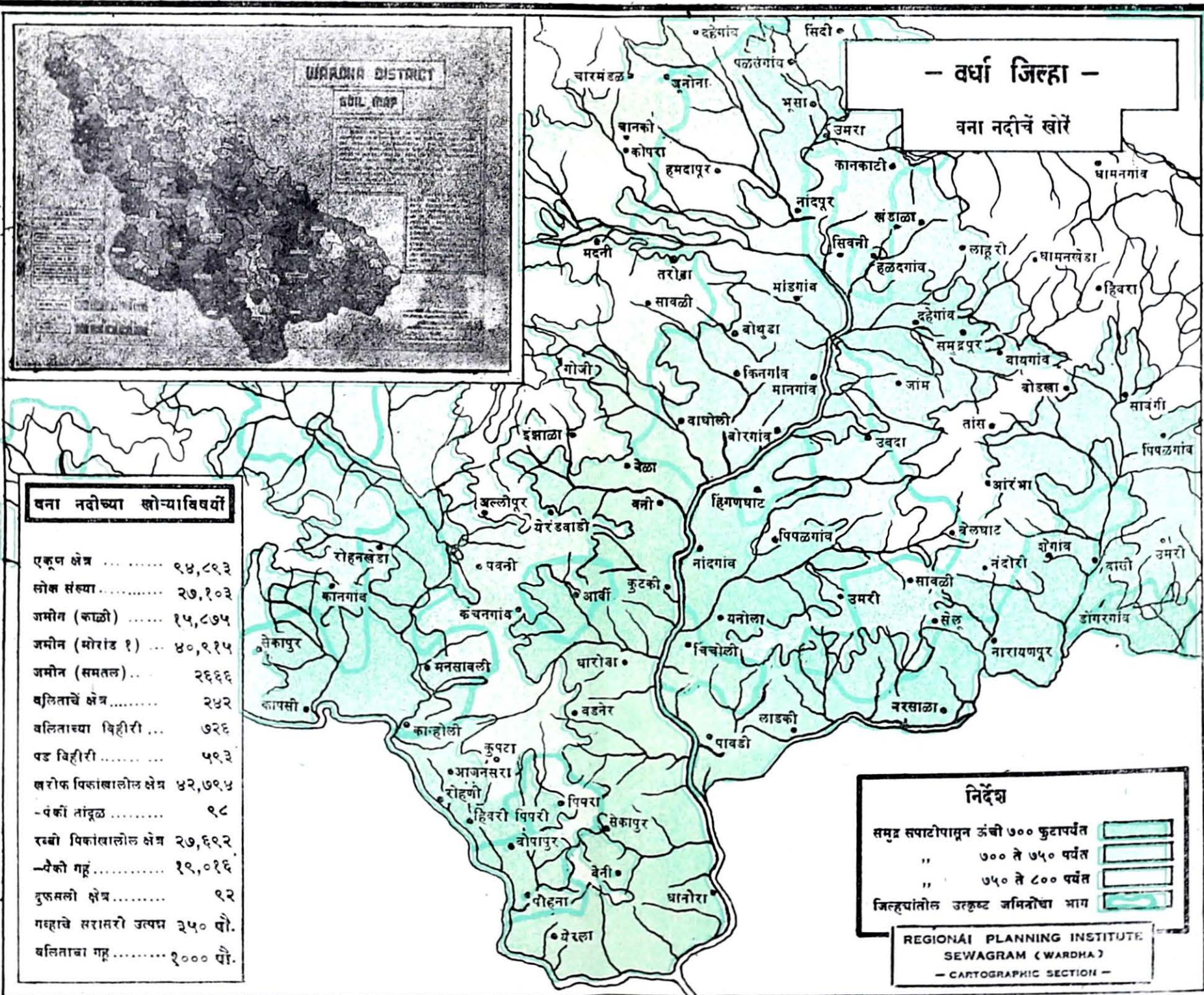
5-19. Wana river basin :

A favourable situation for such service prevails in the wheat tract of Wardha District, too. The basin of Wana river in Hinganghat Talsil possesses famous wheat lands. Present average outturns of wheat hardly

bypass 400 lbs. mark. Provision of two or three waterings would mean a three fold rise in yields. The cultivator is conscious of this fact. The river and the streams in this area have a fairly rich flow upto mid-February, when waterings for wheat have to be given. What is wanting is a service capable enough to cater to the timely needs in a most reliable manner. If per acre per watering charges do not exceed 20 to 25 rupees, there is every likelihood that area under wheat will increase by threefold. It will also develop into double cropped area by taking recourse to cultivation of paddy during kharif season. Sowing season of wheat after paddy is generally late by one month; and unless irrigation is assured, cultivation of paddy during Kharif season is not practised on wheat lands.

5-20. Organisations on the lines of cooperative Lift Irrigation Societies can hope to muster strength in this venture. Current procedure of Government help prescribes that per acre costs of such schemes should not exceed Rs. 350. Members of the society would collect 25 per cent of the capital costs in the form of share capital, to which government would add an equal size contribution in the form of subsidy. The remainder would be raised through long term loan repayable in 15 equal instalments, at 4.5 % interest. Besides this a subsidy not exceeding Rs. 1800 per year to cover management expenses like salaries of the driver etc., is provided for the three initial years.

But the fact that such co-operatives have not taken roots in Wardha, lends support to a plea which was often voiced by people. They wanted the government to initiate the service and make water available on regular water charges. Government also have made such approaches in the past. In Bijapur District of old Bombay State, such services were departmentally organised and offered to cultivators on Krishna near Bagalkot and on Malaprabha near Badami. Even today on Panchganga in Kolhapur, department is offering such service. In Wana River basin if this service is initiated and handed over to co-operatives in course of time, wheels of Co-operative Lift irrigation shall start moving in the desired direction.



वना नदीच्या खोऱ्याविषयी

एकूण क्षेत्र	९४,८९३
सोबत संख्या	२७,१०३
जमोन (काळी)	१५,८७५
जमोन (भोरांड १)	४०,९१५
जमोन (समतल)	२६६६
वलिताचें क्षेत्र	२४२
वलिताच्या विहीरी ...	७२६
पड विहीरी	५९३
खरोक पिकाखालील क्षेत्र	४२,७९४
-पकी तांदूळ	९८
रब्बी पिकाखालील क्षेत्र	२७,६९२
-पेकी गहू	१९,०१६
दुफसली क्षेत्र	९२
गव्हाचे सरासरी उत्पन्न	३५० पौ.
वलिताचा गहू	१००० पौ.

निर्देश

समुद्र सपाटीपासून उंची ७०० फुटापर्यंत	[Dark Green Box]
७०० ते ७५० पर्यंत	[Light Green Box]
७५० ते ८०० पर्यंत	[White Box]
जिल्ह्यातील उत्कृष्ट जमिनीचा भाग	[Thick Green Line]

REGIONAL PLANNING INSTITUTE
SEWAGRAM (WARDHA)
- CARTOGRAPHIC SECTION -

REFERENCE

The map illustrates South-Eastern portions of Wardha District, with their respective elevations. Dark green (upto 700 feet); light green (between 700 to 750) and the white (between 750 to 800.)

The area outlined with thick green line represents good soils of the District. It comprises roughly 90,000 acres. Nearly 50% of this is Medium heavy soil suitable for wheat cultivation. At present only 19,000 acres are under wheat cultivation; and only 100 acres under Kharif Paddy.

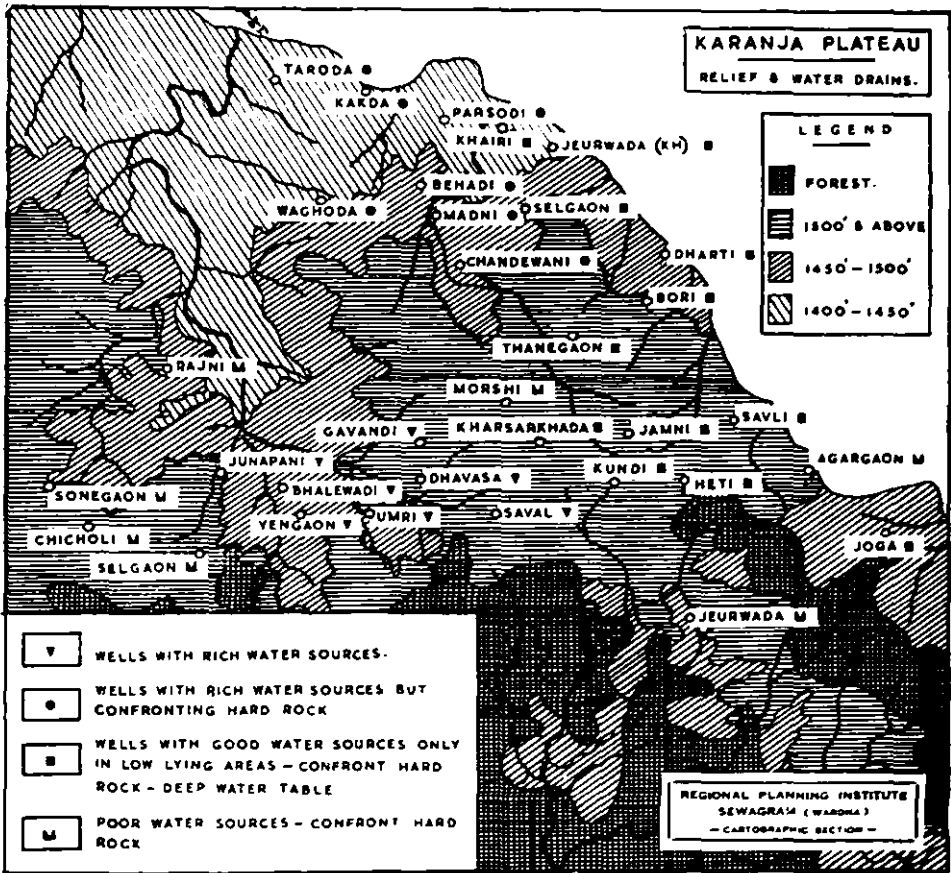
This basin constitutes the rich wheat zone of the district, having enormous potentialities to develop into double cropped area. (See paragraph No. 5.19)

जिल्ह्यातील शेतीच्या मागासलेपणाच्या अनेक कारणांपैकी, पाण्याच्या वापराचा अभाव हे महत्त्वाचे कारण मानावे लागेल. गव्हाच्या शेतीला उपयुक्त अशा जमिनींनी व्यापलेल्या या खोऱ्यांत नदी नाल्यांतून वाहून चाललेल्या पाण्याचा पंपाच्या सहाय्याने जुजबी वापर केल्यास उत्पादन ३०० टक्क्यांनी वाढू शकेल; व पाणी उपसण्याचा खर्च बचावता निव्वळ नफ्यामध्ये कमीत कमी १०० टक्क्यांनी भर पडू शकेल.

6 A PERSPECTIVE OF DEVELOPMENT

6-1 The factors that weigh high in considering well irrigation are not governed so much by its relative merit over other modes of irrigation. They relate mainly to its universal spread out, and to the impact of failures on individual economy of the cultivator. Instances are not wanting where failures in striking water have thrown the farmers in perpetual debts. The element of uncertainty with which well irrigation is accompanied today has to be reduced progressively to negligible proportions. In fact this should be the central theme of development of well irrigation. Techniques and methods have yet to be evolved which when applied on a large scale, would serve that end. Small watersheds constitute suitable units or such studies, the importance of which can hardly be overstressed. Map No. 10 presents a promising subject for such studies.

Map No. 10



Karanja represents one of the advanced irrigation tracts of the District, which its 3,000 acres under irrigation farming; The plateau presents a staggeringly high incidence of unused wells (1994) and forms a fascinating subject for studies in well irrigation.

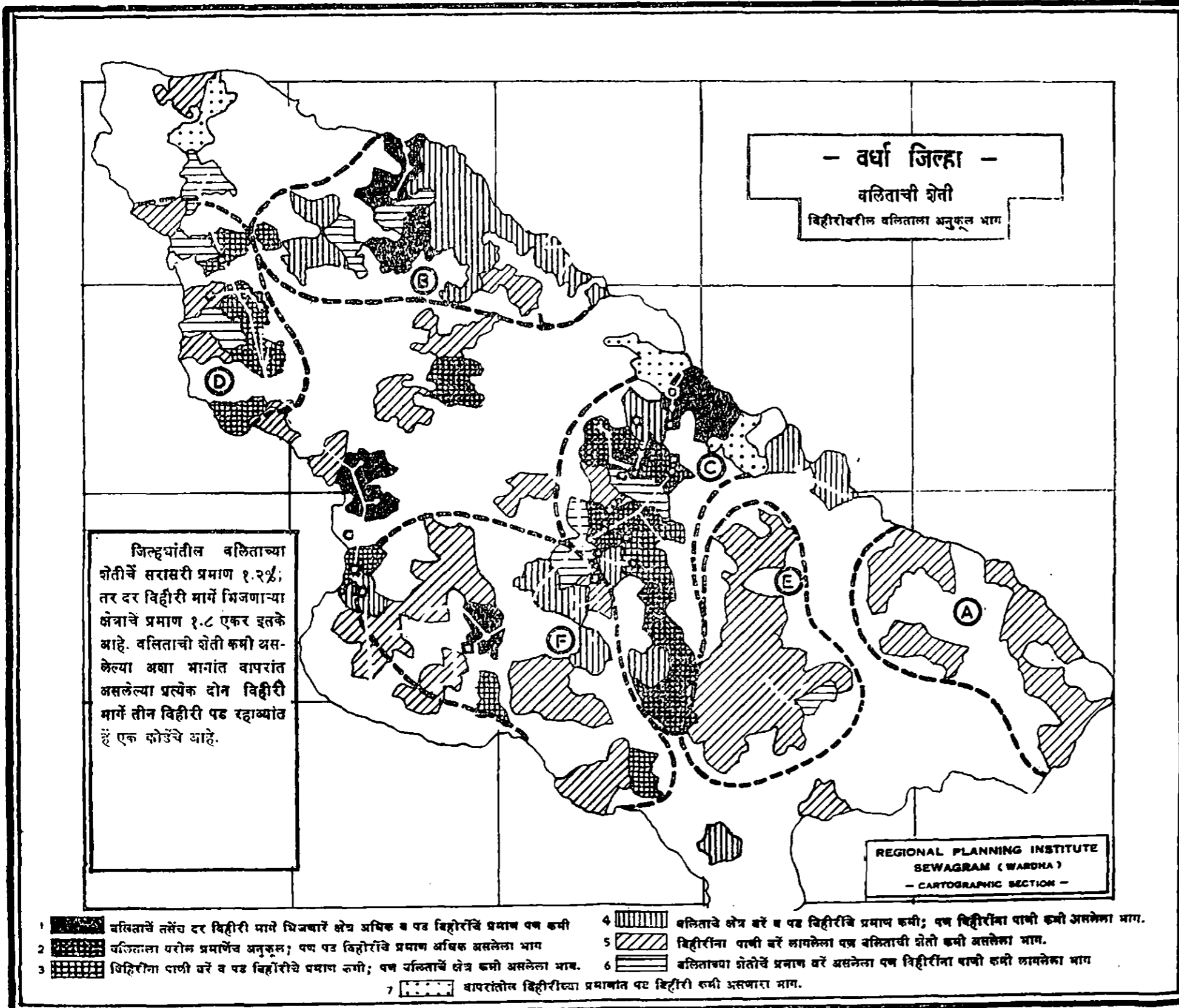
Another equally important aspect of development of well irrigation relates to costs and returns. Since well irrigation is operated entirely on individual risks, this aspect has not attracted sufficient attention so far. Once this consideration predominates, approach to well irrigation would change considerably. It is true : in a tract where failure of crops is a common feature, reliance on wells becomes a normal practice. Wells which are considered as ' Reserves ' and wells which are to be depended upon as regular sources of irrigation, no doubt, are two distinct considerations and may be regarded as such. However, when government has come out to render assistance to cultivators through their Wells Scheme, the entire question of well irrigation has to be reconsidered from a development angle which ensures a scientific approach and a new rationale.

6.2. Performance of well irrigation in the district has been analysed and presented on Maps No. 8 and 11. Average size of irrigation per well, ratio of unused wells to wells in use, and proportion of area under irrigated crops over a given Patwari Circle, have been the basic considerations for this analysis. Areas which have so far not responded favourably to well irrigation in this context in the district are shown in Red Colour on Map No. 8. It should be noted here that no geological or hydrological factors have influenced the analysis. It is merely an economic interpretation. Changes in organization for production and marketing, or for that matter, even in cropping pattern, might change the picture considerably. The classification, nevertheless, indicates the scope of programmes which might help bring out the best in favour of irrigation economy of those respective areas.

6.3. Zone B marked on Map No. 11 indicates an area destined to rely mainly on well irrigation. It is a table land holding no promise for other forms of irrigation. Moreover, orange cultivation which requires light irrigation has been a predominant irrigated crop in this area. Thirdly the area is interspersed with wells having rich water sources, alongside arch failures (See Map No. 10). It is in this zone a concerted drive for an integrated well irrigation programme as discussed under paragraph No. 5.10 be launched and efficacy of various techniques verified.

6.4. Zone A, as well, deserves treatment on similar lines. The area is interspersed with wells with good sub-soil water, and with crusts of basaltic hard rock nearer to the surface. This area marks the eastern end of Trap rock zone. Towards South East of this zone geology takes a complete turn. Unlike Zone B the area, however, does not fall totally beyond the purview of canal irrigation. Waters from Pench and Kanhan could be tapped in favour of this area. Costs of irrigating the area by canals needs to be studied further

6.5. Zone C marks a good spread out of area under irrigated crops. It has also a varied cropping pattern. It forms a Banana tract



The map illustrates response of well irrigation in various Patwari Circles with regard to (a) Average size of irrigated area per working well; (b) proportion of area under irrigated crops to total cropped area; and (c) ratio of unused wells to wells in use.

REFERENCE

1. Favourable in respect of (a) & (b) and even in respect of (c).
 2. Favourable in respect of (a) & (b) but adverse in respect of (c).
 3. Favourable in respect of (a) & (c) but poor in (b).
 4. Favourable in respect of (b) & (c) but poor in (a).
 5. Better in respect of (a) but poor in (b).
 6. Better in respect of (b) but poor in (a).
 7. Better in respect of (c) alone.
- For reference to Zones A, B, C...Please see Chapter No. 6.

of the district. But oranges, chillies, vegetables and even cotton are irrigated on a large scale. The area is infested with a huge number of unused wells. Organization of Marketing might change the present use-unuse pattern to a considerable extent. It has potentialities of developing into an ideal mixed farming tract of the district. A portion of this area shall receive Canal waters from Bor very soon. Certain other parts also, may be benefited from canal waters of other schemes. What is badly missing is organisation for marketing. Marketing would mean a world of difference to irrigation, that way, in almost all areas in the district. But this zone particularly holds a greater promise for its success. One co-operative cotton pool is already functioning in this part ; and Banana cultivators seemed to be eager to join hands for marketing in a co-operative way. In the wake of development on these lines, organisations which will ensure effective use of well waters as explained earlier under paragraph No. 5.5 may have good scope for development.

6.6 Zone E marked on Map No. 11 more or less coincides with the area marked for wheat cultivation on Map No. 9. Prejudices that prevailed in the district regarding irrigation to wheat crop, have mainly contributed to this area remaining far behind in irrigation economy. No serious trial for a cropping pattern has ever been given so far. Wells have been the main source of irrigation here. Well sinking in this tract has become hazardous because of loose soils. Otherwise generally wells strike good water. The area presents a problem in techniques of sinking as well as in construction of wells. A pilot project of a well sinking co-operative society as elaborated under paragraph No. 5.5 with adequate technical guidance from Government may be launched here and assisted by water finding measures.

However, mere well irrigation may not help throw out a promising cropping pattern. Operations on a bigger scale over a compact area having access to markets, would be required to serve that end. Earlier it has been explained under paragraph No. 5.19 how a programme of lift irrigation in this basin would prove promising. A project launched on departmental initiative is a crying need of this tract. If this is answered, the tract might reveal new potentialities in irrigation economy for the district.

6.7 Zone F needs a fair trial for Bandhara irrigation programme as explained earlier under paragraph No. 5.15. Construction of Bandharas in this tract may be tried at first on experimental basis. The area has patches of medium heavy soils mostly located alongside the nallah-beds. It needs to be assessed first if Bandharas in anyway are going to add to the problems of effective drainage of the watersheds and harm the good soils lying in the valley portions. May be different devices, temporary in nature, have to be tried to harness the post-monsoon flows for wheat irrigation. Cement pillars with grooves for inserting planks have

been found to be a workable method in Ramtek Tahsil of Nagpur District. Similar inexpensive methods suited to the area may have to be tried. This method of irrigation has a far greater potential throughout the length and breadth of the district once it is made safer for the soils in the basins. This programme in fact deserves top priority. It would prove complementary to the cropping pattern, and might serve cause of well irrigation in an indirect way. Irrigated cotton and irrigated wheat, no doubt, would mean promising crops for the district.

There is yet another significant aspect which refers to organization of distribution of water that the cultivators would evolve by themselves under this system of irrigation. It will usher in indigenous forms of co-operation, which are so badly in need for a dry farming tract like Wardha.

6.8 Area marked as D is the richest cotton growing tract of the district. It holds potentialities for good Bandhara Schemes. Set backs to well irrigation, however, are closely linked up with the high returns of cotton cultivation. It is already marked by high incidence of unused wells—wells with very good water columns. Wells as 'Reserves' appear to have been a more common practice in this area. Bandhara irrigation that way holds a great promise. But rich potentialities of this area would reveal in the wake of canal irrigation. It is quite likely that the left bank canal of the Upper Wardha River Project will irrigate this area. At present the project, however, does not provide for left bank irrigation. This has to be seriously considered.

Well irrigation, it appears, has a complementary role to play here. Small holders co-operatives, however, may be encouraged to put good or potentially good unused wells back to use. Some form of co-operative use of well waters may mean a major step forward in well irrigation programme in this tract. Government assistance to wells programme may be so channelised that use of waters of unused wells on—co-operative lines becomes more and more feasible. In such case the programme of Govt. assistance should be more encouraging and liberal. This aspect deserves top priority.

6.9. In fact encouragement to such co-operative forms of use of well waters from present day unused wells all over the tract is necessary if the process of wells being abandoned is to be effectively checked. This may mean a long-range programme. In the meanwhile, a programme of financing repairs to old wells may be encouraged by channelising the assistance through Co-operative Well-sinking and repairs societies as elaborated earlier under paragraph No. 5.5. Encouragement may be given for preparation of maps on the lines of the one presented on page 25 for the village Yengaon. It will facilitate work of the proposed societies. Zilla Parishad may take sufficient initiative in this matter and help organise wells programme on a more sound footing.

6.10. As regards programme of canal irrigation, next to left bank canal of Wardha project, claims of Kachnur (Dham) project may be given favourable consideration. The area under its command covers certain scarcity areas of the district. Moreover no other forms of irrigation appear to be feasible in this tract.

A multi-pronged drive on the lines elaborated in preceding paragraphs, supported by a meaningful communications programme on the one hand and by encouragement to suitable cropping patterns on the other may present an altogether different picture of irrigation in Wardha than what is noticed today. Government assistance has to be purposeful. A blanket approach of subsidies may not help develop full potentialities of the respective areas.

APPENDIX A

Statement showing district-wise number of irrigation wells and those not in use together with area irrigated by them in Maharashtra State (1959).

(Area figures in hundreds)

S. No.	District	Total No. of irrigation wells	Number of wells in use.	No. of wells not in use.	% of wells not in use to the total no. of wells in Col. 3	Gross Area All sources (Acres)	Irrigated wells (Acres)	% of area irrigated by wells to total area in col. 7	Average area irrigated per well (Acres)	Gross cropped area (Acres)	% of gross area irrigated by all sources to the gross cropped area	Percentage of gross area irrigated by wells to gross cropped area.
1	2	3	4	5	6	7	8	9	10	11	12	13
1.	W. Khandesh	1,00,23	8,694	1,329	13.3	844	426	15.5	4.8	19,641	4.3	2.2
2.	Nasik	51,084	47,338	3,746	7.3	1,475	549	37.2	1.1	24,257	6.1	2.0
3.	Thana	6,654	6,239	415	6.4	114	89	78.1	1.4	7,791	1.5	1.1
4.	Bombay Suburban	476	386	90	18.9	13	13	100.0	3.3	224	5.8	5.8
5.	Kolaba	4,041	3,684	357	8.8	48	36	75.0	1.0	5,422	0.9	0.7
6.	Ratnagiri	13,480	11,798	1,682	12.5	319	129	40.4	1.1	8,848	3.6	1.5
Bombay Division Total :		85,758	78,139	7,619	11.2	2,813	1,242	57.7	2.11	66,183	3.7	2.2
7.	Ahmednagar	58,314	53,532	4,782	8.2	3,138	1,723	54.9	3.2	32,956	9.5	5.2
8.	Poona	44,085	38,733	5,352	12.1	2,405	906	37.7	2.3	26,755	9.0	3.4
9.	N. Satara	32,793	28,083	4,710	14.4	2,124	711	33.5	2.5	18,087	11.7	3.9
10.	S. Satara	32,384	27,747	4,637	14.3	1,009	728	72.2	2.6	16,241	6.2	4.5
11.	Kolhapur	10,695	9,309	1,386	13.0	763	263	34.5	2.8	10,094	7.6	2.6
12.	Sholapur	48,923	45,858	3,065	6.3	2,933	1,798	61.3	3.9	29,530	9.9	6.1
Poona Division Total :		2,27,194	203,262	23,932	10.5	12,372	6,129	49.5	3.0	1,33,663	9.2	4.5

APPENDIX A (Contd.)

S. No.	District	Total no. of irrigation wells.	No. of wells in use	No. of wells not in use.	% of wells not in use to the total no. of wells in Col. 3	Gross area All sources (acres)	Irrigated wells (acres)	% of area irrigated by wells to total area in Col. 7.	Average area irrigated per well (Acres)	Gross cropped area (acres)	% of gross area irrigated by all sources to the gross cropped area	% of gross area irrigated by wells to gross cropped area
1	2	3	4	5	6	7	8	9	10	11	12	13
13.	E. Khandesh	46,174	34,689	11,485	24.9	887	605	68.2	1.8	20,963	4.2	2.9
14.	Aurangabad	29,501	26,009	3,492	11.8	1,190		77.3	3.5	32,098	3.7	2.9
15.	Parbhani	13,292	10,547	2,745	20.7	435	422	97.0	4.0	24,152	1.8	1.7
16.	Bhir	26,944	25,146	1,798	6.7	855	533	62.3	2.2	20,433	4.2	2.6
17.	Osmanabad	17,588	14,714	2,874	16.3	997	778	78.0	5.3	26,829	3.7	2.9
18.	Nanded	4,120	2,880	1,240	30.1	171	152	88.9	5.3	19,800	0.9	0.8
Aurangabad Division Total :		1,37,619	1,13,985	23,634	17.2	4,535	3,410	75.2	2.9	1,44,275	3.1	2.4
19.	Buldhana	19,110	12,693	6,417	33.6	168	165	98.2	1.3	16,947	1.0	1.0
20.	Akola	15,197	2,872	12,325*	81.1	71	67	94.4	2.4	18,918	0.4	0.4
21.	Amravati	13,927	10,109	3,818	27.4	131	127	96.9	1.3	16,703	0.8	0.8
22.	Yeotmal	6,410	3,588	2,822	44.0	61	51	83.6	1.4	18,069	0.3	0.3
23.	Wardha	16,097	5,725	10,372	64.4	106	102	96.2	1.8	9,898	1.1	1.0
24.	Nagpur	34,490	18,746	15,744	45.6	594	313	52.7	1.7	13,167	4.5	2.4
25.	Chanda	9,085	6,399	2,686	29.6	2,125	27	1.3	0.4	13,499	15.7	0.2
26.	Bhandara	11,127	8,410	2,717	24.4	3,098	64	2.1	0.8	12,465	24.9	0.5
Nagpur Division Total :		1,25,443	68,542	56,901	45.4	6,354	916	14.4	1.3	1,19,666	5.3	0.8
State Total :		9,62,764	463,928	1,12,086	21.07	26,074	11,697	49.2	2.57	4,63,787	5.3	2.47

*Figures to be verified. Source : Report of the Technical Committee on Wells Scheme, Government of Bombay 1959.

APPENDIX B

Particulars of wells in use in village Yengaon (Karanja Revenue Circle)

Serial No. as shown on Map	Particulars of construction						Area Under Irrigation			Water lifting device	Remarks
	Construction	Total depth of the well	Diameter	Water Column	Year of construction	If Taccavi was secured	Seasonal	Perennial	Total		
1	2	3	4	5	6	7	8	9	10	11	12
1.	B	12	7	4	1957	No.	Nil	0.75	0.75	M	
2.	B	21	10	3	1930		0.50	Nil	0.50	M	
3.	A	21	11	5	Old	Rs. 400- for repairs	0.50	3.00	3.50	M	
4.	B	24	10	9	Old		No.	M
5.	B	26	8	13	1922	...	3.0	2.0	5.0	M	
6.	A	21	8	10	Old	...	3.0	...	3.0	M	
7.	B	21	10	13	1932	...	...	1.0	1.0	M	
8.	A	17	22	8	1932	...	8.30	...	8.30	Oil Engine	Rs. 1500 own ex- penditure —do—
9.	A	11	12	5	1957	...	2.50	2.0	4.50	Oil Engine	
10.	B	20	11	9	1958	...	0.50	1.0	1.50	M	
11.	B	21	11	12	1961	...	1.15	0.50	1.65	M	
12.	B	13	10	7	1957	...	...	2.50	2.50	M	
13.	B	12	10	5	Old	...	...	0.20	0.20	M	
14.	B	11	7	5	Old	...	1.0	...	1.00	M	
15.	B	17	8	4	Old	...	1.50	2.00	3.50	Oil Engine	
16.	B	17	8	4	1912	...	...	1.0	1.0	M	
17.	A	22	15	4	1961	Yes	3.00	4.00	7.00	Oil Engine	

A—Pucca construction; B—Kaccha construction; M—Water lift provided by Mhote.

APPENDIX B (Continued)

Serial No. as shown on Map	Particulars of construction					Area under Irrigation				Remarks	
	Construction	Total depth of the well	Diameter	Water Column	Year of construction	If Taccavi was secured	Seasonal	Perennial	Total		Water lifting device
1	2	3	4	5	6	7	8	9	10	11	12
18.	A	20	9	10	1932	No.	1.00	2.50	3.50	M	
19.	A	24	21	7	Old	...	1.30	5.35	6.65	M	
20.	A	20	12	7	Old	...	1.0	2.00	3.0	M	
21.	B	22	7	5	Old	...	1.55	...	1.55	M	
22.	A	25	7	9	Old	...	0.75	1.00	1.75	M	
23.	A	15	14	2	Old	...	0.50	1.00	1.50	M	
24.	A	17	9	8	Old	...	...	1.00	1.00	M	
25.	A	24	12	7	1932	...	4.0	4.00	8.0	M	
26.	B	9	10	2	1932	...	...	1.50	1.50	M	
27.	A	21	13	6	1912	Rs. 800 for re- pairs	1.0	...	1.0	M	
28.	A	16	14	5	1947	...	1.30	6.00	7.30	Oil Engine	
29.	B	11	7	3	1931	...	...	1.00	1.00	M	
30.	A	13	11	3	1931	...	...	1.00	1.00	M	
31.	B	14	9	4	1931	No.	...	0.30	0.30	M	
32.	B	14	7	5	1931	...	0.30	...	0.30	M	
33.	A	18	11	3	1931	...	0.20	4.00	4.20	Oil Engine	
34	B	12	14	2	1959	...	...	0.30	0.30	M	
35.	B	27	11	4	Old	...	...	1.00	1.00	M	
36.	B	23	11	4	Old	...	...	1.00	1.00	M	
							37.85	52.90	90.75	Total Mhotes ... 30 Oil Engines...6	

A — Pucca Construction.

B — Kaccha construction

M—Water lift provided by Mhote.

APPENDIX B-2

Particulars of wells not in use in the village Yengaon
(Karanja Revenue Circle)

S. No.	Particulars of construction				Year of construction	Present condition of the well	If Taccavi was secured	Main reason for its abandonment
	Construction	Total depth of the well (in feet)	Diameter (in feet)	Water column (in feet)				
1	2	3	4	5	6	7	8	9
37.	B	...	...	...	Old	Totally ruined	Not available	In total ruins
38.	B	...	...	...	Work in progress	...	...	... ..
39.	B	...	...	...	Old	Totally ruined	Not available	In total ruins
40.	B	—	—	—	Old	—	—	In total ruins
41.	A	19	9	9	Prior to 1945	Construction intact	...	Hard rock : water not struck
42.	B	14	9	3	Prior to 1930	Slightly Damaged	...	Inadequate supply of water; used for drinking water for cattle.
43.	A	16	17	Nil	Prior to 1930	Damaged	...	Hard rock struck. Digging left half way.
44.	A	10	16	4	Prior to 1945	Collapsed	Taccavi of Rs. 1,000/- secured.	Hard rock. Inadequate supply of water.
45.	B	11	12	5	Prior to 1945	Damaged	...	Hard rock. Inadequate supply of water.
46.	B	12	10	3	Prior to 1930	Damaged	...	Hard rock — inadequate water

A—Pucca Construction

B—Kaccha construction

APPENDIX B-2 (continued)

S. No.	Particulars of construction				Year of construction	Present condition of the well	If Taccavi was secured	Main reason for its abandonment
	Construction	Total depth of the well in feet	Diameter in feet	Water column in feet				
1	2	3	4	5	6	7	8	9
47.	B	13	10	2	Prior to 1945	Damaged	—	Hard rock — inadequate water
48.	B	23	7	7	Prior to 1945	Good	...	Murum layers : inadequate water
49.	B	11	10	1	Prior to 1945	Good	...	Hard rock — left incomplete
50.	B	8	12	Nil	Prior to 1945	Collapsed	...	Inadequate water. Hard rock. Left incomplete. Water not struck.
51.	B	15	19	1.5	Prior to 1945	„	...	Hard rock — left incomplete.
52.	A	17	9	Nil	Prior to 1945	„	...	Hard rock-left incomplete ; water not struck.
53.	B	...	...	...	Not available	In total ruins	...	...
54.	B	17	9	2	Prior to 1945	Heavily silted	...	Murum layers—cultivator unable to repair for want of finances.
55.	B	17	9	Nil	Prior to 1945	Damaged.	...	Hard rock struck—left incomplete
56.	B	...	...	...	Not available	In total ruins	...	...
57.	B	22	12	5	Prior to 1945	Damaged	...	Murum layers—inadequate supply of water.
58.	B	20	10	0.5	Not available	Collapsed	...	Requires major repairs.
59.	B	17	9	Nil	Prior to 1945	Damaged	...	Hard rock encountered. Water not struck
60.	B	...	...	...	...	In total ruins	...	On the bank of Nallah.
61.	B	...	...	...	...	In total ruins	...	Damaged on account of flooding of Nallah.
62.	B	...	...	...	...	In total ruins	...	Damaged on account of flooding of Nallah.

A — Pucca construction.

B — Kaccha construction.

APPENDIX C

Statement showing extent of consumption of Electricity for lifting water from wells in Wardha (1960—61) recorded as in the month of July 1961.

Serial No.	Name of the village.	Revenue Inspector's circle	Total no. of consumers.	Number of consumers consuming power more than the minimum prescribed			
				for yearly total	Percent. Even for summer season	Percent	Percent
1	2	3	4	5	6	7	8
1.	Sewagram	Sindi	17	13	76	11	64
2.	Kharangana	„	17	2	11	4	23
3.	Chitoda	„	5	4	80	4	80
4.	Salod	Wardha	38	14	36	18	47
5.	Inzapur	Wardha	7	4	57	2	28
6.	Selu Kate	Sindi	1	...	...	...	...
7.	Barbadi	„	15	5	33	7	46
8.	Borgaon	Selu	12	4	33	5	41
9.	Warud	Selu	13	10	77	11	84
10.	Selsura	Deoli	6	...	...	...	...
11.	Nalwadi	Wardha	16	3	18	4	25
12.	Isapur	Deoli	5	3	60	1	20
13.	Wadadh	Deoli	10	3	38	2	25
14.	Chichala	Sindi	5	1	20	3	60
15.	Dattapur	Sindi	4	2	50	3	75
16.	Mahakal	Selu	2	1	50	2	100
17.	Pipri	Wardha	5	1	20	...	...
18.	Khapri	Deoli	10	2	20	2	20
19.	Seldo	Selu	4	...	...	...	...
20.	Digras	Sindi	3	1	33	...	...
21.	Deoli	Deoli	54	10	18	8	14
22.	Saongi	Deoli	10	2	20	3	30
23.	Satoda	Selu	11	6	54	5	45
24.	Sindi	Sindi	18	5	28	6	33
25.	Bela	Selu	6	...	...	...	...
26.	Sawangi	Wardha	1	1	100	1	100
27.	Asola	Pulgaon	1	1	100	1	100
28.	Arvi	Arvi	43	20	46	20	46
29.	Dautpur	Arvi	7	1	14	1	14
30.	Pachegaon	Rohana	7	1	14	2	28

APPENDIX C (Continued)

Serial No.	Name of the village	Revenue Inspector's circle	Total no. of consumers.	Number of consumers consuming power more than the minimum prescribed			
				for yearly total	Percent,	Even for summer season	Percent
1	2	3	4	5	6	7	8
31.	Pipri	Rohana	7	1	14	2	28
32.	Maneri	Arvi	7	...	...	...	...
33.	Varadh	Arvi	13	3	20	2	13
34.	Jalgaon	Arvi	35	22	62	18	51
35.	Borgaon	Arvi	7	3	43	...	...
36.	Belora	Arvi	7	3	43	1	14
37.	Borgaon (Hatla)	Arvi	3	...	...	...	...
38.	Talegaon	Arvi	39	18	46	23	59
39.	Nachangaon	Pulgaon	39	24	61	25	64
40.	Rohana	Rohana	22	11	50	11	50
41.	Virul	Rohana	25	4	16	3	12
42.	Sorta	Rohana	1	1	100	1	100
43.	Pulgaon	Pulgaon	5	4	80	3	60
44.	Selu	Selu	38	25	66	28	73
45.	Kini	Selu	11	7	63	8	72
46.	Juwadi	Selu	5	4	80	4	80
47.	Ghorad	Selu	11	6	54	5	45
48.	Lehki	Selu	52	33	63	46	88
49.	Surgaon	Selu	18	7	39	10	55
50.	Hingni	Selu	33	16	59	20	60
51.	Wadgaon	Selu	49	28	57	38	77
52.	Moi	Selu	15	5	33	8	53
53.	Zadsi	Selu	37	17	46	18	48
54.	Pimpalkhuta	Kharangana	5	3	60	3	60
55.	Borikokate	Selu	8	3	37	4	50
56.	Salai Peth	Selu	7	3	43	3	43
57.	Hinganghat	Hinganghat	11	4	36	4	36

APPENDIX C (*Continued*)

List of villages approved for electrification.

- | | |
|-----------------------------|-------------------------------|
| 1. Kutki - Wardha. | 12. Sakra - Hinganghat. |
| 2. Talodi - Wardha. | 13. Ashta - Wardha. |
| 3. Tuljapur - Wardha. | 14. Hamdapur - Wardha. |
| 4. Waghala - Wardha. | 15. Nandora - Wardha. |
| 5. Jaipur - Wardha. | 16. Mandaogad - Wardha |
| 6. Chanki - Wardha. | 17. Shirpur - Wardha. |
| 7. Kopra - Wardha. | 18. Karanji (Bhoge) - Wardha. |
| 8. Takli - Wardha. | 19. Nagapur - Wardha. |
| 9. Karanji (Kazi) - Wardha. | 20. Dhanora - Wardha. |
| 10. Madni - Wardha. | 21. Dodki - Wardha. |
| 11. Hivra - Hinganghat. | 22. Morangana - Arvi. |

Supplementary list of village electrified till 30th Oct. '62.

- | | |
|--------------------------------|-----------------------------------|
| 1. Paunar - Wardha. | 26. Talegaon - Arvi. |
| 2. Salod (Hirapur) - Wardha. | 27. Panwadi - Arvi. |
| 3. Wadadh - Wardha. | 28. Rasulabad - Arvi. |
| 4. Kamthi - Wardha. | 29. Bhisnoor - Arvi. |
| 5. Hivra - Wardha. | 30. Kajali - Arvi. |
| 6. Umri - Wardha. | 31. Dhawoli Bahadurpur.-Arvi. |
| 7. Ratnapur - Wardha. | 32. Wagholi - Hinganghat. |
| 8. Bhidi - Wardha. | 33. Dabha - Hinganghat. |
| 9. Muradgaon - Wardha. | 34. Ganeshpur - Hinganghat. |
| 10. Nandora - Wardha. | 35. Nagzari - Arvi. |
| 11. Dhanoli - Wardha. | 36. Dhavadi - Arvi. |
| 12. Inzala - Wardha. | 37. Madni - Arvi. |
| 13. Vijaygopal - Wardha. | 38. Behadi - Arvi. |
| 14. Waigaon (Nipani) - Wardha. | 39. Karanja - Arvi. |
| 15. Kurzadi - Wardha. | 40. Sondi - Wardha. |
| 16. Jamtha - Wardha. | 41. Salai Kala - Wardha. |
| 17. Sonegaon (Abaji) - Wardha. | 42. Palasgaon - Wardha. |
| 18. Nagzari - Wardha. | 43. Palasgaon near Bhidi-Wardha . |
| 19. Agargaon - Wardha. | 44. Kholapur - Wardha. |
| 20. Loni - Wardha. | 45. Yeli Keli - Wardha. |
| 21. Ashti - Arvi. | 46. Sukli - Wardha. |
| 22. Rahati - Arvi. | 47. Anji - Wardha. |
| 23. Ashta - Arvi. | 48. Paunar - Wardha. |
| 24. Jam - Arvi. | 49. Kharangana - Arvi. |
| 25. Peth Ahmadpur - Arvi. | 50. Dahegaon Gondi - Arvi. |

APPENDIX D

BAGLAN SYSTEM OF BANDHARA IRRIGATION.

(The following Note is prepared by extracting relevant portions from Beale's Report (Part I) and from the Report of Mr. Visvesvaraya Committee of 1938).

“The North Deccan districts differ from the other parts of the Presidency by their extensive system of bandharas or masonry weirs with channels taking off on one or both banks. The flow in the rivers and channels is principally during the monsoon and rabi seasons, but a small hot season supply is sometimes obtained. This is an ancient form of irrigation. The system of cultivation under bandharas has reached perfection in what is called the “Baglan”—a tract including the Burai, the west Panjhra valley, the Mosum and the whole Girna valley west of Malegaon.

In this part the thal or area commanded by a bandhara and its channel, is usually divided into four nearly equal parts or ‘phads,’ the whole of which is annually brought under irrigation. Each phad is subdivided into an equal number of shares or fields according to the number of owners. In any one year, the whole of one phad is devoted to rice, another to sugarcane, the third to wheat, gram, peas etc., and the fourth to bajri or kharif jowar etc. All cultivators in a given phad are bound to grow the same crop so as to equate their water requirements. Further, they are not allowed to change the rotation of crop pattern fixed by the villagers in advance. In the next year the same crops are grown but on different phads, viz., in the following order :— (1) sugarcane, (2) wheat, (3) bajri, (4) rice and in the next two years the crops move round in the same rotation until in the fifth year they regain their original ‘position. This rotation continues without interruption, the only periods of fallow being the interval between the crops. Manure is put on before the rice crop, and again, by those who can afford, for the sugarcane. This system is termed as quadrennial rotation. In triennial the bajri is omitted ; in quinquennial rotation, two sorts of rice are grown, superior Kamod and ordinary.

Under *pacca bandharas*, which are not controlled exclusively by the irrigation department, a consolidated land and water assessment was fixed on the area irrigated under the *bandharas* at the time of the survey. The repairs to the *bandharas* are done by the Government from the revenue of the consolidated assessment.

This system of distribution of irrigation water was advocated by some witnesses for adoption before the Bombay Irrigation Inquiry Committee, 1938. Speaking of the *phad* system in a Technical Paper (No. 16, issued in 1929) Mr. C. C. Inglis, I. S. E., Superintending Engineer, Irrigation Development and Research Circle, Poona, has explained why its introduction on major irrigation canals is not practicable. He writes :—

“ ... It was not proposed to divide the blocks into *phads* because it was realised that such a drastic distribution of holdings would be impossible ; but it was anticipated that exchanges of land could be arranged between those with land outside the selected blocks who wanted to grow cane in the blocks and those with lands inside the blocks who did not want to grow cane.

“ The cane areas were not concentrated into large blocks and practically the only alteration that took place was that cane areas were standardised by demarcation, but they remained scattered widely over large areas wherever there was a demand for them.

“ The advantages which occurred from the introduction of blocks were, however, very great ; because when the areas were standardised it was possible for the canal staff to distribute water much more economically ; and the cultivators, having an assurance of water for a period of years, found it worth while to carry out improvements to their land. ”

The technical difficulties mentioned above do not seem to be insurmountable and serious attempts should be made to find out how this *Baglan* system of irrigation can be introduced. This system should be tried as an experiment on all new schemes since introduction of co-operative farming is Government policy to-day.